SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	METEOROLOGY	**x**	**x**
C1.1	**THE ATMOSPHERE**	**x**	**x**
C1.1.1	**a. Properties, composition and structure.**	**x**	**x**
C1.1.1.1	**Properties**	**x**	**x**
	Describe the vertical division of the atmosphere up to flight level (FL) 650, based on the temperature variations with height.		
	List the different layers and their main qualitative characteristics up to FL 650.		
C1.1.1.2	**b. Composition and structure**	**x**	**x**
	Describe the troposphere.		
	Describe the main characteristics of the tropopause.		
	Describe the proportions of the most important gases in the air in the troposphere.		
	Describe the variations of the FL and temperature of the tropopause from the poles to the equator.		
	Describe the breaks in the tropopause along the boundaries of the main air masses.		
	Indicate the variations of the FL of the tropopause with the seasons and the variations of atmospheric pressure.		
C1.2.1	**c. ICAO International standard atmosphere (ISA).**	**x**	**x**
C1.2.1.1	**Properties**	**x**	**x**
	Explain the use of standardised values for the atmosphere.		
	List the main values of the ISA MSL pressure, MSL temperature, the vertical temperature lapse rate up to FL 650, height and temperature of the tropopause.		
C1.2.1.2	**ISA deviation.**	**x**	**x**
	Calculate the temperature and temperature deviations (in relation to International Standard Atmosphere (ISA)) at specified levels.		
C1.2	**ATMOSPHERIC PRESSURE**	**x**	**x**
C1.2.1	**General**	**x**	**x**
C1.2.1.1	**a. Definition.**	**x**	**x**
	Define 'atmospheric pressure'.		
C1.2.1.2	**b. Measurement and units in use: Pa, hPa/ Mb /inches mercury/ millimetres mercury**	**x**	**x**
	List the units of measurement of the atmospheric pressure used in aviation (hPa, inches of mercury). (Refer to Subject 050 10 01 01)		
C1.2.1.3	**c. QNH, QFE, QFF and QNE/1013.25 hPa**	**x**	**x**
	Reduction of pressure to QFF (MSL)		
	Define 'QFF'.		
	Explain the reduction of measured pressure (QFE) to QFF (MSL).		
	Mention the use of QFF for surface weather charts.		
C1.2.1.4	**d. Pressure variation with height and diurnal variation**	**x**	**x**

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	METEOROLOGY	x	x
	Pressure variation with height, contours (isohypses)		
	Explain the pressure variation with height.		
	Describe quantitatively the variation of the barometric lapse rate. Remark: An approximation of the average value for the barometric lapse rate near mean sea level (MSL) is 30 ft (9 m) per 1 hPa.		
	State that (under conditions of ISA) pressure is approximately 50 per cent of MSL at 18 000 ft and density is approximately 50 per cent of MSL at 22 000 ft and 25 per cent of MSL at 40 000 ft.		
C1.2.2	**Pressure systems**	x	x
C1.2.2.1	**e. Isobars.**	x	x
	Define isobars and identify them on surface weather charts.		
C1.2.2.2	**f. Pressure gradient.**	x	x
	Define the term 'horizontal pressure gradient'.		
	Explain how the pressure gradient force acts in relation to the pressure gradient.		
	Explain how the Coriolis force acts in relation to the wind.		
C1.2.2.3	**g. Low-pressure systems:**	x	x
C1.2.2.3	**Characteristics and related terminology.**	x	x
	Define 'low pressure areas' as areas with lower pressure than in the surrounding areas at the same level		
C1.2.2.4	**Typical cyclonic weather.**	x	x
C1.2.3	**c. High-pressure systems.**	x	x
C1.2.3.1	**Characteristics and related terminology.**	x	x
	List the different types of anticyclones.		
C1.2.3.2	**Typical anti-cyclonic weather.**	x	x
	Describe the properties of and the weather associated with warm and cold anticyclones.		
C1.3	**TEMPERATURE**	x	x
C1.3.1	**General**	x	x
C1.3.1.1	**a. Units in use and conversion between units**	x	x
	Define 'air temperature'.		
	List the units of measurement of air temperature used in aviation meteorology (Celsius, Fahrenheit, Kelvin). (Refer to Subject 050 10 01 01)		
	Convert between temperatures in degrees Celcius and degrees Fahrenheit using the formulas: (deg F) = (deg C) × 1.8 + 32, and (deg C) = (deg F − 32) / 1.8		
C1.3.2	**b. Heating of the atmosphere and heat transfer processes:**	x	x
C1.3.2.1	**Insolation.**	x	x
	Describe solar radiation reaching the Earth.		

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	METEOROLOGY	**x**	**x**
	Describe the filtering effect of the atmosphere on solar radiation.		
C1.3.2.2	**Radiation, conduction, convection.**	**x**	**x**
	Describe radiation.		
	Describe terrestrial radiation.		
	Explain how local cooling or warming processes result in transfer of heat.		
	Explain the effect of absorption and radiation in connection with clouds.		
	Explain the process of conduction.		
	Explain the role of conduction in the cooling and warming of the atmosphere.		
	Explain the process of convection.		
	Name the situations in which convection occurs.		
C1.3.3	**c. Advection.**	**x**	**x**
C1.3.3.1	**Process and occurrence**	**x**	**x**
	Explain the process of advection.		
	Name the situations in which advection occurs.		
C1.3.4	**d. Diurnal variation of temperature.**	**x**	**x**
C1.3.4.1	**Effects on warming/cooling of Earth's surface**	**x**	**x**
	Explain the cooling/warming of the surface of the Earth by radiation.		
	Explain the cooling/warming of the air by molecular or turbulent heat transfer to/from the earth or sea surfaces.		
	Describe qualitatively the influence of the clouds on the cooling and warming of the surface and the air near the surface.		
	Explain the influence of the wind on the cooling and warming of the air near the surfaces.		
C1.4	**HUMIDITY**	**x**	**x**
	Water vapour in the atmosphere	**x**	**x**
C1.4.1.1	**a. Atmospheric water and changes of state:**	**x**	**x**
	Water vapour in the atmosphere		
	Describe the significance for meteorology of water vapour in the atmosphere.		
	Indicate the sources of atmospheric humidity.		
	Define 'condensation', 'evaporation', 'sublimation', 'freezing and melting' and 'latent heat'.		
	List the conditions for condensation/evaporation.		
	Explain the condensation process.		
	Explain the nature of and the need for condensation nuclei.		
	Explain the effects of condensation on the weather.		
	List the conditions for freezing/melting.		
	Explain the process of freezing.		

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	METEOROLOGY	**x**	**x**
	Explain the nature of and the need for freezing nuclei.		
	Define 'supercooled water'. (Refer to Subject 050 09 01 01)		
	List the conditions for sublimation.		
	Explain the sublimation process.		
	Explain the nature of and the need for sublimation nuclei.		
C1.4.2	**Changes of state**	**x**	**x**
C1.4.2.1	**b. Latent heat.**	**x**	**x**
	Describe the absorption or release of latent heat in each change of state of water.		
	Illustrate all the changes of state of water with practical examples.		
C1.4.2.2	**c. Saturation, vapour pressure and dew point temperature.**	**x**	**x**
	Define 'saturation of air by water vapour'.		
	Define 'dew point'.		
	Describe the relationship between temperature and dew point.		
C1.4.3	**d. Measurement of humidity:**	**x**	**x**
C1.4.3.1	**Absolute humidity.**	**x**	**x**
	Define 'absolute humidity'		
C1.4.3.2	**Relative humidity.**	**x**	**x**
	Define 'relative humidity'.		
	Explain the factors that influence the relative humidity at constant pressure.		
	Explain the diurnal variation of the relative humidity.		
	Estimate the relative humidity of the air from the difference between dew point and temperature.		
C1.5	**DENSITY**	**x**	**x**
C1.5.1	**a. Definition:**	**x**	**x**
C1.5.1.1	**Terms and general properties**	**x**	**x**
	State that (under conditions of ISA) pressure is approximately 50 per cent of MSL at 18 000 ft and density is approximately 50 per cent of MSL at 22 000 ft and 25 per cent of MSL at 40 000 ft.	*x*	*x*
C1.5.2	**b. Factors affecting density:**	**x**	**x**
C1.5.2.1	**Temperature, Pressure**	**x**	**x**
	Describe the relationship between pressure, temperature and density.		
C1.5.2.2	**Altitude and latitude.**	**x**	**x**
	Describe the vertical variation of the air density in the atmosphere.		
C1.5.2.3	**Humidity.**	**x**	**x**
	Describe the change of air density with increasing humidity		
C1.5.3	**c. Density altitude:**	**x**	**x**

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	METEOROLOGY	x	x
C1.5.3.1	**Definition.**	x	x
	Define 'Density Altitude'		
C1.5.3.2	**Calculating density altitude.**	x	x
	From example values given with pressure altitude and temperature, determine the density altitude using the mechanical flight calculator or the formula (120 ft per degree Celcius deviation from ISA-Temperature)		
C1.6	**ALTIMETRY**	x	x
C1.6.1	**a. Variation of atmospheric pressure levels with changing pressure and temperature.**	x	x
C1.6.1.1	**Effects from temperature and pressure distribution**	x	x
	Explain the influence of pressure areas on true altitude.		
	Explain the influence of temperature on true altitude		
C1.6.2	**b. Calculations involving pressure and temperature corrections.**	x	x
C1.6.2.1	**Pressure corrections**		
	Calculate the different readings on the altimeter when the pilot uses different settings (QNH, 1013.25, QFE).		
	Illustrate with a numbered example the changes of altimeter setting and the associated changes in reading when the pilot climbs through the transition altitude or descends through the transition level.		
	Derive the reading of the altimeter of an aircraft on the ground when the pilot uses the different settings.		
	Describe qualitatively how the effect of accelerated airflow due to topography (the Bernoulli effect) affects altimetry.		
C1.6.2.2	**Temperature corrections**		
	Explain the influence of the air temperature on the distance between the ground and the level read on the altimeter and between two FLs.		
	State that the 4 per cent-rule can be used to calculate true altitude from indicated altitude, and also indicated altitude from true altitude (not precise but sufficient due to the approximation of the 4 per cent-rule.)		
C1.6.3	**c. Calculating true altitude.**	x	x
C1.6.3.1	**Corrections for pressure and temperature in non-ISA conditions** *Remark: The following rules should be considered for altimetry calculations:* *a) All calculations are based on rounded pressure values to the nearest lower hPa.* *b) The value for the barometric lapse rate between MSL and 700 hPa to be used is 30 ft/hPa as an acceptable approximation of the barometric lapse rate.* *c) To determine the true altitude/height, the following rule of thumb, called the '4 per cent-rule', shall be used: the altitude/height changes by 4 per cent for each 10 degrees C temperature deviation from ISA.* *d) If no further information is given, the deviation of the outside-air temperature from ISA is considered to be constantly the same given value in the whole layer.* *e) The elevation of the aerodrome has to be taken into account. The temperature correction has to be considered for the layer between the ground and the position of the aircraft.*	x	x

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	METEOROLOGY	x	x
	Determine the true altitude/height for a given altitude/height and a given ISA temperature deviation.		
	Calculate the terrain clearance and the lowest usable FL for given atmospheric temperature and pressure conditions.		
C1.7	**WIND**	x	x
C1.7.1	**Definitions and terminology:**	x	x
C1.7.1.1	**a. Veering and backing.**	x	x
	Define the terms 'veering' and 'backing' of wind		
C1.7.1.2	**b. Wind direction and speed.**	x	x
	Define 'wind' and 'surface wind'.		
	State the units of wind directions (degrees true in reports; degrees magnetic from tower) and speed (kt, m/s).		
C1.7.2	**c. Formation of wind:**	x	x
C1.7.2.1	**Pressure gradient force.**	x	x
	Define the term 'horizontal pressure gradient'.		
	Explain how the pressure gradient force acts in relation to the pressure gradient.		
C1.7.2.2	**Coriolis effect.**	x	x
	Explain how the Coriolis force acts in relation to the wind.		
C1.7.2.3	**Geostrophic wind and Buys Ballot's law.**	x	x
	Explain the development of the geostrophic wind.		
	Indicate how the geostrophic wind flows in relation to the isobars/isohypses in the northern and in the southern hemisphere.		
	Analyse the effect of changing latitude on the geostrophic wind speed.		
C1.7.2.4	**Gradient wind.**	x	x
	Explain the gradient wind effect and indicate how the gradient wind differs from the geostrophic wind in cyclonic and anticyclonic circulation.		
C1.7.2.5	**Surface wind.**	x	x
	Describe why and how the wind changes direction and speed with height in the friction layer in the northern and in the southern hemisphere (rule of thumb).		
	Name terrain, wind speed and stability as the main factors that influence the vertical extent of the friction layer.		
	Explain the relationship between isobars and wind (direction and speed). *Remark: Approximate value for variation of wind in the friction layer (values to be used in examinations):* *Type of landscape: Wind speed in friction layer in per cent of the geostrophic wind: over water: ca. 70 per cent; over land: ca. 50 per cent; The wind in the friction layer blows across the isobars towards the low pressure. Angle between wind direction and isobars. Over water: ca. 10 degrees; over land: ca. 30 degrees. WMO - No. 266.*		
C1.7.2.6	**Diurnal variation of wind.**	x	x
	State the surface and air-mass conditions that influence the wind in the friction layer (diurnal variation).		

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	METEOROLOGY	**x**	**x**
C1.7.3	**d. Upper winds**	**x**	**x**
C1.7.3.1	**General global upper air circulation**	**x**	**x**
	Describe the general global circulation. (Refer to Subject 050 08 01 01)		
	Describe the general tropospheric and low stratospheric circulation. (Refer to Subject 050 02 03 01)		
	Indicate on a map the trade winds (tropical easterlies) and describe the associated weather.		
	Indicate on a map the doldrums and describe the associated weather.		
	Indicate on a sketch the latitudes of subtropical high (horse latitudes) and describe the associated weather.		
C1.7.3.2	**Thermal winds**	**x**	**x**
C1.7.3.3	**Jet stream winds**	**x**	**x**
	Describe jet streams.		
	State the defined minimum speed of a jet stream (60 kt).		
	State the typical figures for the dimensions of jet streams.		
	Explain the formation and state the heights, the speeds, the seasonal variations of speeds, the geographical positions, the seasonal occurrence and the seasonal movements of the arctic (front) jet stream, the polar (front) jet stream, the subtropical jet stream, and the tropical (easterly/equatorial) jet stream.		
	Location of jet streams and associated CAT areas		
	Sketch or describe where polar front and arctic jet streams are found in the troposphere in relation to the tropopause and to fronts.		
	Describe and indicate the areas of worst wind shear and CAT.		
C1.7.3.4	**CAT (Clear Air Turbulence)**	**x**	**x**
	Describe CAT.		
	Describe the formation of CAT.		
	State where CAT is found in association with jet streams, in high-level troughs and in other disturbed high-level air flows. (Refer to Subject 050 09 02 02)		
	State that remote sensing of CAT from satellites is not possible and that forecasting is limited.		
	State that pilot reports of turbulence are a very valuable source of information as remote measurements are not available.		
	Describe the effects of CAT on flight. (Refer to Subject 050 02 06 03)		
	Indicate the possibilities of avoiding CAT in flight: in the flight planning: weather briefing, selection of track and altitude; during flight: selection of appropriate track and altitude.		
C1.8	**CLOUDS**	**x**	**x**
C1.8.1	**a. Cloud observations and measurement:**	**x**	**x**
C1.8.1.1	**Cloud amount.**	**x**	**x**
	Indicate the means of observing clouds for the purpose of recording: type, amount, height of base (ceilometers), and top.		

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	METEOROLOGY	**x**	**x**
	State the clouds which are indicated in METAR, TAF and SIGMET.		
	Define 'oktas'.		
C1.8.1.2	**Definitions of cloud ceiling and cloud base.**	**x**	**x**
	Define 'cloud base'.		
	Define 'ceiling'.		
	Name the unit and the reference level used for information about cloud base (ft).		
C1.8.2	**b. Cloud formation:**	**x**	**x**
C1.8.2.1	**Convective, Orographic, Frontal, Convergent, Turbulent:**	**x**	**x**
	Explain cloud formation by adiabatic cooling, conduction, advection and radiation.		
	Describe cloud formation based on the following lifting processes: unorganised lifting in thin layers and turbulent mixing; forced lifting at fronts or over mountains; free convection.		
	List cloud types typical for stable and unstable air conditions.		
	Summarise the conditions for the dissipation of clouds.		
C1.8.3	**c. Cloud classification.**	**x**	**x**
C1.8.4	**d. Cloud types.**	**x**	**x**
C1.8.4.1	**Specification by shape**	**x**	**x**
	Describe the different cloud types and their classification.		
	Identify by shape cirriform, cumuliform and stratiform clouds.		
	Identify by shape and typical level the 10 cloud types (general).		
	Describe and identify by shape the following species and supplementary features: castellanus, lenticularis, congestus, calvus, capillatus and virga.		
C1.8.4.2	**e. Flying conditions in the different types of clouds**	**x**	**x**
	Assess the 10 cloud types for icing and turbulence.		
C1.9	**PRECIPITATION**	**x**	**x**
C1.9.1	**a. Types of precipitation.**	**x**	**x**
C1.9.1.1	**Precipitation in Aerodrome Forecasts (TAF) and METAR**	**x**	**x**
	List and describe the types of precipitation given in the aerodrome forecast (TAF) and METAR codes (drizzle, rain, snow, snow grains, ice pellets, hail, small hail, snow pellets, ice crystals, freezing drizzle, freezing rain).		
C1.9.1.2	**Variants by water content and cloud type**	**x**	**x**
	State that, because of their size, hail stones can cause significant damage to aircraft.		
	Explain the mechanism for the formation of freezing precipitation.		
	Describe the weather conditions that give rise to freezing precipitation.		
	Distinguish between the types of precipitation generated in convective and stratiform clouds.		
C1.9.2	**b. Intensity of precipitation.**	**x**	**x**

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	METEOROLOGY	**x**	**x**
C1.9.2.1	**Relation to cloud type**	**x**	**x**
	Assign typical precipitation types and intensities to different cloud types.		
C1.9.3	**c. Continuity of precipitation.**	**x**	**x**
C1.9.4	**d. Flying conditions in the different types of precipitation**	**x**	**x**
C1.10	**THUNDERSTORMS**	**x**	**x**
C1.10.1	**a. Formation:**	**x**	**x**
C1.10.1.1	**Conditions for development.**	**x**	**x**
	Name the cloud types which indicate the development of thunderstorms.		
C1.10.2	**b. classification:**	**x**	**x**
C1.10.2.1	**Convective, Orographic, Convergent, Frontal, Nocturnal:**	**x**	**x**
	Describe the different types of thunderstorms, their location, the conditions for and the process of development, and list their properties (air-mass thunderstorms, frontal thunderstorms, squall lines, supercell storms, orographic thunderstorms).		
C1.10.3	**c. Severe thunderstorms and Squall lines**	**x**	**x**
C1.10.4.3	**d. The three stages of thunderstorm development.**	**x**	**x**
	Assess the average duration of thunderstorms and their different stages.		
	Describe a supercell storm: initial, supercell, tornado and dissipating stage.		
	Summarise the flight hazards associated with a fully developed thunderstorm.		
	Indicate on a sketch the most dangerous zones in and around a single-cell and a multi-cell thunderstorm.		
C1.10.5	**e. Hazards:**	**x**	**x**
C1.10.5.1	**Windshear and turbulence.**	**x**	**x**
	Define 'wind shear' (vertical and horizontal).		
	Describe the conditions, where and how wind shear can form (e.g. thunderstorms, squall lines, fronts, inversions, land and sea breeze, friction layer, relief).		
C1.10.5.2	**Microbursts.**	**x**	**x**
	Define the term 'downburst'.		
	Distinguish between macroburst and microburst.		
	State the weather situations leading to the formation of downbursts.		
	Describe the process of development of a downburst.		
	Give the typical duration of a downburst.		
	Describe the effects of downbursts.		
C1.10.5.3	**Hail.**		
	State that, because of their size, hail stones can cause significant damage to aircraft.		
C1.10.5.4	**Icing.**		

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	METEOROLOGY	x	x
	Describe the position of the dangerous zones of icing in fronts, in stratiform and cumuliform clouds, and in the different precipitation types.		
	Indicate the possibilities of avoiding dangerous zones of icing: in the flight planning: weather briefing, selection of track and altitude; during flight: recognition of the dangerous zones, selection of appropriate track and altitude.		
C1.10.5.5	**Lightning.**	x	x
	Describe the development of lightning discharges.		
	Describe the effect of lightning strike on aircraft and flight execution.		
C1.10.6	**f. Avoidance and penetration.**	x	x
C1.10.6.1	**Flight techniques and use of on-board equipment**	x	x
	Explain how the pilot can anticipate each type of thunderstorm: through pre-flight weather briefing, observation in flight, use of specific meteorological information, use of information given by ground weather radar and by airborne weather radar. (Refer to Subject 050 10 01 04), use of a lightning detector (stormscope). (Refer to Subject 050 10 01 04), use of the stormscope (lightning detector).		
	Describe practical examples of flight techniques used to avoid the hazards of thunderstorms.		
C1.11	**ICE ACCRETION**	x	x
C1.11.1	**a. Airframe icing:**	x	x
C1.11.1.1	**Conditions for formation.**	x	x
	Summarise the general conditions under which ice accretion occurs on aircraft (temperatures of outside air; temperature of the airframe; presence of supercooled water in clouds, fog, rain and drizzle; possibility of sublimation).		
	Explain the general weather conditions under which ice accretion occurs on airframe.		
	Explain the formation of supercooled water in clouds, rain and drizzle. (Refer to Subject 050 03 02 01)		
	Explain qualitatively the relationship between the air temperature and the amount of supercooled water.		
	Explain qualitatively the relationship between the type of cloud and the size and number of the droplets in cumuliform and stratiform clouds.		
	Indicate in which circumstances ice can form on an aircraft on the ground: air temperature, humidity, precipitation.		
	Explain in which circumstances ice can form on an aircraft in flight: inside clouds, in precipitation, and outside clouds and precipitation.		
	Explain the influence of fuel temperature, radiative cooling of the aircraft surface and temperature of the aircraft surface (e.g. from previous flight) on ice formation.		
	Describe the different factors that influence the intensity of icing: air temperature, amount of supercooled water in a cloud or in precipitation, amount of ice crystals in the air, speed of the aircraft, shape (thickness) of the airframe parts (wings, antennas, etc.).		
	Explain the effects of topography on icing.		
	Explain the higher concentration of water drops in stratiform orographic clouds.		

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	METEOROLOGY	**x**	**x**
C1.11.1.2	**Kinetic heating formula.**	**x**	**x**
C1.11.2	**b. Types of icing:**	**x**	**x**
C1.11.2.1	**Clear (glaze) ice.**	**x**	**x**
	Define 'clear ice'.		
	Describe the conditions for the formation of clear ice.		
	Explain the formation of the structure of clear ice with the release of latent heat during the freezing process.		
	Describe the aspects of clear ice: appearance, weight, solidity.		
C1.11.2.2	**Rime ice.**	**x**	**x**
	Define 'rime ice'.		
	Describe the conditions for the formation of rime ice.		
	Describe the aspects of rime ice: appearance, weight, solidity.		
C1.11.2.3	**Mixed ice.**	**x**	**x**
	Define 'mixed ice'.		
	Describe the conditions for the formation of mixed ice.		
	Describe the aspects of mixed ice: appearance, weight, solidity.		
	Describe the possible process of ice formation in snow conditions.		
C1.11.2.4	**Freezing precipitation and rain ice.**	**x**	**x**
	Explain the mechanism for the formation of freezing precipitation.		
	Describe the weather conditions that give rise to freezing precipitation.		
C1.11.3	**e. Piston engine icing.**	**x**	**x**
C1.11.3.1	**Impact icing.**	**x**	**x**
C1.11.3.2	**Fuel icing.**	**x**	**x**
C1.11.4.3	**f. Carburettor icing: cause, recognition, prevention.**	**x**	**x**
	Explain the general weather conditions under which ice accretion occurs in a venturi carburettor.		
C1.11.5	**g. Gas turbine engine icing.**	**x**	**x**
C1.11.6	**h. ICAO definitions for levels of icing:**	**x**	**x**
C1.11.6.1	**Light, moderate, severe**	**x**	**x**
	State the ICAO qualifying terms for the intensity of icing.		
	Describe, in general, the hazards of icing.		
	Assess the dangers of the different types of ice accretion.		
C1.11.7	**i. Ice protection:**	**x**	**x**
C1.11.7.1	**Anti-icing and de-icing**	**x**	**x**
C1.11.7.2	**Hazards**	**x**	**x**

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	METEOROLOGY	**x**	**x**
C1.12	**TURBULENCE**	**x**	**x**
C1.12.1	**a. Definition, types and causes**	**x**	**x**
C1.12.1.1	**Definition**	**x**	**x**
	State the ICAO qualifying terms for the intensity of turbulence.		
	Describe the effects of turbulence on an aircraft in flight.		
C1.12.1.2	**Types and causes**	**x**	**x**
	Describe atmospheric turbulence and distinguish between turbulence, gustiness and wind shear.		
	Describe that forecasts of turbulence are not very reliable and state that pilot reports of turbulence are very valuable as they help others to prepare for or avoid turbulence.		
	Describe the effects of CAT on flight. (Refer to Subject 050 02 06 03)		
	Indicate the possibilities of avoiding CAT in flight: in the flight planning: weather briefing, selection of track and altitude; during flight: selection of appropriate track and altitude.		
C1.12.2	**b. Mountain waves and associated turbulence:**	**x**	**x**
C1.12.2.1	**Conditions for formation and dangers.**	**x**	**x**
	Explain the origin and formation of mountain waves.		
	State the conditions necessary for the formation of mountain waves.		
	Describe the structure and properties of mountain waves.		
C1.12.2.2	**Visual detection of mountain waves.**	**x**	**x**
	Explain how mountain waves may be identified by their associated meteorological phenomena.		
	Describe that mountain wave effects can exceed the performance or structural capability of aircraft.		
C1.13	**VISIBILITY**	**x**	**x**
C1.13.1	**Terms and definitions**	**x**	**x**
C1.13.1.1	**a. Definition and measurement**	**x**	**x**
	Define 'visibility'.		
	Describe the meteorological measurement of visibility.		
	Define 'prevailing visibility'.		
	Define 'ground visibility'.		
	List the units used for visibility (m, km, statute mile).		
C1.13.1.2	**b. Types of visibility restrictions and their definitions: mist, fog, haze, glare, smog, dust and sand**	**x**	**x**
	Describe the reduction of visibility caused by obscurations: fog, mist, haze, smoke, volcanic ash.		
	Describe the reduction of visibility caused by obscurations: sand (SA), dust (DU).		
C1.13.1.3	**c. Slant visibility**	**x**	**x**
	Describe the differences between ground and flight visibility, and slant and vertical visibility when an aircraft is above or within a layer of haze or fog.		

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	METEOROLOGY	**x**	**x**
C1.13.1.4	**d. Runway visual range (RVR):**	**x**	**x**
	Define 'runway visual range'.		
	Describe the meteorological measurement of runway visual range.		
	Indicate where the transmissometers/forward-scatter meters are placed on the aerodrome.		
	List the units used for runway visual range (m, ft).		
	List the different possibilities to transmit information to pilots about runway visual range.		
	Compare ground visibility, prevailing visibility, and runway visual range.		
C1.13.2	**f. Fog:**	**x**	**x**
C1.13.2.1	**Radiation fog.**	**x**	**x**
	Explain the formation of radiation fog.		
	Describe the significant characteristics of radiation fog, and its vertical extent.		
	Summarise the conditions for the dissipation of radiation fog.		
C1.13.2.2	**Advection fog.**	**x**	**x**
	Explain the formation of advection fog.		
	Describe the different possibilities of advection-fog formation (over land, sea and coastal regions).		
	Describe the significant characteristics of advection fog.		
	Summarise the conditions for the dissipation of advection fog.		
C1.13.2.3	**Frontal fog.**	**x**	**x**
	Explain the formation of frontal fog.		
	Describe the significant characteristics of frontal fog.		
	Summarise the conditions for the dissipation of frontal fog.		
C1.13.2.4	**Orographic (upslope).**	**x**	**x**
	Summarise the features of orographic fog.		
	Describe the significant characteristics of orographic fog.		
	Summarise the conditions for the dissipation of orographic fog.		
C1.13.2.5	**Steam fog**	**x**	**x**
	Explain the formation of sea smoke.		
	Explain the conditions for the development of sea smoke.		
	Summarise the conditions for the dissipation of sea smoke.		
C1.14	**FRONTS**	**x**	**x**
C1.14.1	**a. Mid-latitude (temperate) cyclones.**	**x**	**x**
C1.14.1.1	**General aspects**	**x**	**x**
	Describe the boundaries between air masses (fronts).		

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	METEOROLOGY	**x**	**x**
	Define ‘front’ and ‘frontal zone’.		
	Name the global frontal systems (polar front, arctic front).		
	State the approximate seasonal latitudes and geographic positions of the polar front and the arctic front.		
C1.14.2	**b. Cold fronts:**	**x**	**x**
C1.14.2.1	**Formation, characteristics and weather.**	**x**	**x**
	Define a ‘cold front’.		
	Describe the cloud, weather, ground visibility and aviation hazards at a cold front depending on the stability of the warm air.		
C1.14.2.2	**Changes with the passage of the front.**	**x**	**x**
C1.14.2.3	**Flying conditions and penetration procedures.**	**x**	**x**
	Describe the structure, slope and dimensions of a cold front.		
	Sketch a cross section of a cold front showing weather, cloud and aviation hazards.		
C1.14.3	**c. Warm fronts:**	**x**	**x**
C1.14.3.1	**Formation, characteristics and weather.**	**x**	**x**
	Define a ‘warm front’.		
	Describe the cloud, weather, ground visibility and aviation hazards at a warm front depending on the stability of the warm air.		
C1.14.3.2	**Changes with the passage of the front.**	**x**	**x**
	Sketch a plan and a cross section of a frontal wave (warm front, warm sector, and cold front) and illustrate the changes of pressure, temperature, surface wind and wind in the vertical axis.		
C1.14.3.3	**Flying conditions and penetration procedures.**	**x**	**x**
	Describe the structure, slope and dimensions of a warm front.		
	Sketch a cross section of a warm front showing weather, cloud and aviation hazards.		
C1.15	**REGIONAL CLIMATOLOGY**	**x**	**x**
C1.15.1	**a. ITCZ: characteristics, weather and seasonal movement.**	**x**	**x**
C1.15.1.1	**Seasonal occurrence**	**x**	**x**
	Identify or indicate on a map the positions of the ITCZ in January and July.		
	Explain the seasonal movement of the ITCZ.		
C1.15.1.2	**Flight hazards**	**x**	**x**
	Describe the weather and winds at the ITCZ.		
	Explain the flight hazards associated with the ITCZ.		
C1.15.2	**b. General African climate and significant weather**	**x**	**x**
C1.16	**SOUTH AFRICAN WEATHER**	**x**	**x**
C1.16.1	**Climatic Regions and seasonal patterns**	**x**	**x**

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	METEOROLOGY	**x**	**x**
C1.16.1.1	**a. South African climate and climatic regions.**	**x**	**x**
C1.16.1.2	**b. South African summer patterns.**	**x**	**x**
C1.16.1.3	**c. South African winter patterns.**	**x**	**x**
C1.16.2	**d. South African weather phenomena:**	**x**	**x**
C1.16.2.1	**Mid-latitude (temperate) cyclones (frontal systems).**	**x**	**x**
C1.16.2.2	**Hurricanes (Tropical cyclones).**	**x**	**x**
C1.16.2.3	**Coastal lows.**	**x**	**x**
C1.16.2.4	**The South Westerly Buster**	**x**	**x**
C1.16.2.5	**Easterly weather (the Guti).**	**x**	**x**
C1.16.2.6	**The Cape Doctor**	**x**	**x**
C1.16.2.7	**Cut-off lows and the Black South Easter**	**x**	**x**
C1.17	**METEOROLOGICAL INFORMATION**	**x**	**x**
C1.17.1	**a. Weather analysis:**	**x**	**x**
C1.17.1.1	**Synoptic weather charts and symbols**	**x**	**x**
	Recognise the following weather systems on a surface weather chart (analysed and forecast): ridges, cols and troughs; fronts; frontal side, warm sector and rear side of mid-latitude frontal lows; high- and low-pressure areas.		
	Determine from surface weather charts the wind direction and speed.		
C1.17.1.2	**Significant (prognostic) weather charts**	**x**	**x**
	Decode and interpret significant weather charts (low, medium and high level).		
	Describe from a significant weather chart the flight conditions at designated locations or along a defined flight route at a given FL.		
C1.17.2	**b. Upper winds and temperatures fixed time prognostic charts (South African and international)**	**x**	**x**
C1.17.2.1	**General**	**x**	**x**
	Describe forecast upper-wind and temperature charts.		
C1.17.2.2	**Use of upper-wind and temperature charts**	**x**	**x**
	For designated locations or routes determine from forecast upper-wind and temperature charts, if necessary by interpolation, the spot/average values for outside-air temperature, temperature deviation from ISA, wind direction, and wind speed.		
C1.17.3	**c. Interpretation of:**	**x**	**x**
C1.17.3.1	**METAR, TAF**	**x**	**x**

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	METEOROLOGY	**x**	**x**
	Describe, decode and interpret the following aviation weather messages (given in written or graphical format): METAR, aerodrome special meteorological report (SPECI), trend forecast (TREND), TAF, information concerning en-route weather phenomena which may affect the safety of aircraft operations (SIGMET), information concerning en-route weather phenomena which may affect the safety of low-level aircraft operations (AIRMET), area forecast for low-level flights (GAMET), ARS, volcanic ash advisory information.		
C1.17.3.2	**SPECI**	**x**	**x**
	Describe the general meaning of MET REPORT and SPECIAL REPORT.		
C1.17.3.3	**SIGMET/ AIRMET/ SPECIAL AIR REPORT**	**x**	**x**
	List, in general, the cases when a SIGMET and an AIRMET are issued.		
C1.17.4	**d. Meteorological broadcasts for aviation:**	**x**	**x**
C1.17.4.1	**ATIS**	**x**	**x**
	Describe the meteorological content of broadcasts for aviation: meteorological information for aircraft in flight (VOLMET); automatic terminal information service (ATIS).		

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	RADIO NAVIGATION	x	x
C.2.1	**VHF DIRECTION FINDER (VDF) / GROUND DIRECTIONAL FINDER:**	x	x
C.2.1.1	**Principles, Interpretation and Limitations**	x	x
C.2.1.1.1	**a. Principles**	x	x
	Describe the use of a ground DF.		
	Define the term 'QDM': the magnetic bearing to the station.		
	Define the term 'QDR': the magnetic bearing from the station.		
	Explain that by using more than one ground station, the position of an aircraft can be determined and transmitted to the pilot.		
C.2.1.1.2	**b. Coverage and range**	x	x
	Explain the limitation of range because of the path of the VHF signal.		
	Use the formula: 1.23 × sqrt transmitter height in feet plus 1.23 × sqrt receiver height in feet to calculate the range in NM.		
C.2.2	**NDB/ADF:**	x	x
C.2.2.1	**Principles, Interpretation and Limitations**	x	x
C.2.2.1.1	**a. Principles**	x	x
	Define the acronym 'NDB': non-directional radio beacon.		
	Define the acronym 'ADF': automatic direction-finding equipment.		
	State that the NDB is the ground part of the system.		
	State that the ADF is the airborne part of the system.		
	State that the NDB operates in the LF and MF frequency bands.		
	State that the frequency band assigned to aeronautical NDBs according to ICAO Annex 10 is 190-1750 kHz.		
	Define a 'locator beacon': an LF/MF NDB used as an aid to final approach usually with a range of 10-25 NM.		
	State that certain commercial radio stations transmit within the frequency band of the NDB.		
	State that according to ICAO Annex 10, an NDB station has an automatic ground monitoring system.		
	Describe the use of NDBs for navigation.		
	Describe the procedure to identify an NDB station.		
	Interpret the term 'cone of confusion' in respect of an NDB.		
	State that an NDB station emits a N0N/A1A or a N0N/A2A signal.		
	State the function of the beat frequency oscillator (BFO).		
	State that in order to identify a N0N/A1A NDB, the BFO circuit of the receiver has to be activated.		
	State that on modern aircraft, the BFO is activated automatically.		
C.2.2.1.2	**b. Presentation and interpretation**	x	x
	Name the types of indicators commonly in use: electronic display; radio magnetic indicator (RMI); fixed-card ADF (radio compass); moving-card ADF.		

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	Interpret the indications given on RMI, fixed-card and moving-card ADF displays.		
	Given a display, interpret the relevant ADF information.		
	Calculate the true bearing from the compass heading and relative bearing.		
	Convert the compass bearing into magnetic bearing and true bearing.		
	Describe how to fly the following in-flight ADF procedures: homing and tracking, and explain the influence of wind; interception of inbound QDM and outbound QDR; changing from one QDM/QDR to another; determining station passage and the abeam point.		
C.2.2.1.3	**c. Coverage and range**	**x**	**x**
	State that the power of the transmitter limits the range of an NDB.		
	Explain the relationship between power and range.		
	Describe the propagation path of NDB radio waves with respect to the ionosphere and the Earth's surface.		
	Explain that the interference between sky waves and ground waves leads to 'fading'.		
	Define that the accuracy the pilot has to fly the required bearing in order to be considered established during approach, according to ICAO Doc 8168, has to be within plus/minus 5 degrees.		
	State that there is no warning indication of NDB failure.		
C.2.2.1.4	**d. Errors and accuracy**	**x**	**x**
	Explain 'coastal refraction': as a radio wave travelling over land crosses the coast, the wave speeds up over water and the wave front bends.		
	Define 'night/twilight effect': the influence of sky waves and ground waves arriving at the ADF receiver with a difference of phase and polarisation which introduce bearing errors.		
	State that interference from other NDB stations on the same frequency may occur at night due to sky-wave contamination.		
C.2.2.1.5	**e. Factors affecting range and accuracy**	**x**	**x**
	Describe diffraction of radio waves in mountainous terrain (mountain effect).		
	State that static radiation energy from a cumulonimbus cloud may interfere with the radio wave and influence the ADF bearing indication.		
	Explain that the bank angle of the aircraft causes a dip error.		
C.2.3	**VOR AND DOPPLER VOR**	**x**	**x**
C.2.3.1	**Principles, Interpretation and Limitations**	**x**	**x**
C.2.3.1.1	**a. Principles**	**x**	**x**
	Explain the working principle of VOR using the following general terms: reference phase; variable phase; phase difference.		
	State that the frequency band allocated to VOR according to ICAO Annex 10 is VHF, and the frequencies used are 108.0-117.975 MHz.		

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	State that frequencies within the allocated VOR range 108.0-111.975 MHz, which have an odd number in the first decimal place, are used by instrument landing system (ILS).		
	State that the following types of VOR are in operation: conventional VOR (CVOR): a first-generation VOR station emitting signals by means of a rotating antenna; Doppler VOR (DVOR): a second-generation VOR station emitting signals by means of a combination of fixed antennas utilising the Doppler principle; en-route VOR for use by IFR traffic; terminal VOR (TVOR): a station with a shorter range used as part of the approach and departure structure at major aerodromes; test VOR (VOT): a VOR station emitting a signal to test VOR indicators in an aircraft.		
	State that automatic terminal information service (ATIS) information is transmitted on VOR frequencies.		
	List the three main components of VOR airborne equipment: the antenna; the receiver; the indicator.		
	Describe the identification of a VOR in terms of Morse-code letters and additional plain text.		
	State that according to ICAO Annex 10, a VOR station has an automatic ground monitoring system.		
	State that failure of the VOR station to stay within the required limits can cause the removal of identification and navigation components from the carrier or radiation to cease.		
C.2.3.1.2	**b. Presentation and interpretation**	x	x
	Read off the radial on an RMI.		
	Read off the angular displacement in relation to a preselected radial on a horizontal situation indicator (HSI) or omnibearing indicator (OBI).		
	Explain the use of the TO/FROM indicator in order to determine aircraft position relative to the VOR considering also the heading of the aircraft.		
	Interpret VOR information as displayed on HSI, CDI and RMI.		
	Describe the following in-flight VOR procedures: tracking, and explain the influence of wind when tracking; interception of a radial inbound and outbound to/from a VOR; changing from one radial inbound/outbound to another; determining station passage and the abeam point.		
	State that when converting a radial into a true bearing, the variation at the VOR station has to be taken into account.		
C.2.3.1.3	**c. Coverage and range**	x	x
C.2.3.1.4	**d. Errors and accuracy**	x	x
	Define that the accuracy the pilot has to fly the required bearing in order to be considered established on a VOR track when flying approach procedures, according to ICAO Doc 8168, has to be within the half-full scale deflection of the required track.		
	State that due to reflections from terrain, radials can be bent and lead to wrong or fluctuating indications, which is called 'scalloping'.		
C.2.4	**DME**	x	x
C.2.4.1	**Principles, Interpretation and Limitations**	x	x
C.2.4.1.1	**a. Principles**	x	x
	State that DME operates in the UHF band.		

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	State that the system comprises two basic components: the aircraft component: the interrogator; the ground component: the transponder.		
	Describe the principle of distance measurement using DME in terms of a timed transmission from the interrogator and reply from the transponder on different frequencies.		
	Explain that the distance measured by DME is slant range.		
	Illustrate that a position line using DME is a circle with the station at its centre.		
C.2.4.1.2	**b. VOR/DME**	**x**	**x**
	State that the pairing of VHF and UHF frequencies (VOR/DME) enables the selection of two items of navigation information from one frequency setting.		
	Describe, in the case of co-location with VOR and ILS, the frequency pairing and identification procedure.		
C.2.4.1.3	**c. VORTAC**	**x**	**x**
	State that military UHF tactical air navigation aid (TACAN) stations may be used for DME information.		
C.2.4.1.4	**d. Presentation and interpretation**	**x**	**x**
	State that when identifying a DME station co-located with a VOR station, the identification signal with the higher-tone frequency is the DME which identifies itself approximately every 40 seconds.		
	Calculate ground distance from given slant range and altitude.		
	Describe the use of DME to fly a DME arc in accordance with ICAO Doc 8168 Volume 1.		
	State that a DME system may have a ground speed (GS) and time to station read-out combined with the DME read-out.		
C.2.4.1.5	**e. Coverage and range**	**x**	**x**
	Explain why a ground station can generally respond to a maximum of 100 aircraft.		
	Explain which aircraft will be denied a DME range first when more than 100 interrogations are being made.		
C.2.4.1.6	**f. Errors and accuracy**	**x**	**x**
C.2.4.1.7	**g. Factors affecting range and accuracy**	**x**	**x**
	Explain why the GS read-out from a DME can be less than the actual GS, and is zero when flying a DME arc.		
C.2.5	**ILS**	**x**	**x**
C.2.5.1	**Principles, Interpretation and Limitations**	**x**	**x**
C.2.5.1.1	**a. Principles**	**x**	**x**
	Name the three main components of an ILS: the localiser (LOC); the glide path (GP); range information (markers or DME).		
	State the site locations of the ILS components: the LOC antenna should be located on the extension of the runway centre line at the stop-end; the GP antenna should be locate beyond the runway threshold, laterally displaced to the side of the runway centre line.		
	Explain that marker beacons produce radiation patterns to indicate predetermined distances from the threshold along the ILS GP.		
	State that marker beacons are sometimes replaced by a DME paired with the LOC frequency.		

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	State that in the ILS LOC frequency assigned band 108.0-111.975 MHz, only frequencies which have an odd number in the first decimal are ILS LOC frequencies.		
	State that the GP operates in the UHF band.		
	Describe the use of the 90-Hz and the 150-Hz signals in the LOC and GP transmitters/receivers, stating how the signals at the receivers vary with angular deviation.		
	State that the UHF GP frequency is selected automatically by being paired with the LOC frequency.		
	Explain that both the LOC and the GP antenna radiates side lobes (false beams) which can give rise to false centre-line and false GP indication.		
	Explain that the back beam from the LOC antenna may be used as a published 'non-precision approach'.		
	State that the recommended GP is 3 degrees .		
	Name the frequency, modulation and identification assigned to all marker beacons. All marker beacons operate on 75-MHz carrier frequency. The modulation frequencies of the audio are: outer marker: low; middle marker: medium; inner marker: high. The audio frequency modulation (for identification) is the continuous modulation of the audio frequency and is keyed as follows: outer marker: 2 dashes per second continuously; middle marker: a continuous series of alternate dots and dashes; inner marker: 6 dots per second continuously. The outer-marker cockpit indicator is coloured blue, the middle marker amber, and the inner marker white.		
	State that the final-approach area contains a fix or facility that permits verification of the ILS GP-altimeter relationship. The outer marker or DME is usually used for this purpose.		
C.2.5.1.2	**b. Presentation and interpretation**	**x**	**x**
	Describe the ILS identification regarding frequency and Morse code or plain text.		
	State that an ILS installation has an automatic ground monitoring system.		
	State that the LOC and GP monitoring system monitors any shift in the LOC and GP mean course line or reduction in signal strength.		
	State that warning flags will appear for both the LOC and the GP if the received signal strength is below a threshold value.		
	Describe the circumstances in which warning flags will appear for both the LOC and the GP: absence of the carrier frequency; absence of the modulation simultaneously; the percentage modulation of the navigation signal reduced to 0.		
	Interpret the indications on a CDI and an HSI: full-scale deflection of the CDI needle corresponds to approximately 2.5 degrees displacement from the ILS centre line; full-scale deflection on the GP corresponds to approximately 0.7 degrees from the ILS GP centre line.		
	Interpret the aircraft's position in relation to the extended runway centre line on a back-beam approach.		
	Explain the setting of the course pointer of an HSI and the course selector of an omnibearing indicator (OBI) for front-beam and back-beam approaches.		
C.2.5.1.3	**c. Coverage and range**	**x**	**x**

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	Sketch the standard coverage area of the LOC and GP with angular sector limits in degrees and distance limits from the transmitter: LOC coverage area is 10 degrees on either side of the centre line to a distance of 25 NM from the runway, and 35 degrees on either side of the centre line to a distance of 17 NM from the runway; GP coverage area is 8 degrees on either side of the centre line to a distance of minimum 10 NM from the runway.		
C.2.5.1.4	**d. Errors and accuracy**	**x**	**x**
	Explain that ILS approaches are divided into facility performance categories defined in ICAO Annex 10.		
	Define the following ILS operation categories: Category I; Category II; Category IIIA; Category IIIB; Category IIIC.		
	Explain that all Category III ILS operations guidance information is provided from the coverage limits of the facility to, and along, the surface of the runway.		
	Explain why the accuracy requirements are progressively higher for CAT I, CAT II and CAT III ILS.		
	Explain the following in accordance with ICAO Doc 8168: the accuracy the pilot has to fly the ILS LOC to be considered established on an ILS track is within the half-full scale deflection of the required track; the aircraft has to be established within the half-scale deflection of the LOC before starting descent on the GP; the pilot has to fly the ILS GP to a maximum of half-scale fly-up deflection of the GP in order to stay in protected airspace.		
	State that if a pilot deviates by more than half-course deflection on the LOC or by more than half-dot deflection on the GP, an immediate go-around should be executed because obstacle clearance may no longer be guaranteed.		
	Describe ILS beam bends as deviations from the nominal LOC and GP respectively which can be assessed by flight test.		
	Explain that multipath interference is caused by reflections from objects within the ILS coverage area.		
C.2.5.1.5	**e. Factors affecting range and accuracy**	**x**	**x**
	Define the 'ILS-critical area': an area of defined dimensions around the LOC and GP antennas where vehicles, including aircraft, are excluded during all ILS operations.		
	Define the 'ILS-sensitive area': an area extending beyond the ILS-critical area where the parking or movement of vehicles, including aircraft, is controlled to prevent the possibility of unacceptable interference to the ILS signal during ILS operations.		
	Microwave landing system (MLS)		
C.2.6	**AIRBORNE WEATHER RADAR**	**x**	**x**
C.2.6.1	**Principles, Interpretation and Limitations**	**x**	**x**
C.2.6.1.1	**a. Principles**	**x**	**x**
	List the two main tasks of the weather radar in respect of weather and navigation.		
	State that modern weather radars employ frequencies that give wavelengths of about 3 cm that reflect best on wet hailstones.		
	State that the antenna is stabilised in the horizontal plane with signals from the aircraft's attitude reference system.		
	Describe the cone-shaped pencil beam of about 3 to 5 degrees beam width used for weather detection.		
C.2.6.1.2	**b. Presentation and interpretation**	**x**	**x**

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	Explain the functions of the following different controls on the radar control panel: off/on switch; function switch with WX, WX plus T and MAP modes; gain-control setting (auto/manual); tilt/autotilt switch.		
	Name, for areas of differing reflection intensity, the colour gradations (green, yellow, red and magenta) indicating the increasing intensity of precipitation.		
	State the use of azimuth-marker lines and range lines in respect of the relative bearing and the distance to a thunderstorm on the screen.		
C.2.6.1.3	**c. Coverage and range**	**x**	**x**
	Explain how the radar is used for weather detection and for mapping (range, tilt and gain, if available).		
C.2.6.1.4	**d. Errors, accuracy and limitations**	**x**	**x**
	Explain why AWR should be used with extreme caution when on the ground.		
C.2.6.1.5	**e. Factors affecting range and accuracy**	**x**	**x**
	Explain the danger of the area behind heavy rain (shadow area) where no radar waves will penetrate.		
	Describe appropriate tilt settings in relation to altitude and thunderstorms.		
	Explain why a thunderstorm may not be detected when the tilt is set too high.		
C.2.6.1.6	**f. Application to navigation**	**x**	**x**
	Describe the navigation function of the radar in the mapping mode.		
	Describe the use of the weather radar to avoid a thunderstorm (Cb).		
	Explain how turbulence (not CAT) can be detected by a modern weather radar.		
	Explain how wind shear can be detected by a modern weather radar.		
C.2.7	**SECONDARY RADAR AND TRANSPONDER**	**x**	**x**
C.2.7.1	**Principles, Interpretation and Limitations**	**x**	**x**
C.2.7.1.1	**a. Principles**	**x**	**x**
	State that the ATC system is based on the replies provided by the airborne transponders in response to interrogations from the ATC secondary radar.		
	State that the ground ATC secondary radar uses techniques which provide the ATC with information that cannot be acquired by the primary radar.		
	State that an airborne transponder provides coded-reply signals in response to interrogation signals from the ground secondary radar and from aircraft equipped with traffic alert and collision avoidance system (TCAS).		
	State the advantages of secondary surveillance radar (SSR) over a primary radar regarding range and collected information due to transponder principal information and active participation of the aircraft.		
C.2.7.1.2	**b. Modes and codes**	**x**	**x**
	State that the interrogator transmits its interrogations in the form of a series of pulse pairs.		
	Name the interrogation modes: Mode A; Mode C; Mode S.		
	State that the interrogation frequency and the reply frequency are different.		

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	Explain that the decoding of the time interval between the pulse pairs determines the operating mode of the transponder: Mode A: transmission of aircraft transponder code; Mode C: transmission of aircraft pressure altitude; Mode S: selection of aircraft address and transmission of flight data for the ground surveillance.		
	State that Mode A designation is a sequence of four digits which can be manually selected from 4 096 available codes.		
	State that in Mode C reply, the pressure altitude is reported in 100-ft increments.		
	State that in addition to the information provided, on request from ATC, a special position identification (SPI) pulse can be transmitted but only as a result of a manual selection by the pilot (IDENT button).		
	State the need for compatibility of Mode S with Mode A and C.		
	Explain that Mode S transponders receive interrogations from TCAS and SSR ground stations.		
	State that Mode S interrogation contains either the aircraft address, selective call or all-call address.		
	State that every aircraft is allocated an ICAO aircraft address, which is hard-coded into the Mode S transponder (Mode S address).		
	Explain that a 24-bit address is used in all Mode S transmissions, so that every interrogation can be directed to a specific aircraft.		
	State that Mode S can provide enhanced vertical tracking, using a 25-ft altitude increment.		
	State that SSR can be used for automatic dependent surveillance - broadcast (ADS-B).		
C.2.7.1.3	**c. Presentation and interpretation**	**x**	**x**
	State that an aircraft can be identified by a unique code.		
	State which information can be presented on the ATC display system: pressure altitude; flight level; flight number or aircraft registration number; GS.		
	Explain the use and function of the selector modes: OFF, Standby, ON (Mode A), ALT (Mode A, C and S), TEST, and of the reply lamp.		
C.2.7.1.4	**d. Errors and accuracy**	**x**	**x**
C.2.8	**GLOBAL NAVIGATION SATELLITE SYSTEM**	**x**	**x**
C.2.8.1	**Principles, Interpretation and Limitations**	**x**	**x**
C.2.9.1.1	**a. Principles**	**x**	**x**
	State that GNSS supplies three-dimensional position fixes and speed data, plus a precise time reference.		
	State that a GNSS receiver is able to determine the distance to a satellite by determining the difference between the time of transmission by the satellite and the time of reception.		
	State that the initial distance calculated to the satellites is called pseudo-range because the difference between the GNSS receiver and the satellite time references initially creates an erroneous range.		
	State that each range defines a sphere with its centre at the satellite.		
	State that there are four unknown parameters (x, y, z and Delta t) (receiver clock error) which require the measurement of ranges to four different satellites in order to get the position.		
	State that the GNSS receiver is able to synchronise to the correct time reference when receiving four satellites.		

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	State that the receiver is able to calculate aircraft ground speed using the space vehicle (SV) Doppler frequency shift or the change in receiver position over time.		
C.2.9.1.2	**b. Operation of NAVSTAR GPS**	**x**	**x**
	Define 'receiver autonomous integrity monitoring (RAIM)' as a technique that ensures the integrity of the provided data by redundant measurements.		
	State that RAIM is achieved by consistency checks among range measurements.		
	State that basic RAIM requires five satellites. A sixth one is for isolating a faulty satellite from the navigation solution.		
	State that agreements have been concluded between the appropriate agencies for the compatibility and interoperability by any approved user of NAVSTAR and GLONASS systems.		
	State that the different GNSSs use different data with respect to reference systems, orbital data, and navigation services.		

SACAA Ref	*Description*	*SACAA IR(A)*	*SACAA IR(H)*
	AIR LAW AND ALL WEATHER OPERATIONS	**x**	**x**
C3.1	**SOUTH AFRICAN CIVIL AVIATION REGULATIONS**	**x**	**x**
C3.1.1	**a. Part 1.01.1 Definitions**	**x**	**x**
	- Adequate aerodrome	**x**	**x**
	- aerodrome	**x**	**x**
	- aerodrome operating minima	**x**	**x**
	- Aeronautical information publication	**x**	**x**
	- Aircraft flight manual	**x**	**x**
	- Aircraft operating manual X	**x**	**x**
	- Airmanship	**x**	**x**
	- All weather operations	**x**	**x**
	- Alternate aerodromes	**x**	**x**
	- Altitude	**x**	**x**
	- Approach and landing operation with vertical guidance	**x**	**x**
	- BARO VNAV system	**x**	**x**
	- Category I (CAT I) operation	**x**	**x**
	- Category II (CAT II) operation	**x**	**x**
	- Category IIIA (CAT IIIA) operation	**x**	**-**
	- Category IIIB (CAT IIIB) operation	**x**	**-**
	- Category IIIC (CAT IIIC) operation	**x**	**-**
	- Ceiling	**x**	**x**
	- Circling approach	**x**	**-**
	- Class A, B, C, D, E, F, G airspace	**x**	**x**
	- Cloud break procedure	**x**	**x**
	- Cloud Ceiling	**x**	**x**
	- Communication failure procedure	**x**	**x**
	- Competency	**x**	**x**
	- Controlled flight	**x**	**x**
	- Critical phase of flight	**x**	**x**
	- Current flight plan	**x**	**x**
	- Decision Altitude/height	**x**	**x**

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	- Electronic flight bag	x	x
	- En-route safe Altitude	x	x
	- Estimated off-block time	x	x
	- Estimated time of arrival (IFR)	x	x
	- Expected Approach time	x	x
	- Extended range operations	x	-
	- Final Approach	x	x
	- Final Approach and take-off area	-	x
	- Final Approach fix	x	x
	- Flight	x	x
	- Flight Level	x	x
	- Flight Time	x	x
	- General Aviation Operation	x	x
	- Full Flight Simulator	x	x
	- GNSS	x	x
	- GNSS incident	x	x
	- Ground visibility	x	x
	- Hazard	x	x
	- height	x	x
	- Heliport operating minima	-	x
	- Human factors principles	x	x
	- Human performance	x	x
	- Initial Approach fix	x	x
	- Initial Approach segment	x	x
	- Instrument Approach and landing operation	x	x
	- Instrument Approach procedure	x	x
	- Instrument flight time	x	x
	- Instrument Ground time	x	x
	- Instrument time	x	x
	- Instrument meteorological conditions	x	x
	- Integrated Aeronautical information package	x	x

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	- Isolated aerodrome	**x**	**x**
	- Lateral navigation	**x**	**x**
	- Level	**x**	**x**
	- Low visibility procedures	**x**	**x**
	- Low visibility take-off	**x**	**x**
	- Manoeuvring area	**x**	**x**
	- Meteorological information	**x**	**x**
	- Meteorological service	**x**	**x**
	- Minimum descent Altitude / height	**x**	**x**
	- Missed Approach point	**x**	**x**
	- Missed Approach procedure	**x**	**x**
	- Movement area	**x**	**x**
	- Navigation specification	**x**	**x**
	- Night	**x**	**x**
	- Non-precision Approach	**x**	**x**
	- Notice to airmen	**x**	**x**
	- Obstacle clearance Altitude / height	**x**	**x**
	- Operator	**x**	**x**
	- Owner	**x**	**x**
	- Performance based navigation	**x**	**x**
	- Precision Approach	**x**	**x**
	- Precision Approach and landing operation	**x**	**x**
	- Pressure Altitude	**x**	**x**
	- Primary-means navigation system	**x**	**x**
	- Problematic use of psychoactive substances	**x**	**x**
	- Psychoactive substances	**x**	**x**
	- RAIM warning	**x**	**x**
	- Receiver Autonomous Integrity Monitoring	**x**	**x**
	- Required navigation performance	**x**	**x**
	- RNP Type	**x**	**x**
	- RNAV/BARO VNAV procedures	**x**	**x**

SACAA Ref	*Description*	*SACAA IR(A)*	*SACAA IR(H)*
	- RNAV specification	**x**	**x**
	- RNP specification	**x**	**x**
	- RNP Type	**x**	**x**
	- Runway	**x**	**x**
	- Runway-holding position	**x**	**x**
	- Runway incursion	**x**	**x**
	- Runway visual range	**x**	**x**
	- Safety pilot	**x**	**x**
	- Separate runways	**x**	**x**
	- SIGMET information	**x**	**x**
	- Special VFR flight	**x**	**x**
	- Suitable aerodrome	**x**	**x**
	- Supplemental-means navigation system	**x**	**x**
	- Take-off Alternate aerodrome	**x**	**x**
	- Terminal arrival Altitude	**x**	**x**
	- Threat	**x**	**x**
	- Threat management	**x**	**x**
	- Total Estimated elapsed time	**x**	**x**
	- Total vertical error	**x**	**x**
	- Track	**x**	**x**
	- Traffic alert and collision avoidance system	**x**	**x**
	- Traffic avoidance advice	**x**	**x**
	- Transition Altitude	**x**	**x**
	- Transition Level	**x**	**x**
	- Vertical navigation	**x**	**x**
	- Visibility	**x**	**x**
	- Visual Approach	**x**	**x**
	- Visual flight rules flight	**x**	**x**
	- Visual meteorological conditions	**x**	**x**
C3.1.2	**b. PART 61: PILOT LICENSING**	**x**	**x**
C3.1.2.1	**SUBPART 1: GENERAL- 61.01.8 Logging of flight time (Paragraphs: 9, 11, 12, 17, 18)- 61.01.9 Crediting of flight time and theoretical knowledge (Paragraphs 12, 14, 15, 25**	**x**	**x**

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
C3.1.2.2	**SUBPART 11 INSTRUMENT RATING- 61.11.1 General- 61.11.2 Requirements- 61.11.4 Skills test- 61.11.5 Privileges and limitations of an instrument rating**	**x**	**x**
C3.1.2.3	**SUBPART 11 INSTRUMENT RATING- 61.11.1 General- 61.11.2 Requirements- 61.11.4 Skills test- 61.11.5 Privileges and limitations of an instrument rating**	**x**	**x**
C3.1.3	**c. PART 91: GENERAL AVIATION AND OPERATING FLIGHT RULES**	**x**	**x**
	- 91.01.1 Applicability	**x**	**x**
	- 91.01.12 Use of time	**x**	**x**
	- 91.01.16 Psychoactive substances	**x**	**x**
	- 91.02.1 Crew composition and qualifications	**x**	**x**
	- 91.02.3 Crew member responsibilities	**x**	**x**
	- 91.02.4 Recency	**x**	**x**
	- 91.02.6 Laws, regulations and procedures	**x**	**x**
	- 91.02.7 Duties of PIC regarding flight preparation	**x**	**x**
	- 91.02.8 Duties of PIC regarding flight operations	**x**	**x**
	- 91.03.4 Air traffic service flight plan and associated procedures (Paragraph: 7)	**x**	**x**
	- 91.04.1 Use and installation of instruments and equipment	**x**	**x**
	- 91.04.5 Flight, navigation and associated equipment for aircraft operated under IFR	**x**	**x**
	- 91.04.6 Additional equipment for single-pilot operation under IMC or at night	**x**	**x**
	- 91.04.9 Equipment for operations in icing conditions	**x**	**x**
	- 91.04.15 Supplemental oxygen in case of pressurized aircraft	**x**	**x**
	- 91.04.28 Airborne collision avoidance system	**x**	**x**
	- 91.04.30 Terrain awareness and warning systems (TAWS)	**x**	**x**
	- 91.04.31 RVSM operations	**x**	**-**
	Explain the requirements for flights in reduced vertical separation minima (RVSM) airspace.	*x*	*-*
	Explain what equipment is required to operate in airspace with reduced vertical separation minima (RVSM).	*x*	*-*
	- 91.05.1 Communication equipment	**x**	**x**
	List the minimum equipment required for IFR flights.	*x*	*x*
	Explain the general requirements for communication and navigation equipment.	*x*	*x*
	Explain why the radio-communication equipment must be able to send and receive on 121.5 MHz.	*x*	*x*
	Explain the requirements regarding the provision of an audio selector panel.	*x*	*x*
	List the requirements for communication and navigation equipment when operating under IFR or under VFR over routes not nav	*x*	*x*
	Explain the conditions under which a crew member interphone system and public address system are mandatory.	*x*	*x*
	List the equipment for operations requiring a radio communication.	*x*	*x*

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	List the equipment for operations that require a radio navigation system.	*x*	*x*
	- 91.05.2 Navigation equipment	**x**	**x**
	Explain what equipment is required to operate in airspace with reduced vertical separation minima (RVSM).	*x*	*x*
	Explain the requirements regarding the provision of a transponder.	*x*	*x*
	Explain the requirements regarding the management of aeronautical databases.	*x*	*x*
	- 91.05.3 Use of global navigation satellite system	**x**	**x**
	- 91.05.4 Operational criteria for use of RNAV/BARO VNAV systems	**x**	**x**
	State that pilots must not fly an RNP APCH unless it is retrievable by procedure name from the on-board navigation database ar	*x*	*x*
	State that an RNP APCH to LNAV minima is a non-precision IAP designed for two-dimensional approach operations.	*x*	*x*
	State that an RNP APCH to lateral navigation (LNAV)/vertical navigation (VNAV) minima has lateral guidance based on GNSS ar	*x*	*x*
	State that an RNP APCH to LNAV/VNAV minima may only be conducted with vertical guidance certified for the purpose.	*x*	*x*
	Explain why an RNP APCH to LNAV/VNAV minima based on Baro-VNAV may only be conducted when the aerodrome temperatu	*x*	*x*
	State that the correct altimeter setting is critical for the safe conduct of an RNP APCH using Baro-VNAV.	*x*	*x*
	State that an RNP APCH to LNAV/VNAV minima is a three-dimensional operation.	*x*	*x*
	State that an RNP APCH to localiser performance with vertical guidance (LPV) minima is a three-dimensional operation.	*x*	*x*
	State that RNP APCH to LPV minima requires a final approach segment (FAS) data block.	*x*	*x*
	State that RNP approaches to LPV minima require SBAS.	*x*	*x*
	- 91.06.9 Aircraft speed	**x**	**x**
	- 91.06.18 Compliance with rules of air and air traffic control clearances and instructions	**x**	**x**
	- 91.06.21 Visibility and distance from cloud (Paragraphs: 1a, 2)	**x**	**-**
	- 91.06.21 Visibility and distance from cloud (Paragraph: 1b)	**-**	**x**
	- 91.06.22 Special VFR weather minima (Paragraph: 1)	**x**	**-**
	- 91.06.22 Special VFR weather minima (Paragraph: 2)	**-**	**x**
	- 91.06.23 VFR flight determination and weather deterioratio	**x**	**x**
	- 91.06.24 Compliance with IFR	**x**	**x**
	- 91.06.25 Aircraft equipment	**x**	**x**
	- 91.06.26 Change from IFR flight to VFR flight	**x**	**x**
	- 91.06.27 IFR procedures	**x**	**x**
	- 91.06.32 Minimum heights (Paragraph: 3)	**x**	**x**
	- 91.06.33 Semi-circular rule	**x**	**x**
	Select routes taking the following criteria into account: classification of airspace; restricted areas; VFR semicircular rules; visuall	*x*	*x*

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	- 91.06.34 Aerodrome approach and departure procedures	**x**	**x**
	- 91.07.2 Minimum flight altitudes	**x**	**x**
	Define the following altitudes: minimum en-route altitude (MEA); minimum obstacle clearance altitude (MOCA); minimum secto	*x*	*x*
	Extract the following altitudes from the chart(s): MEA; MOCA; MSA; MORA; Grid MORA; MAA; MCA; MHA.	*x*	*x*
	State who is responsible for terrain separation during IFR flight inside and outside controlled airspace.	*x*	*x*
	State the minimum obstacle clearance requirements for en-route IFR flight inside and outside controlled airspace.	*x*	*x*
	State when a temperature error correction must be applied by either the pilot or ATC.	*x*	*x*
	Identify and explain the use of minimum radar vectoring altitudes.	*x*	*x*
	Calculate the minimum pressure altitude required with a given obstacle clearance, magnetic track, OAT, QNH and reduced verti	*x*	*x*
	Calculate true altitude above a given datum using a given pressure altitude, OAT and QNH.	*x*	*x*
	- 91.07.3 Use of aerodromes	**x**	**x**
	Explain the operator's responsibility regarding aerodrome/heliport operating minima.	*x*	*x*
	Define the following terms: 'circling', 'low-visibility procedures', 'low-visibility take-off', 'visual approach'.	*x*	*x*
	Define the following terms: 'final approach and take-off area'.	-	*x*
	- 91.07.5 Aerodrome operating minima	**x**	**x**
	Aerodrome operating minima: explain under which conditions the commander can commence take-off.	*x*	*x*
	Aerodrome operating minima: explain that take-off minima are expressed as visibility or runway visual range (RVR).	*x*	*x*
	Aerodrome operating minima: explain the take-off RVR value depending on the aerodrome facilities.	*x*	*x*
	Aerodrome operating minima: explain the system minima for non-precision approach (NPA) (minimum descent altitude/height (	*x*	*x*
	Aerodrome operating minima: explain under which conditions a pilot can continue the approach below MDA/H or DA/H.	*x*	*x*
	Aerodrome operating minima: explain the lowest minima for precision approach category 1 (including single-pilot operations).	*x*	*x*
	Aerodrome operating minima: explain the lowest minima for precision approach category 2 operations.	*x*	*x*
	Aerodrome operating minima: explain the lowest minima for precision approach category 3 operations.	*x*	*x*
	Aerodrome operating minima: explain the lowest minima for circling and visual approach.	*x*	*x*
	Aerodrome operating minima: explain the RVR value and cloud ceiling depending on the aerodrome.	*x*	*x*
	Aerodrome operating minima: explain under which conditions an airborne radar approach can be performed and state the relev	*x*	*x*
	- 91.07.6 Threshold crossing height	**x**	**x**
	- 91.07.7 Pre-flight selection of aerodromes	**x**	**x**
	- 91.07.8 Planning minima for IFR flights	**x**	**x**
	- 91.07.9 Meteorological conditions	**x**	**x**
	- 91.07.12 Fuel supply	**x**	**x**

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	Determine relevant data, such as fuel capacity, fuel flow/ consumption at different power/thrust settings, altitudes and atmosp	*x*	*x*
	Calculate the attainable flight time/range from given average fuel flow/consumption and available amount of fuel.	*x*	*x*
	Calculate the required fuel from given average fuel flow/ consumption and required time/range to be flown.	*x*	*x*
	Calculate the required fuel for a VFR flight from given forecast meteorological conditions.	*x*	*x*
	State the minimum amount of remaining fuel required on arrival at the destination and alternate aerodromes/ heliports.	*x*	*x*
	Explain and describe how to calculate nautical air miles (NAM) from nautical ground miles (NGM).	*x*	*x*
	Calculate the required fuel for an IFR flight from given forecast meteorological conditions.	*x*	*x*
	Taxi fuel	**x**	**x**
	Determine the fuel required for engine start and taxiing by consulting the fuel-usage tables or graphs from the flight manual ta	*x*	*x*
	Trip fuel	**x**	**x**
	Define trip fuel and name the segments of flight for which the trip fuel is relevant.	*x*	*x*
	Determine the trip fuel for the flight by using data from the fuel tables or graphs from the flight manual.	*x*	*x*
	Contingency fuel	**x**	**x**
	Explain the reasons for having contingency fuel.	*x*	*x*
	Calculate the contingency fuel according to the applicable operational requirements.	*x*	*x*
	Alternate fuel	**x**	**x**
	Explain the reasons and regulations for having alternate fuel and name the segments of flight for which the alternate fuel is rele	*x*	*x*
	Calculate the alternate fuel in accordance with the applicable operational requirements and relevant data from the navigation	*x*	*x*
	Final reserve fuel	**x**	**x**
	Explain the reasons and regulations for having final reserve fuel.	*x*	*x*
	Calculate the final reserve fuel for an aircraft in accordance with the applicable operational requirements and by using relevant	*x*	*x*
	Additional fuel	**x**	**x**
	Explain the reasons and regulations for having additional fuel.	*x*	*x*
	Calculate the additional fuel for a flight in accordance with the applicable operational requirements.	*x*	*x*
	Extra fuel	**x**	**x**
	Explain the reasons and regulations for having extra fuel in accordance with the applicable operational requirements.	*x*	*x*
	Calculate the possible extra fuel under given conditions.	*x*	*x*
	Explain the fuel penalty incurred when loading extra fuel (i.e. the additional fuel consumption due to increased mass).	*x*	*x*
	Calculation of total fuel and completion of the fuel section of the navigation plan (fuel plan)	**x**	**x**
	Calculate the total fuel required for a given flight.	*x*	*x*
	Complete the fuel plan.	*x*	*x*

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	- 91.07.15 Instrument approach and departure procedures	**x**	**x**
	- 91.07.25 Approach and landing conditions	**x**	**x**
	- 91.07.26 Approach ban	**x**	**x**
	- 91.07.31 Simulated instrument flight in aircraft	**x**	**x**
C3.2	**SOUTH AFRICAN CIVIL AVIATION TECHNICAL STANDARDS**	**x**	**x**
C3.2.1	**SA-CATS 91 General Aviation and Operating Flight Rules**	**x**	**x**
C3.2.1.1	**- TS 91.03.3 Aircraft Checklists**	**x**	**x**
C3.2.1.2	**- TS 91.04.28 Airborne Collision Avoidance System**	**x**	**x**
C3.2.1.3	**- TS 91.05.1 Communication equipment (Paragraph: 5)**	**x**	**x**
C3.2.1.4	**- TS 91.05.2 Navigation equipment (Paragraph: 1)**	**x**	**x**
C3.2.1.5	**- TS 91.05.3 Use of global navigation satellite system**	**x**	**x**
C3.2.1.6	**- TS 91.06.16 Mandatory radio communications in controlled airspace (Radio communication failure (RCF) procedures – Gen**	**x**	**x**
	State the action to be taken in case of communication failure on a controlled VFR flight.	*x*	*x*
	Identify the frequencies to be used in an attempt to establish communication.	*x*	*x*
	State the additional information that should be transmitted in the event of receiver failure.	*x*	*x*
	Identify the SSR code that may be used to indicate communication failure.	*x*	*x*
	Explain the action to be taken by a pilot that experiences a communication failure in the aerodrome traffic pattern at controlled	*x*	*x*
	Describe the action to be taken in case of communication failure on an IFR flight.	*x*	*x*
	Describe the action to be taken in case of communication failure on an IFR flight when flying in visual meteorological conditions	*x*	*x*
	Describe the action to be taken in case of communication failure on an IFR flight when flying in instrument meteorological condi	*x*	*x*
	Explain the causes and possible safety impacts of a blocked frequency.	*x*	*x*
C3.2.1.7	**- TS 91.07.2 Minimum flight altitudes**	**x**	**x**
C3.2.1.8	**- TS 91.07.5 Aerodrome operating minima**	**x**	**x**
C3.2.1.9	**- TS 91.07.7 Preflight selection of aerodromes**	**x**	**x**
C3.2.1.10	**- TS 91.07.8 Planning Minima for IFR flights**	**x**	**x**
C3.2.1.11	**- TS 91.07.12 Fuel supply**	**x**	**x**
C3.3	**ICAO Document 8168 Procedures for Air Navigation Services – Volume I Flight Procedures**	**x**	**x**
C3.3.1	**a. Part I FLIGHT PROCEDURES — GENERAL: Section 1, Chapter 1 Definitions:**	**x**	**x**
C3.3.1.1	**- Aerodrome elevation - Airborne collision avoidance system (ACAS) - Altitude - Area navigation (RNAV) - Base turn - Circling**	**x**	**x**
	Recall all definitions included in ICAO Doc 8168, Volume I, Part I, Section 1, Chapter 1.	*x*	*x*
	Interpret all abbreviations and acronyms as shown in ICAO Doc 8168, Volume I, Part I, Section 1, Chapter 2.	*x*	*x*

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
C3.2.1.2	**PART I Section 2: General principles: Chapter 1, General Information, Paragraphs: 1.1, 1.2**	**x**	**x**
C3.2.1.3	**PART I Section 3 Departure procedures:Chapter 1: General criteria for departure proceduresChapter 2: Standard instrument c**	**x**	**x**
	State the factors dictating the design of instrument departure procedures.	*x*	*x*
	Explain in which situations the criteria for omnidirectional departures are applied.	*x*	*x*
	Explain the terms 'straight departure' and 'turning departure'.	*x*	*x*
	Explain what is the meaning of an 'omnidirectional departure'.	*x*	*x*
C3.2.1.4	**PART I Section 4: Arrival and approach proceduresChapter 1: General criteria for arrival and approach proceduresChapter 2: A**	**x**	**x**
	General criteria	**x**	**x**
	State the general criteria (except 'Speeds for procedure calculations') of the approach procedure design: instrument approach a	*x*	*x*
	Name the five possible segments of an instrument approach procedure.	*x*	*x*
	State the reasons for establishing aircraft categories for the approach.	*x*	*x*
	State the maximum angle between the final approach track and the extended RWY centre line to still consider a non-precision a	*x*	*x*
	State the minimum obstacle clearance (MOC) provided by the minimum sector altitudes (MSAs) established for an aerodrome.	*x*	*x*
	State that a pilot shall apply wind corrections when carrying out an instrument approach procedure.	*x*	*x*
	State the most significant factor influencing the conduct of instrument approach procedures.	*x*	*x*
	Explain why a pilot should not descend below obstacle clearance altitude/height (OCA/H), which are established for: precision a	*x*	*x*
	Describe in general terms the relevant factors for the calculation of operational minima.	*x*	*x*
	State the following acronyms in plain language: DA, DH, OCA, OCH, MDA, MDH, MOC, DA/H, OCA/H, MDA/H.	*x*	*x*
	Explain the relationship between the terms: DA, DH, OCA, OCH, MDA, MDH, MOC, DA/H, OCA/H, and MDA/H.	*x*	*x*
	Approach procedure design	**x**	**x**
	Describe how the vertical cross section for each of the five approach segments is broken down into the various areas.	*x*	*x*
	State within which area of the cross section the minimum obstacle clearance (MOC) is provided for the whole width of the area.	*x*	*x*
	Define the terms 'IAF', 'IF', 'FAF', 'FAP', 'MAPt' and 'TP'.	*x*	*x*
	State the accuracy of facilities providing track (VHF omnidirectional radio range (VOR), instrument landing system (ILS), non-dire	*x*	*x*
	State the optimum descent gradient (preferred for a precision approach) in degrees and per cent.	*x*	*x*
	Arrival and approach segments	**x**	**x**
	Name the five standard segments of an instrument approach procedure, and state the beginning and end for each of them.	*x*	*x*
	Describe where an arrival route normally ends.	*x*	*x*
	State the main task of the initial approach segment.	*x*	*x*
	Describe the maximum angle of interception between the initial approach segment and the intermediate approach segment (pr	*x*	*x*
	Describe the main task of the intermediate approach segment.	*x*	*x*

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	State the main task of the final approach segment.	*x*	*x*
	Name the two possible aims of a final approach.	*x*	*x*
	Explain the term 'final approach point' in case of an ILS approach.	*x*	*x*
	State what happens if an ILS glide path (GP) becomes inoperative during the approach.	*x*	*x*
	Missed approach	**x**	**x**
	Name the three phases of a missed approach procedure and describe their geometric limits.	*x*	*x*
	State the main task of a missed approach procedure.	*x*	*x*
	Define the term 'missed approach point (MAPt)'.	*x*	*x*
	Describe how an MAPt may be established in an approach procedure.	*x*	*x*
	State the pilot's action if, upon reaching the MAPt, the required visual reference is not established.	*x*	*x*
	Describe what a pilot is expected to do in the event a missed approach is initiated prior to arriving at the MAPt.	*x*	*x*
	State whether the pilot is obliged to cross the MAPt at the height (HGT)/altitude (ALT) required by the procedure or whether the	*x*	*x*
	Visual manoeuvring (circling) in the vicinity of the aerodrome (AD)	**x**	**x**
	Describe what is meant by 'visual manoeuvring (circling)'.	*x*	*x*
	Describe how a prominent obstacle in the visual manoeuvring (circling) area outside the final approach and missed approach ar	*x*	*x*
	State for which category of aircraft the obstacle clearance altitude/height (OCA/H) within an established visual manoeuvring (ci	*x*	*x*
	Describe how the minimum descent altitude/height (MDA/H) is specified for visual manoeuvring (circling) if the OCA/H is known	*x*	*x*
	State the conditions to be fulfilled before descending below MDA/H in a visual manoeuvring (circling) approach.	*x*	*x*
	Explain why there can be no single procedure designed that will cater for conducting a circling approach in every situation.	*x*	*x*
	State how the pilot is expected to act after initial visual contact during a visual manoeuvring (circling).	*x*	*x*
	Describe what the pilot is expected to do if visual reference is lost while circling to land from an instrument approach.	*x*	*x*
C3.2.1.5	**PART I Section 6: Holding proceduresChapter 1: Holding Criteria Chapter 2: Obstacle Clearance**	**x**	**x**
	Entry and holding	**x**	**x**
	Explain why deviations from the in-flight procedures of a holding established in accordance with ICAO Doc 8168 are dangerous.	*x*	*x*
	State that if for any reason a pilot is unable to conform to the procedures for normal conditions laid down for any particular hol	*x*	*x*
	Describe the shape and terminology associated with the holding pattern.	*x*	*x*
	State the bank angle and rate of turn to be used whilst flying in a holding pattern.	*x*	*x*
	Explain why a pilot in a holding pattern should attempt to maintain tracks and how this can be achieved.	*x*	*x*
	Describe where outbound timing begins in a holding pattern.	*x*	*x*
	State where the outbound leg in a holding terminates if the outbound leg is based on DME.	*x*	*x*
	Describe the three heading entry sectors for entries into a holding pattern.	*x*	*x*

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	Describe the terms ‘parallel entry’, ‘offset entry’ and ‘direct entry’.	*x*	*x*
	Determine the correct entry procedure for a given holding pattern.	*x*	*x*
	State the still-air time for flying the outbound entry heading with or without DME.	*x*	*x*
	Describe what the pilot is expected to do when clearance is received specifying the time of departure from the holding point.	*x*	*x*
	Obstacle clearance	*x*	*x*
	Describe the layout of the basic holding area, entry area and buffer area of a holding pattern.	*x*	*x*
	State which obstacle clearance is provided by a minimum permissible holding level referring to the holding area, the buffer area	*x*	*x*
C3.2.1.6	**PART I Section 8: Procedures for use by helicoptersChapter 1: IntroductionChapter 2 Chapter 3**	**-**	**x**
C3.2.2	**b. PART II - FLIGHT PROCEDURES — RNAV AND SATELLITE-BASED**	**x**	**x**
	Section 1 GENERALChapter 1: General information for RNAV systems Chapter 2: Terminal arrival altitude (TAA)Chapter 3: General information for basic GNSS	**x**	**x**
	Section 2 DEPARTURE PROCEDURES: Area navigation (RNAV) departureChapter 1: Procedures for navigation systems using basic GNSS receivers	**x**	**x**
	Section 3 ARRIVAL AND NON-PRECISION APPROACH PROCEDURESChapter 1 (1.1 to 1.4): Area navigation (RNAV) arrival and approach procedures for navigation systems	**x**	**x**
	Section 4 APPROACH PROCEDURES WITH VERTICAL GUIDANCEChapter 1 (Tables II-4-1-1 & Table II-4-1-2 not required to be m	**x**	**x**
	Section 5 PRECISION APPROACH PROCEDURESChapter 1: GBAS precision approach procedures	**x**	**x**
	Section 6 RNAV HOLDING Chapter 1 (only 1.1): General	**x**	**x**
	Section 7 EN ROUTE Chapter 1 (1.2 only): Area navigation (RNAV) and RNP- based en-route procedures	**x**	**x**
C3.3.3	**c. PART III: Aircraft operating procedures**	**x**	**x**
C3.3.3.1	**Section 1: Altimeter setting procedures**	**x**	**x**
	Basic requirements and procedures	**x**	**x**
	Describe the two main objectives of altimeter settings.	*x*	*x*
	Define the terms ‘QNH’ and ‘QFE’.	*x*	*x*
	Describe the different terms for ALT or flight levels (FLs) respectively, which are the references during climb or descent to change	*x*	*x*
	Define the term ‘flight level (FL)’.	*x*	*x*
	State where FL zero shall be located.	*x*	*x*
	State the interval by which consecutive FLs shall be separated.	*x*	*x*
	Describe how FLs are defined.	*x*	*x*
	Define the term ‘transition altitude (TA)’.	*x*	*x*
	State how TAs shall normally be specified.	*x*	*x*
	Explain how the HGT of the TA is calculated and expressed in practice.	*x*	*x*
	State where TAs shall be published.	*x*	*x*
	Define the term ‘transition level (TRL)’.	*x*	*x*

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	State when the TRL is normally passed on to the aircraft.	x	x
	State how the vertical position of the aircraft shall be expressed at or below the TA and TRL.	x	x
	Define the term 'transition layer'.	x	x
	Describe when the vertical position of an aircraft passing through the transition layer shall be expressed in terms of FLs and whe	x	x
	State when the QNH altimeter setting shall be made available to departing aircraft.	x	x
	Explain when the vertical separation of an aircraft during en-route flight shall be assessed in terms of ALT and when in terms of	x	x
	Explain when, in air-ground communications during an en-route flight, the vertical position of an aircraft shall be expressed in te	x	x
	Describe why QNH altimeter-setting reports should be provided from sufficient locations.	x	x
	State how a QNH altimeter setting shall be made available to aircraft approaching a controlled aerodrome (AD) for landing.	x	x
	State under which circumstances the vertical position of an aircraft above the TRL may be referenced in ALT.	x	x
	Procedures for operators and pilots	**x**	**x**
	State on which setting at least one altimeter shall be set prior to take-off.	x	x
	State where during the climb the altimeter setting shall be changed from QNH to 1013.2 hPa.	x	x
	Describe when a pilot of an aircraft intending to land at an AD shall obtain the TRL.	x	x
	Describe when a pilot of an aircraft intending to land at an AD shall obtain the actual QNH altimeter setting.	x	x
	State where the altimeter settings shall be changed from 1013.2 hPa to QNH during descent for landing.	x	x
C3.4	**RSA Aeronautical Information Publication (AIP)**	**x**	**x**
C3.4.1	**ENR 1.4**	**x**	**x**
C3.4.1.1	**ATS Airspace classification 1.5.1 General**	**x**	**x**
C3.4.2	**ENR 1.5**	**x**	**x**
C3.4.2.1	**1.5.1 General**	**x**	**x**
C3.4.2.2	**1.5.2 Arriving Flights**	**x**	**x**
C3.4.2.3	**1.5.10 Departing flights General**	**x**	**x**
C3.4.2.4	**1.5.10.1 Noise abatement procedures**	**x**	**-**
C3.4.3	**ENR 1.6**	**x**	**x**
C3.4.3.1	**1.6.1 Primary Radar**	**x**	**x**
C3.4.3.2	**1.6.2 Secondary Surveillance Radar**	**x**	**x**
C3.4.3.3	**(excl 1.6.2.3.4 & 1.6.2.3.5)**	**x**	**x**
C3.4.4	**ENR 1.7**	**x**	**x**
C3.4.4.1	**South African AIP ALTIMETER SETTING PROCEDURES (excl 1.7.3 b.)**	**x**	**x**
C3.4.5	**ENR 1.8**	**x**	**x**

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
C3.4.5.1	Regional Supplementary Procedures(excluding Example table under 1.8.1.2.7; Table 2 under 1.8.3; Minima under Tables 4 (N	x	x
C3.4.6	AD section	x	x
C3.4.6.1	Interpretation of information provided by the AIP Aerodrome (AD) section:(Candidates should take note of the information in RSA AIP GEN section 2.2 for AIP abbreviati	x	x
C3.5	JEPPESEN MANUAL	x	x
C3.5.1	Interpretation of information provided by the JEPPESEN manual:	x	x
C3.5.1.1	- AIRPORT	x	x
C3.5.1.2	- SID	x	x
C3.5.1.3	- STAR	x	x
C3.5.1.4	- ILS approach	x	x
C3.5.1.5	- VOR approach	x	x
C3.5.1.6	- NDB approach	x	x
C3.5.1.7	- AREA	x	x
C3.5.1.8	- RADAR MINIMUM ALTITUDE	x	x
C3.5.2	JEPPESEN HIGH / LOW ALTITUDE ENROUTE CHARTS: a. Recognition and knowledge of:	x	x
C3.5.2.1	- Air route structure	x	x
C3.5.2.2	- MEA, MOCA, MORA, Grid MORA	x	x
C3.5.2.3	- airspace structure and classification	x	x
C3.5.2.4	- communication frequencies	x	x
C3.5.2.5	- chart symbols	x	x
C3.5.2.6	- danger, restricted and prohibited airspace	x	x
C3.5.2.7	- en route holding patterns	x	x
C3.5.2.8	- aerodrome information	x	x
C3.5.2.9	- radio navigation facilities and frequencies	x	x
C3.6	ICAO ANNEX 14 – AERODROMESVolume I Aerodrome Design and Operations	x	x
C3.6.1	a. Definitions	x	x
C3.6.1.1	- Barrette	x	x
C3.6.1.2	- Instrument Runway (All types are to be known)	x	x
C3.6.1.3	- Primary Runway(s)	x	x
C3.6.2	a. Chapter 2 Aerodrome data	x	x
C3.6.2.1	- 2.2 Aerodrome reference point	x	x
	Describe where the AD reference point shall be located and where it shall normally remain.	*x*	*x*

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
C3.6.2.2	**- 2.3 Aerodrome and runway elevation**	**x**	**x**
C3.6.3	**b. Chapter 5 Visual aids for navigation**	**x**	**x**
C3.6.3.1	**5.2 Markings- 5.2.1 General- 5.2.2 Runway designation marking- 5.2.3 Runway centre line marking- 5.2.4 Threshold marking**	**x**	**x**
	Markings	**x**	**x**
	Name the colours used for the various markings (RWY, TWY, aircraft stands, apron safety lines).	*x*	*x*
	State where a RWY designation marking shall be provided and describe the different layouts (excluding dimensions).	*x*	*x*
	Describe the application and general characteristics (excluding dimensions) of: RWY-centre-line markings; THR markings; touch	*x*	*x*
	Signs	**x**	**x**
	Explain which signs are the only ones on the movement area utilising red.	*x*	*x*
	List the provisions for illuminating signs.	*x*	*x*
	Name the kinds of signs which shall be included in mandatory instruction signs.	*x*	*x*
	Name the colours used for mandatory instruction signs.	*x*	*x*
	Describe by which sign a pattern 'A' RWY holding position (i.e. at an intersection of a TWY and a non-instrument, non-precision	*x*	*x*
	Describe by which sign a pattern 'B' RWY holding position (i.e. at an intersection of a TWY and a precision approach RWY) mark	*x*	*x*
C3.6.3.2	**5.3 Lights- 5.3.4 Approach lighting systems- 5.3.5 Visual approach slope indicator systems- 5.3.7 Runway lead-in lighting systems**	**x**	**x**
	Lights	**x**	**x**
	Describe the mechanical safety considerations regarding elevated approach lights and elevated RWY, SWY and TWY lights.	*x*	*x*
	List the conditions for the installation of an aerodrome beacon (ABN) and describe its general characteristics.	*x*	*x*
	Describe the different kinds of operations for which a simple approach lighting system shall be used.	*x*	*x*
	Describe the basic installations of a simple approach lighting system including the dimensions and distances normally used.	*x*	*x*
	Describe the principle of a precision approach category I lighting system including information such as location and characterist	*x*	*x*
	Describe the principle of a precision approach category II and III lighting system including information such as location and char	*x*	*x*
	Describe the wing bars of the precision approach path indicator (PAPI) and the abbreviated precision approach path indicator (A	*x*	*x*
	Interpret what the pilot will see during an approach using a helicopter approach path indicator (HAPI).	*x*	*x*
	Explain the application and characteristics (as applicable, but limited to colour, intensity, direction and whether fixed or flashing	*x*	*x*
	State the timescale within which aeronautical ground lights shall be made available to arriving aircraft.	*x*	*x*
	Approach lighting systems	**x**	**x**
	Name the two main groups of approach lighting systems.	*x*	*x*
	Describe the two different versions of a simple approach lighting system.	*x*	*x*
	Describe the two different basic versions of precision approach lighting systems for CAT I.	*x*	*x*
	Describe the diagram of the inner 300 m of the precision approach lighting system in the case of CAT II and III.	*x*	*x*

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	Describe how the arrangement of an approach lighting system and the location of the appropriate THR are interrelated.	*x*	*x*

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	FLIGHT PERFORMANCE AND PLANNING	**x**	**x**
C.4.1	**BASIC AERODYNAMIC THEORY:**	**x**	**x**
C.4.1.1	**a. Definitions, terminology and concepts:**	**x**	**x**
C.4.1.1.1	**- Wing characteristics: Angle of attack, chord line, camber**	**x**	**x**
	Describe the originating point and direction of the resultant force caused by the pressure distribution around an aerofoil.		
	Resolve the resultant force into the components 'lift' and 'drag'.		
	Describe the direction of lift and drag.		
	Define the 'aerodynamic moment'.		
	List the factors that affect the aerodynamic moment.		
	Describe the aerodynamic moment for a symmetrical aerofoil.		
	Describe the aerodynamic moment for a positively and negatively cambered aerofoil.		
	Define 'angle of attack' (alpha).		
C.4.1.1.2	**- Lift, weight, thrust**	**x**	**x**
	Describe the forces that act on an aeroplane in straight, horizontal, and steady flight.		
	List the four forces and state where they act on.		
	Explain how the four forces are balanced, including the function of the tailplane.		
	Describe the effect of engine thrust on pitching moments for different engine locations.		
C.4.1.1.3	**- Graph: Coefficient of Lift/ angle of attack**	**x**	**x**
	Describe the CL-alpha graph.		
	Explain the significant points: point where the curve crosses the horizontal axis (zero lift); point where the curve crosses the vertical axis (alpha equals 0); point where the curve reaches its maximum (CLMAX).		
C.4.1.1.4	**- Drag types: induced, profile, form, parasite, skin friction, interference**	**x**	**x**
	State that total drag consists of parasite drag and induced drag.		
	Explain the factors that cause induced drag.		
	Describe the relationship between induced drag and total drag in straight and level flight with variable speed.		
	Describe the means to reduce induced drag: aspect ratio; winglets; tip tanks; wing twist; camber change.		
	Describe the types of drag that are included in parasite drag.		
	Describe form (pressure) drag and the factors which affect its magnitude.		
	Describe interference drag and the factors which affect its magnitude.		
	Describe friction drag and the factors which affect its magnitude.		
	Explain the total drag-speed graph and the constituent drag components.		
	Describe the CL-CD graph (polar).		
	Indicate minimum drag on the graph.		
	Explain why the CL-CD ratio is important as a measure of performance.		

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
C.4.1.1.5	**- Ground effect**	**x**	**x**
	Explain the effects of entering and leaving ground effect.		
	Effect on stalling angle of attack (alphaCRIT)		
	Describe the influence of ground effect on alphaCRIT.		
	Effect on take-off and landing characteristics of an aeroplane		
	Describe the influence of ground effect on take-off and landing characteristics and performance of an aeroplane.		
	Describe the difference in take-off and landing characteristics of high- and low-wing aeroplanes.		
C.4.2	**PERFORMANCE TERMINOLOGY AND THEORY**	**x**	**x**
C.4.2.1	**Phases of Flight**	**expanded**	**expanded**
C.4.2.1.1	**- Define "steady" flight**	**x**	**x**
	Explain how drag (thrust) and power required vary with speed in straight and level flight.		
	Explain the effect of excess thrust and power on speed in level flight.		
	Describe how the maximum achievable straight and level flight IAS and TAS vary with altitude.		
	Describe situations in which a pilot may elect to fly for 'maximum endurance' or 'maximum range'.		
C.4.2.1.2	**- The forces during steady climbing and descending flight**	**x**	**x**
	Resolve the forces during a steady climb.		
	Explain climb performance in relation to the thrust available and thrust required (angle of climb), and power available and power required (rate of climb).		
	Resolve the forces during steady descent and in the glide.		
	Explain descent performance in relation to thrust available and thrust required (drag), and power available and power required.		
C.4.2.1.3	**- The opposing forces during horizontal steady flight**	**x**	**x**
C.4.2.2	**Thrust and Power curves**	**expanded**	**expanded**
C.4.2.2.1	**- The "thrust/power required" and "thrust/power available" graph curves**	**x**	**x**
	Interpret the 'thrust/power required' and 'thrust/power available' curves in straight and level flight.		
	Interpret the 'thrust/power required' and 'thrust/power available' curves in a steady climb.		
	Interpret the 'thrust/power required' and 'thrust/power available' curves in a steady descent.		
C.4.2.2.2	**- The effect of excess thrust and excess Power on speed and/or climb performance**	**x**	**x**
	Explain the meaning and effect of 'excess thrust' and 'excess power' in a steady climb.		
	Explain the meaning of 'excess thrust required' (excess drag) and 'excess power required' in a steady descent.		
C.4.2.3	**Climb and Descent**	**expanded**	**expanded**
C.4.2.3.1	**- Climb angle and climb gradient**	**x**	**x**
	Define the terms 'climb angle' and 'climb gradient'.		
	State the difference between climb angle and gradient.		

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
C.4.2.3.2	**- Flight path angle and flight path gradient**	**x**	**x**
	Define the terms 'flight-path angle' and 'flight-path gradient'.		
	Explain the difference between climb/descent angle and flight-path angle.		
C.4.2.3.3	**- Descent angle and descent gradient**	**x**	**x**
	Define the terms 'descent angle' and 'descent gradient'.		
	Explain the difference between climb/descent angle and flight-path angle.		
C.4.2.3.4	**- Service and absolute ceiling**	**x**	**x**
	Define 'absolute ceiling'.		
C.4.3	**RANGE AND ENDURANCE PERFORMANCE**	**x**	**x**
C.4.3.1	**a. Range and endurance**	**x**	**x**
C.4.3.1.1	**Flying for range: Propeller propulsion**	**x**	**-**
	Define a propeller-driven aeroplane's SFC and describe how it affects fuel flow and specific range.		-
	Explain the optimum speed to achieve maximum SR for a propeller-driven aeroplane in relation to the power required and drag graphs.		-
C.4.3.1.2	**Flying for range: Jet propulsion**	**x**	**-**
	Define a turbojet aeroplane's specific fuel consumption (SFC) and describe how it affects fuel flow and specific range.		-
	Explain the optimum speed for maximum SR for a turbojet aeroplane in relation to the drag curve.		-
C.4.3.1.3	**Flying for range: Helicopter**	**-**	**x**
C.4.3.1.4	**Flying for endurance: Propeller propulsion**	**x**	**-**
	Explain fuel flow in relation to TAS and thrust for a propeller-driven aeroplane.		-
	State the speed for maximum endurance for a propeller-driven aeroplane and the disadvantages of holding at this speed (e.g. high angle of attack (AoA) and lack of speed stability).		-
	Explain the effect of wind and altitude on endurance, and the maximum endurance speed for a propeller-driven aeroplane.		-
C.4.3.1.5	**Flying for endurance: Jet propulsion**	**x**	**-**
	Explain fuel flow in relation to TAS and thrust for a turbojet aeroplane.		-
	State the speed for maximum endurance for a turbojet aeroplane.		-
	Explain the effect of wind and altitude on endurance, and the maximum endurance speed for a turbojet aeroplane.		-
C.4.3.1.6	**Flying for endurance: Helicopter**	**-**	**x**
C.4.4	**AIRSPEED TERMINOLOGY AND SYMBOLS**	**x**	**x**
C.4.4.1	**Terminology and symbols**	**expanded**	**expanded**
C.4.4.1.1	**a. IAS, RAS / CAS, TAS, GS (groundspeed)**	**x**	**x**

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	Define 'IAS', 'CAS', 'EAS', and 'TAS'.		
C.4.4.1.2	**b. VA, VNO, VNE, VX, VY**	**x**	**x**
	Define and explain the following terms: critical engine; speed for best angle of climb (VX); speed for best rate of climb (VY).		
	Explain the effect of configuration on climb performance (angle and rate of climb, and VX and VY).		
	Define 'VMO', 'VNO', and 'VNE'.		
	Explain the significance of VMO, VNO and VNE, and the differences between these airspeeds.		
	Explain the hazards of flying at speeds above VNE and VMO.		
C.4.4.1.3	**c. VS, VS1, VSO, VFO, VFE, VLO, VLE, VMO, VS1g, VSR, VSR0, VSR1 X**	**x**	**-**
	Describe the reason for flap/landing gear limitations. Define 'VLO'. Define 'VLE'.		-
	Explain why there is a difference between VLO and VLE in the case of some aeroplane types.		-
	Define 'VFE' and describe flap limiting speeds.		-
	Describe flap design features, procedures and warnings to prevent overload.		-
C.4.4.1.4	**d. VMCG, VMCA, VMC, V1, VR, V2, VREF, VLOF, VMBE**	**x**	**-**
	Define and explain the following speeds in accordance with CS-25 or CS-Definitions: reference stall speed (VSR); reference stall speed in a specific configuration (VSR1); 1-g stall speed at which the aeroplane can develop a lift force (normal to the flight path) equal to its weight (VS1g); minimum control speed with critical engine inoperative (VMC); minimum control speed on or near the ground (VMCG); minimum control speed at take-off climb (VMCA); engine failure speed (VEF); take-off decision speed (V1); rotation speed (VR); take-off safety speed (V2); minimum take-off safety speed (V2MIN); minimum unstick speed (VMU); lift-off speed (VLOF); maximum brake energy speed (VMBE); maximum tyre speed (VMax Tyre).		-
	Define 'VMC'.		-
	Describe how VMC is determined.		-
	Explain the influence of the CG location.		-
	Define 'VMCL'.		-
	Describe how VMCL is determined.		-
	Explain the influence of the CG location.		-
	Define 'VMCG'.		-
	Describe how VMCG is determined.		-
	Explain the influence of the CG location.		-
C.4.5	**METEOROLOGICAL TERMINOLOGY**		
C.4.4.1	**Terminology and symabols**	**expanded**	**expanded**
C.4.4.1.1	**a. International Standard Atmosphere (ISA)**	**x**	**x**
C.4.4.1.2	**b. OAT, IOAT, TAT, SAT, RAT**	**x**	**x**

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	Define the following and explain the relationship between them: outside air temperature (OAT); total air temperature (TAT); static air temperature (SAT).		
	Explain the term 'ram rise' and convert TAT to SAT.		
	Explain why TAT is often displayed and that TAT is the temperature input to the air-data computer.		
C.4.4.1.3	**c. Temperature deviation from ISA**	**x**	**x**
C.4.4.2	**Altimeter settings**	**expanded**	**expanded**
C.4.4.2.1	**d. Pressure altitude, Density altitude**	**x**	**x**
	Define the following terms: height, altitude; indicated altitude, true altitude; pressure altitude, density altitude.		
C.4.4.2.2	**e. QNH, QFE, QNE**	**x**	**x**
	Define the following barometric references: 'QNH', 'QFE', '1013.25'.		
C.4.5	**FACTORS AFFECTING AIRCRAFT PERFORMANCE**	**x**	**x**
C.4.5.1	**Take-off and Landing**	**expanded**	**expanded**
C.4.5.1.1	**- Temperature** **- Air density** **- Aircraft mass** **- Aeroplane configuration** **- The effect of flap settings** **- Aeroplane antiskid system status** **- Aircraft centre of gravity** **- Aerodrome runway surface** **- Aerodrome runway slope** **- The effect of flap settings**	**x**	**x**
	Explain the effects of the following runway (RWY) variables on take-off distances: RWY slope; RWY surface conditions: dry, wet and contaminated; RWY elevation.		
	Explain the effects of the following aeroplane variables on take-off distance: aeroplane mass; take-off configuration; bleed-air configurations.		
	Explain the effects of the following meteorological variables on take-off distances: wind; temperature; pressure altitude.		
C.4.5.2	**Enroute**	**expanded**	**expanded**
C.4.5.2.2	**- The effects of different recommended power settings on range and endurance** **- The effect of wind and altitude on range and endurance**	**x**	**x**
	Define the term 'long-range cruise'.		
	Explain the differences between flying at long-range speed and maximum-range speed with regard to fuel-flow and speed stability.		
C.4.5.2	**Approach and landing**	**expanded**	**expanded**

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
C.4.5.2.2	**- The effect of wind component on take-off and landing performance** **- The effect of mass, wind and speed on descent performance**	x	x
	Explain the effect of runway slope, surface conditions and wind on the maximum landing mass for a given landing distance available in accordance with the applicable operational requirements.		
	Explain the effect of temperature and pressure altitude on the maximum landing mass for a given landing distance available.		
C.4.7	**AEROPLANE PERFORMANCE CLASSIFICATION: South African Civil Aviation Regulations**	x	-
C.4.7.1	**a. Part 91.08 Performance Operating Limitations:**	x	-
C.4.7.1.1	**- Part 91.08.1 General provisions X**	x	-
C.4.7.1.2	**- Part 91.08.4 Aeroplane performance classification X**	x	-
C.4.7.1.3	**- Part 91.08.5 Performance limitations Class A and Class C aeroplanes X**	x	-
C.4.7.1.4	**- SACATS 91.08.5 Performance limitations Class A and Class C aeroplanes**	x	-
C.4.8	**HELICOPTER PERFORMANCE CLASSIFICATION: South African Civil Aviation Regulations**	-	x
C.4.8.1	**Part 1.01.1 Definitions**	-	x
C.4.8.1.1	**- Operations in performance Class 1**	-	x
C.4.8.1.2	**- Operations in performance Class 2**	-	x
C.4.8.1.3	**- Operations in performance Class 3**	-	x
C.4.8.2	**Part 91: General Aviation and Operating Flight Rules**	-	x
C.4.8.2.1	**- Part 91.08.1 General provisions**	-	x
C.4.8.2.2	**- Part 91.08.2 Helicopter operating limitations**	-	x
C.4.8.2.3	**- Part 91.08.3 Helicopter performance classification**	-	x
C.4.9	**STAGES OF FLIGHT**	x	x
C.4.9.1	**- take-off**	x	x
C.4.9.2	**- climb**	x	x
C.4.9.3	**- level Flight**	x	x
C.4.9.4	**- descending**	x	x
C.4.9.5	**- approach and landing**	x	x
C.4.10	**CALCULATION OF PET and PNR**	x	x
C.4.10.1	**- PET (point of equal time)**	x	x
C.4.10.2	**- CP (critical point)**	x	-
C.4.10.3	**- PNR (point of no return)**	x	x
C.4.10.4	**- PSR (point of safe return)**	x	-
C.4.11	**SPECIFIC PERFORMANCE**	x	x
C.4.11.1	**a. Fuel weight and Performance**	x	x

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
C.4.11.1.1	- Specific fuel weight (AVGAS and Jet A-1)	x	x
C.4.11.1.2	- Specific gravity	x	x
C.4.11.2	b. Specific endurance	x	x
C.4.11.2.1	- Explain Specific endurance	x	x
C.4.11.2.2	- Calculation of Specific endurance	x	x
C.4.11.3	c. Theory and calculation of specific range:	x	x
C.4.11.3.1	- Explain specific range	x	x
C.4.11.3.2	Calculation of specific endurance - ANM/fuel ratio - GNM/fuel ratio	x	x
C.4.11.4	d. Specific fuel consumption (SFC):	x	x
C.4.11.4.1	Theory of SFC	x	x
C.4.11.4.2	Effect of the following on SFC - Engine power / thrust - Altitude - Weight	x	x
C.4.11.4.3	- Calculation of SFC	x	x
C.4.12	FUEL PLANNING	x	x
C.4.12.1	a. Fuel requirements of South African legislation:	x	x
C.4.12.1.1	- CAR 91.07.12 Fuel supply	x	x
C.4.12.1.2	- CATS 91.07.12 Fuel supply (1. Planning criteria for aeroplanes) X	x	-
C.4.12.1.3	- CATS 91.07.12 Fuel supply (2.. Fuel and oil supply for helicopters) X	-	x
C.4.12.2	b. In-flight fuel management and fuel state awareness	x	x
C.4.12.2.1	- Importance of fuel state awareness and log-keeping	x	x
C.4.12.2.2	- Unplanned events that could affect fuel state	x	x
C.4.13	DOCUMENTATION AND SOURCES OF PREFLIGHT INFORMATION	x	x
C.4.13.1	a. CAR 91.03.1 Documents to be carried on board	x	x
C.4.13.1.1	Aircraft flight manual (AFM): - Layout of an AFM - CAR 91.03.2 Aircraft flight manual	x	x
C.4.13.1.2	Checklists - CAR 91.03.3 Aircraft checklist	x	x
C.4.13.1.3	ATS Flight plan - CAR 91.03.4 Air traffic service flight plan and associated procedures	x	x

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
C.4.13.1.4	**Flight folio** **- CAR 91.03.5 Flight folio**	**x**	**x**
C.4.13.2	**b. Fuel record**	**x**	**x**
C.4.13.2.1	**- CAR 91.03.6 Fuel record**	**x**	**x**
C.4.13.3	**c. Certificate of release to service**	**x**	**x**
C.4.13.3.1	**- CAR 91.03.7 Certificate of release to service**	**x**	**x**
C.4.13.4	**d. Notice to airmen (NOTAM)**	**x**	**x**
C.4.13.4.1	**- types**	**x**	**x**
C.4.13.4.2	**- Classification**	**x**	**x**
C.4.13.5	**e. Minimum equipment list (MEL)**	**x**	**x**
C.4.13.5.1	**- Definition**	**x**	**x**
C.4.13.5.2	**- Master minimum equipment list (MMEL)**	**x**	**x**
C.4.13.5.3	**- Operational use of MEL**	**x**	**x**
C.4.13.6	**f. RSA AIP & AIP Supplements**	**x**	**x**
C.4.13.6.1	**- Purpose of AIP and supplements**	**x**	**x**
C.4.13.7	**g. Aeronautical Information Circulars (AIC's)**	**x**	**x**
C.4.13.7.1	**- Purpose**	**x**	**x**
C.4.14	**IFR ALTITUDES**	**x**	**x**
C.4.14.1	**Explain the following altitudes / heights:**	**x**	**x**
C.4.14.1.1	**- MEA, RNAV, MEA, MRA, MAA, MOCA, MORA, MTA, MCA**	**x**	**x**
	Define the following altitudes: minimum en-route altitude (MEA); minimum obstacle clearance altitude (MOCA); minimum sector altitude (MSA); minimum off-route altitude (MORA); grid minimum off-route altitude (Grid MORA); maximum authorised altitude (MAA); minimum crossing altitude (MCA); minimum holding altitude (MHA).		
	Extract the following altitudes from the chart(s): MEA; MOCA; MSA; MORA; Grid MORA; MAA; MCA; MHA.		
	Identify and explain the use of minimum radar vectoring altitudes.		
C.4.14.1.3	**- Reduced Vertical Separation Minima (RSVM)**	**x**	**x**
C.4.14.1.4	**- Height above Ground (QFE)**	**x**	**x**
C.4.14.1.5	**- Barometric pressure for Standard Altimeter Setting (QNE)**	**x**	**x**
C.4.14.1.6	**- Barometric pressure for Local Altimeter Setting (QNH)**	**x**	**x**
C.4.15	**AERODROME TERMINOLOGY (AEROPLANE)**	**x**	**x**
	Declared distances	**expanded**	**expanded**

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
C.4.15.1.2	**- runway length** **- take-off run available (TORA)** **- take-off run required (TORR)** **- take-off distance available (TODA)** **- take-off distance required (TODR)** **- landing distance available (LDA)** **- landing distance required (LDR)** **- Accelerate-stop distance available (ASDA)**	**x**	**-**
	Describe: take-off run available (TORA); take-off distance available (TODA); accelerate-stop distance available (ASDA); and determine each from given data or appropriate aerodrome charts.		
	Define the 'landing distance available' (LDA).		
C.4.15.1.9	**- Accelerate-go**	**x**	**-**
C.4.15.1.10	**- Clearway, stopway**	**x**	**x**
	Describe 'clearway' and 'stopway' according to CS-Definitions.		
C.4.15.1.11	**- Displaced thresholds (permanent / temporary)**	**x**	**x**
C.4.15.1.12	**- runway slope**	**x**	**x**
C.4.15.1.13	**- Runway strength (ACN/PCN)**	**x**	**x**
C.4.15.1.14	**- Balanced and Unbalanced Field Lengths**	**x**	**-**
	Define the term 'balanced field length'.		-
	Describe the relationship between take-off distance and accelerate-stop distance, and identify on a diagram the balanced field length and balanced V1.		-
	Describe the applicability of a balanced field length.		-
	Describe the applicability of an unbalanced field length.		-
	Explain the effect of additional stopway on the allowed take-off mass and appropriate V1 when using an unbalanced field.		-
	Explain the effect of additional clearway on the allowed take-off mass and appropriate V1 when using an unbalanced field.		-
C.4.15.1.15	**- WAT limits**	**x**	**x**
C.4.15.1.16	**- Pre-Flight Altimeter check location**	**x**	**x**
C.4.16	**AERODROME TERMINOLOGY (HELICOPTER)**	**-**	**x**
C.4.16.1	**a. Declared distances — heliports**	**-**	**x**
C.4.16.1.1	**- take-off distance available (TODAH)** **- Rejected take-off distance available (RTODAH)** **- landing distance available (LDAH)**	**-**	**x**

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	Define the following terms: reported headwind component; take-off decision point (TDP); defined point after take-off (DPATO); take-off distance required helicopter (TODRH); take-off distance available helicopter (TODAH); distance required (DR); rejected take-off distance required helicopter (RTODRH); rotation point (RP); committal point (CP); defined point before landing (DPBL); landing decision point (LDP); landing distance available helicopter (LDAH); landing distance required helicopter (LDRH); ditching (see operations).	-	
C.4.17	**MASS AND BALANCE**	**x**	**x**
C.4.17.1	**Mass limitations**	**x**	**x**
C.4.17.1.1	**- The relationship between aircraft mass and structural stress**	**x**	**x**
	Describe the relationship between aircraft mass and structural stress. Remark: See also Subject 021 01 01 00.		
	Describe why mass must be limited to ensure adequate margins of strength.		
C.4.17.1.2	**- The relationship between aircraft mass and performance**	**x**	**x**
	Describe the relationship between aircraft mass and aircraft performance.		
	Describe why aircraft mass must be limited to ensure adequate aircraft performance.		
C.4.17.2	**Centre of gravity (CG) limitations**	**x**	**x**
C.4.17.2.1	**- The relationship between CG position and stability / controllability of aircraft**	**x**	**x**
	Describe the relationship between CG position and stability/controllability of the aircraft.		
C.4.21.2.2	**- The effects of a CG in front of The forward limit and a CG behind The aft limit**	**x**	**x**
	Describe the consequences if CG is in front of the forward limit.		
	Describe the consequences if CG is behind the aft limit.		
C.4.22.2.3	**- Describe The relationship between CG position and aircraft performance**	**x**	**x**
	Describe the relationship between CG position and aircraft performance.	*x*	*x*
	Describe the effects of CG position on performance parameters (speeds, altitude, endurance and range).	*x*	*x*

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	SPECIAL OPERATIONAL PROCEDURES AND HAZARDS	x	x
C.5.1	**GROUND DE-ICING**	x	x
	"Clean aircraft" concept and use of fluids	x	x
C.5.1.1.1	**a. icing conditions**	x	x
	Describe 'the clean aircraft concept' as presented in the relevant chapter of ICAO Doc 9640.		
	Explain why a commander shall not commence take-off unless the external surfaces are clear of any deposit which might adversely affect the performance or controllability of the aircraft except as permitted in the flight manual.		
	Explain the requirements for operations in icing conditions.		
	Procedure to apply in case of performance deterioration, on ground/in flight		
	Explain that the effects of icing are wide-ranging, unpredictable and dependent upon individual aircraft design. The magnitude of these effects is dependent upon many variables, but the effects can be both significant and dangerous.		
	Explain that in icing conditions, for a given speed and a given angle of attack, wing lift can be reduced by as much as 30 % and drag increased by up to 40 %. State that these changes in lift and drag will significantly increase stall speed, reduce controllability, and alter flight characteristics.		
	Explain that ice forming on pitot tubes and static ports or on angle-of-attack vanes may give false altitude, airspeed, angle-of-attack and engine-power information for air-data systems.		
	Explain that ice, frost and snow formed on the critical surfaces on the ground can have a totally different effect on aircraft flight characteristics than ice, frost and snow formed in flight.		
C.5.1.1.2	**b. ground de-icing**	x	x
	Define the following terms: 'anti-icing', 'de-icing', 'one-step de-icing/anti-icing', 'two-step de-icing/anti-icing', 'holdover time'.		
C.5.1.1.3	**c. de-icing and anti-icing fluids**	x	x
	List the types of de-icing/anti-icing fluids available.		
	Explain how the pre-take-off check, which is the responsibility of the pilot-in-command, ensures that the critical surfaces of the aircraft are free of ice, snow, slush or frost just prior to take-off. This check shall be accomplished as close to the time of take-off as possible and is normally made from within the aeroplane by visually checking the wings.		
	Explain why an aircraft has to be treated symmetrically.		
C.5.1.1.4	**d. holdover times**	x	x
	Interpret the guidelines for fluid holdover times and list the factors which can reduce the fluid protection time.		
	Explain the procedure to be followed when an aeroplane has exceeded the holdover time.		
C.5.2	**BIRD STRIKE RISK AND AVOIDANCE**	x	x
	Risk and avoidance	x	x
	Risk	x	x
	Explain that the presence of birds that constitute a potential hazard to aircraft operations is part of the pre-flight information.		

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	Explain how information concerning the presence of birds observed by aircrews is made available to the aeronautical information service (AIS) for distribution as the circumstances dictate.		
	Explain that the Aeronautical Information Publication (AIP) Section En-route (ENR) 5.6 contains information regarding bird migrations.		
	Explain significant data regarding bird strikes contained in ICAO Doc 9137 'Airport Services Manual'.		
	Explain why birds constitute a hazard to aircraft (damage to probes, sensors, engines, windscreens, airframes, degradation in vision, etc.).		
	Avoidance	x	x
	Define the commander's responsibilities regarding the reporting of bird hazards and bird strikes.		
	State that birds tend to flock to areas where food is plentiful. Such areas include: rubbish (garbage) facilities; open sewage treatment works; recently ploughed land; as well as their natural habitats.		
C.5.3	**FIRE AND SMOKE**	x	x
	Occurrence and actions	x	x
C.5.3.1.1	**a. engine fire**	x	x
	Explain that the actions to be taken in the event of an engine fire may be type-specific and should be known by the pilot.		
C.5.3.1.2	**b. fire in the cabin, cockpit, freight compartment**	x	x
C.5.3.1.3	**c. selection of appropriate fire extinguishing agents with respect to fire classification**	x	x
	Identify the different types of extinguishants used in handheld fire extinguishers and the type of fire for which each one may be used.		
	Describe the precautions to be considered when applying fire extinguishants.		
	Identify the appropriate handheld fire extinguishers to be used in the flight crew compartment, the passenger cabin and lavatories, and in the cargo compartments.		
C.5.3.1.4	**d. actions in case of over-heated brakes after aborted take-off and landing**	x	x
	Describe the problems and safety precautions in the event that brakes overheat after a heavy-weight landing or a rejected take-off.		
	Explain the difference in the way steel and carbon brakes react to energy absorption and the operational consequences.		
C.5.3.1.5	**e. smoke in the cockpit and cabin (effects and actions taken)**	x	x
	Explain which actions should be taken in the event of smoke in the flight crew compartment or in the cabin, why these actions may be type-specific, and why they should be known by the pilot.		
C.5.4	**WINDSHEAR, MICROBURST**	x	x
	Hazards and avoidance	x	x
C.5.4.1.1	**a. effects and recognition during approach/departure**	x	x
	Explain how to identify low-level wind shear.		
C.5.4.2.2	**b. actions to avoid and actions taken during encounter**	x	x
	Describe the effects of wind shear and the actions required when wind shear is encountered at take-off and approach.		

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	Describe the precautions to be taken when wind shear is suspected at take-off and approach.		
	Describe the effects of wind shear and the actions required following entry into a strong downdraft wind shear.		
	Describe a microburst and its effects.		
C.5.5	**WAKE TURBULENCE:**	**x**	**x**
	Occurrence and actions	**x**	**x**
C.5.5.1.1	**a. cause**	**x**	**x**
	Describe the term 'wake turbulence'.		
	Describe tip vortex circulation.		
	State when vortex generation begins and ends.		
	Describe vortex circulation on the ground with and without crosswind.		
C.5.5.2.2	**b. influence of speed and mass, wind**	**x**	**x**
	List the three main factors which, when combined, give the strongest vortices (heavy, clean, slow).		
	Describe the wind conditions which are worst for wake turbulence near the ground.		
C.5.5.3.3	**c. actions taken during approach, landing, take-off, crossing behind**	**x**	**x**
	Describe the actions to be taken to avoid wake turbulence, specifically separations.		
C.5.6	**CONTAMINATED RUNWAYS:**	**x**	**-**
C.5.6.1	**a. SA CAR Part 1.01.1 Definitions:**	**x**	**-**
C.5.6.1.1	**- damp runway**	**x**	**-**
C.5.6.1.2	**- dry runway**	**x**	**-**
C.5.6.1.3	**- wet runway**	**x**	**-**
C.5.6.1.4	**- contaminated runway**	**x**	**-**
C.5.6.2	**b. Types of contamination**	**x**	**-**
	Runway condition codes	**x**	**x**
	State the runway condition codes for good braking action, and when a special air report is required.		
C.5.6.3	**c. Hydroplaning / Aquaplaning**	**x**	**-**
C.5.6.3.1	**- types**	**x**	**-**
	Define the different types of hydroplaning.		
C.5.6.3.2	**- critical speed formula**	**x**	**-**
	Compute the two dynamic hydroplaning speeds using the following formulas: spin-down speed (rotating tire) (kt) equals 9 square root (pressure in PSI) spin-up speed (non-rotating tire) (kt) equals 7.7 square root (pressure in PSI).		
	State that it is the spin-up speed rather than the spin-down speed which represents the actual tire situation for aircraft touchdown on flooded runways.		
C.5.6.3.3	**- reducing the effects of hydroplaning**	**x**	**-**
C.5.7	**CFIT**	**x**	**x**

SACAA Ref	*Description*	*SACAA IR(A)*	*SACAA IR(H)*
C.5.7.1	**a. Definition**	**x**	**x**
C.5.7.2	**b. Avoidance**	**x**	**x**
C.5.8	**STABILIZED APPROACH**	**x**	**x**
C.5.8.1	**a. Requirements for a stabilized approach**	**x**	**x**
C.5.8.2	**b. Advantages**	**x**	**x**

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	INSTRUMENTS	**x**	**x**
C.7.1	**AIR DATA INSTRUMENTS**	**x**	**x**
C.7.1.1	**a. Pitot and static system**	**x**	**x**
C.7.1.1.1	**- pitot tube, construction and principles of operation**	**x**	**x**
	Define the following pressure measurements and state the relationship between them: static pressure; dynamic pressure; total pressure.		
	For each of these indicate the various locations and describe the following associated errors and how to correct, minimise the effect of or compensate for them: position errors; instrument errors; errors due to a non-longitudinal axial flow (including manoeuvre-induced errors).		
	Describe a typical pitot/static system and list the possible outputs.		
	Explain the redundancy and the interconnections that typically exist in complex pitot/static systems found in large aircraft.		
	Describe a modern pitot static system using solid-state sensors near the pitot probe or static port converting the air data to numerical data (electrical signals) before being sent to the air-data computer(s).		
C.7.1.1.2	**- static source**	**x**	**x**
	Describe the design and the operating principle of a: static port/source; pitot tube; combined pitot/static probe.		
C.7.1.1.3	**- malfunction**	**x**	**x**
C.7.1.1.4	**-heating**	**x**	**x**
	Explain the purpose of pitot/static system heating.		
C.7.1.1.5	**-alternate static source**	**x**	**x**
	Describe alternate static sources and their effects when used, particularly in unpressurised aircraft.		
C.7.1.2	**b. Altimeter**	**x**	**x**
C.7.1.2.1	**- construction and principles of operation**	**x**	**x**
	List the following two units used for altimeters and state the relationship between them: feet; metres.		
	Explain the operating principles of an altimeter.		
	Describe and compare the following three types of altimeters and reason(s) why particular designs may be required in certain airspace: simple altimeter (single capsule); sensitive altimeter (multi-capsule); servo-assisted altimeter.		
	Give examples of associated displays: pointer, multi-pointer, drum, vertical straight scale.		
	Describe the effects of a blockage or a leakage on the static pressure line.		
	Describe the use of GPS altitude as an alternative means of checking erroneous altimeter indications, and highlight the limitations of the GPS altitude indication.		
C.7.1.2.2	**- simple, sensitive and servo assisted altimeters**	**x**	**x**
C.7.1.2.3	**- errors and tolerances**	**x**	**x**

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	Describe the following errors: static system error; instrument error; barometric error; temperature error (air column not at ISA conditions); lag (altimeter response to change of height).		
	Demonstrate the use of an altimeter correction table for the following errors: temperature corrections; aircraft position errors.		
C.7.1.2.4	**- settings, QNH, QFE, QNE**	**x**	**x**
	Define the following barometric references: 'QNH', 'QFE', '1013.25'.		
C.7.1.2.5	**- pressure, true and absolute altitude**	**x**	**x**
	Define the following terms: height, altitude; indicated altitude, true altitude; pressure altitude, density altitude.		
C.7.1.2.6	**- altitude alert**	**x**	**x**
	Describe the function of an altitude alert system.		
	Describe different types of displays and possible alerts.		
C.7.1.3	**c. Airspeed indicator (ASI)**	**x**	**x**
C.7.1.3.1	**- construction and principles of operation**	**x**	**x**
	List the following three units used for airspeed and state the relationship between them: nautical miles/hour (kt); statute miles/hour (mph); kilometres/hour (km/h).		
	Describe the following ASI errors and state when they must be considered: pitot/static system errors; instrument errors; position errors; compressibility errors; density errors.		
	Explain the operating principles of an ASI (as appropriate to aeroplanes or helicopters).		
	Give examples of an ASI display: pointer, vertical straight scale, and digital (HUD display).		
	Demonstrate the use of an ASI correction table for position error.		
C.7.1.3.2	**- meaning of coloured sectors**	**x**	**x**
	Define and explain the following colour codes that can be used on an ASI: white arc (flap operating speed range); green arc (normal operating speed range); yellow arc (caution speed range); red line (VNE) or barber's pole (VMO); blue line (best rate of climb speed, one-engine-out for multi-engine piston light aeroplanes).		-
C.7.1.3.3	**- maximum speed indicator**	**x**	**x**
	Define and explain the following colour codes that can be used on an ASI: green arc (normal operating speed range); red line (VNE); blue line (maximum airspeed during autorotation).		-
C.7.1.3.4	**- errors, blockages and leaks**	**x**	**x**
	Describe the effects on an ASI of a blockage or a leakage in the static or total pressure line(s).		
	Define the term 'unreliable airspeed' and describe the means by which it can be recognised such as: different airspeed indications between ASIs; unexpected aircraft behaviour; buffeting; aircraft systems warning; aircraft attitude.		
	Describe the appropriate procedures available to the pilot in the event of unreliable airspeed indications: combination of a pitch attitude and power setting; ambient wind noise inside the aircraft; use of GPS speed indications and the associated limitations.		
C.7.1.4	**d. Vertical speed indicator (VSI)**	**x**	**x**

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
C.7.1.4.1	**- construction and principles of operation**	**x**	**x**
	List the two units used for VSIs and state the relationship between them: metres per second; feet per minute.		
	Explain the operating principles of a VSI and an IVSI.		
	Give examples of a VSI display.		
C.7.1.4.2	**- aneroid and instantaneous VSI (IVSI)**	**x**	**x**
	Describe and compare the following types of VSIs: barometric type (VSI); instantaneous barometric type (IVSI); inertial type (inertial information provided by an inertial reference unit).		
	Compare the indications of a VSI and an IVSI during flight in turbulence and appropriate pilot technique during manoeuvring using either type.		
C.7.1.4.3	**- errors**	**x**	**x**
	Describe the following VSI errors: static system errors; instrument errors; time lag.		
	Describe the effects on a VSI of a blockage or a leakage on the static pressure line.		
C.7.2	**GYROSCOPIC INSTRUMENTS**	**x**	**x**
C.7.2.1	**a. Gyroscopic fundamentals**	**x**	**x**
C.7.2.1.1	**- theory of gyroscopic forces (stability, precession)**	**x**	**x**
	Define a 'gyro'.		
	Explain the fundamentals of the theory of gyroscopic forces.		
C.7.2.1.2	**- types, construction and principles of operation:**	**x**	**x**
	Define the 'degrees of freedom' of a gyro. Remark: As a convention, the degrees of freedom of a gyroscope do not include its own axis of rotation (the spin axis).		
	Explain the following terms: rigidity; precession; wander (drift/topple).		
	Explain the three types of gyro wander: real wander; apparent wander; transport wander.		
C.7.2.1.3	**- drive types: electrical, vacuum system**	**x**	**x**
	Describe the two ways of driving gyroscopes and any associated indications: air/vacuum; electrically.		
C.7.2.2	**b. Directional gyro (DG)**	**x**	**x**
C.7.2.2.1	**- construction**	**x**	**x**
C.7.2.2.2	**- principle of operation**	**x**	**x**
	Explain the purpose of the directional gyroscope.		
	Identify the two types of gyro-driven direction indicators: direction indicator; horizontal situation indicator (HSI).		
C.7.2.2.3	**- limitations**	**x**	**x**
	Explain how the directional gyroscope will drift over time due to the following: rotation of the Earth; aircraft manoeuvring; aircraft movement over the Earth's surface/direction of travel.		
	Describe the procedure for the pilot to align the directional gyroscope to the correct compass heading.		
C.7.2.3	**c. Remote indicating compass**	**x**	**x**
C.7.2.3.1	**- construction and principle of operation**	**x**	**x**

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	Describe the principles of operation of a remote-reading compass system.		
C.7.2.3.2	**- components**	**x**	**x**
	Using a block diagram, list and explain the function of the following components of a remote-reading compass system: flux detection unit; gyro unit; transducers, precession amplifiers, annunciator; display unit (compass card, synchronising and set-heading knob, DG/compass/slave/free switch).		
C.7.2.3.3	**- modes of operation**	**x**	**x**
C.7.2.3.4	**- drive types: electrical, vacuum system**	**x**	**x**
C.7.2.3.5	**- application, uses of output data**	**x**	**x**
	State the advantages and disadvantages of a remote-reading compass system compared to a direct-reading magnetic compass with regard to: design (power source, weight and volume); deviation due to aircraft magnetism; turning and acceleration errors; attitude errors; accuracy and stability of the information displayed; availability of the information for several systems (compass card, RMI, automatic flight control system (AFCS)).		
C.7.2.4	**d. Attitude Indicator / Artificial horizon (AI / AH)**	**x**	**x**
C.7.2.4.1	**- construction and principle of operation**	**x**	**x**
	Explain the purpose of the attitude indicator.		
	Identify the two types of attitude indicators: attitude indicator; attitude and director indicator (ADI).		
	State the degrees of freedom.		
C.7.2.4.2	**- turn and acceleration errors**	**x**	**x**
	Describe the effects of the aircraft's acceleration and turns on instrument indications.		
C.7.2.4.3	**- application, uses of output data**	**x**	**x**
	Describe a typical attitude display and instrument markings.		
C.7.2.5	**e. Turn and slip indicator**	**x**	**x**
C.7.2.5.1	**- construction and principle of operation**	**x**	**x**
	Explain the purpose of a rate-of-turn and balance (slip) indicator.		
	Define a 'rate-1 turn'.		
	Describe the indications given by a rate-of-turn indicator.		
	Explain the purpose of a balance (slip) indicator and its principle of operation.		
	Describe the indications of a rate-of-turn and balance (slip) indicator during a balanced, slip or skid turn.		
C.7.2.5.2	**- errors**	**x**	**x**
C.7.2.5.3	**- turn co-ordinator**	**x**	**x**
	Describe the indications given by a turn coordinator (or turn-and-bank indicator).		
	Compare the indications on the rate-of-turn indicator and the turn coordinator.		
C.7.2.5.4	**- rate of turn and angle of bank**	**x**	**x**
	Explain the relation between bank angle, rate of turn and TAS, and how bank angle becomes the limiting factor at high speed (no calculations).		

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
C.7.2.6	**f. Attitude and Heading Reference System (AHRS)**	**x**	**x**
C.7.2.6.1	**- Micro-electro-mechanical sensors (MEMS) accelerometers**	**x**	**x**
C.7.2.6.2	**- basic principle of operation**	**x**	**x**
	Explain that the AHRS is a replacement for traditional gyros using solid-state technology with no moving parts and is a single unit consisting of: solid-state accelerometers; solid-state rate sensor gyroscopes; solid-state magnetometers (measurement of the Earth's magnetic field).		
C.7.2.6.3	**- typical aircraft application**	**x**	**x**
	Explain that the AHRS senses rotation and acceleration for all three axes and senses the direction of the Earth's magnetic field where the indications are normally provided on electronic screens (electronic flight instrument system (EFIS)).		
C.7.3	**HORIZONTAL SITUATION INDICATOR (HSI)**	**x**	**x**
	Types and information displayed	**x**	**x**
C.7.3.1.1	**- construction and principle of operation**	**x**	**x**
	Describe an ADI and an HSI.		
C.7.3.2	**- information displayed**	**x**	**x**
	List all the information that can be displayed on either instrument.		
	Read off the radial on an RMI.		
	Read off the angular displacement in relation to a preselected radial on a horizontal situation indicator (HSI) or omnibearing indicator (OBI).		
	Explain the use of the TO/FROM indicator in order to determine aircraft position relative to the VOR considering also the heading of the aircraft.		
	Interpret VOR information as displayed on HSI, CDI and RMI.		
C.7.4	**ELECTRONIC FLIGHT INSTRUMENT SYSTEM (EFIS)**	**x**	**x**
C.7.4.1	**General Principles**	**x**	**x**
C.7.4.1.1	**Design and operation**	**x**	**x**
	List the following parts of an EFIS: control panel; display units; symbol generator; remote light sensor.		
	Describe the typical layout of the EFIS display units and how there may be a facility to transfer the information from one display unit on to another if a display unit fails.		
C.7.4.2	**Displays and operation**	**x**	**x**
C.7.4.2.1	**- Primary Flight Display (PFD) and information displayed**	**x**	**x**
	Describe that a PFD (or an EADI) presents a dynamic colour display of all the parameters necessary to control the aircraft, and that the main layout conforms with the 'basic T' principle: attitude information in the centre; airspeed information on the left; altitude information on the right; heading/track indication lower centre; flight mode annunciation; basic T; take-off and landing reference speeds; minimum airspeed; lower selectable airspeed; Mach number.		

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	Describe the typical design of the attitude information: artificial horizon with aircraft symbol; superimposed flight director command bars.		
	Describe the typical design of the speed tape: rolling speed scale with numerical read-out of current speed; limiting airspeeds according to configuration; speed trend vector; bug/indication for selected airspeed.		
	Describe the typical design of the altitude information: rolling altitude scale with numerical read-out of current altitude; altimeter pressure setting; bug/indication for selected altitude; means of highlighting the altitude if certain criteria are met.		
	Describe the typical design of the heading/track information: rolling compass scale/rose with numerical read-out of current heading/track; bug/indication for selected heading/track.		
	Describe the typical design and location of the following information: flight mode annunciators (FMAs); vertical speed indicator including TCAS RA command indications; radio altitude; ILS localiser/glideslope and RNP/PBN, GBAS or SBAS horizontal/vertical flight path deviation indicator; decision altitude/height (DA/H).		
C.7.4.2.2	**- Navigation Display (ND) / Multi-function Display (MFD) and information displayed**	**x**	**x**
	Describe that an ND (or an EHSI) provides a mode-selectable colour flight ND.		
	List the following four modes typically available to be displayed on an ND unit: MAP (or ARC); VOR (or ROSE VOR); APP (or ROSE LS); PLAN.		
	List and explain the following information that can be displayed with the MAP (or ARC) mode selected on an ND unit: aircraft symbol, compass scale and range markers; current heading and track (either one may be 'up' depending on selection), true or magnetic; selected heading and track; TAS/GS; wind direction and speed (W/V); raw data radio magnetic indicator (RMI) needles/pointers for VOR/automatic direction-finding equipment (ADF), if selected, including the frequency or ident of the selected navigation facility; route/flight plan data from the FMS; TO/next waypoint data from the FMS; data from the navigation database such as airports, waypoints or navigation facilities as selected; weather radar information; TCAS traffic information (no TCAS commands); TAWS (EGPWS) terrain information; failure flags and messages.		
	List and explain the following information that can be displayed with the VOR or APP (or ROSE VOR or ROSE LS) mode selected on an ND unit: aircraft symbol and compass scale; current heading and track (either one may be 'up' depending on selection), true or magnetic; selected heading and track; TAS/ground speed (GS); wind direction and speed (W/V); VOR or ILS frequency and identification of the selected navigation aid; VOR selected course, deviation indicator and a TO/FROM indicator in a HSI-type display format when in VOR mode; localiser selected course, deviation indicator and glideslope indicator in a HSI-type display format when in APP mode. weather radar information; TCAS traffic information (no TCAS commands); TAWS (EGPWS) terrain information; failure flags and messages.		
	List and explain the following information that can be displayed with the PLAN mode selected on an ND unit: north-up compass rose and range markers; aircraft symbol oriented according to aircraft heading; TAS/GS; wind direction and speed (W/V); route/flight plan data from the FMS; TO/next waypoint data from the FMS; data from the navigation database such as airports, waypoints or navigation facilities as selected; failure flags and messages.		

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	Explain the purpose of PLAN mode and its characteristics such as: no compass information; north is up on the display unit at all times; the centre waypoint is the selected waypoint on the FMS CDU; scrolling through the flight plan on the FMS CDU will shift the map view along the flight path; the aircraft symbol will be positioned in the appropriate place along the flight path; using PLAN mode as the primary mode during flight may lead to disorientation and loss of situational awareness.		
	Distinguish the difference between the appearance of an EXPANDED or FULL/ROSE mode and how the displayed range differs between them.		
	Explain the combination of mode and range selection including how selecting the appropriate range and displayed data can improve situational awareness for a given phase of flight.		
C.7.4.2.3	**- typical aircraft installation**	**x**	**x**
	Describe the purpose of an EFIS control panel and typical selections that may be available: altimeter pressure setting; navigation display (ND) mode selector; ND range selector; ND data selector (waypoints, facilities, constraints, data, etc.); radio-navigation aids selector (VOR 1/2 or ADF 1/2); decision altitude (DA)/decision height (DH) selection.		
	Explain the need for standby instruments to supplement the EFIS in the event of all the display units failing and the challenge of using these standby instruments, namely their size and position on the flight deck.		
C.7.4.2.4	**- crew alerting Display**	**x**	**x**
	State the annunciations given by the FWS and typical location for the annunciator(s): master warning; master caution; advisory.		
	Explain master warning: colour of annunciator: red; nature of aural alerts: continuous; typical failure scenarios triggering the alert.		
	Explain master caution: colour of the annunciator: amber or yellow; nature of aural alerts: attention-getter; typical failure scenarios triggering the alert.		
	Describe a typical procedure following a master warning or master caution alert: acknowledging the failure; silencing the aural warning; initiating the appropriate response/procedure.		
	Explain advisory: colour of the annunciator: any other than red, amber, yellow or green; absence of aural alert; typical scenarios triggering the advisory.		
C.7.5	**FLIGHT DIRECTOR SYSTEM (FD)**	**x**	**-**
C.7.5.1	**General Principles**	**x**	**-**
C.7.5.1.1	**- design and principle of operation**	**x**	**-**
	Explain the purpose of a flight director system.		-
	Explain that the flight director computes and indicates the direction and magnitude of control inputs required in order to achieve an attitude to follow a trajectory.		-
C.7.5.2	**Displays and operation**	**x**	**-**
C.7.5.2.1	**- FD displays and interpretation**	**x**	**-**
	Describe the different types of display: pitch and roll crossbars; V-bar.		-

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	Explain the differences between a flight director and an autopilot and how the flight director provides a means of cross-checking the control/guidance commands sent to the autopilot.		-
	Explain why the flight director must be followed when engaged/shown, and describe the appropriate use of the flight director: flight director only; autopilot only; flight director and autopilot; typical job-share between pilots (pilot flying (PF)/pilot monitoring (PM)) for selecting the parameters when autopilot is engaged versus disengaged; highlight when the flight director should not be followed or should be disengaged.		-
	Give examples of different scenarios and the resulting flight director indications.		-
C.7.5.3.2	**- input sources**	**x**	**-**
C.7.5.4.3	**- integration with attitude director indicator (ADI)**	**x**	**-**
C.7.5.5.4	**- FD mode of operation**	**x**	**-**
	Explain the importance of checking the FMC data or selected autopilot modes through the FMA when using the flight directors. If the flight directors are showing incorrect guidance, they should not be followed and should be turned off.		-
	Explain the purpose of FMAs and their importance being the only indication of the state of a system rather than a switch position.		-
	Describe where the FMAs are normally shown and how the FMAs will be divided into sections (as applicable to aircraft complexity): vertical modes; lateral modes; autothrust modes; autopilot and flight director annunciators; landing capability.		-
	Explain why FMAs for engaged or armed modes have different colour or different font size.		-
	Describe the following FMA display scenarios: engagement of a mode; mode change from armed to becoming engaged; mode reversion.		-
	Explain the importance of monitoring the FMAs and announcing mode changes at all times (including when selecting a new mode) and why only certain mode changes will be accompanied by an aural notification or additional visual cues.		-
	Describe the consequences of not understanding what the FMAs imply or missing mode changes, and how it may lead to an undesirable aircraft state.		-
C.7.5.6.5	**- autoflight guidance**	**x**	**-**
	Explain how the modes available for the flight director are the same as those available for the autopilot, and that the same panel (FCU/MCP) is normally used for selection.		-
C.7.6	**AUTOPILOT**	**x**	**x**
C.7.6.1	**General Principles**	**x**	**x**
C.7.6.1.1	**- general principles of operation**	**x**	**x**
	Describe the purpose of the following components of an autopilot system: flight control unit (FCU), mode control panel (MCP) or equivalent; flight mode annunciator (FMA) (see Subject 022 06 04 00); autopilot computer; actuator.		
C.7.6.1.2	**- types: single axis, two axis, three axis**	**x**	**x**
	Define the three basic control channels.		
	Define the three different types of autopilots: single or 1 axis (roll); 2 axes (pitch and roll); 3 axes (pitch, roll and yaw).		

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
C.7.6.2	**Modes and operation**	x	x
C.7.6.2.1	**- lateral modes (pitch)** **- longitudinal modes (roll)** **- combined modes (roll and pitch)**	x	x
	Explain the following lateral modes: heading (HDG)/track (TRK); VOR (VOR)/localiser (LOC); lateral navigation/managed navigation (LNAV or NAV).		
	Describe the purpose of control laws for pitch and roll modes.		
	Explain the following vertical modes: vertical speed (V/S); flight path angle (FPA); level change (LVL CHG)/open climb (OP CLB) or open descent (OP DES); speed reference system (SRS); altitude (ALT) hold; vertical navigation (VNAV)/managed climb (CLB) or descent (DES); glideslope (G/S).		
	Describe how the autopilot uses speed, aircraft configuration or flight phase as a measure for the magnitude of control inputs and how this may affect precision and stability.		
C.7.7	**RADIO ALTIMETER**	x	x
C.7.7.1	**General Principles**	x	x
C.7.7.1.1	**- principles**	x	x
	Explain the purpose of a low-altitude radio altimeter.		
	Describe the principle of the distance (height) measurement.		
C.7.7.1.2	**- frequency band**	x	x
C.7.7.2	**Presentation and operation**	x	x
C.7.7.2.1	**- presentation and interpretation**	x	x
	Describe the different types of radio-altimeter displays.		
	Describe how the radio altimeter provides input to other systems and how a radio-altimeter failure may impact on the functioning of these systems.		
	State the range of a radio altimeter.		
C.7.7.2.2	**- errors and accuracy**	x	x
	Explain the potential implications of a faulty radio-altimeter and how this in particular may affect the following systems: autothrust (flare/retard); ground-proximity warning systems (GPWSs).		
C.7.8	**PROXIMITY AND WARNING SYSTEMS**	x	x
C.7.8.1	**a. Ground proximity warning system (GPWS)**	x	x
C.7.8.1.1	**- design and principle of operation**	x	x
	Explain the purpose of GPWSs.		
	Explain inputs and outputs of a GPWS and describe its operating principle.		
C.7.8.1.2	**- GPWS indications and warnings**	x	x
	List and describe the different modes of operation of a GPWS.		
C.7.8.2	**b. Terrain Avoidance Warning System (TAWS) or Enhanced GPWS**	x	x

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
C.7.8.2.1	**- design and principle of operation**	**x**	**x**
	Explain the purpose of a TAWS for aeroplanes and of a HTAWS for helicopters, and explain the difference from a GPWS.		
	Explain inputs and outputs of a TAWS/HTAWS and describe its working principle.		
	Give examples of terrain displays and list the different possible alerts.		
	Give examples of time response left to the pilot according to look-ahead distance, speed and aircraft performances.		
C.7.8.3	**c. Traffic Alert and Collision Avoidance System (TCAS / ACAS)**	**x**	**x**
C.7.8.3.1	**- principles of operation**	**x**	**x**
	State that ACAS II is an ICAO standard for anti-collision purposes.		
	Explain that ACAS II is an anti-collision system and does not guarantee any specific separation.		
	Describe the purpose of an ACAS II system as an anti-collision system.		
	State that ACAS II equipment can take into account several threats simultaneously.		
	Describe the interaction between the TCAS II system and the transponder, radio altimeter and the air-data computer: antenna used; computer and links with radio altimeter, air-data computer and mode-S transponder.		
	Explain the principle of TCAS II interrogations.		
	State the typical standard detection range for TCAS II: 35–40 NM horizontally; approximately 2 000 ft above and below (any setting); extension to approximately 10 000 ft above (ABV selected) or approximately 10 000 ft below (BLW selected).		
	Identify the equipment which an intruder must be fitted with in order to be detected by TCAS II.		
C.7.8.3.2	**- displays and traffic indications**	**x**	**x**
	Describe the following outputs from a TCAS: other intruders; proximate intruders; traffic advisory (TA); resolution advisory (RA).		
C.7.8.3.3	**- traffic advisory (TA)**	**x**	**x**
	State that a detected aircraft without altitude-reporting can only generate a TA; describe typical type of traffic and how this can create distractions during flight in certain areas of significant air traffic activity.		
C.7.8.3.4	**- resolution advisory (RA)**	**x**	**x**
	Explain that an RA may or may not require any active control input and the implications of reacting instinctively without awareness of actual control inputs required to comply with the RA.		
	Explain that if two aircraft are fitted with ACAS II, the RA will be coordinated.		
C.7.8.3.5	**- TCAS commands**	**x**	**x**
	List and interpret the following information available from TCAS: the different possible statuses of a detected aircraft: 'other', 'proximate', 'intruder'; the appropriate graphic symbols and their position on the horizontal display; different aural warnings.		
	Explain the indications of a TA and an RA and how an RA will generate a red area on the VSI. Some variants will also include a green area. To manoeuvre the aircraft to comply with the RA, the pilot should 'avoid the red' or 'fly the green'.		
C.7.8.3.6	**- responsibility of Flight crew**	**x**	**x**

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	State that ACAS II will issue commands in the vertical plane only (climb, descent or maintain), and that the commands are complied with as a manual manoeuvre.		
	Explain that the pilot must not interpret the horizontal track of an intruder upon the display.		
C.7.8.3.7	**- principle of reduced surveillance**	**x**	**x**
	Explain the principle of 'reduced surveillance'.		
	Explain that in high-density traffic areas the range may automatically be decreased in order to enable detection of the threats in the proximity of the aircraft due to a limitation of the maximum number of possible intruders the system is able to process.		
C.7.8.4	**d. Altitude alert system**	**x**	**x**
C.7.8.4.1	**- function**	**x**	**x**
	Describe the function of an altitude alert system.		
C.7.8.4.2	**- altitude approach alert** **- altitude deviation alert**	**x**	**x**
	Describe different types of displays and possible alerts.		
C.7.9	**AIR TEMPERATURE INDICATORS**	**x**	**x**
	Units and sensors	**x**	**expaned**
C.7.9.1.1	**- sensors**	**x**	**x**
	Explain temperature.		
	List the following units that can be used for temperature measurement: Kelvin; Celsius; Fahrenheit.		
	State the relationship between these units and convert between them.		
	Identify temperature measurements that are applicable to an aircraft: gas temperature measurement (ambient air, bleed-air systems, air-conditioning systems, air inlet, exhaust gas, gas turbine outlets); liquid-temperature measurement (fuel, oil, hydraulic); component-temperature measurement (generator, transformer rectifier unit (TRU), pumps (fuel, hydraulic), power transfer unit (PTU).		
C.7.10	**MAGNETISM**	**x**	**x**
C.7.10.1	**Magnetic compass**	**x**	**x**
C.7.10.1.1	**- components and principle of operation**	**x**	**x**
	Explain the purpose of a direct-reading magnetic compass.		
C.7.10.1.2	**- serviceability tests**	**x**	**x**
	Describe the serviceability check for a direct-reading magnetic compass prior to flight, such as: the physical appearance of the device; comparing the indication to another known direction such as a different compass or runway direction.		
C.7.10.1.3	**- turning and acceleration errors**	**x**	**x**
	Describe how the direct-reading magnetic compass will only show correct indications during straight, level and unaccelerated flight, and that an error will occur during the following flight manoeuvres (no numerical examples): acceleration and deceleration; turning; during pitch-up or pitch-down manoeuvres.		

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	Explain how the use of timed turns eliminates the problem of the turning errors of a direct-reading magnetic compass, and calculate the duration of a rate-1 turn for a given change of heading.		
C.7.11	**BASIC PRINCIPLES OF PRACTICAL INSTRUMENT FLYING**	**x**	**x**
C.7.11.1	**a. Control instruments**	**x**	**x**
C.7.11.2	**b. Performance instruments**	**x**	**x**
C.7.11.3	**c. Relationship between power / thrust and attitude and resultant performance**	**x**	**x**
C.7.11.4	**d. Instrument cross-check (scan) and scanning techniques:**	**x**	**x**
C.7.11.4	**- Selected radial cross-check**	**x**	**x**
C.7.11.4	**- Inverted-V cross-check**	**x**	**x**
C.7.11.4	**- Rectangular cross-check**	**x**	**x**
C.7.11.4	**- Common cross-check errors**	**x**	**x**
C.7.11.4	**- Instrument interpretation**	**x**	**x**
C.7.11.5	**e. Implication of failure of instruments**	**x**	**x**
C.7.12	**AEROPLANE INSTRUMENT FLYING USING ANALOG INSTRUMENTATION**	**x**	**-**
C.7.12.1	**a. Full panel manoeuvres and common errors:**	**x**	**-**
C.7.12.1.1	**- Straight and level flight**	**x**	**-**
C.7.12.1.2	**- Straight climbs and descents**	**x**	**-**
C.7.12.1	**Turns**	**x**	**-**
C.7.12.1.3	**- Standard rate turns**	**x**	**-**
C.7.12.1.4	**- Timed turns**	**x**	**-**
C.7.12.1.5	**- turns to predetermined headings**	**x**	**-**
C.7.12.1.6	**- Compass turns**	**x**	**-**
C.7.12.1.7	**- Steep turns**	**x**	**-**
C.7.12.1.8	**- Climbing and descending turns**	**x**	**-**
C.7.12.1.9	**- Change of airspeed during turns**	**x**	**-**
C.7.12.1	**Unusual attitudes and recovery**	**x**	**-**
C.7.12.1.10	**- Recognizing unusual attitudes**	**x**	**-**
C.7.12.1.11	**- Recovery from unusual attitudes (nose-high and nose-low)**	**x**	**-**
C.7.12.1.12	**- Common errors in unusual attitudes**	**x**	**-**
C.7.12.1.13	**Instrument take-off**	**x**	**-**
C.7.12.2	**b. Limited (partial) panel manoeuvres and common errors:**	**x**	**-**
C.7.12.2.1	**- straight and level flight**	**x**	**-**
C.7.12.2.2	**- Straight climbs and descents**	**x**	**-**
C.7.12.2	**- Turns**	**x**	**-**

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
C.7.12.2.3	- Standard rate turns	x	-
C.7.12.2.4	- Timed turns	x	-
C.7.12.2.5	- Compass turns	x	-
C.7.12.2.6	- Climbing and descending turns	x	-
C.7.13	**AEROPLANE INSTRUMENT FLYING USING AN ELECTRONIC FLIGHT DISPLAY**	**x**	**-**
C.7.13.1	a. Scanning Techniques:	x	-
C.7.13.1.1	- Selected radial cross-check	x	-
C.7.13.1.2	- Common errors (fixation, omission, emphasis)	x	-
C.7.13.2	b. Basic manoeuvres and common errors:	x	-
C.7.13.2.1	- Straight and level Flight	x	-
C.7.13.2.2	- Straight climbs and descents	x	-
C.7.13.2.3	- Standard rate turns	x	-
C.7.13.2.4	- turns to predetermined headings	x	-
C.7.13.2.5	- Timed turns	x	-
C.7.13.2.6	- Compass turns	x	-
C.7.13.2.7	- Steep turns	x	-
C.7.13.2.8	- Instrument take-off	x	-
C.7.14	**HELICOPTER FLIGHT MANOEUVRES:**	**-**	**x**
C.7.14.1	a. Basic manoeuvres:	-	x
C.7.14.1	Straight and level flight	-	x
C.7.14.1.1	- Common errors during Straight and level Flight	-	x
C.7.14.1.2	- Power control during Straight and level Flight	-	x
C.7.14.1.3	- Common errors during airspeed changes	-	x
C.7.14.1	Straight climbs (constant airspeed and constant rate)	-	x
C.7.14.1.4	- Entry	-	x
C.7.14.1	Straight climbs (constant airspeed and constant rate)	-	x
C.7.14.1.5	- Entry	-	x
C.7.14.1.6	- Level off	-	x
C.7.14.1.7	- Common errors during Straight climbs and descents turns	-	x
C.7.14.1	Turns	-	x
C.7.14.1.8	- turn to a predetermined heading	-	x
C.7.14.1.9	- Timed turns	-	x
C.7.14.1.10	- Change of airspeed in turns	-	x
C.7.14.1.11	- Compass turns	-	x

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
C.7.14.1.12	**- Climbing and descending turns**	**-**	**x**
C.7.14.1.13	**- Common errors during turns**	**-**	**x**
C.7.14.2	**b. Unusual attitudes**	**-**	**x**
C.7.14.2.1	**- Common errors during unusual attitude recoveries Emergencies**	**-**	**x**
C.7.14.3	**c. Emergencies**	**-**	**x**
C.7.14.3.1	**- Autorotations**	**-**	**x**
C.7.14.3.2	**- Servo failure**	**-**	**x**
C.7.14.4	**d. Instrument take-off**	**-**	**x**
C.7.14.4.1	**- Common errors during Instrument take-offs**	**-**	**x**

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	HUMAN PERFORMANCE AND LIMITATIONS	**x**	**x**
C.8.1	**Basics of aviation physiology and health maintenance**	**x**	**x**
C.9.1.1	**MAN AND THE ENVIRONMENT: THE SENSORY SYSTEM**	**x**	**x**
C.9.1.1.1	**The senses**	**x**	**x**
	List the different senses.		
C.9.1.2	**CENTRAL, PERIPHERAL AND AUTONOMIC NERVOUS SYSTEM**	**x**	**x**
C.9.1.2.1	**a. Parts of the central nervous system**	**x**	**x**
	Define the term 'sensory threshold'.		
	Define the term 'sensitivity', especially in the context of vision.		
	Give examples of sensory adaptation.		
	Define the term 'habituation' and state its implication for flight safety.		
C.9.1.2.2	**b. Basic functions**	**x**	**x**
C.9.1.2.3	**c. Transfer of information**	**x**	**x**
C.9.1.2.4	**d. Division of the peripheral nerves into sensory and motor nerves**	**x**	**x**
C.9.1.2.5	**e. Sensitivity**	**x**	**x**
C.9.1.2.6	**f. Sensory adaptation**	**x**	**x**
C.9.1.3	**VISION**	**x**	**x**
C.9.1.3.1	**a. Functional anatomy**	**x**	**x**
	Name the most important parts of the eye and the pathway to the visual cortex.		
C.9.1.3.2	**b. Parts of the eye and the pathway to the visual cortex**	**x**	**x**
C.9.1.3.3	**c. Functionality and components**	**x**	**x**
	State the basic functions of the parts of the eye.		
C.9.1.3.4	**d. Accommodation**	**x**	**x**
	Define 'accommodation'.		
C.9.1.3.5	**e. Rod and cone cells**	**x**	**x**
	Distinguish between the functions of the rod and cone cells.		
	Describe the distribution of rod and cone cells in the retina and explain their relevance to vision.		
C.9.1.3.6	**f. Foveal and peripheral vision**	**x**	**x**
C.9.1.3.7	**g. Visual acuity, visual field, central vision, peripheral vision, fovea and explain their function in the process of vision**	**x**	**x**
	Explain the terms 'visual acuity', 'visual field', 'central vision', 'peripheral vision' and 'the fovea', and explain their function in the process of vision.		
	List the factors that may degrade visual acuity and the importance of 'lookout'.		
C.9.1.3.8	**h. Factors degrading visual acuity**	**x**	**x**
	State the effect of hypoxia, smoking and altitude in excess of 5 000 ft on night vision.		

SACAA Ref	*Description*	*SACAA IR(A)*	*SACAA IR(H)*
C.9.1.3.9	**i. Night vision limitations**	**x**	**x**
	State the limitations of night vision and the different scanning techniques at both night and day.		
C.9.1.3.10	**j. Adapting from day to night**	**x**	**x**
C.9.1.3.11	**k. Adaptation time**	**x**	**x**
	State the time necessary for the eye to adapt both to bright light and the dark.		
C.9.1.3.12	**l. Colour blindness**	**x**	**x**
	Explain the nature of colour blindness.		
C.9.1.3.15	**o. Monocular depth perception**	**x**	**x**
	Distinguish between monocular and binocular vision.		
	Explain the basis of depth perception and its relevance to flight performance.		
	List the possible monocular cues for depth perception.		
C.9.1.4	**HEARING**	**x**	**x**
C.9.1.4.1	**a. Components of the human ear**	**x**	**x**
	State the basic parts and functions of the outer, the middle and the inner ear.		
C.9.1.4.2	**b. Basic functions of the different parts of the auditory system**	**x**	**x**
	Differentiate between the functions of the vestibular apparatus and the cochlea in the inner ear.		
C.9.1.4.3	**c. Function of the cochlea**	**x**	**x**
C.9.1.4.4	**d. Equilibrium**	**x**	**x**
C.9.1.4.5	**e. Functional anatomy**	**x**	**x**
	List the main elements of the vestibular apparatus.		
	State the functions of the vestibular apparatus on the ground and in flight.		
	Distinguish between the component parts of the vestibular apparatus in the detection of linear and angular acceleration as well as on gravity.		
	Explain how the semicircular canals are stimulated.		
C.9.1.4.6	**f. Functions of the vestibular apparatus on the ground and in flight**	**x**	**x**
	Describe air sickness and its accompanying symptoms.		
	List the causes of air sickness.		
	Describe the necessary actions to be taken to counteract the symptoms of air sickness.		
C.9.1.4.7	**g. Semi-circular canals**	**x**	**x**
C.9.1.5	**INTEGRATION OF SENSORY INPUT**	**x**	**x**
C.9.1.5.1	**a. Spatial orientation**	**x**	**x**
	State the interaction between vision, equilibrium, proprioception and hearing to obtain spatial orientation in flight.		
C.9.1.5.2	**b. Illusion**	**x**	**x**
	Define the term 'illusion'.		

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	Give examples of visual illusions based on shape constancy, size constancy, aerial perspective, atmospheric perspective, the absence of focal or ambient cues, autokinesis, vectional false horizons, field myopia, and surface planes.		
	Relate these illusions to problems that may be experienced in flight and identify the danger attached to them.		
C.9.1.5.3	**c. Approach and landing illusion**	**x**	**x**
	List approach and landing illusions for slope of the runway, black-hole approach, and terrain around runway, and state the danger involved with recommendations to avoid or counteract the problems with high or low approach or flare at the wrong time.		
C.9.1.5.4	**d. Flicker vertigo**	**x**	**x**
	State the problems associated with flickering lights (strobe lights, anti-collision lights, propellers and rotors under certain light conditions, etc.).		
C.9.1.5.5	**e. Vestibular illusions**	**x**	**x**
	Describe vestibular illusions caused by the angular accelerations (the Leans, Coriolis) and linear accelerations (somatogravic, G-effect).		
C.9.1.5.6	**f. Seat-off-the-pants senses**	**x**	**x**
	State that the 'seat-of-the-pants' sense is completely unreliable when visual contact with the ground is lost or when flying in instrument meteorological conditions (IMC) or with a poor visual horizon.		
C.9.1.5.7	**g. Spatial disorientation**	**x**	**x**
	Differentiate between vertigo, Coriolis effect, and spatial disorientation.		
C.9.1.5.8	**h. Prevention**	**x**	**x**
	List the measures to prevent or overcome spatial disorientation.		
C.9.1.6	**HUMAN ERROR AND RELIABILITY**	**x**	**x**
C.9.1.6.1	**a. Reliability of human behaviour**	**x**	**x**
	Name and explain the factors that influence human reliability.		
C.9.1.6.2	**b. Mental models and situational awareness**	**x**	**x**
	Define the term 'situation awareness'.		
	List the cues that indicate loss of situation awareness and name the steps to regain it.		
	List the factors that influence one's situation awareness both positively and negatively, and stress the importance of situation awareness in the context of flight safety.		
	Define the term 'mental model' in relation to a surrounding complex situation.		
	Describe the advantages/disadvantages of mental models.		
	Explain the relationship between personal 'mental models' and the creation of cognitive illusions.		
C.9.1.6.3	**c. The theory and models of human error**	**x**	**x**
	Explain the concept of the 'error chain'.		
	Differentiate between an isolated error and an error chain.		
	Distinguish between the main forms/types of errors (i.e. slips, faults, omissions and violations).		

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	Discuss the above errors and their relevance in flight.		
	Distinguish between an active and a latent error, and give examples.		
C.9.1.6.4	**d. Error generation**	x	x
	Distinguish between internal and external factors in error generation.		
	Identify possible sources of internal error generation.		
	Define and discuss the two errors associated with motor programmes (action slip and environmental capture).		
	List the three main sources of external error generation in the flight crew compartment.		
	Give examples to illustrate the following factors in external error generation in the flight crew compartment: ergonomics; economics; social environment.		
	Name the major goals in the design of human-centred human-machine interfaces.		
	Define the term 'error tolerance'.		
	List and describe the strategies that are used to reduce human error.		
	Describe the advantage of planning and the anticipation of future actions.		
C.9.1.6.5	**e. Decision-making**	x	x
C.9.1.6.6	**f. Decision-making concepts**	x	x
	Define the terms 'deciding' and 'decision-making'.		
	Describe the major factors on which decision-making should be based during the course of a flight.		
	Describe the main human attributes with regard to decision-making.		
	Discuss the nature of bias and its influence on the decision-making process.		
	Describe the main error sources and limits in an individual's decision-making mechanism.		
	State the factors upon which an individual's risk assessment is based.		
	Explain the relationship between risk assessment, commitment and pressure of time in decision-making strategies.		
	Explain the risks associated with dispersion or channelised attention during the application of procedures requiring a high workload within a short time frame (e.g. a go-around).		
	Describe the positive and negative influences exerted by other group members on an individual's decision-making process (risky shift).		
	Explain the general idea behind the creation of a model for decision-making based upon: definition of the aim; collection of information; risk assessment; development of options; evaluation of options; decision; implementation; consequences; review and feedback.		
C.8.2	**BASIC AVIATION PSYCHOLOGY**	x	x
C.9.2.1	**HUMAN BEHAVIOUR**	x	x
C.9.2.1.1	**a. Personality, Attitude and behaviour**	x	x
	Describe the factors that determine an individual's behaviour.		
	Define and distinguish between 'personality', 'attitude' and 'behaviour'.		
	State the origin of personality and attitude.		

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	State that with behaviour good and bad habits can be formed.		
	Explain how behaviour is generally a product of personality, attitude and the environment to which one was exposed at significant moments (childhood, schooling and training).		
	State that personality differences and selfish attitude may have effects on flight crew performance.		
C.9.2.1.2	**b. Individual differences in personality and motivation**	**x**	**x**
	Describe the individual differences in personality by means of a common trait model (e.g. Eysenck's personality factors) and use it to describe today's ideal pilot.		
C.9.2.1.3	**c. Identification of hazardous attitudes (error proneness)**	**x**	**x**
	Explain dangerous attitudes in aviation: anti-authority; macho; impulsivity; invulnerability; complacency; resignation.		
	Describe the personality, attitude and behaviour patterns of an ideal crew member.		
	Summarise how a person's attitude influences their work in the flight crew compartment.		
C.9.2.2	**HUMAN OVERLOAD AND UNDERLOAD**	**x**	**x**
C.9.2.2.1	**a. Arousal**	**x**	**x**
	Explain the term 'arousal'.		
	Describe the relationship between arousal and performance.		
	Explain the circumstances under which underload may occur and its possible dangers.		
C.9.2.2.2	**b. Stress**	**x**	**x**
	Explain the term 'stress' and why stress is a natural human reaction.		
	State that the physiological response to stress is generated by the 'fight or flight' response.		
	Describe the function of the autonomic nervous system (ANS) in stress response.		
	Explain the relationship between arousal and stress.		
	State the relationship between stress and performance.		
	State the basic categories of stressors.		
	List and discuss the major environmental sources of stress in the flight crew compartment.		
	Discuss the concept of 'break point' with regard to stress, overload and performance.		
	Name the principal causes of domestic stress.		
	State that the stress experienced as a result of particular demands varies among individuals.		
	Explain the factors that lead to differences in the levels of stress experienced by individuals.		
	List the factors that influence the tolerance of stressors.		
	State that stress is a result of perceived demands and perceived ability.		
	Explain the relationship between stress and anxiety.		
	Describe the effects of anxiety on human performance.		
	State the general effect of acute stress on people.		
	Describe the relationship between stress, arousal and vigilance.		

SACAA Ref	Description	SACAA IR(A)	SACAA IR(H)
	State the general effect of chronic stress and the biological reaction by means of the three stages of the general adaptation syndrome (Selye): alarm, resistance, and exhaustion.		
	Explain the differences between psychological, psychosomatic and somatic stress reactions.		
	Name the typical common physiological and psychological symptoms of human overload.		
	Describe the effects of stress on human behaviour.		
	Explain how stress is cumulative and how stress from one situation can be transferred to a different situation.		
	Explain how successful completion of a stressful task will reduce the amount of stress experienced when a similar situation arises in the future.		
	Describe the effect of human underload/overload on effectiveness in the flight crew compartment.		
	List sources and symptoms of human underload.		
C.9.2.2.3	**c. Fatigue and stress management**	**x**	**x**
	Explain the term 'fatigue' and differentiate between the two types of fatigue (short-term and chronic fatigue).		
	Name the causes of short-term and chronic fatigue.		
	Identify the symptoms and describe the effects of fatigue.		
	List the strategies that prevent or delay the onset of fatigue and hypovigilance.		
	List and describe strategies for coping with stress factors and stress reactions.		
	Distinguish between short-term and long-term methods of stress management.		
	Give examples of short-term methods of stress management.		
	Give examples of long-term methods of coping with stress.		
	Describe the fatigue risk management system (FRMS) as follows: a data-driven means of continuously monitoring and managing fatigue-related safety risks, based upon scientific principles and knowledge as well as operational experience that aims to ensure relevant personnel are performing at adequate levels of alertness.		