Aerospace Systems marking guide and response

External assessment 2021

Combination response (80 marks)

Assessment objectives

This assessment instrument is used to determine student achievement in the following objectives:

1. recognise and describe problems, aerospace technology knowledge, concepts and principles, and systems thinking habits and systems thinking strategies in relation to aircraft performance systems and human factors
2. symbolise and explain ideas, solutions and relationships in relation to aircraft performance systems and human factors
3. analyse problems and information in relation to aircraft performance systems and human factors
5. synthesise information and ideas to propose possible aircraft performance systems and human factors solutions
7. evaluate and refine ideas and solutions to make justified recommendations

Note: Objectives 4, 6 and 8 are not assessed in this instrument.

Purpose

This document consists of a marking guide and a sample response.

The marking guide:

- provides a tool for calibrating external assessment markers to ensure reliability of results
- indicates the correlation, for each question, between mark allocation and qualities at each level of the mark range
- informs schools and students about how marks are matched to qualities in student responses.

The sample response:

- demonstrates the qualities of a high-level response
- has been annotated using the marking guide.

Mark allocation

Where a response does not meet any of the descriptors for a question or a criterion, a mark of '0' will be recorded.

Where no response to a question has been made, a mark of 'N' will be recorded.

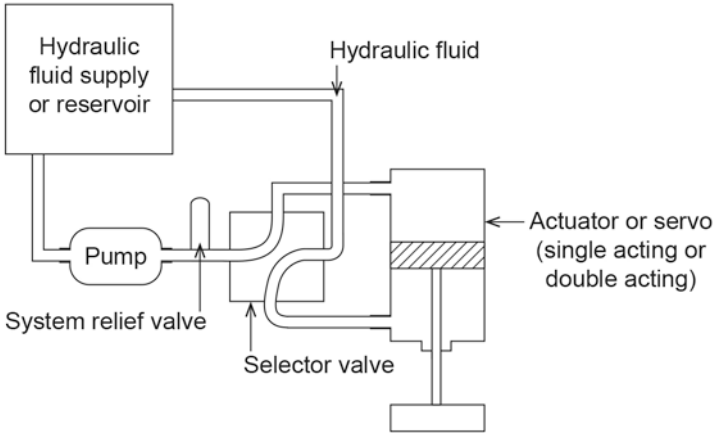
Allowing for FT error — refers to 'follow through', where an error in the prior section of working is used later in the response, a mark (or marks) for the rest of the response can be awarded so long as it still demonstrates the correct conceptual understanding or skill in the rest of the response.

Marking guide

Multiple choice

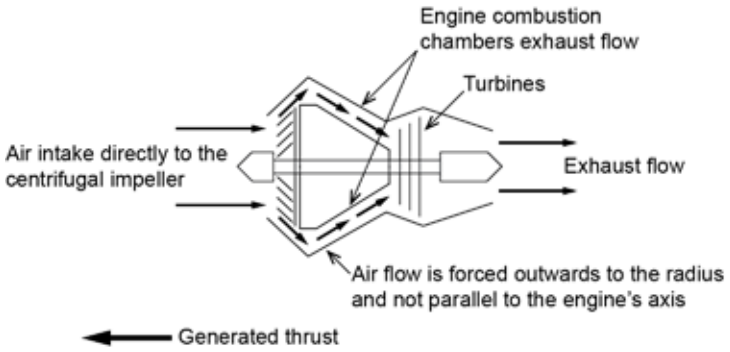
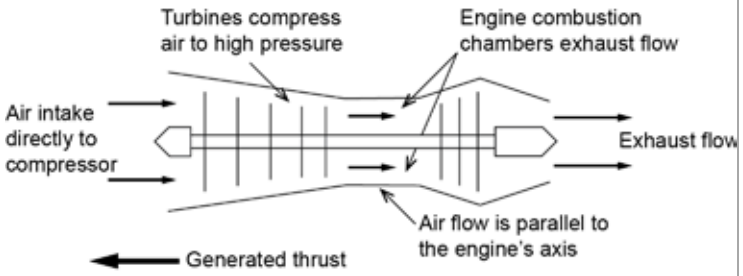
Question	Response
1	C
2	B
3	A
4	B
5	B
6	D
7	D
8	C
9	A
10	C

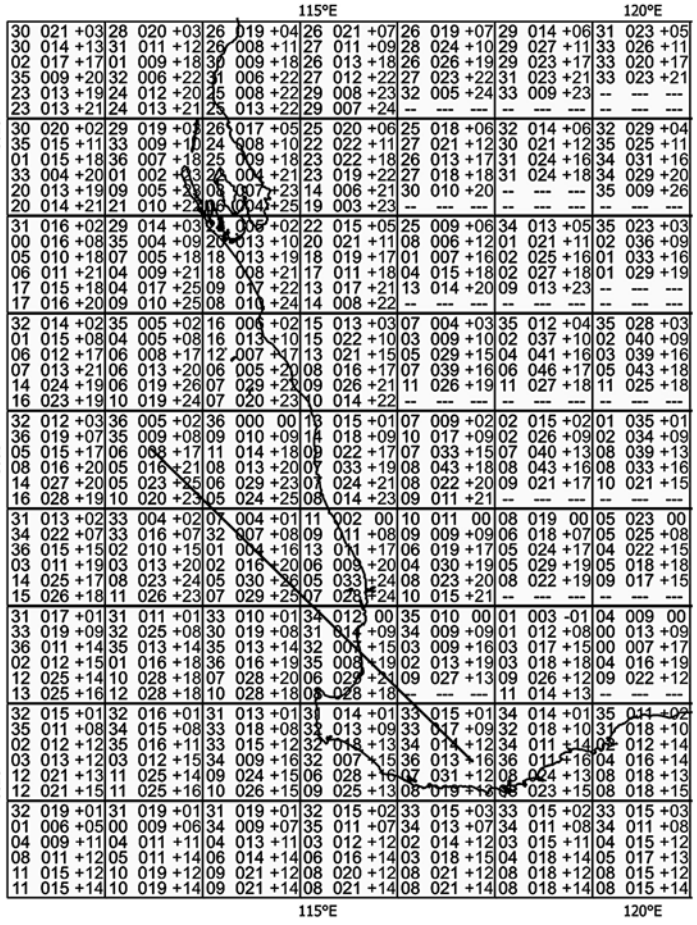
Short response

Q	Sample response	The response:
11		• provides a component **[1 mark]** • provides a second component **[1 mark]** • provides a third component **[1 mark]** • provides a fourth component **[1 mark]** • provides a fifth component **[1 mark]** • provides a sixth component **[1 mark]**
12	1. knowledge level 2. expertise 3. qualifications 4. mental fatigue	• identifies a cognitive factor **[1 mark]** • identifies a second cognitive factor **[1 mark]** • identifies a third cognitive factor **[1 mark]** • identifies a fourth cognitive factor **[1 mark]**

Q	Sample response	The response:
13	The heart will beat faster and harder to keep blood flowing to the brain when exposed to positive G force. Vision may be impaired and the pilot may lose consciousness.	• explains reaction to G force with reference to impact on – heartbeat **[1 mark]** – blood flow to the brain **[1 mark]** – vision **[1 mark]** – consciousness **[1 mark]**
14	Leadership and teamwork are both important attributes of effective crew resource management when they exist together and are not mutually exclusive. In aviation, the pilot in command of an aircraft is the leader as captain and accepts ultimate responsibility and authority overthe flight. Other members of the crew or team, such as the first officer, must be able to question and challenge the captain's decisions when appropriate. There needs to be a balance between the assertiveness ofthe crew and the authority of the captain. This balance is evident when decisions are made using evidence from appropriate crew members.	• explains using wording indicative of – the relationship between leadership and teamwork **[1 mark]** – leaders having responsibility and authority **[1 mark]** – team members needing the ability to question authority **[1 mark]** • provides a valid example in an aviation context **[1 mark]**

Q	Sample response	The response:
15	 Two-bar VASIS provides airport visual approach slope guidance for landing aircraft. The VASIS consists of two bars of two lights, one bar near the landing aircraft and one far from it. The bars display red or white light depending on the glide path of the aircraft. The upper segment of the beam displays a white light and the lower a red light. The lights are seen by the pilot depending on the aircraft's height relative to the correct glide path for landing as shown in the diagram.	• explains using wording indicative of – airfield visual approach slope guidance **[1 mark]** – a system using two light bars near and far from the landing aircraft **[1 mark]** – on glide path configuration **[1 mark]** – above and below glide path configuration **[1 mark]** • provides valid sketches to support the explanation **[1 mark]**
16	Vso is the minimum steady flight speed of an aircraft in a power off configuration at the maximum landing weight in the landing configuration.	• defines using wording indicative of – minimum steady flight speed **[1 mark]** – power off configuration **[1 mark]** – maximum landing weight **[1 mark]** – landing configuration **[1 mark]**
17	The vestibular system in the inner ear allows the pilot to sense movement and determine orientation in the surrounding environment.This enables the pilot to identify the pitch, roll, and yaw movements of the aircraft in normal flight conditions. Without visual reference to the horizon the vestibular system becomes unreliable. The pilot is most likely experiencing the Leans illusion, where they have suddenly returned to level flight following a prolonged turn, or the Coriolis illusion caused by making a prolonged turn, which moves fluid in the ear canal at the same speed as the canal.	• describes the vestibular system as responsible for balance and spatial orientation **[1 mark]** • refers to pitch, roll and yaw **[1 mark]** • provides a plausible analysis of the reliability of the vestibular system in the scenario **[1 mark]** • provides an explanation of a plausible illusion **[1 mark]** • provides an explanation of another plausible illusion **[1 mark]**

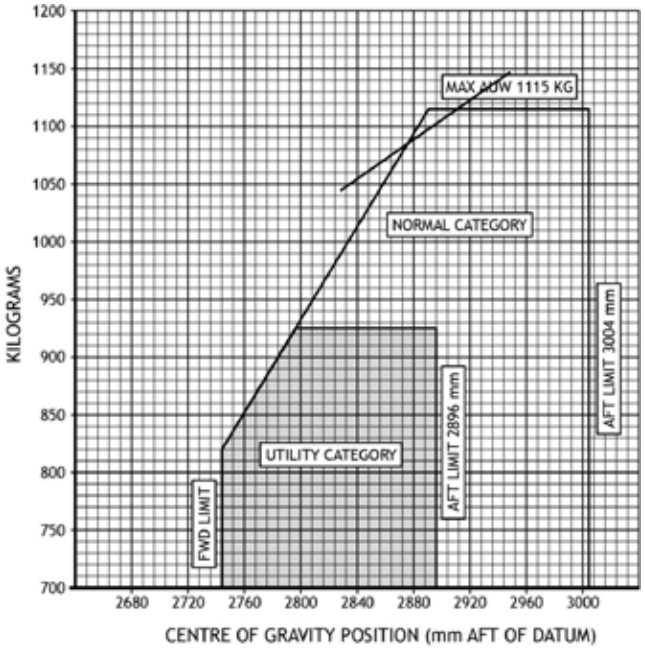
Q	Sample response	The response:
18	Centrifugal flow jet engines compress inlet air using a centrifugal impeller that accelerates air outwardly, perpendicular to the axis of the engine. Air moves radially through to combustion of the compressed air and fuel mixture, rather than parallel to the engine's axis. However, in an axial flow engine, inlet air moves through parallel to the axis of the engine. The inlet air is compressed by a series of compressor turbines before combustion of the compressed air and fuel mixture. Centrifugal flow  Axial flow  	• describes a centrifugal flow jet engine **[1 mark]** • describes an axial flow jet engine **[1 mark]** • identifies a valid difference between the engines **[1 mark]** • provides a valid centrifugal jet engine sketch **[1 mark]** • provides a valid axial flow jet engine sketch **[1 mark]**

Q	Sample response	The response:
19	 The most appropriate altitude is 9500 ft, as the GPWT indicates that the wind is from the north-west throughout the entire flight at the 10 000 ft forecast height. FL140 has a similar wind direction but at slower speeds and not through all sections. Faster wind provides a better tailwind component than other altitudes and therefore a quicker flight time with lower fuel consumption for the aircraft's south-easterly track.	• provides a correctly plotted aircraft track **[1 mark]** • identifies GPWT wind direction as north west **[1 mark]** • identifies the appropriate altitude **[1 mark]** • provides an example to justify the chosen altitude **[1 mark]** • provides a second example to justify the chosen altitude **[1 mark]**

Q	Sample response	The response:
20		• places the instructor and student pilot in Row 1 **[1 mark]** • correctly converts fuel from L to kg **[1 mark]** • uses the loading chart appropriately to show that the aircraft is not safely loaded **[1 mark]** • determines the correct centre of gravity position and arm **[1 mark]** • provides a decision to increase the rear weight using ballast **[1 mark]** • provides a correct rear weight increase **[1 mark]** • provides a correct final aircraft position for the new loading configuration with a correct arm **[1 mark]**

	Weight (kg)	Arm (mm)	Index units
Empty weight	687		19 522
Full oil	7		86
Row 1	210		5775
Row 2			
Baggage			
Subtotal	904	2807	25 383
Fuel (200 L)	142		4189
Total	1046	2827	29 572

	Weight (kg)	Arm (mm)	Index units
Old position	1046	2827	29 572
Add 100 kg baggage nominal	100.0		4210
Amended total	1146	2948	33 782
Baggage weight increase	34.0	4210	1431.4
Final aircraft position	1080	2870	31 003.4

Q	Sample response
	 The plot line cuts with the forward limit line at approximately 1080 kg, which is 34 kg more than the current aircraft weight. Therefore, 34 kg of ballast or baggage must be added to the rear of the aircraft to bring it inside the envelope for safe operation.

Q	Sample response
21	Pilot preconceptions about a particular situation increase the risk of decision-making bias and have a negative influence on aircraft safety. However, preconceptions can support improved performance. This occurs because previous experiences can lead to quicker decision-making, which is often very important in difficult flight situations. In this context, the pilot believes that effective solutions to previous difficult situations would also be effective in the current situation. This sometimes means that important information specific to the current situation might be missed, reducing the pilot's situational awareness. This strategy reduces the pilot's workload and stress but increases the risk of making an incorrect decision. Therefore, pilot preconceptions have an important role to play in reducing thetime required to identify and solve problems. However, care must be taken to identify the nuances of the current situation to reduce the risk of errors that could lead to a critical loss of aircraft safety.

Q	Sample response
22	QNH: 1009 Temp: 28 °C $\text{PA} = \text{Elev} + (1013 - \text{QNH}) \times 30$ $= 4260 + (1013 - 1009) \times 30$ $= 4260 + (4 \times 30)$ $= 4380$ ft ISA deviation PA = 4380 ft Round up to 4500 ft Temp changes: 2 °C / 1000 ft $\text{ISA temp} = 15$ °C at sea level $= 15 - (4.5 \times 2)$ $= 15 - 9$ $= 6$ °C Density altitude $\text{DA} = \text{PA} + [120 \times (\text{OAT} - \text{ISA})]$ $= 4380 + [120 \times (28 - 6)]$ $= 4380 + [120 \times 22]$ $= 4380 + 2640$ $= 7020$ ft Therefore, the aircraft cannot safely land according to the company's SOPs, as the density altitude is above 6500 ft (7020 ft) at 06Z.

Q	Sample response
23	Corryong to Corowa 12º E VAR; wind 300/15 T; TD 1550

Trk (°T)	Trk (°M)	TAS	Wind	HDG	GS	ETI	ETA
276	264	105	288(M)/15	266	90	75	1655

Time to Tallangatta = 50 mins Distance to Tallangatta = 52 nm
GS = 62 kt therefore headwind is 43 kt
Use 1-in-60 to calculate heading to parallel track = 8 nm off track over 52 nm
= 9°
New heading = 266 + 9 = 275°M
To hold original track 11° would have been needed (9°+ 2°)
Putting 11° on computer at 105 kts = 20 kts crosswind component
Putting 43 kts headwind component and 20 kts crosswind on computer = wind vector of 289/47 (M)

Tallangatta to Corowa 60 nm at 62 kt = 57 min
New ETA Corowa = 1727, which is after last light. New heading to Corowa
Using 1-in-60 = 9° parallel + 8° close track Therefore, the new heading is 266 + 17 = 283 °M

The closest alternative licensed airfields for landing are either Albury or Corryong. Wangaratta is not a consideration as it is further away at 64 nm and with a wind vector of 289/47 (M) the arrival time will also be after last light.

Q	Sample response

Tallangatta to Albury = 20 nm from chart Trk (°T)	Trk (°M)	TAS	Wind	HDG	GS	ETI	ETA
303	291	105	289(M)/47	291	58	21	1651

Return to Corryong = 52 nm from chart Trk (°T)	Trk (°M)	TAS	Wind	HDG	GS	ETI	ETA
087	075	105	289(M)/47	061	145	22	1652

It is not possible to continue to Corowa as the ETA is after last light.

The appropriate action is to either divert to Albury on a heading of 291° M with an ETA of 1651 or return to Corryong on a heading of 061° M with an ETA of 1652, as both are licensed airfields and arrival is before last light. Even though both scenarios have a similar ETA, Albury would be the most appropriate destination as the track is in the direction of original travel. This provides for a shorter flight distance to Corowa the next day.

Reference

Question 19
Bureau of Meteorology 2019, *Grid Point Wind and Temperature Forecasts*, www.bom.gov.au/aviation/charts/grid-point-forecasts.

Question 20
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