# Aerospace Systems marking guide

External assessment

## 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

# Purpose

This document is an External assessment marking guide (EAMG).

The EAMG:

  - 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.

# 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.

*Allow FT mark(s)* – 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 still be awarded so long as it still demonstrates the correct conceptual understanding or skill in the rest of the response.

# External assessment marking guide

## Multiple choice

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

## Short response (70 marks)

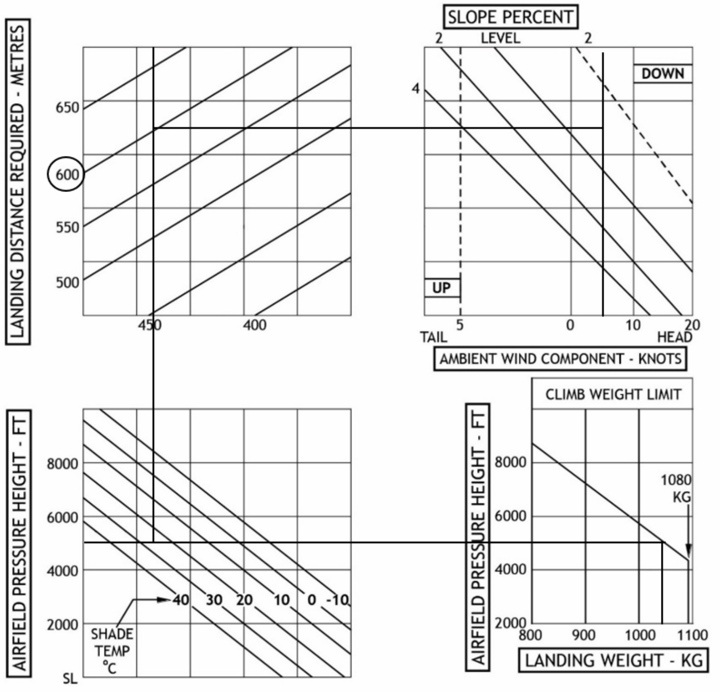
| Q | Sample response | The response: |
|---|---|---|
| 11 | 1. altitude<br>2. attitude<br>3. heading<br>4. vertical speed<br>5. direction of turn<br>6. rate of turn | • provides 6 types of information **[6 marks]**<br>**OR**<br>• provides 5 types of information **[5 marks]**<br>**OR**<br>• provides 4 types of information **[4 marks]**<br>**OR**<br>• provides 3 types of information **[3 marks]**<br>**OR**<br>• provides 2 types of information **[2 marks]**<br>**OR**<br>• provides 1 type of information **[1 mark]** |
| 12 | 1. constant radio communication noise<br>2. poor lighting<br>3. loud engine noise<br>4. aircraft vibration<br>5. high cabin temperature | • provides 5 causes **[5 marks]**<br>**OR**<br>• provides 4 causes **[4 marks]**<br>**OR**<br>• provides 3 causes **[3 marks]**<br>**OR**<br>• provides 2 causes **[2 marks]**<br>**OR**<br>• provides 1 cause **[1 mark]** |

| Q | Sample response | The response: |
|---|---|---|
| 13 | The vestibular system consists of three fluid-filled semicircular canals with fine hairs at their base. The interaction between the hairs and the fluid provides the brain with a sensation of movement. | • explains using wording indicative of<br>- three fluid-filled canals **[1 mark]**<br>- fine hairs **[1 mark]**<br>- interaction between hairs and fluid **[1 mark]**<br>• provides vestibular system purpose as 'a sensation of movement' **[1 mark]** |
| 14 | Hyperventilation is the abnormally fast rate of breathing that leads to a loss of carbon dioxide from the blood. Hypoxia is caused by a lack of oxygen supply to body tissue and organs. When flying at high altitudes, a reduction in cabin pressure causes the cabin oxygen to be less available to the body, which leads to more rapid breathing. | • provides a definition for hyperventilation **[1 mark]**<br>• provides a definition for hypoxia **[1 mark]**<br>• provides an aerospace context **[1 mark]**<br>• provides a relationship between hypoxia and hyperventilation **[1 mark]** |

| Q | Sample response | The response: |
|---|---|---|
| 15 | Primary surveillance radar (PSR) operates using a device that transmits radio waves in pulses as the antenna rotates about its axis. It measures the time interval between transmission and reception of the pulse after contact with an object to determine aircraft range.<br>PSR also determines aircraft elevation using the angle of the returning beam. Additionally, the direction of the aircraft is determined by the position of the rotating antenna after reception of the reflected radio wave. | • explains using wording indicative of<br>- a device that transmits radio waves using a rotating antenna **[1 mark]**<br>- a device that measures the time interval between sent and returning radar pulses **[1 mark]**<br>• determines aircraft<br>- range **[1 mark]**<br>- elevation **[1 mark]**<br>- direction **[1 mark]** |
| 16 | Vb is defined as the turbulence penetration speed of an aircraft. Aircraft are flown at or below this speed in rough or turbulent air. This reduces the amount of load experienced by the aircraft structure during vertical wind gusts. These gusts can increase the aircraft's attack angle, causing a high-speed stall. | • defines using wording indicative of turbulence penetration speed **[1 mark]**<br>• explains using wording indicative of<br>- flown at or below this speed in turbulent air **[1 mark]**<br>- reduce aircraft load factor **[1 mark]**<br>- vertical wind gusts increase the angle of attack **[1 mark]**<br>- high-speed stall **[1 mark]** |
| 17 | A HUD improves safety by providing the pilot with key flight information in the line of their external forward vision, which limits distractions. However, it also has the potential to totally capture the pilot's attention and cause other important sources of flight information to be overlooked. Additionally, the HUD partially obscures the pilot's view of the environment outside the aircraft. This is particularly important for maintaining separation from ground-based obstacles or other aircraft during low-visibility circumstances. The growth in use of HUDs would indicate that their strengths as an aerospace technology outweigh any potential limitations, which results in improved aircraft safety. | • provides a HUD strength **[1 mark]**<br>• provides another HUD strength **[1 mark]**<br>• provides a HUD limitation **[1 mark]**<br>• provides another HUD limitation **[1 mark]**<br>• provides a judgment concerning HUD strengths and limitations for aircraft safety **[1 mark]** |

| Q | Sample response | The response: |
|---|---|---|
| 18 | The flight will pass through GAF areas A, B and C. The best time to depart would be after 03Z as the cloud base in B and C will be lifting from 3000 ft to 5000 ft after 03Z. Before 03Z, the cloud base in C is 3000 ft and the cloud base in B south of YDON/YPKG is 3000 ft. Cloud in the rest of area B is broken stratus at 1500 ft until 01Z. An appropriate height would be below 5000 ft. As the track is slightly west, 4500 ft would be preferred. | • provides a flight area through A, B and C **[1 mark]**<br>• identifies cloud base lift from 3000 ft to 5000 ft **[1 mark]**<br>• identifies correct cloud formation of broken stratus **[1 mark]**<br>• provides departure time as after 03Z **[1 mark]**<br>• provides altitude of 4500 ft for the flight **[1 mark]** |
| 19 | Communication between ATC and pilots requires that ATC transmit a message to the pilot. The pilot reads back the message to ATC. ATC then acknowledges or corrects the message as required. Within the feedback loop it is important that the language used is understood. The effectiveness of the feedback loop can be evaluated through its ability to manage the meaning of words or native language influences.<br>Communication in these circumstances will be effective as long as ATC and pilots are aware of any areas for potential misunderstanding and seek clarification to remove the possibility for communication errors.<br>Many words have more than one meaning in English, which can cause radio communication errors with flight crews. An example would be the number ‘two’ and word ‘to’. In fast-paced communication, these words may be misunderstood. | • correctly analyses the feedback loop using wording indicative of<br>- message read back by pilot **[1 mark]**<br>- ATC acknowledges or corrects pilot read-back **[1 mark]**<br>• provides evaluation criteria **[1 mark]**<br>• evaluates using wording indicative of<br>- seeks clarification **[1 mark]**<br>- areas for potential misunderstanding **[1 mark]**<br>• provides an example **[1 mark]**<br>• provides another example **[1 mark]** |
| 20 | Both alternative airports have passenger facilities available to support an overnight stay, including accommodation, public telephone, toilets and refreshments. Taxi or car hire is available at Shepparton. Both airports have the same runway and taxiway lighting, but Shepparton has PAPI approach guidance. Shepparton’s runway is 500 ft longer. | • identifies PAPI at Shepparton for landing support in fading light **[1 mark]**<br>• identifies 4 passenger facilities correctly **[1 mark]**<br>• identifies availability of fuel **[1 mark]** |

| Q | Sample response | The response: |
|---|---|---|
| | Shepparton’s handling facilities operate from 8 am to 5 pm daily, and after hours with prior notice. Avgas is available at both airports; however, only Tocumwal has carnet card and credit card payment available.<br>Shepparton is the better airport because of the better approach lighting, the longer runway and access to accommodation. The wait for fuel will not be an issue due to the overnight stay. | • identifies Shepparton as the preferred airport **[1 mark]**<br>• identifies that carnet card and credit cards can be used to purchase fuel at Tocumwal **[1 mark]** |
| 21 | There are two types of windscreen anti-icing systems.<br>The first directs a flow of chemical on to the windscreen surface, which prevents ice build-up and removes ice from the windscreen surface. The rate and duration of flow of the chemical is controlled from the aircraft cockpit according to aircraft specifications.<br>The second method is to heat the windscreen using an embedded system of fine wires or other conductive material. An electrical current is actuated from the cockpit control panel. The current can be adjusted to heat the windscreen to prevent the formation of ice or to melt any existing ice. | • provides an anti-icing system **[1 mark]**<br>• provides another anti-icing system **[1 mark]**<br>• explains the operation of one identified anti-icing system **[1 mark]**<br>• explains the operation of the other identified anti-icing system **[1 mark]** |

| Q | Sample response | The response: |
|---|---|---|
| 22 | $\mathrm{PA} = \mathrm{Elev} + (1013 - \mathrm{QNH}) \times 30$<br>$= 4490 + (1013 - 996) \times 30$<br>$= 4490 + (17 \times 30)$<br>$= 5000\ \mathrm{ft}$<br>The aircraft can land at the aerodrome with the 5 kt headwind and 1% slope down as the required landing distance is 600 m and the distance available is 620 m. The aircraft is also not weight limited at this aerodrome due to pressure height. The landing weight of 1000 kg is under the climb weight limit of 1050 kg.<br> | • identifies headwind on the chart **[1 mark]**<br>• identifies runway slope on the chart **[1 mark]**<br>• provides working to give a correct pressure altitude of 5000 ft **[1 mark]**<br>• provides an annotated landing chart to determine<br>  - a correct runway distance of 600 m **[1 mark]**<br>  - climb weight limit of 1050 kg **[1 mark]**<br>• provides a decision that the aircraft can land with a 5 kt headwind on the 1% downward sloping runway **[1 mark]** |

<table>
<tr><th>Q</th><th>Sample response</th><th>The response:</th></tr>
<tr>
<td>23</td>
<td>
Bendigo to Warracknabeal: 11° E var; TAS 90 kt
<table>
<tr><th>Trk (°T)</th><th>Trk (°M)</th><th>TAS</th><th>Wind</th><th>HDG</th><th>GS</th><th>Dist.</th><th>ETI</th></tr>
<tr><td>284</td><td>273</td><td>090</td><td>090(M)/35</td><td>274</td><td>125</td><td>106</td><td>51</td></tr>
</table>
10 min from Warracknabeal diversion required. Flown 86 nm from Bendigo or 20 nm to Warracknabeal.<br>
Original fuel burn = 40 L/hr
<table>
<tr><th></th><th>Time (min)</th><th>Fuel (L)</th></tr>
<tr><td>Flight time</td><td>51</td><td>34</td></tr>
<tr><td>Fixed reserve</td><td>15</td><td>10</td></tr>
<tr><td>Taxi</td><td></td><td>5</td></tr>
<tr><td>Total</td><td>66</td><td>49</td></tr>
</table>
Flown for 41 min before diversion.<br>
41 min = 27 L of fuel used; therefore, 17 L onboard for the diversion, assuming that 5 L fuel is used for taxi at Bendigo airport before take-off and is needed at destination airport.<br>
<b>Divert to St Arnaud</b>
<table>
<tr><th>Trk (ºT)</th><th>Trk (ºM)</th><th>TAS</th><th>Wind</th><th>HDG</th><th>GS</th><th>Dist.</th><th>ETI</th></tr>
<tr><td>121</td><td>110</td><td>090</td><td>090(M)/35</td><td>151</td><td>93</td><td>38</td><td>25</td></tr>
</table>
Fuel required at 25 min = 17 L<br>
<b>Divert to Stawell</b>
<table>
<tr><th>Trk (ºT)</th><th>Trk (ºM)</th><th>TAS</th><th>Wind</th><th>HDG</th><th>GS</th><th>Dist.</th><th>ETI</th></tr>
<tr><td>185</td><td>174</td><td>090</td><td>090(M)/35</td><td>151</td><td>093</td><td>38</td><td>25</td></tr>
</table>
Fuel required at 25 min = 17 L
</td>
<td>
<ul>
<li>provides a Bendigo to Warracknabeal ETI <b>[1 mark]</b></li>
<li>provides fuel total onboard at take-off (49 L) <b>[1 mark]</b></li>
<li>provides fuel available for diversion (17 L) <b>[1 mark]</b></li>
<li>provides diversion distances <b>[1 mark]</b></li>
<li>provides fuel required for diversions <b>[1 mark]</b></li>
<li>provides headings for diversions <b>[1 mark]</b></li>
<li>provides a pilot action determined through use of data <b>[1 mark]</b></li>
<li>provides an ETI to Horsham <b>[1 mark]</b></li>
<li>provides fuel quantity onboard on landing at Horsham <b>[1 mark]</b></li>
</ul>
</td>
</tr>
</table>

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

**Divert to Horsham**

| Trk (ºT) | Trk (ºM) | TAS | Wind | HDG | GS | Dist. | ETI |
|---|---|---|---|---|---|---|---|
| 246 | 235 | 090 | 090(M)/35 | 225 | 123 | 36 | 18 |

Fuel required at 18 min = 12 L

The pilot should divert to Horsham as the available fuel of 12 L will allow the aircraft to safely arrive with fuel to spare if a wind shift occurs. The heading required to track to Horsham from the diversion point is 235° M, ETI 18 mins with 5 L of fuel left onboard after landing, not including taxi fuel.

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</table>