



AVIATION

ATAR course examination 2023

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

Section Two: Short answer

80% (138 Marks)

Question 21

(4 marks)

Calculating pressure height and density altitude are essential to identify aircraft performance.

(a) Calculate airfield pressure height, using the following data:

- airfield elevation 1000 ft
- QNH 1020 hPa
- OAT 9 °C.

Show all workings.

(2 marks)

Description	Marks
$(\text{ISA QNH} - \text{Actual QNH}) \times 30 \text{ ft} + \text{elevation}$	
$(1013 - 1020) \times 30 \text{ ft} + \text{elevation } 1000 \text{ ft}$	1
$-210 + 1000 \text{ ft} = 790 \text{ ft}$	
790 ft	1
Total	2
Shows above working, but mathematical error 1 mark.	

(b) Calculate airfield density altitude, given the following data:

- 2000 ft pressure height
- OAT 15 °C.

Show all workings.

(2 marks)

Description	Marks
$(\text{ISA temperature Deviation} \times 120 \text{ ft}) + \text{PA} = \text{DA}$	
$(15 \text{ °C} - 11 \text{ °C}) \times 120 \text{ ft} + \text{PA } 2000 \text{ ft} = \text{DA}$	1
$4 \text{ °C} \times 120 \text{ ft} + \text{PA } 2000 \text{ ft} = \text{DA}$	
$480 \text{ ft} + 2000 \text{ ft} = 2480 \text{ ft}$	1
Total	2
Shows above working, but mathematical error 1 mark.	

Question 22

(6 marks)

Using the synoptic chart supplied, determine the following:

- (a) The season being experienced in Australia (1 mark)

Description	Marks
summer	1
Total	1

- (b) Forecast QNH at 20°S 160°E (1 mark)

Description	Marks
1012 hPa	1
Total	1

- (c) Meaning of the symbol ----- (1 mark)

Description	Marks
low pressure trough	1
Total	1

- (d) Meaning of the symbol  30 kt (3 marks)

Description	Marks
cold front	1
moving easterly	1
at 30 kt	1
Total	3
Accept other relevant answers.	

Question 23

(11 marks)

- (a) A pilot flying in instrument meteorological conditions (IMC) executes a very slow roll to the left. Suddenly the pilot corrects the aircraft attitude returning to straight and level flight. Explain the illusion the pilot experienced and the associated reasoning for this experience. (4 marks)

Description		Marks
when the pilot's head is moved, fluid in the semi-circular canals move		1
this fluid causes the cupula (or hairs) to detect the motion		1
if the initial turn is slow the turn is not detected by the cupula		1
it results in the cupula indicating a turn to the right		1
Total		4
Accept other relevant answers.		

- (b) An aircraft is flying close to cloud with an operating rotating beacon. Name the illusion likely to be encountered by the crew, the reasoning for the illusion, prevention of the illusion, and **one** side effect. (4 marks)

Description		Marks
Illusion	flicker vertigo	1
Reason	light from rotating beacon reflecting on cloud	1
Prevention	turning off rotating beacon	1
Side-effect	one of dizziness, nausea, unconsciousness or similar to epileptic fit	1
Total		4
Accept other relevant answers.		

- (c) A pilot approaching an aerodrome runway will use visual cues to judge an approach in visual meteorological conditions (VMC). Identify the pilot's perception of their approach path in the following approach scenarios. (3 marks)

Description		Marks
Flown through smoke	approach too high	1
To upsloping runways	approach too high	1
Narrow runway	approach too high	1
Total		3

Question 24

(9 marks)

- (a) The temperature on the ground is 27 °C and the environmental lapse rate is 4 °C per 1000 feet. If a parcel of unsaturated air is forced to rise, explain the resulting effect on that air, including its temperature at 1000 feet. (4 marks)

Description	Marks
air parcel at 1000 ft temperature is 24 °C	1
environmental temperature is 23 °C	1
air parcel is warmer and less dense than environment so will continue to rise	1
indicates an unstable atmosphere	1
Total	4
Accept other relevant answers.	

- (b) Explain the process of frontal lifting related to cloud formation. (5 marks)

Description	Marks
experienced when warmer humid airstream meets a colder airstream	1
the cold, more dense air moves under the warm air	1
the boundary between the masses is called a front	1
as the front moves it forces the warm air to rise	1
when rising air reaches saturation, clouds form	1
Total	5
Accept other relevant answers.	

Question 25

(9 marks)

Describe the principles of operation for the following kinds of radar.

- (a) Primary surveillance radar (PSR). (4 marks)

Description	Marks
radar installation transmits radio waves	1
if these waves hit an object, signal bounces back to the installation	1
location of object (aircraft) is determined by time from transmission to receiving signal	1
aircraft (or object) location is displayed on Air Traffic Control (ATC) equipment	1
Total	4
Accept other relevant answers.	

- (b) Secondary surveillance radar (SSR). (5 marks)

Description	Marks
transmitter sends pulse	1
pulse is received by aircraft transponder	1
transponder sends coded signal to antenna which is decoded	1
information sent includes identity, height and direction	1
over a period of time groundspeed is available to air traffic controllers in addition	1
Total	5
Accept other relevant answers.	

Question 26

(9 marks)

An aircraft is flying from Delta aerodrome to Echo aerodrome (distance of 240 nm) using 75% best economy during the cruise. Assuming no wind, cruise fuel flow of 18 gallons per hour and the data set out below, use the charts on pages 14 to 16 to complete the following table.

	Delta	Cruise	Echo
Pressure altitude (ft)	1000	9000	1000
Temperature (°C)	20	-1	23

	Description			Marks
	Fuel (gal)	Time (minutes)	Distance (nm)	
Climb	5 ±1	10 ±1	20 ±1	1-3
Cruise	23 ±1	77 ±2	202 ±1	1-3
Descent	2 ±1	7 ±1	18 ±1	1-3
Total	30±3	94±3	240±3	
Total				9

Question 27

(9 marks)

Explain the principles of operation of a:

(a) Constant-speed propeller engine.

(5 marks)

Description	Marks
uses a constant-speed unit (CSU) attached to a variable pitch propeller	1
changing the blade angle results in the most efficient angle of attack	1
CSU includes a governor which maintains RPM setting	1
increasing throttle increases manifold pressure and coarsens blade angle	1
to increase power, increase RPM using pitch control then manifold pressure using throttle	1
Total	5
Accept other relevant answers.	

(b) Clamshell (or bucket style) thrust reversal system.

(4 marks)

Description	Marks
exhaust from the stream flow	1
redirected from a rearward flow	1
reducing landing distance required	1
power available is less than in normal thrust direction	1
Total	4
Accept other relevant answers.	

Question 28

(4 marks)

Identify the:

- current visibility
- amount in oktas and height, including datum, of the lowest cloud layer

using the SPECI below:

SPECI YBRM 050331Z 24025G35KT 1500 RA SCT008 SCT012 OVC040 24/24 Q0995 RMK RF01.0/026.2

Description	Marks
1500 metres visibility	1
3 to 4 oktas cloud	1
800 feet	1
above aerodrome level/ground level/QFE	1
Total	4

Question 29

(9 marks)

Knowing the time for last light at a location is vital to ensure compliance with aviation regulations.

- (a) Use the graph on page 20 to calculate the end of daylight time (LMT) for position 16° 53'S, 145° 45'E on 20th December. Show all workings. (2 marks)

Description	Marks
shows working on the chart with minimal errors	1
1857 (± 1)	1
Total	2

- (b) Use the table on page 21 to calculate the end of daylight in Coordinated Universal Time (UTC). Show all workings. (4 marks)

Description	Marks
145° = 9hrs 40 min	1
45' = 3 minutes	1
1857 – 0943	1
end of daylight is 0914 UTC	1
Total	4
Accept other answers, if based on incorrect response from part (a).	

- (c) Identify **three** reasons why the end of daylight may be earlier than identified in part (a). (3 marks)

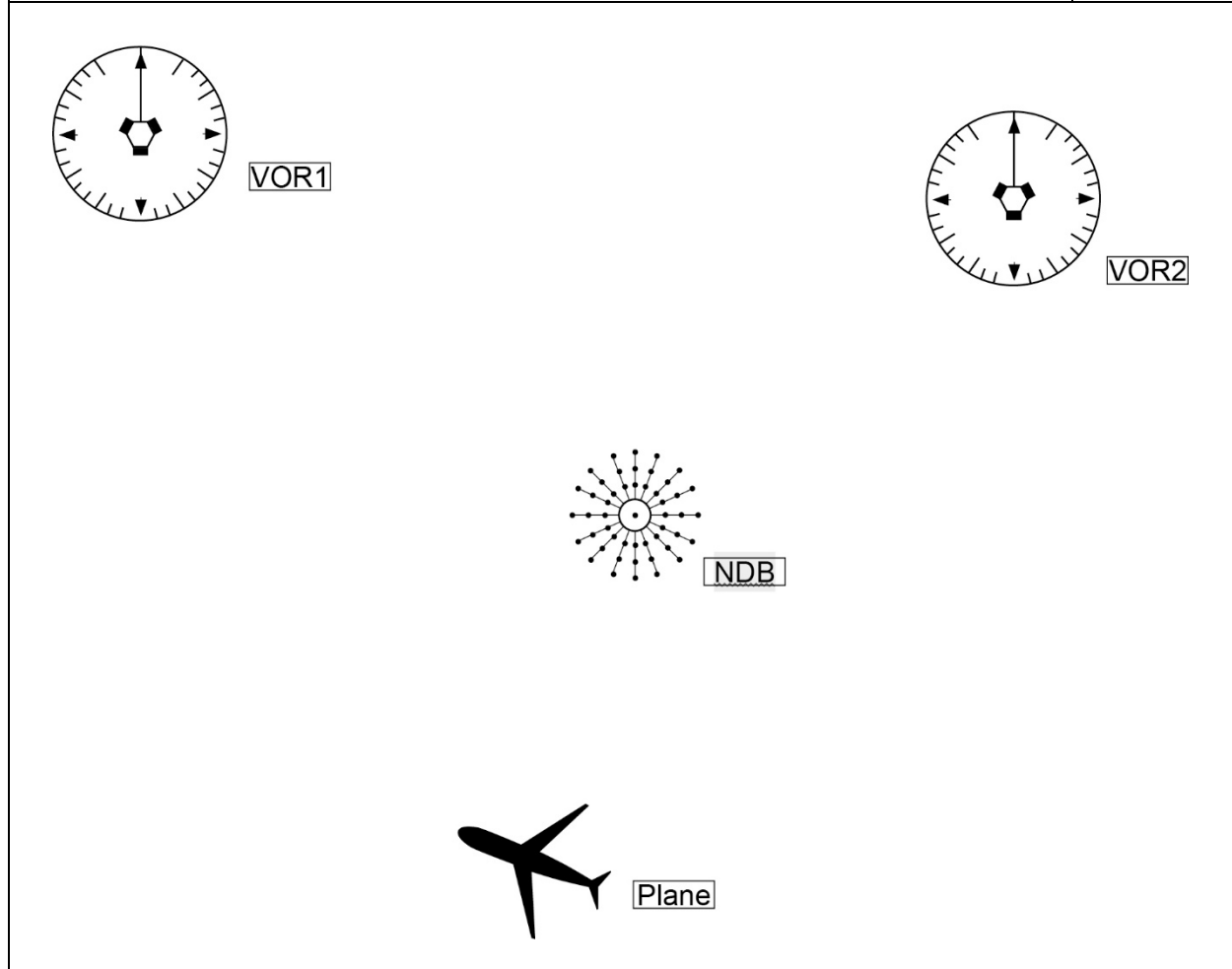
Description	Marks
cloud cover	1
reduced visibility	1
elevated terrain to the west of aerodrome	1
Total	3
Accept other answers.	

Question 30

(4 marks)

Given the following aircraft instrument indication, draw a labelled diagram showing the correct aircraft position relative to the navigation aids.

Description	Marks
aircraft heading as per diagram	1
NDB bearing as per diagram	1
VOR1 positioning as per diagram	1
VOR2 positioning as per diagram	1
Total	4



Question 31

(6 marks)

The introduction of new technologies and other developments in the aviation industry result in other significant impacts.

Explain the likely effect of the following on the aviation industry.

- (a) Unmanned aerial vehicle (UAV): (3 marks)

Description	Marks
Any three of (3 x 1 mark)	
<ul style="list-style-type: none"> competition with manned aircraft for airspace or increased congestion increased risk of collision with other aircraft UAV replace conventional aircraft increased employment 	1–3
Total	3
Accept other relevant answers.	

- (b) Composite materials: (3 marks)

Description	Marks
Any three of (3 x 1 mark)	
<ul style="list-style-type: none"> lighter weight than aluminium resulting in less impact on aerodrome less likely to suffer fatigue (or stronger) than aluminium (greater time between checks) lighter weight leads to better fuel efficiency (or reduced environmental effects) greater payloads resulting in increased payloads 	1–3
Total	3
Accept other relevant answers.	

Question 32

(5 marks)

Aircraft design is imperative to ensure that aircraft are able to perform as expected in all circumstances.

- (a) Lateral stability is vital to the controllability of aircraft. Identify **three** aircraft features incorporated into aircraft design that have an effect on lateral stability. (3 marks)

Description	Marks
high or low wing configuration (or pendulum effect)	1
Dihedral	1
Sweepback	1
Total	3
Accept other relevant answers.	

- (b) Identify the purpose and function of speed brakes in an aircraft. (2 marks)

Description	Marks
purpose: to decelerate aircraft	1
function: when deployed create drag	1
Total	2
Accept other relevant answers.	

Question 33

(4 marks)

Pilot understanding of causal factors in common aircraft accidents is vital to avoid replicating these scenarios. Identify the most likely outcome introduced by the additional risk in the following scenarios.

- (a) Flying at an altitude below 500 feet when not on climb or descent. (1 mark)

Description	Marks
flight into terrain or obstructions/bird strike	1
Total	1
Accept other relevant answers.	

- (b) Not completing checks as per the checklist. (1 mark)

Description	Marks
failure to complete a required action	1
Total	1
Accept other relevant answers.	

- (c) Flight into instrument meteorological conditions (IMC) when not qualified. (1 mark)

Description	Marks
loss of control or collision with terrain	1
Total	1
Accept other relevant answers.	

- (d) Manoeuvring a tailwheel aircraft on the ground. (1 mark)

Description	Marks
ground loop or loss of control	1
Total	1
Accept other relevant answers.	

Question 34

(5 marks)

Pilots are required to have good eyesight, as a large amount of information is received through vision. Explain the concept of myopia and how it is corrected.

Description	Marks
Short sightedness	1
Problems with long distance focusing are focussed in front of the retina	1
caused by refractive power of lens being too strong	1
corrected by placing a lens in front of the eye	1
Total	5
Accept other relevant answers.	

Question 35

(3 marks)

A pilot approaching the destination airport, tunes in to the automatic terminal information service (ATIS) and copies down the following relevant data:

- runway 28 for arrival and departure
- temperature 25 °C
- QNH 1011 hPa
- wind 340°/20 kt.

Using your flight computer for the landing, calculate the:

- (a) Headwind component. (1 mark)

Description	Marks
10 kt	1
Total	1

- (b) Crosswind component and the expected drift direction of the aircraft. (2 marks)

Description	Marks
17 kt	1
left drift	1
Total	2

Question 36

(3 marks)

A pilot has to maintain a track of 240°, at a true airspeed (TAS) of 150 kt. Given the forecast wind is 280°/20 kt, use your flight computer to calculate the:

- (a) Heading to be flown. (1 mark)

Description	Marks
245° ±1	1
Total	1

- (b) Resulting ground speed. (1 mark)

Description	Marks
134 kt ±1	1
Total	1

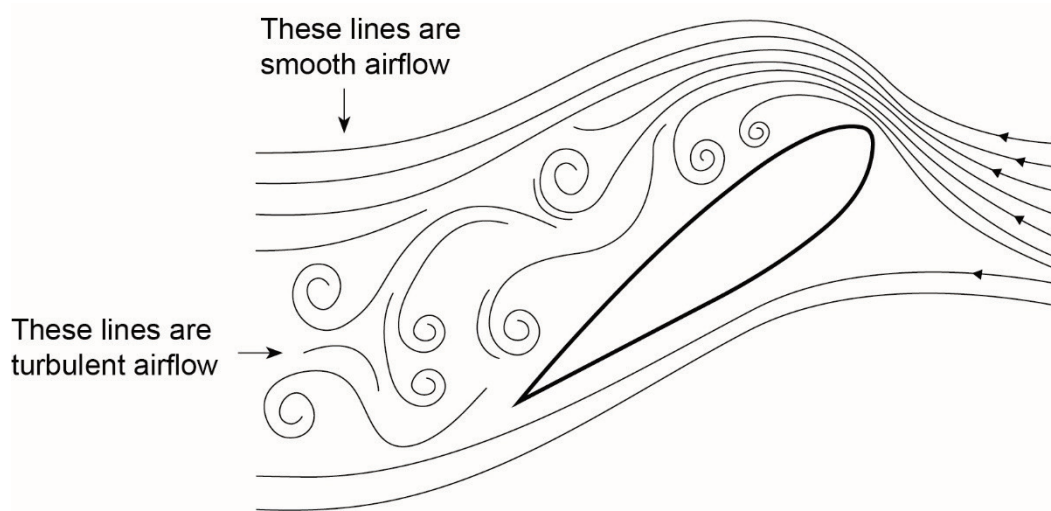
- (c) Amount of fuel used in litres (L), given that the fuel for this leg is calculated to be 8 US gallons. (1 mark)

Description	Marks
30.35 litres ± 0.1	1
Total	1

Question 37

(5 marks)

Complete and annotate the diagram of an aerofoil below to explain the concept of an aircraft stall, including the aerodynamic characteristics in this situation.



Description	Marks
stall is when aerofoil reaches critical angle of attack	1
diagram and explanation show airflow separation over top of wing beyond leading edge (similar to curled lines above)	1
results in loss of lift	1
creates a nose down movement	1
diagram shows smooth airflow above turbulent airflow and underneath the wing	1
Total	5
Accept other relevant answers.	

Question 38

(10 marks)

A helicopter is established in steady forward, level flight. Using the diagram provided below, draw and label the forces on the helicopter during this phase of flight.

Description	Marks
For each force (5 x 2 marks)	
Draws the force by displaying an arrow (does not need to demonstrate the difference between a real force and a component).	1–5
Labels the force Lift (or L), Drag (or D), Weight (or W), Rotor thrust (or RT) and Forward thrust (or FT).	1–5
Total	10

Question 39

(6 marks)

Summarise the developing stage as part of the formation of thunderstorms.

Description	Marks
starts as a cumulus cloud	1
all up currents	1
water droplets are carried by these updraughts	1
droplets regularly increase in size as they strike and combine	1
no precipitation reaches the ground	1
stage lasts 10 to 15 minutes	1
Total	6
Accept other relevant answers.	

Question 40

(6 marks)

Identify the principle of operation and describe the sequence of events taking place within a standard gas turbine engine.

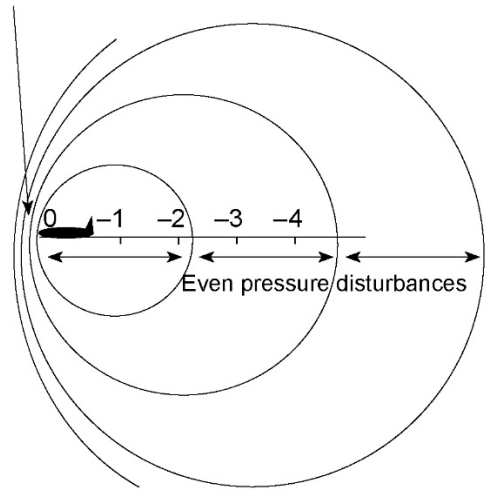
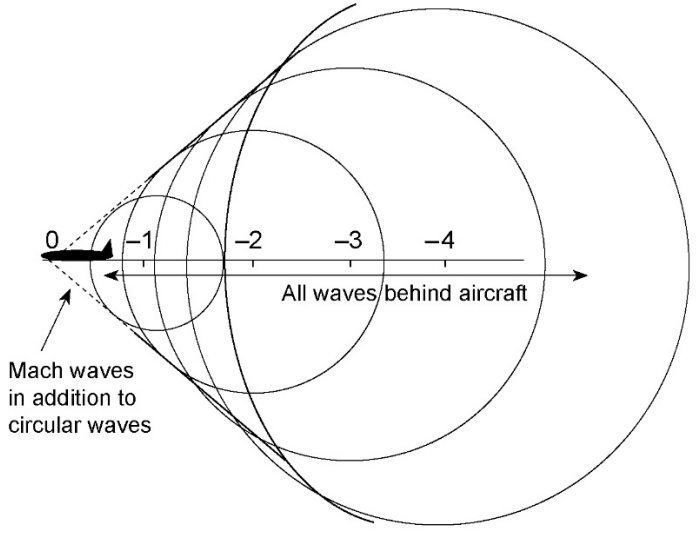
Description	Marks
based on principle of for every action there is an equal and opposite reaction (or Newton's third law of motion)	1
air enters the air intake and pressure is increased by the compressor	1
air is mixed with fuel and then burnt	1
burning causes gas expansion	1
expansion drives the turbine which is connected to the compressor	1
expanding gases are discharged through the exhaust pipe	1
Total	6
Accept other relevant answers.	

Question 41

(5 marks)

Complete the diagrams below to show the difference in pressure wave disturbances between an aircraft flying at subsonic speed and then at supersonic speed.

Description	Marks
subsonic shows even pressure disturbances	1
which bunch up in front of aircraft	1
supersonic aircraft shown with all waves behind aircraft	1
mach waves shown as dashed line in second diagram	1
in addition to circular waves behind	1
Total	5

<p>Pressure disturbances bunch up in front of aircraft</p>  <p style="text-align: center;">Even pressure disturbances</p> <p style="text-align: center;">Pattern of pressure waves from a subsonic aircraft.</p>	 <p style="text-align: center;">All waves behind aircraft</p> <p style="text-align: center;">Pattern of pressure waves from a supersonic aircraft.</p>
<p>Accept other relevant answers.</p>	

Question 42

(6 marks)

Compared to the early 2000s low-cost carriers have become more popular. Outline the effect on the aviation industry, the community and the environment of the increasing numbers of low-cost carriers.

Description	Marks
Effect on industry – any two of (2 x 1 mark)	
<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 	1–2
Effect on communities – any two of (2 x 1 mark)	
<ul style="list-style-type: none"> • increased noise or different noise areas or additional flights • increased night time hours flights • new airports being built resulting in altered noise profiles • different airports being utilised causing new noise areas 	1–2
Effects on environment – any two of (2 x 1 mark)	
<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 	1–2
Total	6
Accept other relevant answers.	

ACKNOWLEDGEMENTS

- Question 37** Yeo, M., Bowers, G., & Bennett, K. (2001). Fig. 1.74 Turbulent Airflow Over a Stalled Wing [Diagram]. *Handbook of Flight* (2nd ed.). WestOne Services, p. 35. Not for operational purposes.
- Question 41** Adapted from: Yeo, M., Bowers, G., & Bennett, K. (2001). Fig. 8.2 Pattern of Waves From a Subsonic Aircraft [Diagram]. *Handbook of Flight* (2nd ed.). WestOne Services, p. 179. Not for operational purposes.
Adapted from: Yeo, M., Bowers, G., & Bennett, K. (2001). Fig. 8.4 Pattern of Waves From a Supersonic Aircraft [Diagram]. *Handbook of Flight* (2nd ed.). WestOne Services, p. 179. Not for operational purposes.

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