



# **AVIATION**

## **ATAR course examination 2020**

### **Marking key**

Marking keys are an explicit statement about what the examining panel expect of candidates when they respond to particular examination items. They help ensure a consistent interpretation of the criteria that guide the awarding of marks.

## Section One: Multiple-choice

20% (20 Marks)

Question	Answer
1	c
2	a
3	b
4	d
5	c
6	d
7	b
8	a
9	a
10	d
11	c
12	b
13	a
14	b
15	c
16	b
17	d
18	a
19	a
20	d

Section Two: Short answer

80% (124 Marks)

Question 21

(2 marks)

Given the following data:

- airfield elevation 715 ft
- QNH 1025 hPa
- OAT 27 °C,

calculate airfield pressure height. Show **all** workings.

Description	Marks
(ISA QNH – Actual QNH) x 30 ft + elevation	
(1013 – 1025) x 30 ft + elevation 715 ft	1
-360 + 715 ft = 355 ft	
355 ft	1
<b>Total</b>	<b>2</b>
Showed above working but mathematical error 1 mark.	

Question 22

(2 marks)

Given the following data:

- airfield pressure height 1500 ft
- QNH 1016 hPa
- OAT 16 °C,

calculate airfield density altitude. Show **all** workings.

Description	Marks
(ISA temperature deviation x 120 ft) + PA = DA	
(16 °C – 12 °C) x 120 ft + PA 1500 ft = DA	1
4 °C x 120 ft + PA 1500 ft = DA	
480 ft + 1500 ft = 1980 ft	1
<b>Total</b>	<b>2</b>
Showed above working but mathematical error 1 mark.	

Question 23

(3 marks)

Colour blindness can cause problems for pilots as a result of their inability to determine particular colours. List **three** instances of such problems.

Description	Marks
Any <b>three</b> of the following (1 mark each)	
<ul style="list-style-type: none"> <li>• light gun signals</li> <li>• aircraft navigation lights</li> <li>• airport beacon</li> <li>• approach/slope indicators</li> <li>• aircraft lights</li> <li>• cockpit lights</li> <li>• chart symbols</li> <li>• aircraft controls.</li> </ul>	1–3
<b>Total</b>	<b>3</b>
Accept other relevant answers.	

**Question 24**

**(4 marks)**

A pilot has a required flight track of 040° T and is flying at a true airspeed (TAS) of 155 kt. The aircraft is experiencing a wind of 080° T/22 kt. Using a flight computer, complete the following table.

Description				Marks
1 mark per correct response listed below				
Drift Angle	Direction of drift	Required heading	Groundspeed	1–4
5°	Left	045° (True)	139 ± 2 kt	
<b>Total</b>				<b>4</b>

**Question 25**

**(2 marks)**

Given an exact time of 1429 Local Mean Time (LMT) and a position of 20° 45' S 125° 25' E, use the Conversion of Arc to Time chart on the next page to convert the LMT to the Coordinated Universal Time (UTC), correct to the nearest second.

Description	Marks
calculates conversion 8 hours 21 minutes 40 seconds	1
0607 20 seconds UTC	1
<b>Total</b>	<b>2</b>
If incorrect conversion achieved in step one but process correctly applied, then award mark for following step.	

**Question 26**

**(5 marks)**

An aircraft is flying within coverage of the Automated Dependent Surveillance Broadcast (ADS-B), primary and secondary surveillance radars. Describe how the aircraft interacts with each form of radar for Air Traffic Control (ATC) to identify the aircraft's position.

- (a) ADSB (1 mark)

Description	Marks
aircraft transmits position to ATC ground station	1
<b>Total</b>	<b>1</b>

- (b) primary surveillance radar (2 marks)

Description	Marks
The radar sends a pulse/signal/radio wave	1
The pulses bounce off the aircraft surface and return to the radar unit	1
<b>Total</b>	<b>2</b>

- (c) secondary surveillance radar (2 marks)

Description	Marks
The radar transmits a signal which the transponder receives	1
The transponder sends aircraft information to the radar unit	1
<b>Total</b>	<b>2</b>

## Question 27

(3 marks)

An aircraft designer wants to develop the most laterally-stable aircraft possible. Name **three** features that would need to be included in the design.

Description	Marks
high wing	1
dihedral	1
sweptback wings	1
<b>Total</b>	<b>3</b>
Accept other relevant answers.	

## Question 28

(2 marks)

Unconventional control surfaces can be designed for multiple purposes on aircraft. Stabilators are common on high-performance aircraft to assist with controllability. Describe the purpose and operation of stabilators on an aircraft.

Description	Marks
acts as a horizontal stabiliser and elevator	1
whole surface moves to achieve control actions	1
<b>Total</b>	<b>2</b>
Accept other relevant answers.	

## Question 29

(4 marks)

Data from the Australian Transport Safety Bureau indicate that, in 2017, the most common form of accident or serious incident in general aviation was terrain collision. Identify **two** possible reasons for terrain collision and state why each is specific to general aviation.

Description	Marks
For any <b>two</b> reasons (2 marks each) 1 mark per reason and 1 mark for why it is specific to general aviation	
pilot distraction due to limited experience or training	1–2
pilot disorientation due to limited experience or training or workload	1–2
aircraft malfunction due to lower airworthy standards	1–2
reduced visibility due to limited experience/training/aircraft capabilities	1–2
<b>Total</b>	<b>4</b>
Accept other relevant answers.	

Question 30

(7 marks)

- (a) What do the initials 'NSW' stand for? (1 mark)

Description	Marks
nil significant weather	1
<b>Total</b>	<b>1</b>

- (b) Use the meteorological information above to determine each of the following:

- (i) forecast QNH at 1800Z on the 27th (1 mark)

Description	Marks
1007 hPa	1
<b>Total</b>	<b>1</b>

- (ii) dewpoint temperature at 1200Z (1 mark)

Description	Marks
18 °C	1
<b>Total</b>	<b>1</b>

- (iii) actual wind at 1200Z (1 mark)

Description	Marks
090° (True) 27 kt gusting 39 kt	1
<b>Total</b>	<b>1</b>

- (iv) when drizzle is forecast and for how long (2 marks)

Description	Marks
between 1600 and 1800 on the 28th	1
periods of up to 1 hour	1
<b>Total</b>	<b>2</b>

- (v) period of validity of the TAF. (1 mark)

Description	Marks
1200Z on the 27th to 1800Z on the 28th (30 hours)	1
<b>Total</b>	<b>1</b>

Question 31

(2 marks)

A pilot is flying from A to B in a twin-engined aircraft (not centreline thrust). The right engine suffers complete power loss, requiring the pilot to apply left rudder force. The pilot decides to use the rudder trim to reduce the excess rudder pedal force. Draw a diagram to demonstrate the operation of a moveable rudder trim tab in this scenario.

Description	Marks
shows rudder deflected to the left of the aircraft	1
shows trim tab in the opposite direction to the rudder	1
<b>Total</b>	<b>2</b>

The diagram shows a top-down view of the tail section of an aircraft. The vertical stabilizer (rudder) is shown deflected to the left. A smaller, moveable trim tab is attached to the bottom of the rudder and is deflected to the right. A text label with an arrow pointing to the trim tab reads: "Tab deflected right forces rudder to left".

Question 32

(4 marks)

- (a) Describe the sensations likely to be perceived by this pilot in Instrument Meteorological Conditions (IMC), immediately before and after the correction. (2 marks)

Description	Marks
initial sense of flying straight when aircraft is banked to the right	1
sense of a turn to the left when aircraft is returned to straight and level	1
<b>Total</b>	<b>2</b>
Accept other relevant answers.	

- (b) How would the sensations be different from those in part (a) for the pilot in Visual Meteorological Conditions (VMC)? (2 marks)

Description	Marks
the pilot has a visual reference to the horizon	1
vision would counteract the illusion of turning when the aircraft is not actually turning after establishing straight and level flight	1
<b>Total</b>	<b>2</b>
Accept other relevant answers or answers which are correct based on part (a).	

**Question 33**

**(2 marks)**

Using a flight computer, determine each of the following.

- (a) If an aircraft is travelling at 147 kt, how many minutes will it take to travel 500 nm? (1 mark)

Description	Marks
204 minutes ±1	1
<b>Total</b>	<b>1</b>

- (b) If an aircraft uses 38 litres per hour and has total usable fuel of 140 litres, how long will it be before it runs out of fuel? (1 mark)

Description	Marks
221 minutes ±1	1
<b>Total</b>	<b>1</b>

**Question 34**

**(4 marks)**

- (a) How is carbon monoxide poisoning most likely to occur in a light aircraft? (1 mark)

Description	Marks
defective heating system	1
<b>Total</b>	<b>1</b>
Accept other relevant answers.	

- (b) Identify **three** symptoms of carbon monoxide poisoning you would observe in the pilot at different stages. (3 marks)

Description	Marks
poor decision making, anxiety, dizziness, nausea or headaches	1
breathing discomfort, confusion, migraine, drowsiness or cherry coloured skin	1
loss of consciousness or death	1
<b>Total</b>	<b>3</b>
Accept other relevant answers.	

**Question 35**

**(2 marks)**

Use the chart on the next page to calculate the End of Daylight time (LMT) on 17 January for the position 20° 45' S 125° 25' E. Show **all** workings.

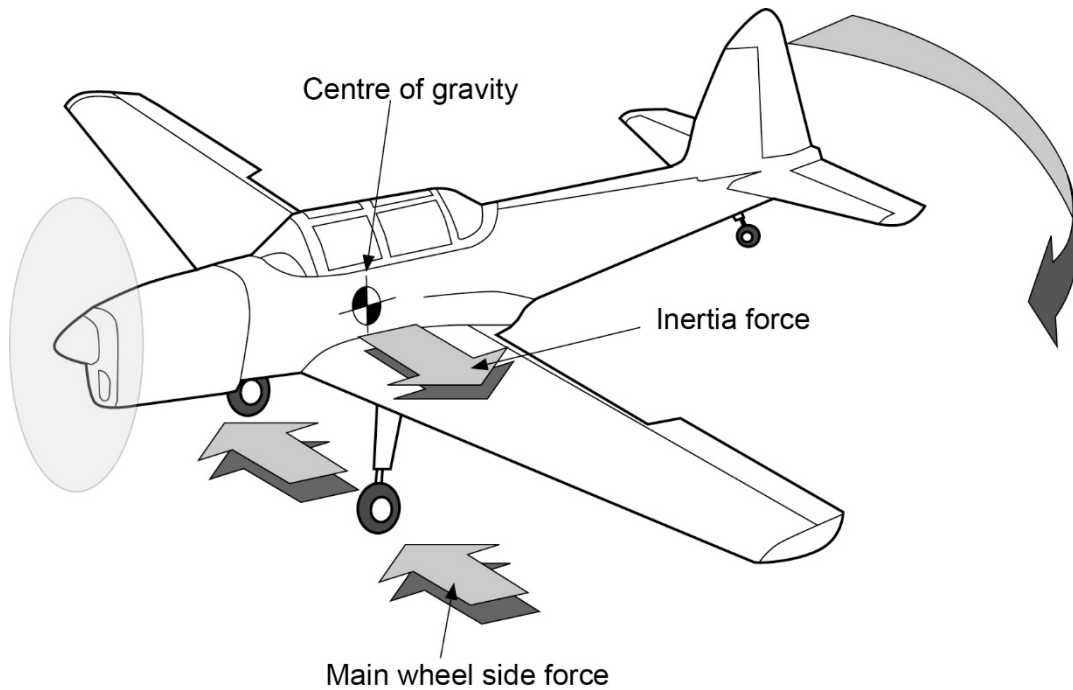
Description	Marks
calculates End of Daylight 1912 ±2	1
shows working on chart with minimal errors	1
<b>Total</b>	<b>2</b>



Question 36

(4 marks)

Tailwheel aircraft tend to loop in certain circumstances when operating on the ground. With the aid of the diagram below, explain the phenomenon of ground loop for an aircraft landing with a strong wind from its starboard side.



Description	Marks
side force from main wheels towards the starboard side and/or wind shown from the starboard side	1
centre of gravity behind the main wheels	1
inertia force from the centre of gravity opposite direction to the main wheel force	1
overall moment of the tail travelling in direction of the force generated from near the centre of gravity	1
<b>Total</b>	<b>4</b>

Question 37

(3 marks)

Antihistamines are commonly used to control a variety of conditions, including allergic reactions. State **three** possible negative effects of using antihistamines for a pilot.

Description	Marks
drowsiness	1
degraded coordination	1
degraded sense of balance	1
<b>Total</b>	<b>3</b>
Accept other relevant answers.	

**Question 38**

**(2 marks)**

A Piper Cherokee is conducting a 60° angle of bank turn. Steep turns can have a significant effect on aircraft performance, so it is important to know the extent of this effect. Calculate the load factor and the increase in stall speed of the aircraft.

Description	Marks
2(G)	1
stall speed increases by 41% (or equivalent wording)	1
<b>Total</b>	<b>2</b>

**Question 39**

**(2 marks)**

An aircraft is being flown to become established on the Instrument Landing System (ILS). Explain the frequency bands received from the ILS ground antennae and their role as part of this system.

Description	Marks
VHF signal sent for horizontal guidance	1
UHF signal sent for glide path	1
<b>Total</b>	<b>2</b>
Accept other relevant answers.	

**Question 40**

**(3 marks)**

Superchargers are used to increase the performance of piston engines at higher altitudes. Explain the operation of a supercharger on a piston engine.

Description	Marks
engine driven compressor	1
compressor raises the air pressure above atmospheric pressure	1
air is directed to inlet manifold under higher pressure	1
<b>Total</b>	<b>3</b>
Accept other relevant answers.	

## Question 41

(11 marks)

- (a) Determine the minimum take-off distance required at Alpha. Show **all** workings clearly on the appropriate chart(s). (2 marks)

Description	Marks
920 metres $\pm 30$	2
(Shows working on chart and slight error made in working)	1
<b>Total</b>	<b>2</b>

- (b) Determine climb, cruise and descent data to complete the table below to find the total:
- flight time
  - flight fuel required (excluding reserves, taxi and unusable fuel).

Ignore all winds in the climb and descent. Show **all** workings clearly on the appropriate chart(s). (9 marks)

Description					Marks
One mark for each correct answer in the climb, cruise and descent columns only					
	Climb	Cruise	Descent	Total	
Fuel (gal)	4 $\pm 1$	39 $\pm 1$	1 $\pm 0.5$	44	1–3
Time (min)	7 $\pm 1$	170 $\pm 3$	3 $\pm 0.5$	180	1–3
Distance (nm)	13 $\pm 1$	410 $\pm 3$	7 $\pm 0.5$	430 nm	1–3
				<b>Total</b>	<b>9</b>

Question 42

(8 marks)

(a) Identify the correct meaning of the following symbols on a synoptic chart.

(i)  (1 mark)

Description	Marks
(low pressure) trough	1
<b>Total</b>	<b>1</b>

(ii)  (1 mark)

Description	Marks
warm front	1
<b>Total</b>	<b>1</b>

(b) Assume that southern Australia is experiencing typical weather patterns.

(i) State the direction of weather flow. (1 mark)

Description	Marks
easterly	1
<b>Total</b>	<b>1</b>

(ii) Identify the pressure systems. (1 mark)

Description	Marks
high pressure systems	1
<b>Total</b>	<b>1</b>

(iii) Describe the prevailing winds. (2 marks)

Description	Marks
south easterly	1
progressing through easterly/north easterly	1
<b>Total</b>	<b>2</b>

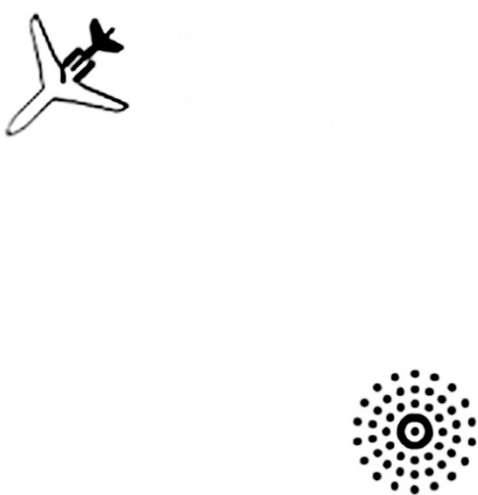
(iv) Describe the visibility. (2 marks)

Description	Marks
normally greater than 10 km	1
except for instances of dust storm or smoke due to bushfires	1
<b>Total</b>	<b>2</b>

Question 43

(2 marks)

An aircraft is established on a bearing of 315° from the NDB on a heading of 225°. Draw a diagram showing the correct positioning of the aircraft relative to the NDB and the aircraft's tracking.

Description	Marks
shows correct positioning relative NDB	1
shows correct aircraft heading	1
<b>Total</b>	<b>2</b>
	
Accept other relevant answers.	

Question 44

(6 marks)

Visual illusions can cause significant problems for pilots. For each of the following illusions, state their cause and effect and identify a way in which they can be managed.

(a) Autokinesis

(3 marks)

Description	Marks
cause – pilot fixates on distant light where there are no other visual cues	1
effect – light will appear to move randomly	1
management – use peripheral vision instead of looking directly	1
<b>Total</b>	<b>3</b>
Accept other relevant answers.	

(b) Flicker vertigo

(3 marks)

Description	Marks
cause – flickering light source	1
effect – dizziness, nausea, unconsciousness or similar to fit	1
management – reducing flickering light, ensuring back of propeller is black, changing propeller RPM	1
<b>Total</b>	<b>3</b>
Accept other relevant answers.	

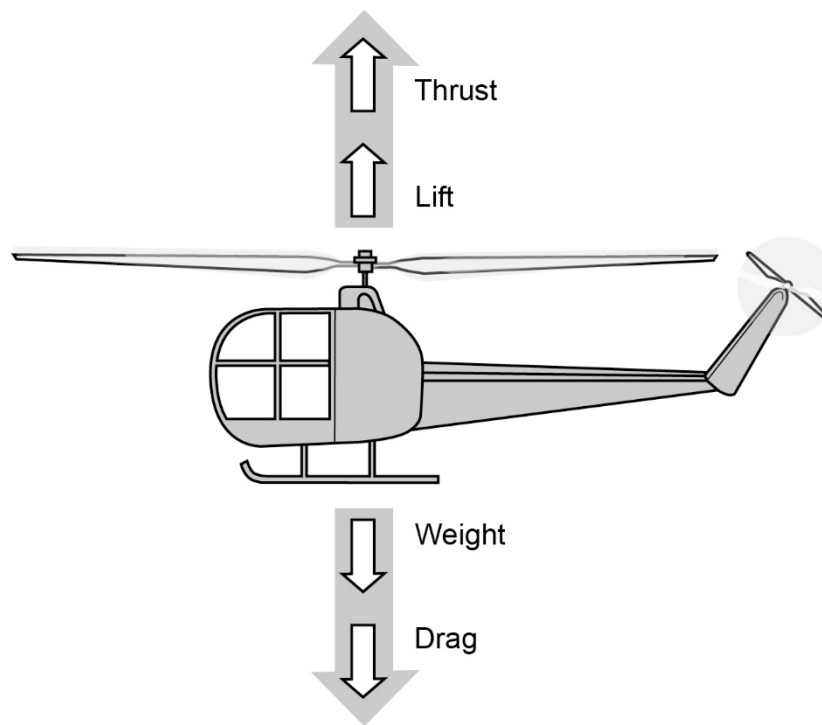
Question 45

(10 marks)

- (a) Helicopters have more complex systems of primary controls than fixed-wing aircraft. State the **three** controls used by helicopter pilots and what each controls. (6 marks)

Description	Marks
For each of <b>three</b> controls (2 marks each) 1 mark per control and 1 mark for what they control	
cyclic controls – helicopter’s direction of movement	1–2
collective controls – pitch angle of the main rotor blades (or climb and descend)	1–2
anti-torque pedals – control the direction of the helicopter nose (or yaw)	1–2
<b>Total</b>	<b>6</b>
Accept other relevant answers.	

- (b) Use the diagram below to illustrate the four forces acting on a helicopter during a vertical descent. (4 marks)



Description	Marks
thrust vertically up	1
weight vertically down	1
lift vertically up	1
drag vertically down	1
<b>Total</b>	<b>4</b>

## Question 46

(4 marks)

A VASIS is a visual aid that helps a pilot to maintain the correct approach to a runway. Complete the table below by identifying what the colours of each light array indicate about the aircraft's positioning relative to the glide slope trajectory.

Description		Marks
Light array	Positioning	
all white lights	aircraft too high	1
red lights above white lights	aircraft on glide slope	1
white lights above red lights	(aircraft upside down) on glide slope	1
all red lights	aircraft too low	1
<b>Total</b>		<b>4</b>

## Question 47

(4 marks)

The following data apply to an aircraft flying between two points:

- distance 270 nm
- TAS 90 kt
- planned track 240° M
- heading flown 230° M.

After flying 90 nm, the aircraft has drifted 6 nm to the left of track.

- (a) Using the 1 in 60 rule, calculate the track made good. Show **all** workings. (2 marks)

Description	Marks
calculates track error 4°	1
236° (M)	1
<b>Total</b>	<b>2</b>

- (b) Using the 1 in 60 rule, calculate the required heading to fly directly to the intended destination. Show **all** workings. (2 marks)

Description	Marks
calculates closing angle 2°	1
total correction is 6° right	
required heading 230° + 6° = 236° (M)	1
<b>Total</b>	<b>2</b>
Accept answer if correct working based on incorrect answer in part (a).	

**Question 48**

**(6 marks)**

An aircraft completing a 45° angle of bank turn experiences additional forces. Use the diagram below to demonstrate the forces experienced in the turn by applying the following labels:

- lift
- vertical component of lift
- weight
- apparent weight
- centripetal force
- centrifugal reaction.

Description	Marks
One mark for each term applied correctly (arrow and label)	1–6
<b>Total</b>	<b>6</b>
Accept other relevant answers.	

**Question 49**

**(3 marks)**

Threat and error management (TEM) is now a vital part of pilot training. Airmanship is integral to TEM and is also taught as part of flight crew training. Identify **three** elements of airmanship that a pilot in command should display.

Description	Marks
Any <b>three</b> of the following (1 mark each)	
Answers could include: <ul style="list-style-type: none"> <li>• maintain effective lookout</li> <li>• maintain situational awareness</li> <li>• assess situations and make decisions</li> <li>• set priorities and manage tasks</li> <li>• maintain effective communications and interpersonal relationships.</li> </ul>	1–3
<b>Total</b>	<b>3</b>
Accept other relevant answers.	



## Question 50

(8 marks)

Low-cost airline carriers (LCCs) have become more popular as a result of their cheaper fares. Discuss how the increase in LCC has affected the:

- broader aviation industry
- community
- environment.

Description	Marks
Effect on the broader aviation industry <ul style="list-style-type: none"> <li>• lower staff wages</li> <li>• increased airline competition</li> <li>• increased airport/airspace congestion</li> <li>• use of underutilised airports</li> <li>• increased delays</li> </ul>	1–3
Effect on the community <ul style="list-style-type: none"> <li>• increased noise</li> <li>• increased unusual hours flights</li> <li>• new airports being built</li> <li>• different airports being utilised</li> <li>• increased tourism</li> </ul>	1–3
Effect on the environment <ul style="list-style-type: none"> <li>• increased carbon dioxide emissions</li> <li>• increased pollutants into ground/water sources</li> </ul>	1–2
<b>Total</b>	<b>8</b>
Accept other relevant answers.	

## ACKNOWLEDGEMENTS

- Question 36** Adapted from: Yeo, M., Bowers, G., & Bennett, K. (2001). Fig. 1 the forces shown tend to cause ground loop in tailwheel aircraft [Diagram]. *Handbook of flight* (2nd ed.). WestOne Services, p.313.  
Not for operational purposes.
- Question 45(b)** Adapted from: Federal Aviation Administration (DOT). (1973). Chapter 2. Aerodynamics of flight (Fig. 10) [Diagram]. *Basic helicopter handbook*. Federal Aviation Agency (DOT), p. 8. Retrieved May, 2020, from <http://avstop.com/ac/basichelicopterhandbook/ch2.html>
- Question 48** Adapted from: Yeo, M., Bowers, G., & Bennett, K. (2001). *Fig. 7.2 manoeuvre loads* [Diagram]. *Handbook of flight* (2nd ed.). WestOne Services, p. 142.  
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