



AVIATION

ATAR course examination 2022

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

Section Two: Short answer

80% (129 Marks)

Question 21

(10 marks)

Various kinds of equipment are used to assist in identifying an aircraft's position in relation to specified criteria.

- (a) Explain the purpose and operation of the Instrument Landing System (ILS). (5 marks)

Description	Marks
Purpose – provides alignment and descent information to pilots when approaching a runway.	1
Transmitter sends two different signal patterns on each side of the runway centreline.	1
When established on runway centreline CDI on the ILS indicator shows centred (or established on runway centreline).	1
Transmitter also sends two different signal patterns below and above correct glideslope.	1
When the correct glideslope is achieved the signal patterns will cause the cockpit indicator to display as on slope.	1
Total	5
Accept other relevant answers.	

- (b) Explain the purpose and operation of automatic dependent surveillance broadcast (ADSB). (5 marks)

Description	Marks
Purpose – used to send position to air traffic control and/or other aircraft.	1
Aircraft system uses GPS to determine position.	1
Aircraft transmitter sends position identity, altitude and velocity.	1
Dedicated ground stations receive these messages.	1
The information is relayed to air traffic control.	1
Total	5
Accept other relevant answers.	

Question 22

(10 marks)

Use the chart below for a flight from Badu Island aerodrome (YBAU) to Watson Cay to Ngulupi, and return to Badu Island aerodrome.

- (a) Given cruising level lowest hemispherical altitude above 2000 feet, magnetic variation 5° East and cruising true air speed (TAS) 120 kt, complete the following flight plan information. (5 marks)

Description		Marks
Completes position information and first line of table correctly.		1
Completes altitude information correctly.		1
Completes tracks correctly.		1
Completes headings correctly.		1
Completes distances correctly.		1
Total		5

Position	Altitude	Track (T)	Heading (M)	Distance (nm)
YBAU				
Watson Cay	3500	069° ±1	064° ±1	18 ±1
NGI	2500	192° ±1	187° ±1	12 ±1
YBAU	2500	292° ±1	287° ±1	15 ±1

- (b) On the Ngulupi to Badu Island aerodrome leg, the aircraft is established off track over St Pauls Helipad. Using the 1 in 60 rule, calculate the track error to the nearest degree. Show **all** workings. (2 marks)

Description	Marks
shows appropriate working ($5 \div 60 = 0.08$, $1.4 \div 0.08$), (acceptable to use 1.5 as distance of track in calculation)	1
track error = 16.8° or 17° if rounded	1
Total	2

- (c) Taking the track error above, use the 1 in 60 rule to calculate the required closing angle and required heading for Badu Island. Show all workings. (3 marks)

Description	Marks
closing angle = $10.2 \div 60 = 0.17$, $1.4 \div 0.17 = 8^\circ$	1
new heading = old heading (287°) - track error (17°) - closing angle (8°)	1
new heading = 262°M ±2	1
Total	3

Note: if a calculation error made in part (a) is used with correct response for part (b), then award marks as appropriate.

Question 23

(7 marks)

- (a) How many cold fronts are indicated? (1 mark)

Description	Marks
four	1
Total	1


- (b) Identify the mean sea level pressure to the nearest hectopascal at position 20°S, 160°E. (1 mark)


Description	Marks
1010	1
Total	1

- (c) Identify the feature indicated by - - - - - (1 mark)

Description	Marks
(low pressure) trough	1
Total	1

- (d) Draw the symbol for a warm front. (1 mark)

Description	Marks
Identifies  as warm front.	1
Total	1

- (e) Interpret the meaning of the black arrow  20kt shown in the chart on page 10. (3 marks)

Description	Marks
front direction	1
in an Easterly direction	1
moving at 20 knots	1
Total	3

Question 24

(8 marks)

Safety is vital in aviation operations to ensure the wellbeing of those working in the industry, as well as that of customers. Discuss how the following can improve aviation safety in the cockpit and the aviation environment.

(a) Good situational awareness (4 marks)

Description	Marks
Having good awareness means having a mental picture of all relevant information.	1
This can extend to a broad number of areas such as location, conditions, aircraft state, and airspace.	1
This awareness allows the crew to manage scenarios before they become a major issue.	1
Avoids the most negative effects such as aircraft crash, incidents or encountering unsafe conditions.	1
Total	4
Accept other relevant answers.	

(b) Good communication skills (4 marks)

Description	Marks
Communication includes the exchange of information between pilots, air traffic control, other aviation specialists and other aircraft.	1
Standard phrases and procedures are an important part of communication procedures.	1
This avoids confusion and ensures all are ready and prepared to receive the message.	1
As a result accurate actions can be completed based on good information.	1
Total	4
Accept other relevant answers.	

Question 25

(4 marks)

Stability is vital for the controllability of aircraft. A directionally stable aircraft experiencing rotation around the vertical axis (yaw) tends to return to straight and level flight. Explain the factors that enable the aircraft to return to its original altitude.

Description	Marks
Once yawed, airflow hits side of aircraft (or keel surfaces) and/or fin.	1
Most of the keel surface is behind centre of gravity (CoG).	1
Dynamic pressure is therefore behind CoG forcing fuselage into line with airflow.	1
Surface of fin also assists by providing force in restoring direction.	1
Total	4
Accept other relevant answers.	

Question 26

(6 marks)

Forces acting on an aircraft have a significant impact on its operation. The aircraft below is in a climb with power. Use labelled arrows to show direction of

- the forces acting on the aircraft, and
- **two** resultant forces in this situation.

Description	Marks
shows correct lift (L)	1
shows correct drag (D)	1
shows correct weight (W)	1
shows correct thrust (T)	1
shows one correct resultant force (R_1)	1
shows second correct resultant force (R_2)	1
Total	6

For copyright reasons this diagram cannot be reproduced in the online version of this document.

Question 27

(4 marks)

It is accepted that good physical condition of the pilot is critical for top performance. A pilot flying after scuba diving experiences decompression sickness.

- (a) Define 'decompression sickness'. (1 mark)

Description	Marks
Decreased pressure on the body, resulting in nitrogen being released forming bubbles in blood.	1
Total	1
Accept other relevant answers.	

- (b) State **two** symptoms of decompression sickness. (2 marks)

Description	Marks
Any two of	
<ul style="list-style-type: none"> • headaches • nausea • pain in joints • paralysis 	1–2
Total	2
Accept other relevant answers.	

- (c) How might the pilot reduce the effects of decompression sickness? (1 mark)

Description	Marks
Resolved by descending to lower altitudes.	1
Total	1
Accept other relevant answers.	

Question 28

(4 marks)

The effects of spatial disorientation on a pilot can be dangerous.

- (a) Define 'spatial disorientation' (1 mark)

Description	Marks
The inability of a pilot to determine the attitude, altitude or airspeed of an aircraft relative to the Earth/horizon.	1
Total	1
Accept other relevant answers.	

- (b) State **two** possible negative outcomes if a pilot is spatially disoriented. (2 marks)

Description	Marks
Any two of	
<ul style="list-style-type: none"> • uncertainty of direction • loss of control • placing the aircraft into unsafe situations/attitudes • accidents/terrain collision 	1–2
Total	2
Accept other relevant answers.	

- (c) Outline how a pilot can overcome the effects of spatial disorientation. (1 mark)

Description	Marks
The pilot needs to trust the instruments.	1
Total	1
Accept other relevant answers.	

Question 29

(6 marks)

Weight and balance calculations are vital to the safety of an aircraft and its occupants.

- (a) Complete the table below for a Piper PA-32RT-300T Turbo Lance aircraft to show the weight, position of the centre of gravity and moment at zero fuel weight. (4 marks)

Description	Marks
weight 3055.8	1
CoG 92.4	1
moment 282370	1
completed moments above ZFW	1
Total	4
Note: errors of additions in moments and weights may be taken into consideration for CoG calculation only.	

Position	Weight (lb)	Arm (in)	Moment (lb/in)
Aircraft	2335.8		195 086
Front	355	85.5	30 352.5
Centre	15	118.1	1771.5
Rear	350	157.6	55 160
Forward baggage	0	42.0	0
Aft baggage	0	178.7	0
Zero fuel weight	3055.8	92.4	282 370

- (b) Using the Piper PA32 RT-300T take-off weight chart on the next page and the following data:
- OAT 26 °C
 - PH 1500 ft
 - surface long dry grass
 - slope 1% up
 - 9 kt headwind
 - take-off weight 1550 kg,

calculate the take-off distance required. Show **all** workings. (2 marks)

Description	Marks
1090 metres ± 10 required and shows working.	2
Shows working with minimal error outside tolerances.	1
Total	2

Question 30

(9 marks)

Gravity-induced loss of consciousness (G-LOC) has a significant effect on the human body.

(a) Explain the concept of G-LOC. (4 marks)

Description	Marks
A pilot in normal flight experiences force of gravity on the body (1G).	1
During manoeuvres the body experiences forces beyond gravity.	1
The body struggles to pump oxygen through the blood.	1
Results in various effects on the human body due to lack of oxygen.	1
Total	4
Accept other relevant answers.	

(b) Identify **three** effects on the human body in an aircraft that proceeds from 1G through to 4G. (3 marks)

Description	Marks
Any three of	
<ul style="list-style-type: none"> • limbs difficult to move • body pulled downwards causing discomfort • heart has difficulty pumping blood, causing brain to be starved of blood • tunnel vision due to lack of blood • dimming of vision or grey out • no vision or black out • unconsciousness • death 	1–3
Total	3
Accept other relevant answers.	

(c) Describe how the above effects on the human body can be reduced. (2 marks)

Description	Marks
G or pressure suit	1
healthy lifestyle/nutrition/no smoking	1
Total	2
Accept other relevant answers.	

Question 31

(4 marks)

During summer, Australia experiences longer periods of daylight than throughout winter. Explain the reason for this.

Description	Marks
Earth's axis is tilted reference the Sun.	1
During summer season the Earth experiences greater direct sunlight as a result of the tilt.	1
This causes the beginning of daylight to be earlier and end of daylight later.	1
During winter the tilt causes less direct sunlight and therefore shorter days than summer.	1
Total	4
Accept other relevant answers.	

Question 32

(8 marks)

Weather phenomena can have significant impacts on aviation operations.

- (a) Explain the formation of radiation fog. (4 marks)

Description	Marks
Generally experienced in winter months within the influence of a high pressure system.	1
Forms in the early morning or late evening.	1
Formed by air in contact with Earth losing its heat to the ground from conduction.	1
When dewpoint is reached water vapour forms into fog.	1
Total	4

- (b) State **four** requirements for the formation of radiation fog. (4 marks)

Description	Marks
light winds	1
cloudless skies	1
high relative humidity	1
condensation nuclei	1
Total	4

Question 33

(5 marks)

Due to operational limitations of the magnetic compass, other instruments tend to be preferred for identifying aircraft heading. Outline the **five** limitations encountered when using a magnetic compass.

Description	Marks
Magnetic variation needs to be applied as the north and magnetic poles are in different locations.	1
Deviation needs to be applied as there can be electrical or magnetic differences.	1
Errors associated with the compass especially closer to the poles due the magnet in the compass being freely suspended.	1
Acceleration or deceleration errors due to inertia in the compass.	1
Turning errors due to centripetal forces in the compass.	1
Total	5
Accept other relevant answers.	

Question 34

(3 marks)

Explain the effect of altitude on the performance of propeller driven aircraft.

Description	Marks
higher altitude results in decreased air density	1
this reduces lift	1
and reduces propeller efficiency which reduces thrust	1
Total	3

Question 35

(5 marks)

Aircraft can be flown in different configurations depending on the desired outcome of the flight. Explain the aircraft configuration flown when maximum range is required.

Description	Marks
flown at indicated airspeed for maximum lift/drag ratio	1
utilise power setting for maximum lift/drag ratio	1
lean mixture required	1
flying at a height which requires full throttle to supply the required power	1
aircraft is in cleanest configuration	1
Total	5

Question 36

(6 marks)

Most basic aircraft have a standard fixed propeller for simplicity, although an alternative propeller design exists that can be used.

- (a) State the name of the alternative propeller design and outline its primary advantage. (2 marks)

Description	Marks
variable pitch propeller	1
ability to increase performance by varying pitch angle	1
Total	2
Accept other relevant answers.	

- (b) The ability to utilise this alternative propeller design has other benefits. Name **two** additional functional benefits of this design and state the resulting advantages. (4 marks)

Description	Marks	
One mark per definition and one mark per consequence.		
feathered propeller	reduces drag on a shutdown engine	1–2
reverse pitch propeller	reduces landing runway required	1–2
Total	4	
Accept other relevant answers, including a relevant answer for an incorrect answer to part (a).		

Question 37

(8 marks)

Aviation reports and forecasts are vital to the safety of aviation operations within Australia.

(a) Identify **two** weather reports and state their purpose. (4 marks)

Description	Marks
Any two of (2 x 2 marks)	
<ul style="list-style-type: none"> • Aerodrome warning provide advice on meteorological conditions that will adversely impact an aerodrome • METAR routine report of meteorological conditions at an aerodrome • SPECI special report of meteorological conditions when certain significant criteria are met • AIRMET provides information on deteriorating conditions not included on a graphical area forecast (GAF) • Runway visual range (RVR) provides guidance on visibility conditions below 2000 metres • SIGMET advises of en-route weather phenomena likely to be hazardous to aircraft • Volcanic ash advisories report presence of volcanic ash 	1–4
Total	4
Accept other relevant answers.	

(b) Identify **two** weather forecasts and state their purpose. (4 marks)

Description	Marks
Any two of (2 x 2 marks)	
<ul style="list-style-type: none"> • Area QNH identifies expected mean sea level pressure • Terminal Aerodrome Forecast (TAF) records expected meteorological conditions within 5 nm of an aerodrome • Graphical area forecast (GAF)range describes meteorological phenomena for operations between ground and 1000 feet AMSL • Grid point wind and temperature (GPWT) identifies wind speed direction and temperature • Route sector wind forecast identify conditions on highly utilised air routes • SIGWX describes significant weather expected within the range FL100 to FL630 	1–4
Total	4

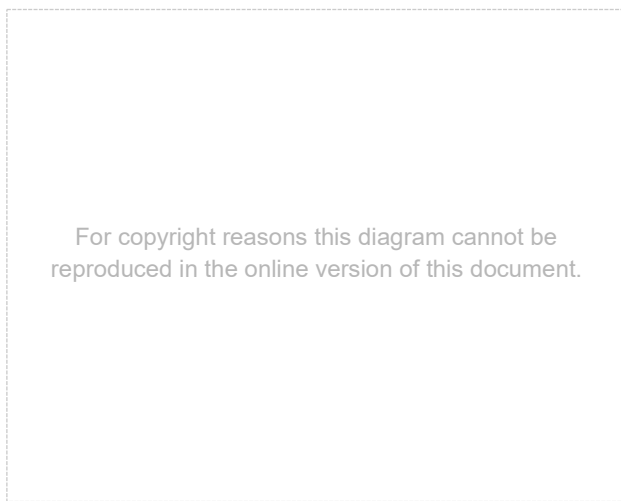
Question 38

(13 marks)

It is vital for a helicopter pilot to understand the controls as well as forces acting on the aircraft in different scenarios.

- (a) A helicopter is established in autorotative flight at a steady forward airspeed of 60 knots. Using the diagram provided, draw and label the forces acting on the aircraft during this phase of flight. (7 marks)

Description	Marks
Identifies each of the forces drawn as per below.	1–3
Labels each of the three forces as LIFT (L), DRAG (D) and WEIGHT (W).	1–3
Draws the forces in equilibrium, i.e. the resultant force of L and D is intentionally drawn to show that it equals the force of Weight (see diagram below) i.e. the dotted long lines are in balance.	1
Total	7



- (b) A helicopter pilot is sitting in their aircraft on the ground with the engine running and all checks complete. State the name of each of the **three** primary controls that will be used to conduct a take-off to forward flight and outline the associated function. (6 marks)

Description		Marks
For each of the six correct responses (6 x 1 mark)		
Primary control	Function	1–6
collective	to increase lift or to increase lift/pitch of all rotor blades at the same time or similar	
tail rotor pedals or anti-torque pedals (no mark for 'rudder')	to control yaw	
cyclic	to control the sideways or lateral control of the helicopter or to turn the helicopter or to bank the helicopter or to accelerate the helicopter forwards	
Total		6
Accept other relevant answers.		

Question 39

(3 marks)

One of the primary negative impacts of the aviation industry is noise. This creates pressure to design aircraft which limit their noise contour. State **three** ways in which aircraft can be designed to reduce their level of noise on the surrounding community.

Description	Marks
use of quieter engines	1
reduction of airframe/aerodynamic noise	1
reduction of aircraft system noise	1
Total	3
Accept other relevant answers.	

Question 40

(6 marks)

Air traffic congestion in various parts of the world is increasingly affecting further development of aviation both positively and negatively. Explain the effects of congestion on the following:

Description	Marks
Aviation industry: Any two of	1-2
<ul style="list-style-type: none"> • increased airport/airspace congestion • use of underutilised airports or requirements to build new airports or expand existing airports • increased delays or holding • increased traffic during traditionally quieter times to balance workload 	
Communities: Any two of	1-2
<ul style="list-style-type: none"> • increased noise or different noise areas • increased unusual hours flights • new airports being built resulting in altered noise profiles • different airports being utilised causing new noise areas 	
Environment: Any two of	1-2
<ul style="list-style-type: none"> • increased carbon dioxide emissions • increased pollutants into ground/water sources • increased land clearing or dredging to establish new airports 	
Total	6
Accept other relevant answers.	

ACKNOWLEDGEMENTS

- Question 26** Adapted from: Hartley, A. (2016). [Diagram of aeroplane with four forces of flight]. Retrieved June, 2022, from <http://smartflighttraining.com/>
- Question 38(a)** Adapted from: Federal Aviation Administration. (1973). Chapter 2. Aerodynamics of Flight (Fig. 10). *Basic Helicopter Handbook*. Federal Aviation Administration, p. 8. Retrieved June, 2022, from <http://avstop.com/ac/basichelicopterhandbook/ch2.html>

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