Aerospace Systems marking guide and response

External assessment 2022

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.

Queensland Government
Queensland Curriculum & Assessment Authority
For all Queensland schools

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 EAMG.

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

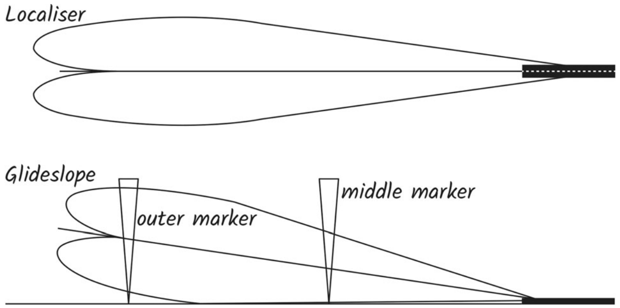
Question	Response
1	D
2	B
3	A
4	B
5	A
6	D
7	C
8	D
9	C
10	B

Short response

Q	Sample response	The response:
11	QNH = 1007 hPa Outside air temperature (OAT) = 24 ℃ Pressure altitude = airfield elevation+(ISA pressure−QNH) × 30 Pa = 21ft + (1013hPa – 1007 hPa) x 30 Pa = 21ft + (6) x 30 Pa = 201ft Density altitude = pressure altitude + [120 × (OAT−ISA Temp)] Da = 201 + [120 x (24℃ - 15 ℃)] Da = 1281 ft	• determines − QNH of 1007 hPa **[1 mark]** − OAT of 24 ℃ **[1 mark]** − pressure altitude **[1 mark]** − density altitude **[1 mark]**
12	1. binocular vision 2. empty field myopia 3. effects of low oxygen 4. illusions 5. perceptions 6. scanning	• provides one vision issue **[1 mark]** • provides a second vision issue **[1 mark]** • provides a third vision issue **[1 mark]** • provides a fourth vision issue **[1 mark]** • provides a fifth vision issue **[1 mark]** • provides a sixth vision issue **[1 mark]**
13	Turbofan engines are preferred for medium- and long-range airliners. Aircraft equipped with turbofan engines attain a higher maximum speed than aircraft equipped with a turboprop engine. Turbofans are also usually more efficient than turbojets at subsonic speeds.	• identifies that turbofan engines are preferred **[1 mark]** • provides one reason why turbofan engines are preferred **[1 mark]** • provides a second reason why turbofan engines are preferred **[1 mark]**

Q	Sample response	The response:
14a)	RWY 04/22 = sealed 1428 metres RWY 14/32 = unsealed (gravel) 829 metres Hazard = bird hazard	• identifies one runway length in metres **[1 mark]** • identifies another runway length in metres **[1 mark]** • identifies a potential hazard **[1 mark]**
14b)	RWY 04/22 is most appropriate as the tyre pressure of the Saab 340 exceeds the tyre pressure limits of RWY 14/32.	• determines RWY 04/22 as the most appropriate runway for landing and take-off **[1 mark]** • provides a reasoned explanation **[1 mark]**
15	Three factors adversely affecting situational awareness in this scenario are: • attention narrowing • stress/high workload • distractions and interruptions. The captain and first officer's decision-making is most likely affected because of stress caused by the critically low fuel in the aircraft due to an unforeseen headwind.	• provides one situational awareness factor **[1 mark]** • provides a second situational awareness factor **[1 mark]** • provides a third situational awareness factor **[1 mark]** • explains how one factor leads to poor decision-making **[1 mark]**

Q	Sample response	The response:

16	
	An instrument landing system (ILS) is a precision runway approach aid, employing two radio beams to provide pilots with vertical and horizontal guidance during the landing approach. The localiser (LOC) provides azimuth guidance, while the glideslope (GS) defines the correct vertical descent profile.
		• provides a sketch of the localiser **[1 mark]**
		• provides a sketch of the glideslope **[1 mark]**
		• explains that
		  – ILS is a precision runway approach aid employing two radio beams **[1 mark]**
		  – the localiser (LOC) provides azimuth guidance **[1 mark]**
		• the glideslope (GS) defines the correct vertical descent profile **[1 mark]**

Q	Sample response	The response:
17a)	**Ground speed** <u>To Uluru</u> Magnetic heading = 229º – 2º = 227º M True course = 233º, Wind = 180/08 (176º M), TAS = 145 kts Ground speed = 140 kts (with 5 kt headwind) <u>From Uluru</u> Magnetic heading = 49º + 3º = 52º M True course = 53º, Wind = 180/08 (176º M), TAS = 14 5kts Ground speed = 150 kts (with 5 kt tailwind) **ETE (using the flight calculator)** *Distance = 181 nm, TAS = 140 kts and TAS = 150 kts* 78 minutes (outbound) + 30mins scenic flight + 73 minutes (inbound) = 181 minutes 181 minutes / 60 = 3.016 3 hours (0.016 x 60) = 3 hours 1 minute	• determines the ground speed to the destination **[1 mark]** • determines the ground speed from the destination **[1 mark]** • determines ETE **[1 mark]**

Q	Sample response	The response:
17b)	A limitation of TCAS is that drones and helicopters may not be equipped with transponders, therefore they would be undetectable. Drones will not be displayed by the TCAS as they are restricted to 400 ft (120 m) and are deemed to be ‘on ground’.	• explains a limitation of TCAS **[1 mark]**
17c)	The risk of mid-air collision is extremely low, given the Cessna (fixed-wing aircraft) will operate at 4500 ft and helicopters are expected to maintain a flight altitude of 3500 ft with drones operating below 400 ft as determined by the chart information and drone law.	• determines there is a low risk of mid-air collision during the scenic flight **[1 mark]** • provides an example to support the decision **[1 mark]**

Q	Sample response	The response:
18	The dusty conditions caused the flight instruments to malfunction. The pitot tube and drain hole appear to be obstructed with a clear static system. The ASI remained constant at 145 kts until the pilot completed a controlled descent and climb manouevre. During the climb, static pressure decreases, allowing the diaphragm that is trapped in the pitot system to expand. This causes the indicator to overread. During the descent, static pressure increases, allowing the diaphragm that is trapped in the pitot system to compress. This causes the indicator to underread.	• determines the cause of the problem **[1 mark]** • analyses the problem and conveys that the – pitot tube is obstructed with clear static system **[1 mark]** – ASI instrument remains constant at 145 kts **[1 mark]** – static pressure would decrease against the diaphragm, causing it to expand during a climb and increasing the ASI reading **[1 mark]** – static pressure would increase against the diaphragm, causing it to compress during a descent and decreasing the ASI reading **[1 mark]**

Q	Sample response	The response:

19a)

Sample response

NAV/COMM LOG											
	LSALT	ALT	TAS	TR (m)	WIND	HDG	G/S	DIST	ETI	EET	PLN EST
YWLG											
YBKE	1536	A075	125	261	320°/20	269	115	113	59	59	0029

Fuel	Min	Litres
Climb		
Cruise	59	40
Alternate		
Sub-total	59	40
*VRB RES (15%)		
*Fixed RES (45 min)	45	30

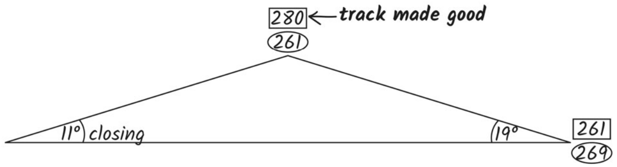
Fuel		Min	Litres
Holding	Inter 30 min		
	Tempo 60 min		
Taxi			14
Fuel required		104	84
Fuel margin		9	6
Endurance		113	90

Track error

After 42 nm – 13 nm off track
71 nm – 13 nm off track
113 nm

19° ← **track error**
11°
30°

The pilot needs to turn left 30°, and the new HDG to YBKE is 239°M ← **new HDG**



The response:

- determines:
  - fuel log **[1 mark]**
  - track error of 19° **[1 mark]**
  - track made good of 280° M **[1 mark]**
  - closing angle of 11° **[1 mark]**
  - new heading to YBKE of 239° M **[1 mark]**

19b)

Sample response

Analysis of the information points to the pilot suffering dehydration, which affected their decision-making ability. The cockpit was hot, and the pilot had a coffee between flights, which is a diuretic.

The causal loop further supports the dehydration assumption as the pilot has already been flying for an extended period at altitude and may have encountered an unplanned weather event, given the ground speed was slower than originally planned.

In conclusion, the pilot's decision to continue to YBKE is unsound due to fatigue caused by dehydration. This affected their ability to determine that there was not enough fuel to continue to YBKE and be within the 45 min fixed fuel reserve regulations.

The response:

- evaluates that the decision was unsound, using the reasoning that
  - there isn't enough fuel to continue to YBKE and be within the 45 min fixed fuel reserve regulations **[1 mark]**
  - the pilot's decision-making was affected by dehydration **[1 mark]**
- supports the decision with data **[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="10">NAV/COMM LOG</th></tr>
<tr><th></th><th>LSALT</th><th>ALT</th><th>TAS</th><th>TR (m)</th><th>WIND</th><th>HDG</th><th>G/S</th><th>DIST</th><th>ETI</th></tr>
<tr><td>Hobart (HBA)</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Triabunna (TNA)</td><td></td><td>A095</td><td>150 kt</td><td>027</td><td>215/14</td><td>026</td><td>164</td><td>26</td><td>10</td></tr>
<tr><td>Buxton Point (BP)</td><td></td><td>A095</td><td>150 kt</td><td>300</td><td>215/14</td><td>000</td><td>162</td><td>16</td><td>6</td></tr>
</table>
</td><td>• determines:
– ALT [1 mark]
– heading (HDG) [1 mark]
– ground speed (GS) [1 mark]
– estimated time interval (ETI) [1 mark]</td></tr>
<tr><td>20b)</td><td>The pilot will depart 7500’ & 9500’ controlled airspace at 9.5 nm NE Triabunna.</td><td>• provides where aircraft departs controlled airspace [1 mark]</td></tr>
</table>

<table>
<tr><th>Q</th><th>Sample response</th><th>The response:</th></tr>
<tr><td>21</td><td>The ATCO is most likely experiencing the following situational awareness factors:
• stress and workload
• physiological factors
• system design.
The controller’s environment is extremely stressful with a high workload, which can affect the ability to process information.
Physiological factors such as illness and medication can have a drastic effect on information processing, and therefore the controller’s situational awareness.
System design could also be a contributing factor. If the information ergonomics are not presented in a user-friendly way, the controllers situation awareness will suffer.
The risk could have been mitigated if the controller:
• monitored their health, wellbeing and stress
ensured the system design was user-friendly with good ergonomics.</td><td>• identifies three situational awareness factors [1 mark]
• explains
– one situational awareness factor [1 mark]
– a second situational awareness factor [1 mark]
– a third situational awareness factor [1 mark]
• provides one example of how the risk in the scenario could have been mitigated [1 mark]
• provides a second example of how the risk in the scenario could have been mitigated [1 mark]</td></tr>
</table>

Q	Sample response	The response:
22a)	Medications and altitude hypoxia are two variables that will increase a pilot's BAC level	• determines one variable [1 mark] • determines a second variable [1 mark]
22b)	The brain is a crucial organ and alcohol can impair reaction time, reasoning, judgment and memory loss. It can also decrease the ability of the brain to use oxygen, which can be magnified by altitude. Alcohol causes eye muscle imbalance, leading to double vision and focus difficulties. Finally, alcohol is absorbed into the fluid of the inner ear and stays there after it has been eliminated from the blood, brain and body tissues. It can lead to dizziness, disorientation, vertigo and decreased hearing perception.	• identifies three crucial organs and explains the impact of alcohol on – the brain **[1 mark]** – the eyes **[1 mark]** – the inner ear **[1 mark]**

Q	Sample response	The response:
23	The scenario suggests that the pilot’s loss of situational awareness was likely caused by several factors which lead to the runway excursion. Situational awareness involves an accurate understanding of what is going on around you, and what is likely to happen next. The pilot’s situational awareness was comprised due to the stress of carrying passengers with what was possibly excess luggage, further compounded by the increased workload in transporting four passengers. Another possible factor is that the pilot was young and inexperienced with unexpected weather changes. Crew resource management is important as the pilot didn’t communicate information clearly and concisely to passengers. The pilot also did not show any leadership skills, as they failed to plan and prioritise their workload. The environment also played a part as the pilot did not use all resources available.	• draws a conclusion about the circumstances that led to the runway excursion **[1 mark]** • provides a definition for situational awareness **[1 mark]** • explains one contributing factor affecting situational awareness **[1 mark]** • explains a second contributing factor affecting situational awareness **[1 mark]** • explains a third contributing factor affecting situational awareness **[1 mark]** • analyses CRM, using the reasoning that the pilot’s CRM was not effective for – communication **[1 mark]** – leadership **[1 mark]** – environment **[1 mark]**