Government of **Western Australia**
School Curriculum and Standards Authority

AVIATION

ATAR course examination 2017

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

Section Two: Short answer 80% (116 Marks)

Question 21 (4 marks)

(a) Calculate airfield pressure altitude. Show **all** workings. (2 marks)

Description	Marks
(ISA QNH – Actual QNH) X 30 ft + Elevation	
(1013 – 1017) x 30 ft + Elevation 229 ft	1
-120 + 229 = 109 ft	
109 ft	1
Total	2

(b) Calculate airfield density altitude. Show **all** workings. (2 marks)

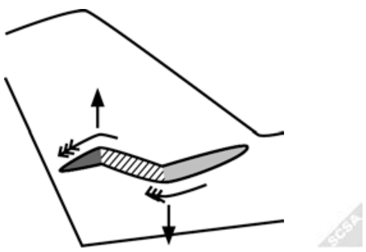
Description	Marks
(ISA temperature Deviation x 120 ft) + PA = DA	
(28 °C – 15 °C) x 120 ft + PA 109 ft = DA	1
1560 ft + 109 ft = 1669 ft	
1669 ft	1
Total	**2**

Question 22 (4 marks)

(a) State the purpose of the elevator trim. (1 mark)

Description	Marks
To relieve pilot workload and/or reduce control loading	1
Total	**1**

(b) Explain the operational principles of the elevator trim. Draw a diagram to assist with your explanation. (3 marks)

Description	Marks
Application of a trim on the elevator moves a small tab which acts as an aerofoil to produce a force either up or down depending on its positioning. This will allow this force to support some of the pressure being exerted by the airflow over the elevator	1–2
Diagram relevant and useable to reflect airflow and lift vectors 	1
Total	**3**

Question 23 **(2 marks)**

A pilot is about to order fuel for their 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 100 kg.

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

Description	Marks
100/0.72 =	1
= 138 L (Maximum acceptable answer 138.8 L)	1
Total	**2**
Note: 139 L (just over maximum fuel volume). Overload aircraft unacceptable - no marks	

Question 24 **(4 marks)**

(a) What heading would be required to be flown to maintain the planned track? (1 mark)

Description	Marks
030° M (+0/1°)	1
Total	**1**

(b) What ground speed would the aircraft be maintaining? (1 mark)

Description	Marks
Effective TAS138 + tail wind 6 kts	
GS 144 kt (+/–2 kt)	1
Total	**1**

(c) Use **only** the 1 in 60 rule to determine the actual Track Made Good (TMG) if, after travelling 20 miles, the aircraft was 4 nm left of track. (2 marks)

Description	Marks
Distance of track: 4 nm in 20 nm = 12 nm in 60 nm	
12 nm in 60 nm = 12°	1
Tracking 020° M so if 12° left of track then left drift	
TMG = 008° M	1
Total	**2**

Question 25 **(6 marks)**

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

Description	Marks
161 kt (+/–1 kt)	2
Shows correct working on chart but appears to have misread speed	1
Total	**2**

(b) Determine the new TAS if the aircraft was set up to fly 75% power for best economy while still maintaining the advised altitude. (2 marks)

Description	Marks
159 kt (+/–1 kt)	2
Shows correct working on chart but appears to have misread speed	1
Total	**2**

(c) To achieve best economy, what should the mixture be leaned to show? (2 marks)

Description	Marks
Leaned to 50 °F rich of peak EGT	1
1650 °F max allowable	1
Must make full statement as above	
Total	**2**

Question 26 **(4 marks)**

(a) Determine the planned ground speed. (1 mark)

Description	Marks
Time 40 minutes Distance 160 nm	
GS 240 kt (no margin exact answer)	1
Total	**1**

(b) After 40 nm the pilot found that he was 4 nm south of track. Determine the required heading to track direct to the destination waypoint. Show **all** workings. (3 marks)

Description	Marks
4 nm in 40 nm = 6 nm in 60 nm = 6° TE	1
4 nm in 120 nm = 2 nm in 60 nm = 2° CA	1
Aircraft travelling west and has drifted to south. Heading change to north required 270° M + 6° TE + 2° CA = 278° M	1
Total	**3**
If student demonstrates principles however makes error in TE or CA give allowance for such errors in final heading calculation only	

Question 27 **(3 marks)**

Using the End of daylight chart below, calculate last light in LMT on 10 February for Kalgoorlie (30° 45’S, 121° 30’E). Show **all** workings.

Description	Marks
1920 LMT (–1/+2 minutes)	2
1920 LMT (–2/+3 minutes)	1
Showed workings correctly to support answer given	1
Total	**3**
Note: Showed workings correctly but incorrectly recorded result outside tolerance above - one mark.	

Question 28 **(3 marks)**

(a) Determine the ground speed of this aircraft if it flies 305 nm in 105 minutes. (1 mark)

Description	Marks
174 kt (+1/–0 kt)	1
Total	**1**

(b) Given a total fuel on board prior to taxi of 185 litres and a fuel flow of 36 litres per hour, determine the safe endurance of this aircraft (in minutes). Show **all** workings. (2 marks)

Description	Marks
FOB 185 L	
Less fixed reserve 45 min @ 36 L/hr = 27L	1
Less taxi 5L	
= 153 L @ 36 L/hr = 255 minutes (+/–0 min)	1
Total	**2**
Note: One mark if they showed all working to include all deductions required with a single nominal identifiable error in mathematical calculations only	

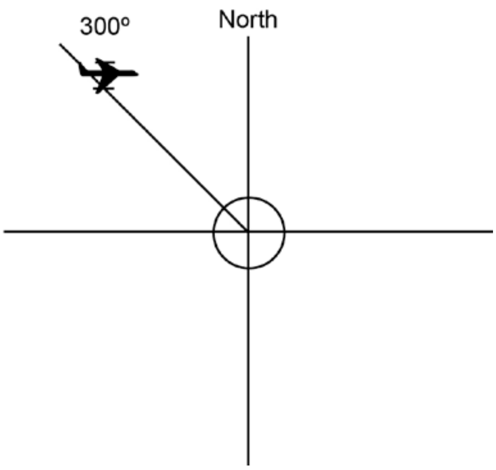
Question 29 **(2 marks)**

The following data apply to an aircraft:

- heading 090° M
- navigation instrumentation
  DME – 30 nm
- VOR information
  OBI 120
  flag shows TO
  CDI – centred.

Plot the aircraft's position and orientation as accurately as possible using your navigational plotter and WAC scale ruler on the basic orientation diagram below.

Note: Circle represents collocated VOR/DME.

Description	Marks
 Showed aircraft in correct position and orientation in heading	2
Showed aircraft in correct position but incorrectly orientated in heading	1
Total	**2**

Question 30 **(4 marks)**

Compare primary surveillance radar (PSR) to secondary surveillance radar (SSR) and state **two** advantages of each.

Description	Marks
Primary radar – advantages	
No on-board equipment in aircraft required is independent unit	1
Can be used to monitor movement of all type of vehicle to include vehicles on ground	1
Secondary radar – advantages	
Interrogation type system – provides identification and altitude of aircraft	1
Not degraded by weather and or size/radar characteristics of aircraft	1
Total	**4**

Question 31 **(5 marks)**

(a) State **three** of the environmental conditions that would be required for the formation and continuance of an extensive dust storm in Central Australia. (3 marks)

Description	Marks
Dry sandy/dusty surface and atmosphere	1
Unstable atmosphere	1
Strong winds and/or gust fronts	1
Total	**3**

(b) Explain how these three environmental conditions interact with each other to form and sustain the dust storm. (2 marks)

Description	Marks
Wind blowing over sandy dusty surface lift dust into air	1
Unstable atmosphere allowing dust to rise	1
Example: In order for a dust storm to develop the wind has to be strong enough to firstly dislodge the dust particles from the surface and then lift them up into the atmosphere. The minimum wind speed depends on the size of the dust particles, with larger particles needing higher wind speeds to become airborne. In Australia, the minimum wind speed required is about 30 km/hr. Once airborne, to lift the dust to high levels, the atmosphere must be unstable. This instability can often be created by intense surface heating or the passage of a trough or cold front across the region. Once aloft the dust particles move away from the source region under the influence the pre-dominant upper level winds	
Total	**2**

Question 32 **(4 marks)**

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

TAS	Track magnetic	Winds magnetic	Angle of drift	Direction of drift	Heading	GS
115 kt	070°	125/25				

Description		Marks
Angle of drift	10° (+1/–0)	1
Direction of drift	left	1
Heading	080° M (+1/–0)	1
GS	99 kt (+3/–1)(Eff TAS 113 kt – headwind 14 kt)	1
	Total	**4**

Question 33 **(11 marks)**

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

Description	Marks
1040 m (+/–10 m)	2
1040 m (+/–20 m)	1
Total	**2**
Note: Incorrect answer or outside tolerances but workings on chart with nominal apparent error in reading final result – one 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
One mark for each correct answer in the climb cruise and descent columns only					
	Climb	**Cruise**	**Descent**	**Total**	
Fuel (gal)	2 (+1/–0)	28.5 (+/–1)	1 (+1/–0)	31.5	1–3
Time (min)	4 (+1/–0)	125 (+/–2)	5 (+1/–0)	134	1–3
Distance (nm)	9 (+/–1)	303 (+/–2)	12 (+/–1)	**325 nm**	1–3
				Total	**9**
Note: Use the total column only to assist in resolving any issues with tolerances in each row (Maximum one mark can be allocated for each of fuel and time if total comes within stated tolerance). Row cannot exceed maximum of three marks.					

Question 34 **(21 marks)**

(a) Given that the aircraft in this case study was flying at FL110 and the opposite direct traffic was flying at an altitude of 10 000 ft, explain why they passed with so little altitude between them. (2 marks)

Description	Marks
They were operating on different pressure datums or settings **or** One aircraft was operating on area QNH while the other was on 1013	1
The buffer provided by the transition layer was reduced due to the low atmospheric pressure	1
Total	**2**

(b) Identify **two** key threats and **two** key errors associated with all aspects of the descent from Fl150 to A080. Give a reason for your answer for each threat and each error. (8 marks)

Description	Marks
Two marks for each threat. One mark for threat and one mark for reason	
Threats could include: • weather: low pressure 983 HPA (transition layer depth increased) • traffic: opposite direction traffic A100.	 1–2 1–2
Two marks for each error. One mark for error and one mark for reason	
Errors could include: • descended into the transition layer – QNH 983 makes transition layer • attempted to pick way through line of thunderstorms – diversion around storm should have been carried out rather than choosing to fly in close proximity of thunderstorms.	 1–2 1–2
Total	**8**
Accept other relevant answers	

(c) What would be the **most** likely trigger for the thunderstorms experienced during this flight? (2 marks)

Description	Marks
Horizontal convergence and uplift of air	1
As a result of the cold front	1
Total	**2**

(d) With which season of the year would the weather conditions experienced on this flight be **most** commonly associated? (1 mark)

Description	Marks
Winter	1
Total	**1**

(e) Although the case study does not detail the damage received by the aircraft, outline **two** hazards that could have caused the damage. (4 marks)

Description	Marks
Two marks for each hazard. Maximum four marks	
Hazard and outline could include: • severe turbulence – excessive g force causing structural limitations to be exceeded • severe hail – damage to aircraft from impact of hail • lightning – lightning strike on aircraft causing electrical damage or structural damage i.e. hole in skin.	 1–2 1–2 1–2
Total	**4**
Accept other relevant answers	

(f) What term would be used to describe the **most** applicable temperature lapse rate while the aircraft was inside the storm cell? State the amount of the lapse rate. (2 marks)

Description	Marks
Saturated Adiabatic Lapse Rate **or** SALR	1
1.5 °C/1000 ft	1
Total	**2**

(g) The pilot had a valid ARFOR, TAF, TTF and METAR available for Perth Airport (YPPH). Immediately after leaving the storm, which forecast type would be the **most** appropriate to use for the arrival at YPPH? Give a reason for your answer. (2 marks)

Description	Marks
TTF	1
TTF is current and supersedes the TAF during its validity period (3 hrs)	1
Total	**2**

Question 35 **(7 marks)**

(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)

Position	Weight (lb)	Arm (in)	Moment (lb/in)
Aircraft	2335.8		195086.0
Front	340.0	85.5	29070.0
Centre	25.0	118.1	2952.5
Rear	340.0	157.6	53584.0
Fwd baggage	unavailable	42.0	0
Aft baggage	0	178.7	0
Zero fuel weight	3040.8	92.3	280692.5

Description	Marks
Weight 3040.8lb	1
COG 92.3 in	1
Moment ZFW 280692.5lbin	1
Completed all other moments above ZFW total	1
Total	**4**
Note: Errors in additions of moments and weights may be taken into account for COG calculation only.	

(b) The aircraft is then loaded with 438 lb of fuel. Complete the table below to show the weight, position of the centre of gravity and moment for the aircraft at ramp prior to taxi. (3 marks)

Position	Weight (lb)	Arm (in)	Moment (lb/in)
Fuel	438	93.6	40996.8
Ramp weight	3478.8	92.48	321689.3

Description	Marks
Ramp weight 3478.8 lb	1
COG 92.48 in	1
Moment calculation Fuel 321689.3	1
Total	**3**
Note: Errors in ZFW totals may be taken into account to determine Ramp weight and COG position provided fuel moments calculated correctly 40996.8 lb/in.	

Question 36 **(4 marks)**

State the **two** main factors affecting directional stability in an aircraft. State how each could increase directional stability. (4 marks)

Description	Marks
Two marks for each factor. One mark for factor and one mark for how it increases stability	
Size of vertical stabiliser (tail fin) – Increase size surface area greater stability	1–2
Position of centre of gravity as far forward as allowable – The further forward the centre of gravity the greater the arm the greater the Moment for a smaller force applied	1–2
Total	**4**

Question 37 **(3 marks)**

Threat and Error Management (TEM) forms a large part of the strategies adopted by the aviation industry globally to enhance safety. Using a scenario based example, explain how the application of TEM can be utilised pre-flight by a pilot. (3 marks)

Description	Marks
Explanation includes:	
Identify and predict issues or events that may affect them	1
Plans accordingly to account for these hazards or develop and implement confer measures for these threats	1
Example: Threat and error management can be utilised to identify/predict issues operational and environmental threats, hazards and events that may arise during a flight based on understanding and utilising all available data to plan as thoroughly as possible to mitigate the risks	
States a scenario based example	1
Example: Prior assessment of weather during the planning phase allows for suitable diversions to be considered in the flight plan and allow fuel contingencies to cover diversions alternates holds etc	
Total	**3**
Accept other relevant answers	

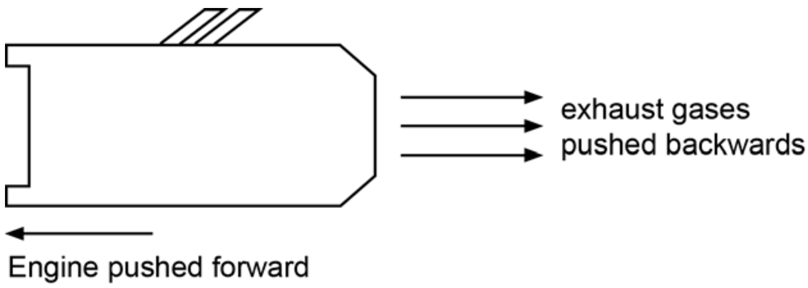
Question 38 **(3 marks)**

Given a time of 1935 Local Mean Time (LMT) and a position of 32° 15'S 123° 20'E, use the Conversion of Arc to Time chart below to convert LMT to Coordinated Universal Time (UTC). Show **all** workings.

Description	Marks
1935 LMT	
Less Arc conversion 123° = 8 hrs 12 min	
20' = 1 min 20 sec	
Showed correct workings from arc of conversion chart as above	1
Total = 8 hrs 13 min (+1/–0 min)	1
1935 – 8 hrs 13 min = 1122 UTC same day	
1122 UTC (+1/–0 min)	1
Total	**3**

Question 39 **(3 marks)**

Define Newton's Third Law and give an example to demonstrate its application in aviation.
(Draw and label a diagram if it helps you to explain.) (3 marks)

Description	Marks
Definition:	1
Every action has an equal and opposite reaction	
Example	
Propulsion of a Jet engine	1
Engine pushed forward, exhaust gases pushed backward	1
Diagram can be self-explanatory eg. Jet engine 	
Total	**3**
Accept other relevant aviation examples	

Question 40 **(4 marks)**

If the term CAVOK was shown in the forecast for an aerodrome, what specific information would that indicate to a pilot?

Description	Marks
One mark for each of the following	
The visibility is 10 km or more	1
There is no significant cloud below 5000 ft AGL or below the 25 nm MSA	1
There is no cumulonimbus or towering cumulus	1
There is no phenomena reducing visibility/dust devils etc.	1
Total	**4**

Question 41 **(4 marks)**

Many low-cost carriers (LCCs) have been launched throughout the world in recent years: for example, Jetstar Airways, AirAsia and Tigerair.

The impact and success of these LCCs depends on a variety of market conditions. Outline **four** key components that would contribute to the ongoing success of a new LCC entering the market.

Description	Marks
One mark for each key component.	
Key components could include: • a significant middle class to drive demand and growth • air transport liberalisation and privatisation of monopolistic state-owned carriers • low-cost transport infrastructure • qualified workers • appropriate safety and security regulations • cost-effective financing • fuel availability and cost • good governance/corporate management • desirable destinations • reasonable pricing structure.	1–4
Total	**4**
Accept other relevant answers	

Question 42 **(11 marks)**

(a) Using the formula provided, determine the maximum amount of baggage that could be added to the aft baggage compartment for both zero fuel weight and take-off weight to stay within the centre of gravity for both forward and aft limits. Show **all** workings. (4 marks)

$$\text{Weight to add} = \frac{\text{Gross weight x desired change of centre of gravity}}{\text{Distance between loading station and desired centre of gravity}}$$

Description	Marks
Two marks for Zero fuel weight Aft baggage amount	
2950 lb x 3.2 / 82.7	1
114.1 lb	1
Two marks for Take-off weight Aft baggage amount	
3500 lb x 3.1 / 82.7	1
131.2 lb	1
Total	**4**

Question 42 (continued)

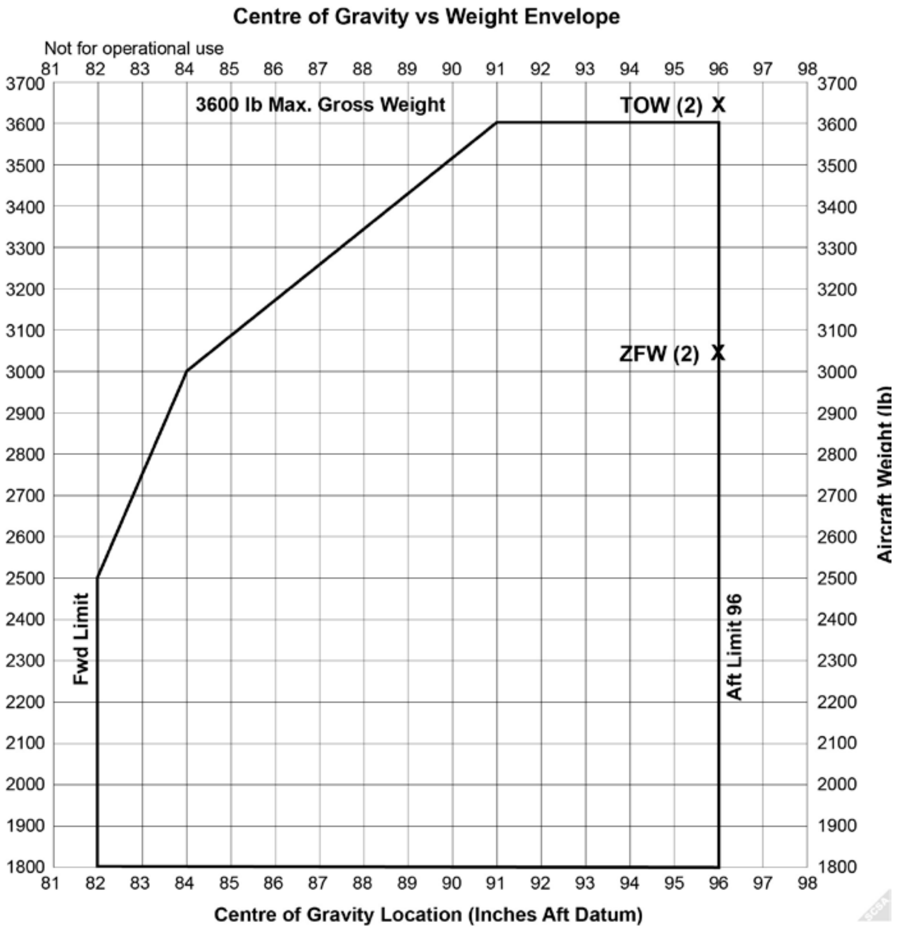
(b) Complete the new weights and centre of gravity positions for zero fuel weight (2) and take-off weight (2) based on your answers from part (a) above. (2 marks)

	Weight (lb)	Arm (in)	Moment (lb/in)
Aft baggage	114	178.7	20372
Zero fuel weight (2)	3064	96	294132

Aft baggage	131	178.7	23409
Take-off weight (2)	3631	96	348559

Description	Marks
Completes table as above using moments and calculated arm of 96 in and Zero fuel weight (2) of 3064 lb	1
Completes table as above using moments and calculated arm of 96 in and Take-off weight (2) of 3631 lb	1
Total	**2**
Note: If errors in weights are carried through from part (a) award full marks for appropriate use of these incorrect figures.	

(c) Use the centre of gravity vs weight chart provided to plot and label both the zero fuel weight (2) and take-off weight (2) position. (2 marks)



Description	Marks
Plotted ZFW (2) weight and arm as shown on chart	1
Plotted TOW (2) weight and arm as shown on chart	1
Total	**2**

(d) On the basis of your calculations and observations, determine the maximum baggage that can be added to the aircraft and still remain within **all** limitations. Explain your answer. (3 marks)

Description	Marks
Maximum baggage restricted to 100 lb **or** figure zero fuel weight calculations only	1
Although calculations conducted for maximum potential showed that 114 lb could be added at ZFW and 131 lb could be added at TOW	1
both of these amounts would cause the aircraft to exceed the maximum structural weight limit (3600 lb) when fully loaded for flight	1
Total	**3**
Note: If stated maximum baggage was 114 lb and candidate stated ZFW was the most limiting remaining inside envelope and under structural limits - one mark.	

ACKNOWLEDGEMENTS

Question 31(b) Excerpt adapted from: Bureau of Meteorology. (n.d.). *What is a dust storm?* Retrieved November, 2017, from www.bom.gov.au/nsw/sevwx/facts/dust.shtml
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