



AVIATION

ATAR course examination 2016

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)

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

Section Two: Short answer

80% (117 Marks)

Question 21

(4 marks)

(a) Calculate airfield pressure altitude. Show **all** workings.

(2 marks)

Description	Marks
$(ISA\ QNH - Actual\ QNH) \times 30 + \text{evaluation}$	
$1013 - 1002 \times 30 + \text{elevation } 2015\ \text{ft}$	1
$330\ \text{ft} + 2015\ \text{ft} = 2345\ \text{ft}$	
2345 ft	1
Total	2

(b) Calculate airfield density altitude. Show **all** workings.

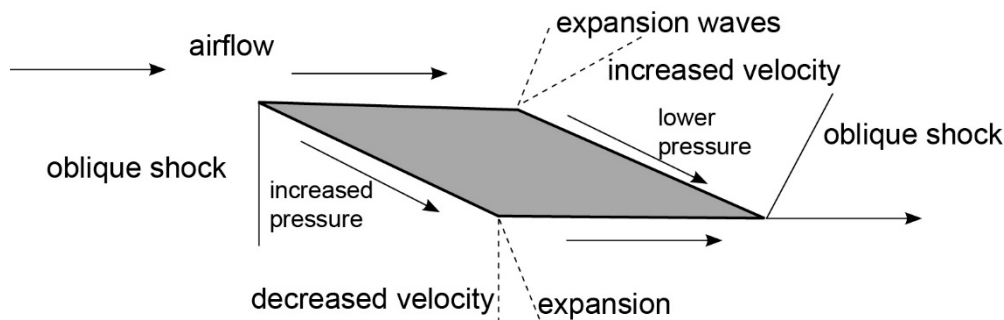
(2 marks)

Description	Marks
$(ISA\ \text{temperature deviation} \times 120\ \text{ft}) + PA = DA$	
$(14\ ^\circ\text{C} - 10\ ^\circ\text{C}) \times 120\ \text{ft} + PA\ 2345\ \text{ft} = DA$	1
$480\ \text{ft} + 2345\ \text{ft} = 2825\ \text{ft}$	
2825 ft	1
Total	2
Note: If PA from part (a) is incorrect but all other workings are correct award full marks.	

Question 22

(6 marks)

Draw a labelled diagram in the space below, to show how a double wedge aerofoil creates lift in supersonic flight when it is at its optimum angle to the airflow.



Description	Marks
Shows airfoil orientation	1
Shows shock and expansion wave	1
Shows relative velocities	1-2
Shows relative pressures	1-2
Total	6

Question 23

(3 marks)

Use your flight computer to calculate and complete the following table.

TAS	Track magnetic	Winds magnetic	Drift	Heading	GS
105 kt	225°	075/22			

Description	Marks
Drift 6° R + 0/-1°	1
Heading 219° (220° acceptable if drift shown as 5°R)	1
GS 123 kt +/- 2 kt	1
Total	3

Question 24

(3 marks)

- (a) What is the name given to the inability of the eye to focus different meridians simultaneously? For example, power poles (vertical), remain in focus but the wires (horizontal) are out of focus.

Description	Marks
astigmatism	1
Total	1

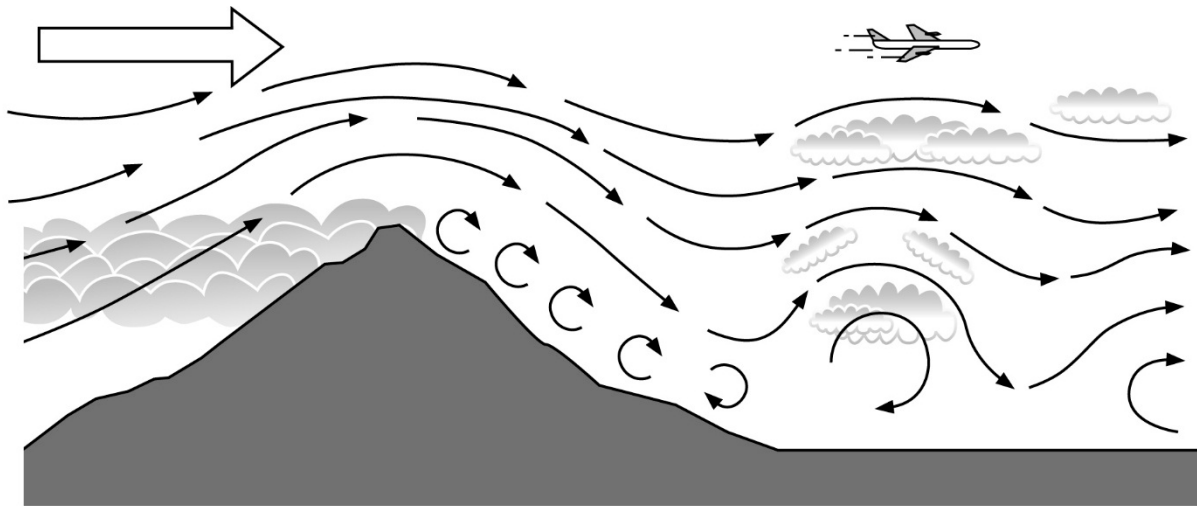
- (b) What is the cause of this condition?

Description	Marks
Unequal curvature of the cornea or lens	2
If said unequal curvature of eye	1
Total	2

Question 25

(7 marks)

- (a) Draw a labelled diagram in the space below, to show the likely airflow associated with mountain waves and the associated rotor zone. (4 marks)



Description	Marks
Showed mountain and the following in the appropriate positions	
Lenticularis cloud	1
Direction of Wind flow in appropriate wave formation	1
Rotors or roll cloud	1
Labelled correctly	1
May show cap cloud upwind of mountain for additional mark (not to exceed 4 in total)	
Total	4

- (b) State **two** environmental conditions required for mountain waves to form. (2 marks)

Description	Marks
One mark for each condition. Maximum two marks.	
Answers could include, but are not limited to the following: <ul style="list-style-type: none"> • Wind flow at almost right angle to mountain (accept up to 30° from the right angle) • Wind greater than 25 kt increasing with height (accept 15 kt if said in conjunction with increasing in height) • An upper stable layer at ridge height between an unstable layer below and a unstable or weak stable layer above • Mentions only stable layer at ridge and unstable or weak stable layer above 	1-2
Total	2

- (c) State **one** type of cloud associated with mountain waves. (1 mark)

Description	Marks
Lenticular cloud/lenticularis cloud or roll cloud/rotor cloud	1
Total	1

Question 26

(8 marks)

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

Description	Marks
830 m +/- 10 m	2
830 m +/- 20 m	1
Total	2
Note: Incorrect answer or outside tolerances but complete workings on chart with nominal error award 1 mark.	

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

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

Description					Marks
For each row:					
• all correct – three marks					
• three correct – two marks					
• two correct – one mark					
	Climb	Cruise	Descent	Total	
Fuel (gal)	7 +/- 1.5	29.2 +/- 1	2 +/- 1	38.2 +/- 1.5	1–3
Time (min)	11 +/- 1	128 +/- 1	7 +/- 1	146.0 +/- 2	1–3
Distance (nm)	21 +/- 1	362 +/- 1	18.0 +/- 1	401 nm	1–3
				Total	9

Question 27

(6 marks)

Given the following information, calculate the cloud top, dew point and freezing level within the cloud. Show **all** workings in the grid provided below.

- condensation level is 3000 ft
- initial temperature of surface air is 18 °C at sea level
- initial temperature of rising air is 21 °C at sea level

ELR = 4°/1000 ft to 2000 ft
 2°/1000 ft from 2000 ft to 5000 ft
 1°/1000 ft from 5000 ft upward

Level (ft)	ELR	DALR/SALR	
15 000	-6	-6.0	Cloud tops
14 000	-5	-4.5	
13 000	-4	-3.0	
12 000	-3	-1.5	
11 000	-2	0.0	Freezing level
10 000	-1	1.5	
9000	0	3.0	
8000	1	4.5	
7000	2	6.0	
6000	3	7.5	
5000	4	9.0	
4000	6	10.5	
3000	8	12	Dew point
2000	10	15	
1000	14	18	
Sea level	18	21	

(a) Cloud top.

Description	Marks
15 000 ft and showed working	2
Showed working above but made calculation error	1
Total	2

(b) Dew point.

Description	Marks
12 °C and showed working	2
Showed working above but made calculation error	1
Total	2

(c) Freezing level in cloud.

Description	Marks
11 000 ft and showed workings	2
Showed working above but made calculation error	1
Total	2

Question 28

(4 marks)

(a) Define Positive Static Stability of an aircraft.

(2 marks)

Description	Marks
An aircraft that has positive static stability tends to return to its original attitude after it has been disturb in flight	1-2
Total	2
Note: Must state 'return to its original attitude' for full marks	

(b) Define Positive Dynamic Stability of an aircraft.

(2 marks)

Description	Marks
An aircraft with positive dynamic stability tends to want to return to its original attitude however will oscillate around that attitude with those oscillations reducing over time	1-2
Total	2
Note: Must state 'return to its original attitude over time' for full marks	

Question 29

(4 marks)

List **four** factors that affect the longitudinal stability of an aircraft in flight.

Description	Marks
Location of centre of gravity in relationship to wing	1
Location of tail plane/or canard in relationship to centre of gravity	1
Thrust/drag line of aircraft	1
Area of or size of tail plane	1
Total	4

Question 30

(6 marks)

- (a) Determine the TAS for a flight conducted for best power. (2 marks)

Description	Marks
174 kt +/- 2 kt	1
Shows working on chart	1
Total	2

- (b) To achieve best power what should the mixture be leaned to and are there any restrictions applied to this setting. (2 marks)

Description	Marks
Leaned to 150 °F rich of peak EGT	1
1650 °F max allowed	1
Must make full statement as above	
Total	2

- (c) Determine the new TAS if the aircraft was required to descend and fly at 4000 ft pressure altitude, while still maintaining 81% power. New OAT 28 °C. (2 marks)

Description	Marks
163 kt +/- 2 kt	1
Shows working on chart	1
Total	2

Question 31

(8 marks)

- (a) What is the visibility for this forecast if **not** flying in the specified VISIBILITY conditions shown. (1 mark)

Description	Marks
9999 or greater than 10 km	1
Total	1

- (b) State in detail the winds and temperature forecast to be expected at 14 000 ft and 0700 h. Show **units** of measurement. (3 marks)

Description	Marks
Wind. 280° True	1
15 kt	1
Temperature minus 6 °C	1
Total	3

- (c) Using plain language, what is meant by each of the abbreviations shown in the WEATHER section of this ARFOR? (4 marks)

Description	Marks
FG Fog	1
BR Mist	1
FU Smoke	1
+FU Heavy smoke	1
Total	4

Question 32

(2 marks)

A pilot is about to order fuel for her aircraft. The following data apply:

- fuel tanks capacity 210 L
- AVGAS specific gravity 0.72.

In order for the aircraft to remain within performance limitations, the **maximum** fuel that can be carried cannot exceed 135 kg.

Determine the maximum number of litres that must be ordered so as to **not** exceed these limitations. Show **all** workings.

Description	Marks
187 L (maximum acceptable answer 187.5 L)	2
Minimum answer 187 L	1
188 L (just over maximum fuel volume). Overloaded aircraft unacceptable	0
Total	2

Question 33

(4 marks)

- (a) What heading would be required to fly and maintain the planned track if a constant 15 kt crosswind was being experienced from the right? (1 mark)

Description	Marks
132° M	1
Total	1
Note: no tolerance as drift is just off the 7°	

- (b) What ground speed would the aircraft be maintaining if it was being subjected to a constant wind 125° M/25 kt? (1 mark)

Description	Marks
95 kt	1
Total	1
Note: groundspeed below/above 95 kt is not an acceptable answer 100% headwind	

- (c) Use the 1 in 60 rule to determine the actual Track Made Good (TMG) if, after travelling 75 miles, the aircraft was 5nm left of track. (2 marks)

Description	Marks
Distance off track: 5 nm in 75 nm = 4 nm in 60 nm	
4 nm in 60 = 4°	1
Direction of drift: left 125 °M less 4° drift = TMG 121 °M	
121 °M	1
Total	2

Question 34

(2 marks)

Using the End of Daylight chart below, calculate last light in LMT on 20 January for Broome (17° 57'S, 122° 14'E). Show **all** workings.

Description	Marks
1905 LMT +/- 2 minutes	2
Showed workings correctly but incorrectly recorded result	1
Total	2

Question 35

(3 marks)

A VFR aircraft is travelling east and passes overhead its initial way point at UTC 1535 and has estimated its next way point at UTC 1621. If the winds are forecast to remain constant and the distance between waypoints is 218 nm,

- (a) determine the planned ground speed. (1 mark)

Description	Marks
Time: 46 minutes; Distance: 218 nm	
GS 284 kt +/- 2 kt	1
Total	1

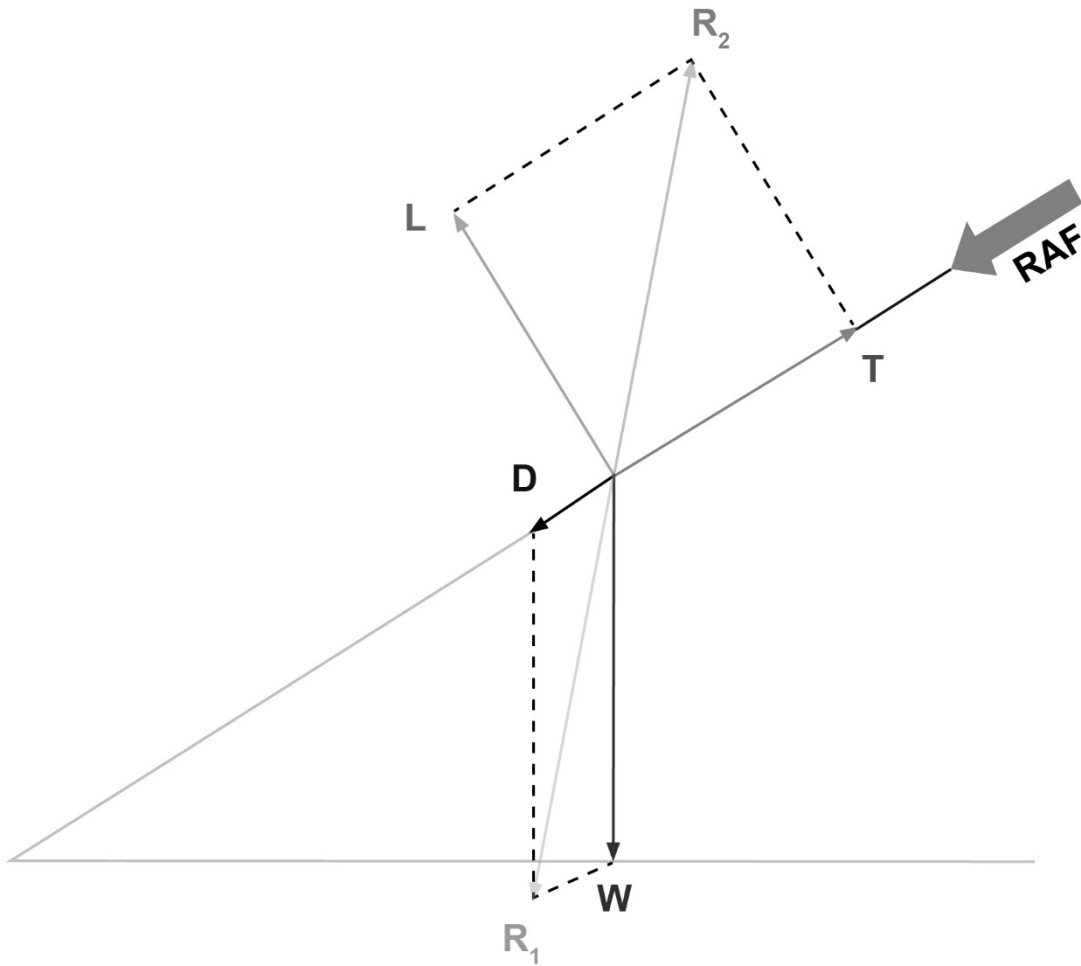
- (b) determine the track error **and** direction of drift experienced if, after travelling 90 miles the aircraft is located 6 miles south of the planned track. (2 marks)

Description	Marks
4°	1
Right drift (South)	1
Total	2

Question 36

(6 marks)

Draw a labelled diagram in the space below, to show the disposition of forces of an aircraft in a climb with power.



Description	Marks
Must show :	
relative airflow (RAF)	1
drag line	1
thrust line greater than drag line	1
lift perpendicular to RAF	1
weight acting straight down	1
resolve with resultants 1 and 2	1
Total	6

Question 37

(3 marks)

Given a time of 0640 LMT and a position of 26° 22'S 147° 20'E, use the Conversion of Arc to Time chart below to convert Local Mean Time (LMT) to UTC. Show **all** workings.

Description	Marks
0640 LMT	
Less Arc conversion 147° = 9 hr 48min	
20' = 1 min 20 sec	
Showed correct workings from arc of conversion chart as above	1
total = 9 hr 50 min +/- 1 min	1
0640 – 0950 = 2050 previous day	
UTC = 2050 +/- 1 min	1
Total	3

Question 38

(2 marks)

- (a) Determine the ground speed of this aircraft if it flies 615 nm in 135 minutes. (1 mark)

Description	Marks
274 kt +/- 3 kt	1
Total	1

- (b) Given a total fuel on board of 275 litres and a fuel flow of 48 litres per hour, determine the safe endurance of this aircraft (in minutes). (1 mark)

Description	Marks
FOB 275 L	
Less fixed reserve 45 min @ 48 L/hr = 36 L	
Less taxi fuel 5 L	
= 234 L/48 L/hr = 290 minutes	
290 minutes +/- 2 minutes	1
Extra tolerance to compensate for some errors in flight computer	
Total	1

Question 39

(6 marks)

Unmanned Aerial Vehicles (UAVs) are now in common use throughout the world to carry out both civil and military tasks; however the ease of availability to the civilian population has raised concerns by governments and the general population in two distinct areas.

State the **two** main areas of concern and explain why each is of particular significance.

Description	Marks
Three marks for each area. Maximum six marks.	
Concern one: Privacy	1
Explains clearly that UAVs can be used to record, photograph and spy on private property	2
States some valid information about UAVs and privacy	1
Concern two: Safety	1
Explains clearly that UAVs utilising controlled airspace are hazards to other aircraft and/or malfunctioning UAVs can cause injury and damage with loss of control	2
States some valid information about UAVs and safety	1
Total	6

Question 40

(7 marks)

Before and during World War II, aircraft crew routinely experienced the symptoms of insufficient oxygen in the blood.

(a) What is this condition called? (1 mark)

Description	Marks
Hypoxia	1
Total	1

(b) Describe **two** major symptoms of this condition. (4 marks)

Description	Marks
Two marks for each symptom. Maximum four marks.	
Describes clearly the symptom	2
Lists a symptom	1
Answers could include, but are not limited to the following:	
<div style="border: 1px dashed gray; padding: 10px; margin: 10px auto; width: 80%;"> <p>For copyright reasons this text cannot be reproduced in the online version of this document, but may be viewed at www.news-medical.net/health/Hypoxia-Symptoms.aspx</p> </div>	
Total	4

(c) Outline why this condition rarely affects commercial flight crew today. (2 marks)

Description	Marks
Outlines why hypoxia rarely affects commercial flight crew today	2
States some valid information about hypoxia and commercial flight crew	1
Answers could include, but are not limited to the following: <ul style="list-style-type: none"> • flight crew awareness • hypoxia training techniques over the last decade mean that these challenges can now be met with safe, accessible and more cost effective training technologies which can only result in better safety through improved defences • better aircraft pressurisation and warning systems • greater understanding of the cause and symptoms associated with hypoxia • stronger regulation as to the requirement for use of supplementary oxygen 	
Total	2

Question 41

(2 marks)

Given that an aircraft is heading 250° M on a relative bearing of 270° on the ADF (Automatic Directional Finder), determine the track to the navigational aid. Use a diagram to assist with your answer or show **all** workings.

Description	Marks
Heading + ADF (RB) = track to station	
$250^\circ \text{M} + 270^\circ = (520^\circ - 360^\circ)$	
$= 160^\circ \text{M}$	1
Used labels and orientated diagram to show how answer obtained	1
<p>The diagram shows a central point with four arrows pointing to boxes labeled 'north', 'south', 'west', and 'east'. A line points from the center to a box labeled 'Heading 250°'. A curved arrow indicates a 90-degree angle from the 'north' line down to the 'Heading 250°' line. Another line points from the center to a box labeled 'Track to station 160°'. A box labeled 'RB 270°' is placed between the 'north' and 'Heading 250°' lines.</p>	
OR Used formula to show workings (no diagram required)	
Total	2

Question 42**(2 marks)**

Freight and passenger jet aircraft built before 1977 have been progressively banned from utilising airports in built-up areas throughout the world including Perth. Why does this ban apply to them and not to jet aircraft built after 1977?

Description	Marks
Noise abatement policies	1
Older aircraft exceed new adopted noise limitations where as new aircraft have been designed to operate within the established limitations in order to meet market forces, i.e. airline customer operating requirements	1
Total	2

Question 43**(4 marks)**

State the correct name for the following airspeed limitation abbreviations:

Description	Marks
• Va – maximum manoeuvring speed	1
• Vb – turbulence penetration speed	1
• Vne – never exceed speed	1
• Vs – stall speed	1
Total	4

Question 44

(6 marks)

Describe the basic operating principles of a turbocharger fitted to a piston-engined aircraft.
 (Use the space below to draw a diagram with your answer if desired.)

Description	Marks
<div style="border: 1px dashed gray; padding: 10px; margin: 10px auto; width: 80%;"> <p>For copyright reasons this text cannot be reproduced in the online version of this document, but may be viewed at www.turbo-tec.eu/uk/turbocharger-principle-of-operation/</p> </div>	1
	1-2
	1
	1-2
Total	6
<p>Example of diagram</p> <div style="border: 1px dashed gray; padding: 10px; margin: 10px auto; width: 80%;"> <p>For copyright reasons this image cannot be reproduced in the online version of this document, but may be viewed at www.turbochargersnz.com/about-turbochargers</p> </div>	

Question 45

(6 marks)

Case study

- (a) With regard to Threat and Error Management (TEM), state **one** of the threats that would be relevant in the case study on page 28. (1 mark)

Description	Marks
One mark for a relevant threat.	
Answers could include: <ul style="list-style-type: none"> • Low cloud, rain or weather • Pressure to conduct flight 	1
Total	1

- (b) Why would this be considered a threat? (1 mark)

Description	Marks
It is an event that could impact on the flight which is outside the control of the flight crew/pilot	1
Total	1

- (c) Which sense organ do you believe was causing the illusion that the pilot was experiencing? (1 mark)

Description	Marks
Semi-circular canals or Vestibular apparatus	1
Total	1

- (d) Name the illusion that you believe the pilot experienced that caused the undesired aircraft state. (1 mark)

Description	Marks
The leans (spatial disorientation) – a pilot may perceive straight and level flight when in actually the plane will be in a balanced turn – banked turn	1
Total	1

- (e) What manoeuvre had the aircraft entered to cause the rapid descent? (1 mark)

Description	Marks
Spiral dive or graveyard spiral	1
Total	1

- (f) What was the most likely cause of the tunnel vision the pilot experienced as a result of the recovery manoeuvre of the aircraft after leaving the cloud? (1 mark)

Description	Marks
Excess G's pulled in the spiral dive and pull out manoeuvre	1
Total	1

ACKNOWLEDGEMENTS

- Question 40(b)** Mandal, A. (n.d.). *Hypoxia symptoms*. Retrieved June, 2016, from www.news-medical.net/health/Hypoxia-Symptoms.aspx
- Question 40(c)** Cable, G.G., & Westerman, R. (2010, August). Hypoxia recognition training in civilian aviation: A neglected area of safety. *Journal of the Australasian Society of Aerospace Medicine (JASAM)*, 5(1), p. 6. Retrieved June, 2016, from www.hypoxic-training.com/new_abstracts/2010_JASAM_Cable_Westerman_Neglected_Area_of_Safety_Normobaric_Hypoxia_Training.pdf
- Question 44** Turbo-Tec Ltd. (n.d.). *Turbocharger—principle of operation* [Text]. Retrieved June, 2016, from www.turbo-tec.eu/uk/turbocharger-principle-of-operation/
- Turbo-Tec Ltd. (n.d.). *Turbo compressor* [Image]. Retrieved June, 2016, from www.turbochargersnz.com/about-turbochargers

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