Aerospace Systems marking guide and response

External assessment 2024

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.

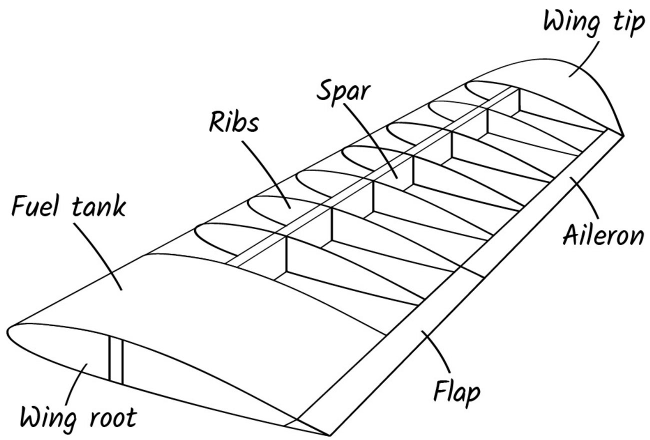
Allowing for FT error — refers to 'follow through', where an error in the prior section of working is used later in the response, a mark (or marks) for the rest of the response can be awarded so long as it still demonstrates the correct conceptual understanding or skill in the rest of the response.

Marking guide

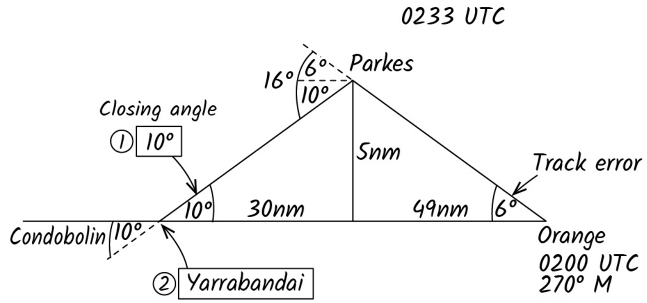
Multiple choice

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

Short response

Q	Sample response	The response:
11		• labels aileron **[1 mark]** • labels flap **[1 mark]** • labels fuel tank **[1 mark]** • labels spar **[1 mark]** • labels ribs **[1 mark]** • labels wing tip and wing root **[1 mark]**
12	The instrument landing system (ILS) uses ground-based transmitters and aircraft-based receivers to provide glide slope/vertical guidance and localiser/horizontal guidance for landing approach. On the glide path, markers identify where aircraft must be within limits to continue. Limitations: – instrument landing systems can experience frequency congestion – failure of any transmitters or receivers means the approach must be discontinued.	• identifies instrument landing system (ILS) **[1 mark]** • explains – ground-based transmitters and aircraft-based receivers **[1 mark]** – localiser provides horizontal guidance **[1 mark]** – glide slope provides vertical guidance/3° approach to runway **[1 mark]** • provides a plausible limitation **[1 mark]** • provides a second plausible limitation **[1 mark]**
13	Bearing is 122° T. 1-degree west variation, so magnetic bearing is 123° M. The distance from Northam to Quairading is 44 NM. The highest spot point 10 NM either side of track is 1900 ft. So LSALT is 2900 ft. Hemispherical cruising altitudes are odd plus 500 ft, so flight planned altitude will be 3500 ft.	• provides valid true bearing **[1 mark]** • provides 1-degree west variation **[1 mark]** • determines magnetic bearing **[1 mark]** • provides valid distance **[1 mark]** • identifies LSALT as 2900 ft **[1 mark]** • identifies planned altitude as 3500 ft **[1 mark]**

Q	Sample response	The response:
14	Vestibular system illusions: the leans, the Coriolis illusion Visual/night illusions: the false horizon, autokinesis Landing illusions: runway width, runway slope	• identifies a vestibular system illusion **[1 mark]** • identifies a second vestibular system illusion **[1 mark]** • identifies a visual/night illusion **[1 mark]** • identifies a second visual/night illusion **[1 mark]** • identifies a landing system illusion **[1 mark]** • identifies a second landing system illusion **[1 mark]**
15	The first and second officers must speak up clearly and immediately with safety concerns. Pilots in command (captains) are responsible for listening carefully and seriously considering these concerns. International flying involves fatigue, so it is important that crew communicate clearly with each other in the handover of crew rests. In international flying it is important that pilots and ATC speak English and use standard phraseology to avoid confusion.	• identifies a valid CRM communication strategy **[1 mark]** • identifies a second valid CRM communication strategy **[1 mark]** • identifies a third valid CRM communication strategy **[1 mark]**
16	In the scenario provided, a pilot would use the following systems thinking habits: • the big picture — examining the dynamics of the navigation systems and the relationships between its parts or components • consequences — analysing the short-term implications of their decision to avoid using the RNAV technology to minimise risks • changes in perspectives — looking at navigation systems from a number of different viewpoints to understand how they operate and the impact they have. Possible systems thinking strategies that could be implemented are: • iceberg visual frameworks — used to examine the RNAV technology beyond the individual signal jamming incidents to investigate any other patterns • causal loop diagrams — used to represent the dynamics and relationships of the GPS signal jamming impact on ATC and aircraft operations.	• describes a systems thinking habit **[1 mark]** • describes a second systems thinking habit **[1 mark]** • describes a third systems thinking habit **[1 mark]** • describes a systems thinking strategy **[1 mark]** • describes a second systems thinking strategy **[1 mark]**

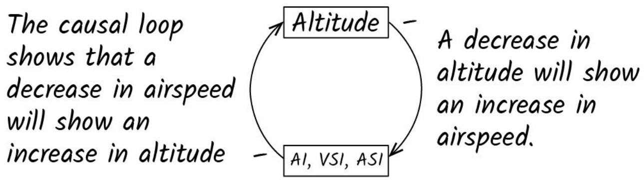
<table>
<tr><th>Q</th><th>Sample response</th><th>The response:</th></tr>
<tr><td>17</td><td>


Departed Orange at 0200 UTC.
Arrived Parkes at 0233 UTC.
∴ Ground speed $= 90$ kts i.e. 33 mins + 49 NM
Track made good $= 270 + 6$
$= 276^\circ$ M
Closing angle $= 10^\circ$
New HDG at intercept $=$ HDG to intercept $+10$
Time from Parkes to Condobolin = 33 mins.
i.e. another 49 NM to run.
∴ ETA to Condobolin is 0200 + 66 mins = 0306 UTC.
The new heading to Yarrabandai is original HDG – 6° and the new ETA for Condobolin is 0306 UTC. The track made good is 276° M and the closing angle is 10° M. The town at the re-interception point is Yarrabandai.
</td><td>
• determines
– new HDG to Condobolin [1 mark]
– new ETA to Condobolin [1 mark]
– track made good to Parkes [1 mark]
– closing angle from Parkes [1 mark]
– the re-inception point as Yarrabandai [1 mark]
</td></tr>
</table>

Q	Sample response	The response:

18	**Coonabarabran ERSA**
	1520 m sealed runway 11/29.
	Has PAL and LIRL lighting only on 14/32.
	Some bird and animal hazards.
	Appropriate runway is 11 with a crosswind of 15 kts, which is within aircraft limitations.
	PA = Elev + 30 (1013 – QNH)
	PA = 2117 + 30 (1013 – 1000)
	PA = 2117 + 390
	PA = 2507 ft
	ISA temp at PA = 15 – (2.5 × 1.98)
	= 15 – 4.95
	= 10.05
	DA = PA + 120 (OAT – ISA temp at PA)
	DA = 2507 + 120 (20 – 10.05)
	DA = 2507 + 1194
	DA = 3701 ft
	With DA of 3701 ft, the new runway length required is:
	= 1100 + (3.7 × 30)
	= 1211 m
	The runway length of 1520 m is longer than the landing distance required (1211 m) by 309 m, therefore this aerodrome is suitable.
	
	Quirindi ERSA
	1106 m sealed runway 06/24.
	Has passenger facility of public telephone and toilet.
	PAL and LIRL.
	Taxiway lighting.
	Radio nav aid of NDB.
	Hazards include birds, stones, military flying in CTAF and D523.
	
	Appropriate runway is 24 with a crosswind of 10 kts, which is within aircraft limitations.
	DA = 3644 ft
	With DA of 3644 ft, the new runway length available is:
		• analyses relevant ERSA information for landing operations at CBB **[1 mark]**
		• analyses relevant ERSA information for landing operations at QDI **[1 mark]**
		• determines
		  – pressure altitude for CBB **[1 mark]**
		  – density altitude for CBB **[1 mark]**
		  – new runway distance required for QDI and CBB **[1 mark]**
		  – crosswind for CBB and QDI **[1 mark]**
		• correctly determines CBB as the most suitable airfield for diversion **[1 mark]**
		• justifies chosen airfield with data **[1 mark]**

Q	Sample response	The response:
	= 1100 + (3.6 x 30) = 1208 m The runway length of 1106 m is shorter than the landing distance required (1208 m) by 102 m, therefore QDI is not suitable. The crosswind of 15 kts on landing is within the aircraft limitations. Quirindi does have better lighting with taxiway lights for night landing and radio nav aid to assist in the diversion, although a longer landing distance at CBB is more suitable and more appropriate for landing.	
19	The aircraft is taking off, as indicated by the instrument panel. The airspeed is low, which supports a speed at rotation, as all aircraft have a slow speed at take-off. The attitude indicator shows an approximate 7–10° nose up and wings level, consistent with rotation as the nose of the aircraft is raised at take-off. The turn coordinator also shows wings level. The altimeter shows an altitude of 60 ft, again consistent with take-off as the plane is low to the ground. The vertical speed indicator reads a 300 ft per minute rate of ascent, which is a positive rate of climb that all aircraft must achieve after take-off. This also separates it from a landing scenario.	• identifies reasoned data including – ASI shows low airspeed **[1mark]** – VSI shows climb **[1 mark]** – altimeter shows aircraft close to the ground **[1 mark]** • analyses that – the rate of climb is consistent with take-off, as all aircraft must show a positive rate of climb after take-off **[1 mark]** – the airspeed is consistent with take-off, as aircraft are at a slower speed as they take off **[1 mark]** – to take off, the nose of the aircraft is raised, which is shown by the attitude indicator **[1 mark]**

<table>
<tr><th>Q</th><th>Sample response</th><th>The response:</th></tr>
<tr><td>20a)</td><td>
<table>
<tr><th colspan="2">Fuel</th><th>Min</th><th>Litres</th></tr>
<tr><td colspan="2">Climb</td><td></td><td></td></tr>
<tr><td colspan="2">Cruise</td><td>36</td><td>21</td></tr>
<tr><td colspan="2">Alternate</td><td></td><td></td></tr>
<tr><td colspan="2">Sub-total</td><td>36</td><td>21</td></tr>
<tr><td colspan="2">VRB RES (15%)</td><td></td><td></td></tr>
<tr><td colspan="2">Fixed RES (45 min)</td><td>45</td><td>26</td></tr>
<tr><td>Holding</td><td>Inter 30 min</td><td></td><td></td></tr>
<tr><td></td><td>Tempo 60 min</td><td></td><td></td></tr>
<tr><td colspan="2">Taxi</td><td></td><td>3</td></tr>
<tr><td colspan="2">Fuel required</td><td>81</td><td>50</td></tr>
<tr><td colspan="2">Fuel margin</td><td>284</td><td>166</td></tr>
<tr><td colspan="2">Endurance</td><td>365</td><td>216</td></tr>
</table>
</td><td>
• determines
– cruise time to be 36 minutes [1 mark]
– cruise litres to be 21 L [1 mark]
– fixed reserve to be 26 L [1 mark]
– fuel margin in minutes [1 mark]
</td></tr>
<tr><td>20b)</td><td>On landing, the aircraft will have 166 L or 284 mins. For a further one-hour flight, the pilot will have 60 minutes endurance or 35 L. Therefore, a one-hour flight is legally possible.</td><td>• provides a valid judgment supported by data [1 mark]</td></tr>
<tr><td>21</td><td>
The pilot would use the attitude indicator (AI) to level out and confirm level with vertical speed indicator (VSI) and altimeter (ALT).
The pilot would then adjust engine parameters to cruise profile and monitor straight and level flight using the feedback loop below.


This understanding shows that monitoring the AI and maintaining level flight with the help of VSI and ALT can assist a pilot in the case of ASI failure.
</td><td>
• determines
– a valid flight instrument to set level flight [1 mark]
– a second valid flight instrument to set level flight [1 mark]
– engine instruments and attitude parameters to assume safe indicated airspeed (ASI) [1 mark]
• provides
– a valid visual framework/representation or feedback loop sketch [1 mark]
– valid explanation annotations for the visual framework/representation or feedback loop [1 mark]
• evaluates chosen course of action using wording indicative of
– in cases of ASI failure, the AI, VSI and ALT can be monitored to assume a safe indicated airspeed [1 mark]
</td></tr>
</table>

Q	Sample response	The response:
22	For landing: • RWY 17 is the preferred runway for landing between 8 pm to 7 am, as it keeps aircraft flying the low terrain to the north and away from suburban areas to minimise noise. • Both RWY 35 and 30 have flight paths over suburbs, so this would be undesirable from a noise perspective. • RWY 12 would require low flight over the main suburban areas of Canberra. This is highly undesirable from both a noise perspective and also presents safety concerns, as it exposes more suburbia than either of the other options and is therefore the least preferred RWY. For departing: • RWY 35 is preferred for take-off, as the DAP requires a heading of 350°. This ensures aircraft don't fly over the higher ground to the east and west as well as ensuring aircraft do not fly over suburbs in Canberra. • Passing abeam Mt Majura has two purposes. The first is noise avoidance over Canberra by ensuring aircraft are well clear of the suburbs prior to turning. The second reason is safety, as aircraft will have sufficient altitude to clear the mountain and high ground to the east.	• identifies – landing requirements are between 8 pm to 7 am (overnight) **[1 mark]** – RWY 35 and 30 require aircraft to fly overhead sections of suburbia **[1 mark]** • determines – RWY 17 is the most appropriate for landing and RWY 35 is the most appropriate for departing **[1 mark]** • justifies – that RWY 17 is clear of Canberra suburbs **[1 mark]** – that Mt Majura is far enough away to stay clear of terrain **[1 mark]** – that Mt Majura is far enough away from suburbs to minimise noise impact **[1 mark]** – safety factor/danger areas with high ground to the east and south-west **[1 mark]** • evaluates – the relationship between noise abatement and the landing and departure instructions based on criteria **[1 mark]**

References

Question 11

Diagram adapted from *Pilot's Handbook of Aeronautical Knowledge*, 2024, Federal Aviation Administration, Washington DC, www.faa.gov/sites/faa.gov/files/05_phak_ch3_0.pdf.

Question 14

'Spatial Disorientation', CFI Notebook, https://www.cfinotebook.net/notebook/aeromedical-and-humanfactors/spatial-disorientation.

Question 15

Johnston, M 2020, 'Sky Safety: Understanding Crew Resource Management (CRM) In Aviation', California Aeronautical University, https://calaero.edu/aeronautics/aeronautical-decision-making-adm/crew-resource-management-crm.

Question 20

Adapted from CASA 2024, 'Flight planning notepad', Australian Government Civil Aviation Safety Authority, https://shop.casa.gov.au/products/flight-planning-notepad-flight-planning-notepad.