Government of **Western Australia**
Curriculum Council

WACE
Western Australian Certificate of Education

Western Australian Certificate of Education
Examination, 2010

Question/Answer Booklet

AVIATION
Stage 3

Please place your student identification label in this box

Student Number: In figures | | | | | | | | |

In words _____

_____

Time allowed for this paper
Reading time before commencing work: ten minutes
Working time for paper: two and a half hours

Materials required/recommended for this paper
To be provided by the supervisor
This Question/Answer Booklet
Multiple-choice Answer Sheet
Aviation Appendices Booklet comprising:

Appendix A	WAC Excerpt (Sydney)
Appendix B	PA-32RT Fuel, Time and Distance to Climb Performance Chart
Appendix C	PA-32RT Fuel, Time and Distance to Descend Performance Chart
Appendix D	PA-32RT Cruise Performance Chart
Appendix E	PA-32RT Take-Off Weight Chart
Appendix F	End of Daylight Graph
Appendix G	Time-arc Conversion

To be provided by the candidate
Standard items: pens, pencils, eraser, correction fluid/tape, ruler, highlighters

Special items: Flight computer, navigational ruler and protractor, non-programmable calculators satisfying the conditions set by the Curriculum Council for this course

Important note to candidates
No other items may be taken into the examination room. It is **your** responsibility to ensure that you do not have any unauthorised notes or other items of a non-personal nature in the examination room. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.

Structure of the examination

The Aviation examination comprises a written examination worth 80 per cent of the total examination score and a practical examination worth 20 per cent of the total examination score.

Structure of this paper

Section	Number of questions available	Number of questions to be answered	Suggested working time (minutes)	Marks available	Percentage of total exam
Section One: Multiple-choice	20	20	30	20	16
Section Two: Short Answer	20	20	120	80	64
				Total	80

Instructions to candidates

1. The rules for the conduct of Western Australian external examinations are detailed in the *Year 12 Information Handbook 2010.* Sitting this examination implies that you agree to abide by these rules.

2. Answer the questions according to the following instructions.

   Section One: Answer all questions on the separate Multiple-choice Answer Sheet provided. For each question shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. If you make a mistake, place a cross through that square, do not erase or use correction fluid, and shade your new answer. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

   Sections Two: Write answers in this Question/Answer Booklet.

3. Working or reasoning should be shown clearly when calculating or estimating answers.

4. You must be careful to confine your responses to the specific questions asked and to follow any instructions that are specific to a particular question.

5. Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.
   - Planning: If you use the spare pages for planning, indicate this clearly at the top of the page.
   - Continuing an answer: If you need to use the space to continue an answer, indicate in the original answer space where the answer is continued, i.e. give the page number. Fill in the number of the question(s) that you are continuing to answer at the top of the page.

See next page

Section One: Multiple-choice **16% (20 Marks)**

This section has **20** questions. Answer **all** questions on the separate Multiple-choice Answer Sheet provided. For each question shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. If you make a mistake, place a cross through that square, do not erase or use correction fluid, and shade your new answer. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Suggested working time: 30 minutes.

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1. On a Lambert Conformal Conic projection, the position where the cone slices into the Earth is known as the

   (a) limit of projections.
   (b) mid-standard parallel.
   (c) prime meridian.
   (d) standard parallels.

2. An aircraft is cruising at A035 and the pilot decides to climb to FL125 at a constant 500 feet per minute. If the ground distance travelled during the climb was 45 nm, what was the average ground speed experienced during this climb?

   (a) 108 kt
   (b) 135 kt
   (c) 120 kt
   (d) 150 kt

3. An aircraft is tracking 115°T. The magnetic variation for the area is 10°E. The aircraft is tracking outbound from an NDB with a steady indication of 185° on the ADF. What is the aircraft's magnetic heading?

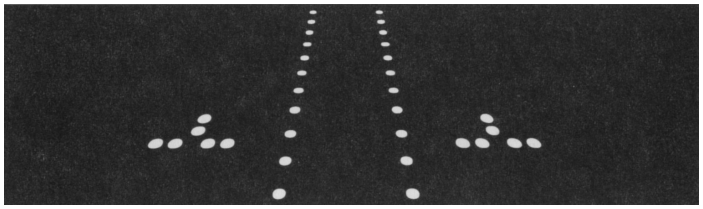
   (a) 100°
   (b) 105°
   (c) 110°
   (d) 115°

4. On which radial would an aircraft be located when its VOR display is as shown below?

   (a) 254°
   (b) 249°
   (c) 259°
   (d) 269°

See next page

5. On final approach to the runway, a pilot observes the white guidance lights shown below. This indicates that the aircraft is



(a) above the correct approach path.
(b) dangerously low.
(c) below the correct approach path.
(d) on the correct approach path.

6. The part of the ear most involved with balance is the

(a) Eustachian tube.
(b) sinus.
(c) vestibular apparatus.
(d) cochlea.

7. A pilot is planning a flight with the following information.

The flight planned track of 120°T	W/V 005°T/20 kt
Aircraft TAS 135 kt	Magnetic Variation 7°W

Given the above conditions, the heading and groundspeed are closest to

(a) 119°M and 143 kt
(b) 122°M and 116 kt
(c) 101°T and 128 kt
(d) 128°T and 143 kt

8. Winds in the lower levels of the stratosphere generally flow from the west. The primary reason for this is

(a) the Coriolis effect.
(b) they are in the same direction as the Earth's rotation.
(c) they are in the opposite direction to the Earth's rotation.
(d) the jet stream effect.

9. Which of the following statements about clouds is the most accurate?

(a) Cirrus cloud is composed of ice crystals.
(b) Stratus clouds are usually present in an unstable atmosphere.
(c) Cumulus clouds are usually associated with an inversion layer.
(d) Cumulonimbus clouds usually form when fog begins to lift due to the heating effects of the Sun.

See next page

10. An aircraft that is flying south from the centre of a high pressure area in the southern hemisphere is most likely to experience a

    (a) headwind.
    (b) tailwind.
    (c) drift to the west.
    (d) drift to the east.

11. As the air near the base of a mountain heats during the day, the most likely local wind that will be produced is

    (a) a Föhn wind.
    (b) an anabatic wind.
    (c) a gradient wind.
    (d) a katabatic wind.

12. The flying conditions above and below cumulonimbus cloud respectively are usually

    (a) turbulent, smooth.
    (b) smooth, turbulent.
    (c) turbulent, turbulent.
    (d) smooth, smooth.

13. Supersonic airflow

    (a) chokes in a supersonic venturi.
    (b) conforms to Bernoulli's Law.
    (c) experiences difficulty in negotiating sharp corners.
    (d) accelerates through a shock wave.

14. Under which of the circumstances described below is a helicopter most likely to experience retreating blade stall?

    (a) The pilot initiates a sudden and sustained forward acceleration.
    (b) The angle of attack of the retreating blade is too small.
    (c) The helicopter is being flown too fast.
    (d) The helicopter has flown into a severe down-draft.

15. A shock stall is similar to a conventional stall in that

    (a) both can occur at any airspeed.
    (b) both can occur at any angle of attack.
    (c) the pilot must accelerate to recover.
    (d) lift is destroyed and airflow separation occurs.

See next page

16. For a helicopter in flight, the phenomenon known as transverse flow effect is the tendency for it to

    (a) tilt to one side as it accelerates forward.
    (b) pitch upward when slowing abruptly.
    (c) translate sideways in the hover.
    (d) yaw to the left when transitioning to forward flight.

17. Cyclic stick movements are transmitted by a mechanical linkage to the rotor pitch horns via the

    (a) collective pitch control.
    (b) anti-torque control.
    (c) swash plate.
    (d) flapping hinge.

18. At night, by looking to the side of (rather than straight at) dimly-lit ground objects, pilots will usually

    (a) be less susceptible to spatial disorientation.
    (b) not lose their dark adaptation.
    (c) distinguish colours more readily.
    (d) see the objects more clearly.

19. Which of the following is **not** a symptom of hyperventilation?

    (a) dizziness
    (b) tingling sensation in fingers and toes
    (c) bluish discolouration of lips and fingernails
    (d) rapid heart rate

20. The main poisonous gas produced by piston and gas turbine engines is

    (a) carbon monoxide.
    (b) carbon dioxide.
    (c) nitrogen dioxide.
    (d) methane.

End of Section One

See next page

Section Two: Short answer **64% (80 Marks)**

This section has **20** questions. Answer **all** questions. Write your answers in the spaces provided.

Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.

- Planning: If you use the spare pages for planning, indicate this clearly at the top of the page.
- Continuing an answer: If you need to use the space to continue an answer, indicate in the original answer space where the answer is continued, i.e. give the page number. Fill in the number of the question(s) that you are continuing to answer at the top of the page.

Suggested working time: 120 minutes.

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21. Given a pressure altitude of 8000 feet, an outside air temperature of ISA + 10°C, a ground speed of 210 knots, a tailwind of 30 knots and a fuel flow of 120 litres per hour, use your flight computer to determine the following:

    (a) density altitude (1 mark)

    (b) calibrated air speed (CAS) (1 mark)

    (c) fuel used after travelling a ground distance of 66 nm (1 mark)

22. Considering the form of the Earth and navigation, explain what is meant by the following terms:

    (a) magnetic variation (1 mark)

    (b) isogonal (1 mark)

See next page

23. A private VFR flight is being planned from Canberra ACT to Young NSW, using CAAP234-1 guidelines for fuel requirements. Use the flight information in the table below to answer the questions about the flight.

TAS	130 knots
Head wind	10 knots
Fuel flow	45 litres/hour
Taxi reserve	8 litres
Fixed reserve	45 minutes
Flight time	39 minutes
Track	325°M

(a) Determine the **minimum** fuel quantity required to be on board prior to taxi. (1 mark)

(b) Determine the ground distance from Canberra to Young. (1 mark)

(c) On arrival at Young, the fuel was checked and it was found that an **additional** six minutes of fuel remained in the tanks. What was the **actual** average ground speed that had been experienced? (1 mark)

(d) After determining that the highest en-route terrain is 3200 feet and the lowest forecast cloud base is at 7000 feet, what is the correct altitude at which to plan this flight to Young? (1 mark)

24. An aircraft with a TAS of 125 knots is tracking 270°M in an area where the wind is 160°T at 20 knots. Given that the area has a magnetic variation of 10°E, calculate the following:

(a) Drift (1 mark)

(b) Magnetic heading (1 mark)

(c) Ground speed (1 mark)

See next page

Refer to the Sydney WAC excerpt in Appendix A to answer Questions 25 and 26

25. An aerodrome is located approximately 75 nm east of Canberra Airport on a bearing of 070°M.

(a) What is the name of this aerodrome? (1 mark)

(b) What are the latitude and longitude of this aerodrome? (1 mark)

Latitude: _____ Longitude: _____

26. An aircraft departed from Canberra at 2340 UTC to fly directly to Wollongong (34° 34'S, 150° 47'E). No allowance was made for any wind that might be blowing. After 22 minutes the aircraft was overhead the township of Wingello (34° 42'S, 150° 09'E).

Using the 1 in 60 rule **and showing all your working**, calculate the

(a) track error (1 mark)

(b) track made good (1 mark)

(c) closing angle (1 mark)

(d) change of heading required to fly directly to Wollongong Airport (1 mark)

(e) new estimated time of arrival over Wollongong Airport, if the newly–calculated ground speed remains constant (1 mark)

See next page

27. (a) Explain the principles of operation of the Automatic Dependent Surveillance Broadcast (ADSB) system. (2 marks)

(b) State two advantages of ADSB compared with the current air traffic management system in Australia. (2 marks)

(c) Explain the operation of Distance Measuring Equipment (DME). (2 marks)

(d) State **two** specific items of information that DME displays for a pilot. (1 mark)

See next page

28. **Use Appendices F and G to help answer the following question.**
Calculate the time for the end of daylight on 5 January at an aerodrome that is located at 34° 34'S, 150° 47'E. Show all working and give your final answer in Eastern Standard Time (EST). (3 marks)

Answer: _____

29. (a) In supersonic aerodynamics, what is a shock wave? (1 mark)

_____

_____

_____

(b) Use a labelled diagram to show the formation of a normal shock wave on a conventional subsonic aerofoil. (2 marks)

(c) What is the difference between normal and oblique shock waves? (1 mark)

_____

_____

_____

_____

_____

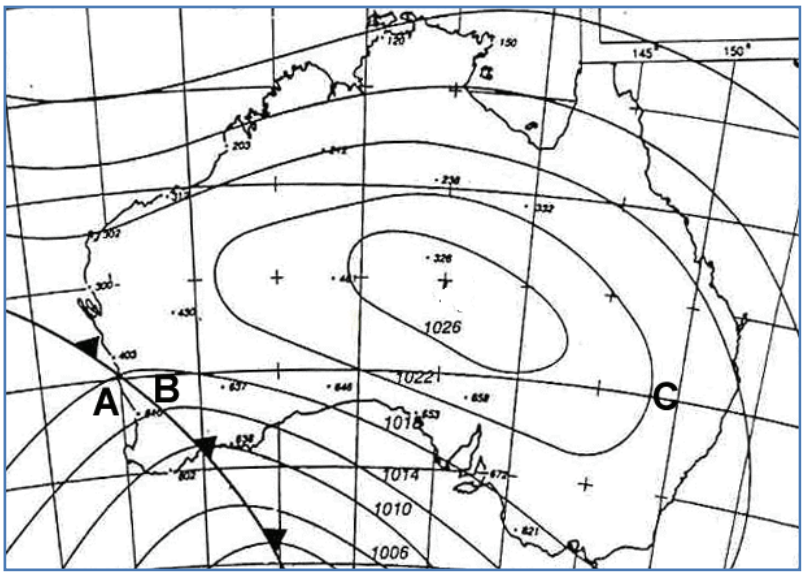
30. (a) In helicopter aerodynamics, what is meant by dissymmetry of lift? (2 marks)

(b) What compensation is made in the design of a helicopter to allow for dissymmetry of lift? (2 marks)

31. In the summer, the south-western corner of Western Australia is generally hot and dry. Explain briefly why these conditions occur, addressing

- the type and position of the pressure system that produces the conditions;
- the direction of the prevailing winds; and
- why they are hot and dry. (3 marks)

See next page



32. Study the preceding synoptic chart and answer the following questions.

(a) Identify the dominant pressure system on the chart, explaining the reason for your choice. (1 mark)

(b) Would the temperature at A be higher or lower than that at B? (1 mark)

(c) What would you forecast to be the wind direction at C? (1 mark)

(d) State the QNH for an airfield located at C. (1 mark)

See next page

33. Read the excerpt from the area forecast below and answer the questions in the spaces provided.

WIND:

3000	5000	7000	10000	14000	18500
310/30	300/35	300/40	310/50 MS06	310/60 MS12	310/90 MS14

CLOUD:
ISOL CB 5000/30000 SW MT JACKSON/NORSEMAN AFTER 04Z
SCT ST 2500/3000 IN TS/SH
BKN CU 5000/15000
BKN AC ABOVE 10000

WEATHER:
ISOL TS IN THE SW AFTER 0400Z SH

VISIBILITY:
5000M IN TS/SH.

ICING:
MOD IN CU TOPS/AC

MURRIN-MURRIN (YMMI)
TAF YMMI 281643Z 2210
30015G25KT 9999 LIGHT SHOWERS OF RAIN SCT050 BKN100
INTER 2203 MAX35KT 5000 SHOWERS OF RAIN SCT010
T 16 20 24 25 Q 1005 1006 1007 1008

(a) The forecast minimum visibility for YMMI is (1 mark)

_____

(b) The depth of the stratus cloud is (1 mark)

_____

(c) The height of the base of the most hazardous type of cloud is (1 mark)

_____

(d) In plain language, the wind velocity at 10 000 feet is (1 mark)

_____

(e) The difference between ISA and forecast temperatures at 14 000 feet is (1 mark)

_____

See next page

34. Modern aircraft are equipped with systems that alert the pilots to situations that may jeopardise their safety. Many pilots have been able to avert disaster by responding to these cockpit alerts. They are categorised as **Warnings,** which require an immediate response; **Cautions,** which require a crew action within a reasonably short period of time; and **Advisories,** which require a crew to respond when they have time. Warnings and cautions are shown in red or yellow on the EFIS and are accompanied by sounds such as a bell, voice warning, siren, gong, etc. In one circumstance the control column is actually physically shaken.

Below is a table of situations, appropriate alerts and the nature of the warnings given to airliner pilots. Fill in the missing spaces. (4 marks)

Situation	Type of Alert	Alerting Mechanism
Engine fire		Continuous bell
Low hydraulic quantity		Single beep
	Warning	Voice (Pull up!)
Excessive angle of attack	Warning	

35. Threat and error management is now practised by all branches of aviation in order to avoid situations that may jeopardise the safety of any flight. In this context, compare what is meant by a 'threat' with what is meant by an 'error'. (2 marks)

See next page

36. State two physiological effects on the human body of exposure to sustained, high, positive G forces. (2 marks)

37. Explain two methods that can be used to reduce the detrimental effects of high positive G forces on the body. (2 marks)

See next page

38.

This Antonov An-225, the world's biggest aircraft, was originally designed to return the Russian Space Shuttle to its launch pad from the aerodrome at which it landed on its return from space. Although it was never actually used for that purpose, it has been used to transport heavy machinery into earthquake-devastated areas such as Haiti in 2010 and to carry oversized cargoes to war zones such as Afghanistan. It has also been used in 2010 to transport heavy drilling equipment to oil drilling sites. Explain four of the design features of this aircraft that have made it the only aircraft in the world capable of undertaking these tasks. (4 marks)

- _____
- _____
- _____

See next page

39. Answer the following questions about a planned flight of 160 nm from an airstrip on Murchison Downs Station to Carnarvon in a PA-32RT by using the information in the table below, together with the take-off weight and performance charts in **Appendices B, C, D and E**.

Murchison Downs Station		**Carnarvon**		**En-route**	
Pressure height	1200 feet	**Pressure Height**	50 feet	**Cruising Level**	FL120
Temperature	35°C	**Temperature**	36°C	**OAT**	+3°C
Surface	Short dry grass	**Wind**	Nil	**Fuel Flow**	15.7 gph
Slope	2% down-slope			**TAS**	150 kt
Wind	Nil			**Wind**	Nil
Runway length	820 m				

(a) Determine the maximum take-off weight allowed at Murchison Downs Station. (3 marks)

Answer: _____

(b) Calculate the following and insert your answers in the table below.

(i) Total flight time, including climb, cruise and descent into Carnarvon.
(ii) Total fuel required for the flight alone (excluding reserve, taxi and unusable fuel).

Use the Murchison Downs Station wind for the climb calculation; en-route wind for the cruise; and Carnarvon wind for the descent. Show all working clearly in the space below the table. (6 marks)

	Climb	**Cruise**	**Descent**	**Total**
Fuel (gal)				
Time (min)				
Distance (nm)				

See next page

40. Read the following narrative and answer the questions at the end.

A new aerodrome had been constructed at a country town and its flying club decided to celebrate the occasion by organising an air show. The new aerodrome only had one runway, aligned in an east-west direction. The weather for the event was clear skies with a morning temperature of 20°C and a 10 knot easterly wind, becoming 35°C and calm by the time the displays began in the afternoon.

Eighteen-year-old Melissa had gained her Private Pilot Licence only three months previously. She lived in another country town and this was her first air show. She was eager to demonstrate her recently-gained skills to her mother and grandmother, who were accompanying her. Her Piper Cherokee aircraft was not very powerful and once loaded with the fuel needed to complete the total trip it was at its maximum permissible take-off weight.

During her training, Melissa had impressed her instructors with her piloting skills and her careful and considered approach to all her flying. At the air show, she was unexpectedly asked to do something exciting. A group of women pilots invited all the visiting women pilots, including Melissa, to take off in succession and fly a circuit around the airfield.

Melissa had never met so many women pilots before and was excited even to be in their company. All were older and more experienced than she and several worked as charter pilots and flying instructors. She was impressed by their wealth of knowledge and flattered to have been asked to join them.

Eventually it was time for Melissa to board her aircraft for the flypast. She had decided that instead of landing after the circuit, as the other pilots intended, she would leave the parade and set course for home. Consequently, she had to take her passengers with her in the fly-past.

When she started up and taxied out to join the line of aircraft assembling on the taxiway, her position was close to the rear of the queue.

Melissa felt a little concerned when the charter pilot in the first aircraft was authorised by the Controller to make an 'intersection departure'. This meant that aircraft would not begin their take-offs from the beginning of the runway but from where it intersected a taxiway, little more than half way from the end. Melissa was troubled because she had never done this before; she always used the full length available. She could not leave the queue and taxi to the far end of the runway for an individual take-off, because she was 'boxed in' by the two aircraft in the line behind her. Melissa reasoned that when she reached the head of the queue, if she was unhappy with the distance available, she would ask the controller's permission to taxi back up the runway before turning and taking off.

Melissa glanced at the wind-sock. It hung limply, so there would be no headwind to reduce her take-off distance. She watched intently as the leading aircraft carried out their take-offs, and relaxed as each rose easily into the sky well short of the runway end. She also felt comforted that she was following in line and doing exactly the same as the professional pilots. Her only concern was that the aircraft immediately ahead of hers seemed to use an excessive distance for its take-off and its subsequent climb out was very shallow. It only just cleared the trees beyond the runway.

What Melissa did not observe was that all the preceding aircraft were more powerful than hers and most had only two people on board. Also, she did not realise that the sea-breeze had just arrived and the wind was now blowing from the south-west.

See next page

Melissa completed her pre-take-off checks. After seeing all the preceding aircraft lift off successfully, she no longer felt the need to ask for permission to back-track on the runway to give herself more take-off distance. When the Controller cleared her for take-off, she moved quickly onto the runway and opened up to full power, but did not take a last look at the wind-sock to check the wind strength and direction.

The engine responded normally but as the aircraft accelerated the airspeed indicator was very slow to rise. The end of the runway drew nearer but the Cherokee was only just approaching flying speed. In the last 30 metres Melissa had to make a crucial decision: to lift off with barely enough speed to fly, or to close the throttle and run into the rocky paddock ahead, causing considerable aircraft damage. She chose to lift off.

The aircraft flew off the runway but, although climbing, the angle was flat. Soon, the trees at the end of the overshoot were in Melissa's path. She eased back a little more to try to clear them but the stall warning horn began to sound.

The Cherokee skimmed over the lower branches and was almost over the very top of the tree when the wheels touched the foliage. This was too much for the little aircraft. It lost speed, its nose pitched down, and it descended into the ground, with a force of impact that was not survivable.

The subsequent accident report revealed that, given all the circumstances that existed at the time, it would have been almost impossible for the Cherokee to have achieved a safe take-off on that last flight.

(a) Explain briefly the environmental factors that led to a situation in which an aircraft that had flown safely in the morning could not do so in the afternoon. (3 marks)

See next page

(b) Explain briefly the human factors that led a previously safe and conscientious pilot to attempt to fly an aircraft in circumstances in which it was not possible to do so.

(5 marks)

End of questions

Additional working space

Additional working space

ACKNOWLEDGEMENTS

Section One

Question 4 Diagram from: Yeo, M., Bowers, G., Bennett, K., (2001). *Handbook of Flight* (2nd ed.). Perth: WestOne Services.

Question 5 Diagram from: Yeo, M., Bowers, G., Bennett, K., (2001). *Handbook of Flight* (2nd ed.). Perth: WestOne Services.

Section Two

Question 32 Chart from: Yeo, M., Bowers, G., Bennett, K., (2001). *Handbook of Flight* (2nd ed.). Perth: WestOne Services.

Question 38 Photograph of Antonov An225: Retrieved June, 2010, from http://en.wikipedia.org/wiki/File:An-225-manchester-2006.jpg

Diagram of Antonov An225: retrieved June, 2010, from www.aerospaceweb.org/aircraft/transport-m/an225/

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