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

WACE
Western Australian Certificate of Education

Western Australian Certificate of Education Examination, 2014

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

Number of additional answer booklets used (if applicable): ☐

To be provided by the candidate

Standard items: pens (blue/black preferred), pencils (including coloured), sharpener, correction fluid/tape, eraser, ruler, highlighters

Special items: non-programmable calculators approved for use in the WACE examinations, navigation plotter (or ruler and protractor), flight computer

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.

TRIM 2014/50242
Web version of 2014/42461
Copyright © School Curriculum and Standards Authority 2014
Ref: 14-014

Structure of the examination

The WACE Aviation Stage 3 examination consists of a written component worth 80 per cent of the total examination score and a practical (performance) component 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	26	26	120	121	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 2014*. 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, then shade your new answer. Do not erase or use correction fluid/tape. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

   Section Two: Write your 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 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, then shade your new answer. Do not erase or use correction fluid/tape. 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.

---

1. True air speed is determined by correcting

   (a) ground speed for density.
   (b) calibrated air speed for position and instrument error.
   (c) indicated air speed for density.
   (d) calibrated air speed for density.

2. An aircraft has a ground speed of 235 knots. Allowing for a 35 knot tailwind the actual air speed is equivalent to

   (a) 200 knots indicated air speed.
   (b) 200 knots calibrated air speed.
   (c) 200 knots true air speed.
   (d) an air speed that cannot be determined on the basis of the data provided.

3. Which of the following does **not** form part of the cockpit flight controls of a helicopter?

   (a) collective pitch lever
   (b) cyclic pitch control
   (c) torque pedals
   (d) anti-torque pedals

4. To achieve maximum range in an aircraft, it should be flown at the speed that is also the speed for

   (a) minimum power.
   (b) best rate of climb.
   (c) maximum thrust.
   (d) best lift drag ratio.

5. To convert local mean time (LMT) into coordinated universal time (UTC), which of the following **must** be taken into account?

   (a) any designated daylight saving period that may exist
   (b) the current longitude
   (c) the current latitude
   (d) the current standard time zone

See next page

6. Which of the following navigational aids would **not** provide slope guidance for a pilot on approach to landing?

(a) GPS
(b) PAPI
(c) ILS
(d) T-VASIS

7. Following the passage of a cold front, conditions would reflect a

(a) decrease in atmospheric pressure.
(b) rise in temperature.
(c) heavy nimbostratus cloud.
(d) decrease in temperature.

8. Anabatic winds

(a) are strengthened by gravity.
(b) form on cold, cloudless nights.
(c) flow more strongly down a smooth, ice covered mountain.
(d) rely on solar radiation.

9. An aircraft is more likely to experience a microburst when flying beneath

(a) stratocumulus cloud.
(b) virga.
(c) stratus cloud.
(d) cirrocumulus cloud.

10. In order for conditions to be declared as CAVOK in an aerodrome TAF

(a) low, drifting snow cannot be included.
(b) cloud tops must be below 5000 ft.
(c) any shallow fog must be expected to disperse before the TAF expires.
(d) visibility must be 9999 m or less.

11. The Critical Mach Number of an aircraft is reached when

(a) the lower portion of the wing first experiences supersonic flow.
(b) an increase in thrust produces no increase in speed.
(c) the first part of the aircraft experiences supersonic flow.
(d) further acceleration of the aircraft would result in structural damage and possible destruction.

See next page

12. The tropopause

    (a) is a boundary region between the troposphere and the stratosphere.
    (b) is a line separating the troposphere from the stratosphere.
    (c) is located at an altitude of 36 090 ft.
    (d) only occurs when the outside air temperature reduces to -56.5 °C.

13. The Environmental Lapse Rate is

    (a) 1.5 °C per 1000 ft in saturated air and 3.0 °C per 1000 ft in dry air.
    (b) 1.5 °C per 1000 ft in dry air and 3.0 °C per 1000 ft in saturated air.
    (c) averaged as 2.0 °C per 1000 ft.
    (d) normally measured by a radiosonde.

14. A group of aircraft passengers at a beach resort plan to undertake some scuba diving prior to departure. It is recommended that they wait some time before flying so they don't get decompression sickness. The gas responsible for this sickness is

    (a) oxygen.
    (b) carbon dioxide.
    (c) nitrogen.
    (d) helium.

15. Which of the following statements about carbon monoxide (CO) is correct?

    (a) CO poisoning is caused by a lack of CO_2 in the lungs.
    (b) CO poisoning is best remedied by breathing fresh air.
    (c) Haemoglobin will carry O_2 molecules in preference to CO molecules.
    (d) CO has a distinct colour and odour and is therefore easy to detect.

16. Loud noises can cause damage to the ears. Above what level of noise should protection be worn to avoid hearing loss?

    (a) 50 dB
    (b) 80 dB
    (c) 100 dB
    (d) 130 dB

17. Which of the following statements regarding colour blindness is true?

    (a) It affects females more than males.
    (b) It is caused by a defect in the rods of the retina.
    (c) It generally causes difficulty in distinguishing between red and green.
    (d) An individual who is colour blind will not be able to become a pilot.

See next page

18. The term ‘redout’ refers to the physiological condition of

(a) the blood pooling in the head during a high positive G manoeuvre.
(b) the lower eyelid closing over the eye in a negative G manoeuvre.
(c) the upper eyelid closing over the eye in a high positive G manoeuvre.
(d) none of the above.

19. Generally the highest ‘g load’ the body can sustain before loss of consciousness in less than two seconds is

(a) +8g.
(b) +6g.
(c) -8g.
(d) -6g.

20. Under the threat and error management (TEM) model, a latent threat is

(a) one that will occur only in the air.
(b) the result of a deliberate violation.
(c) immediately obvious and can be resolved quickly.
(d) one that is not immediately obvious.

End of Section One

See next page

Section Two: Short answer **64% (121 Marks)**

This section has **26** 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 that you are continuing to answer at the top of the page.

Suggested working time: 120 minutes.

Question 21 **(4 marks)**

An aircraft is tracking 250° M maintaining 185 kt TAS.
Use your flight computer to answer the following questions.

(a) What heading would be required to fly and maintain the planned track if a constant 20 kt crosswind was being experienced from the left? (1 mark)

(b) What ground speed would the aircraft be maintaining if it was being subjected to a constant wind 220° M/40 kt? (1 mark)

(c) Use the 1 in 60 rule to determine the magnitude of the track error after travelling 45 nm if the actual track made good (TMG) was 246° M. (2 marks)

Distance off track

Direction of drift

See next page

Question 22 **(2 marks)**

Given the following aircraft performance data:
TAS 135 kt
Altitude 3500 ft
(Ignore any climb and descent requirements)

(a) Determine the ground speed of this aircraft if it flies 468 nm in 135 minutes. (1 mark)

(b) Given usable fuel on board (ignore reserves) of 115 litres and a fuel flow of 30 litres per hour, what is the endurance of this aircraft (in minutes)? (1 mark)

Question 23 **(4 marks)**

A VFR aircraft is travelling east and passes overhead its initial way point at UTC 0205. The pilot has estimated the next way point at UTC 0311.
If the winds are forecast to remain constant and the distance between way points is 235 nm

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

(b) Calculate the track error **and** direction of drift experienced if, after travelling 90 nm, the aircraft is located 3 nm south of the planned track. (2 marks)

(c) Terrain and cloud separation requirements have determined that this flight must be undertaken somewhere between 4000 ft and 6000 ft.

At what altitude must this aircraft fly in order to ensure that the flight is undertaken using and maintaining the correct hemispherical flight procedures for a VFR flight? (1 mark)

See next page

Question 24 **(6 marks)**

Three distinct conditions normally precede the formation of a cyclone over the Indian Ocean.

State each of the **three** conditions necessary and explain how each aids the formation of the cyclone.

Condition one: _____

_____

_____

Condition two: _____

_____

_____

Condition three: _____

_____

_____

Question 25 **(2 marks)**

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

- Fuel tanks capacity 240 L
- AVGAS specific gravity 0.72

Note: In order for the aircraft to remain within its performance limitations, the **maximum fuel** that can be added cannot exceed 112 kg.

Determine the maximum fuel volume in litres that can be ordered so as **not** to exceed the performance limitations of the aircraft.

_____

_____

See next page

Question 26 **(5 marks)**

A pilot has tuned, identified and tested an ADF at night to a non-directional beacon (NDB) located at a distance well outside the official published range.

(a) Explain why it is possible for the radio signal the pilot has been tracking along to actually disappear as the aircraft gets closer to the station and then reappear some time later as the aircraft continues its approach. (2 marks)

(b) Why will this phenomenon be unlikely to occur during daylight hours?
(Draw and label a diagram if it helps you to explain.) (3 marks)

See next page

Question 27 **(10 marks)**

Take-off and landing performances are restricted by certain environmental and runway design factors.

State **five** factors that will **increase** an aircraft's take-off run required (TORR) and explain each factor.

Note: Assume take-off run available (TORA) and aircraft take-off weight are **not** factors.

Factor one: _____

Explanation: _____

_____

_____

Factor two: _____

Explanation: _____

_____

_____

Factor three: _____

Explanation: _____

_____

_____

Factor four: _____

Explanation: _____

_____

_____

Factor five: _____

Explanation: _____

_____

_____

See next page

Question 28 **(5 marks)**

A trigger is the name given to a requirement or pre-condition leading to rising air masses that precede the formation of a thunderstorm.

(a) List **four** triggers that will initiate air rising before a thunderstorm. (4 marks)

One: _____

Two: _____

Three: _____

Four: _____

(b) Which of the above triggers would be **most** significant in the formation of thunderstorms throughout most of the Australian landmass? (1 mark)

_____

Question 29 **(2 marks)**

The official charts produced for the Australian aviation industry include the following: WAC, VTC, VNC and ERC (low).

(a) Which of the charts listed above does **not** provide any PRD information? (1 mark)

_____

(b) Give the correct full name for this chart. (1 mark)

_____

_____

Question 30 **(6 marks)**

The magnetic compass is a critical instrument in aviation. However, it does have two limitations – variation and deviation.

(a) Define variation and describe how its effects can be overcome for aircraft navigation. (3 marks)

(b) Define deviation and describe how its effects can be overcome for aircraft navigation. (3 marks)

Question 31 **(4 marks)**

Hypoxia is a condition that can be a potential safety hazard to a pilot flying an aircraft.

(a) What is hypoxia? (1 mark)

(b) A pilot begins to experience hypoxia in flight. What are **two** actions the pilot should take immediately to remove the threat? (2 marks)

One: _____

Two: _____

(c) Explain why susceptibility to hypoxia increases after donating blood. (1 mark)

See next page

Question 32 **(3 marks)**

A helicopter has tail rotor pedals.

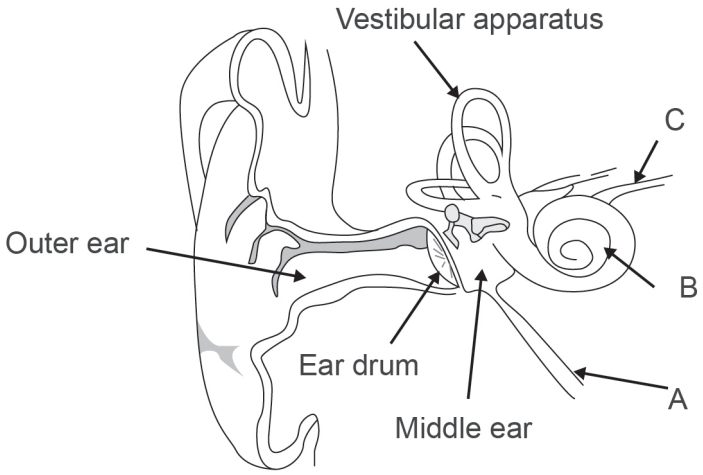
(a) What is the purpose of the tail rotor pedals? (1 mark)

(b) What operational principle governs their use? (1 mark)

(c) What is the effect of utilising the tail rotor pedals during normal flight?
(Draw and label a diagram if it helps you to explain.) (1 mark)

See next page

Question 33 **(3 marks)**



Structure of the ear

Identify parts A, B and C in the above diagram of the ear.

A: _____

B: _____

C: _____

Question 34 **(3 marks)**

An aircraft is accelerated rapidly during take-off and climb out. The pilot, having no visual horizon, experiences the somatogravic illusion (spatial disorientation).

(a) Explain what the pilot will believe is occurring. (1 mark)

_____

_____

(b) State the **most** likely response of an inexperienced pilot who fails to recognise and act on this illusion. (1 mark)

_____

_____

(c) Which part of the vestibular system is being affected when a person experiences the somatogravic illusion? (1 mark)

_____

_____

See next page

Question 35 **(5 marks)**

List **five** conditions necessary for the formation of a deep layer of radiation fog?

One: _____

Two: _____

Three: _____

Four: _____

Five: _____

Question 36 **(6 marks)**

(a) Describe how the Earth's rotation and revolution around the Sun cause a change in the beginning and ending of daylight hours throughout the year.

Use a diagram to assist with your explanation. (5 marks)

_____

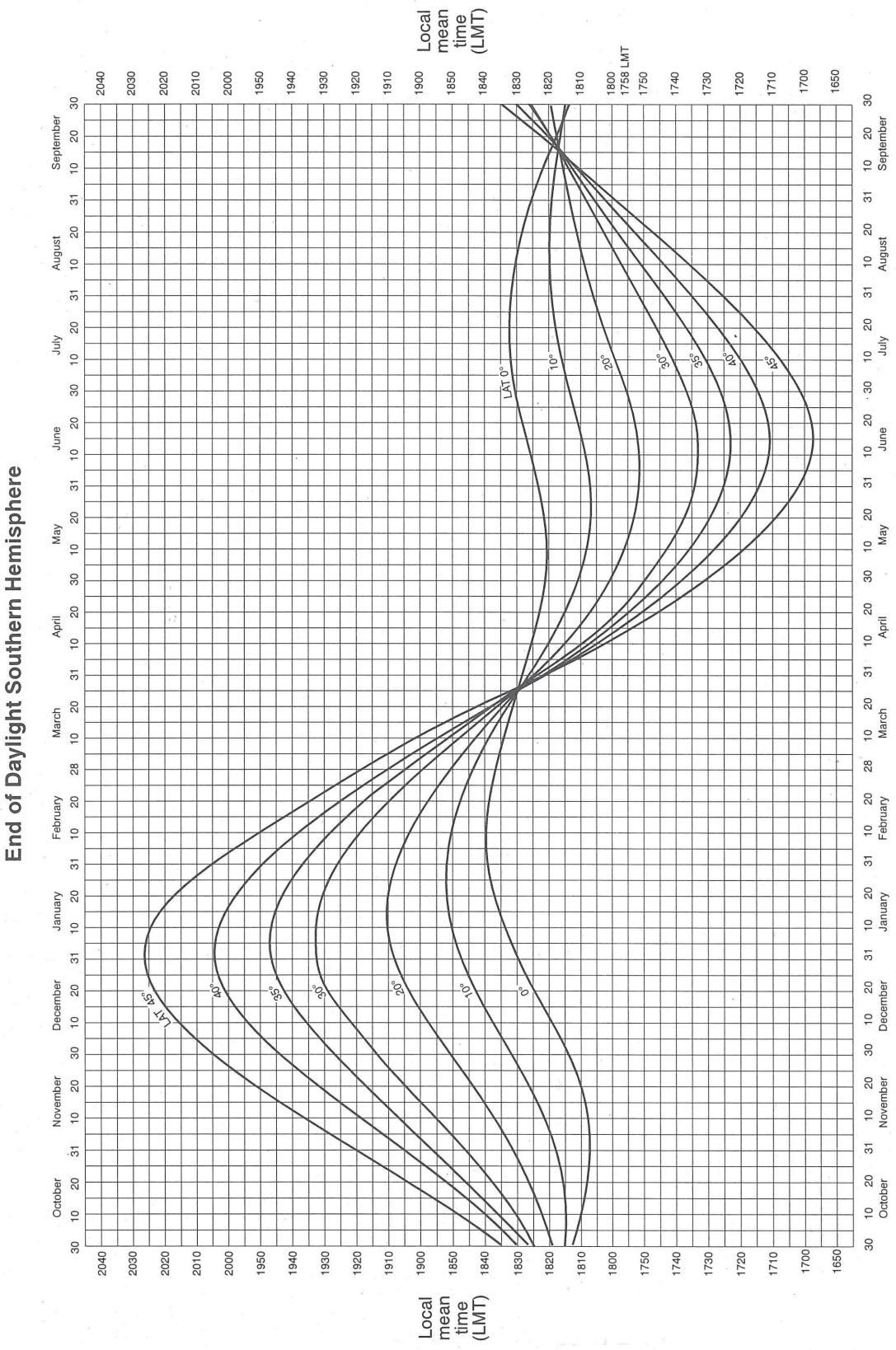
_____

_____

_____

_____

(b) Use the End of Daylight chart below to determine last light on the 5th of July for a position 24° 05’ S, 115° 03’ E. (1 mark)



See next page

Question 37 **(5 marks)**

An aircraft flies by the shortest possible route from Lat. 35° 0' S Long. 125° 35' E to a position Lat. 12° 30' S Long. 125° 35' E.

(a) Determine the true track flown. Justify your answer. (3 marks)

(b) Determine the ground distance travelled. Show **all** workings. (2 marks)

Question 38 **(3 marks)**

Use the PA-32RT performance chart on page 19 and the following data to answer the questions below.

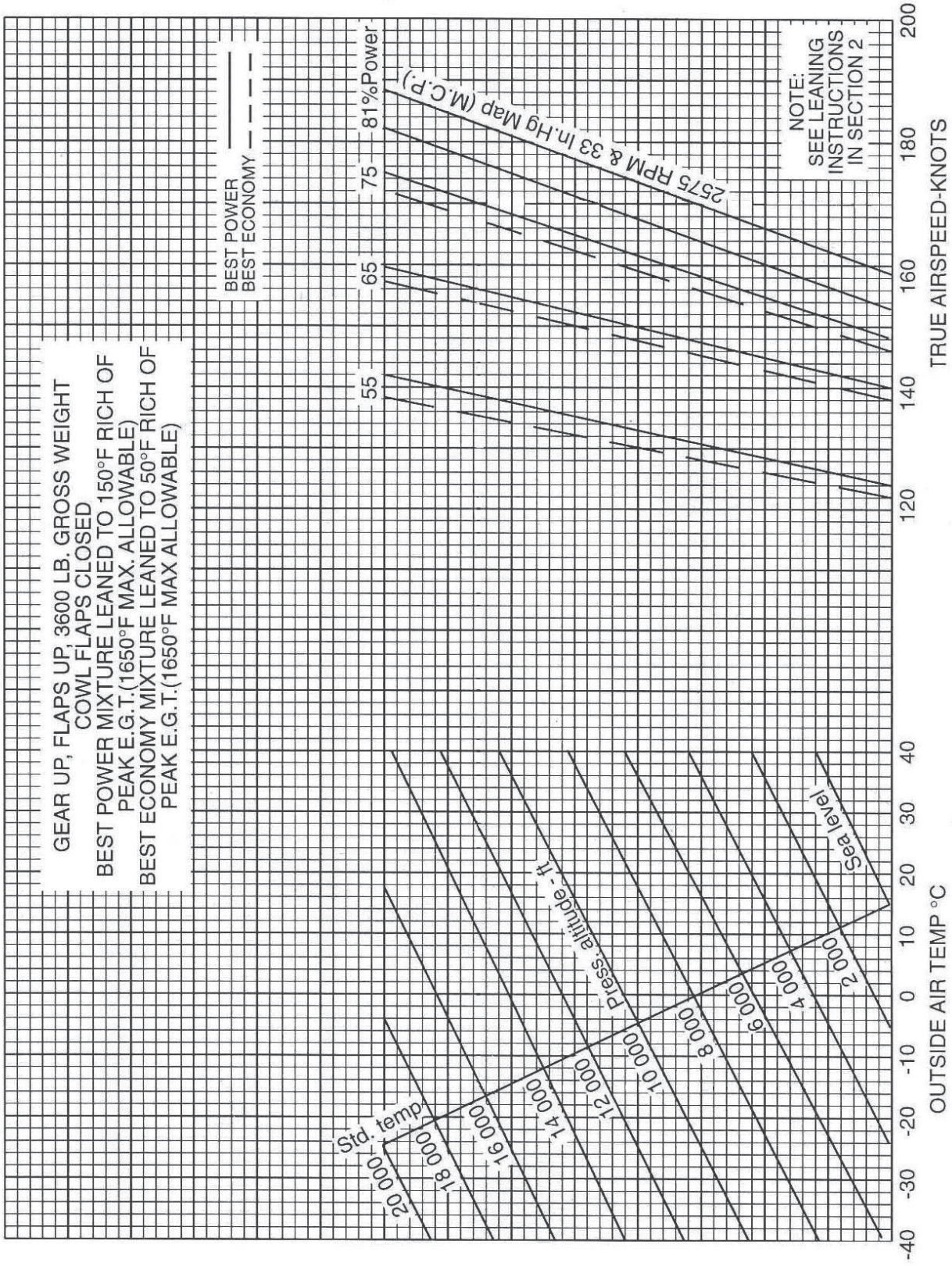
- Outside air temperature 20 °C.
- Pressure altitude 8000 ft.
- Power setting 75%.

(a) Determine the TAS for a flight conducted for best economy. (1 mark)

(b) To achieve best economy, what should the mixture be leaned to? (1 mark)

(c) Determine the new TAS if a reduction of power is made to 55% at best economy. (1 mark)

See next page



PA-32RT performance chart

See next page

Question 39 **(2 marks)**

State **two** advantages of sweepback of the wings and tail assembly (empennage) of transonic aircraft.

One: _____

_____

Two: _____

_____

Question 40 **(3 marks)**

Refer to the Sydney World Aeronautical Chart (WAC) excerpt on page 21 to answer the following questions.

(a) Which aerodrome is located at position Lat. 35° 09' S Long. 150° 42' E. (1 mark)

_____

Goulburn Airport is located north-north-east of Canberra Airport.

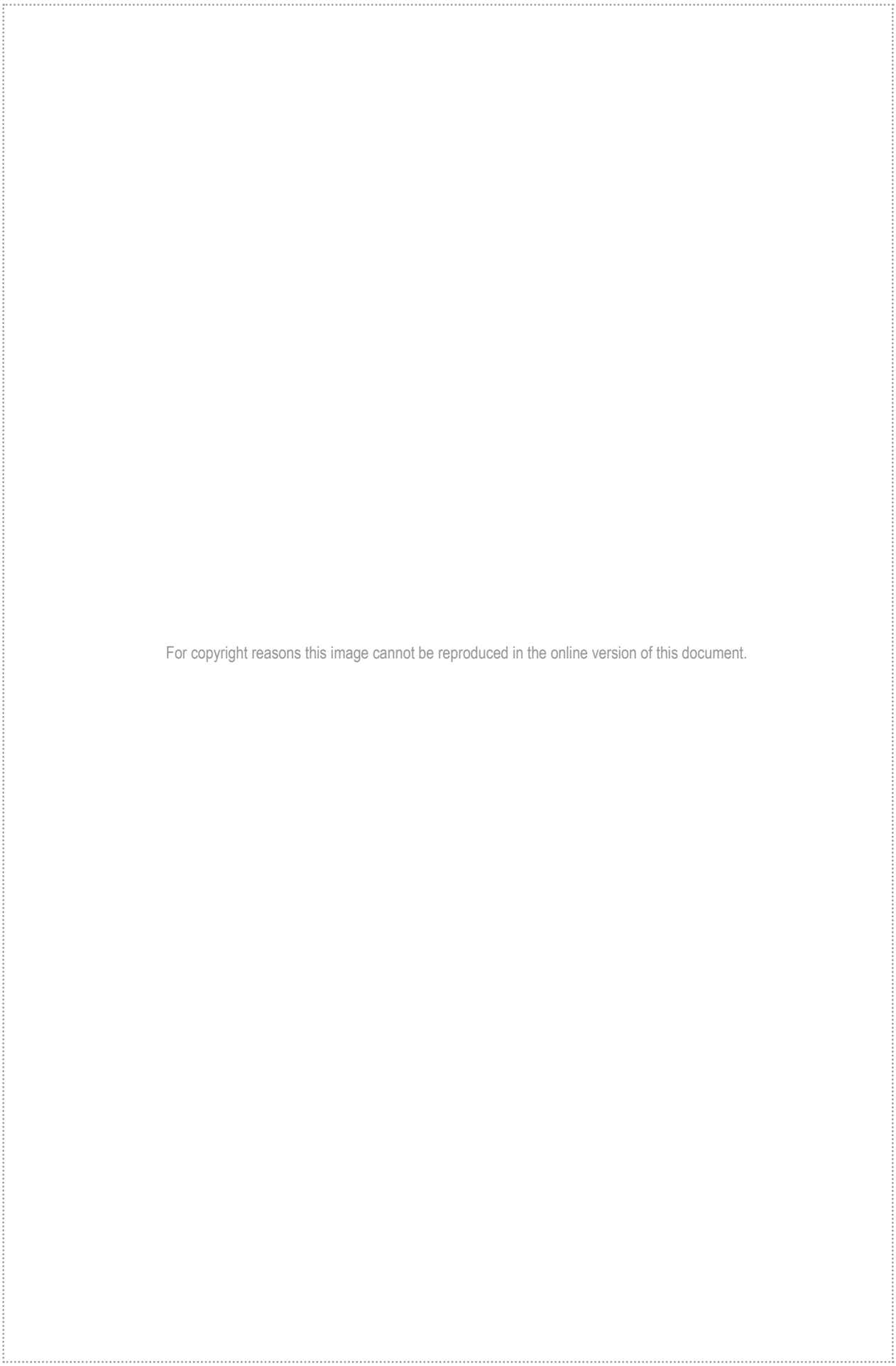
(b) Determine the magnetic track from Canberra Airport to Goulburn Airport. (1 mark)

_____

(c) Determine the distance in nautical miles from Canberra Airport to Goulburn Airport. (1 mark)

_____

See next page



See next page

Question 41 **(7 marks)**

Complete the following questions related to the physiology of the eye.

(a) There are **two** types of light sensitive cells located on the _____. They are the _____, which can see in colour and the _____, which can only see in black, white and shades of grey. (3 marks)

(b) The ability of the eye's _____ to change focus from near to far objects is known as _____. (2 marks)

(c) To determine visual acuity, a standard eye chart is used. The person stands at a standard distance from the chart and identifies letters of diminishing size. The normal visual acuity for an eye being tested this way is 6/6. Explain the meaning of '6/6'. (1 mark)

_____

_____

(d) Why would the smoking of cigarettes affect a person's night vision capabilities? (1 mark)

_____

_____

Question 42 **(6 marks)**

A person on a flight in a light aircraft that is encountering persistent turbulent conditions may begin to experience motion sickness.

(a) Explain the **most** likely physiological cause of motion sickness. (2 marks)

_____

_____

(b) What could the person do to alleviate the symptoms of motion sickness and why does this strategy work? (2 marks)

_____

_____

See next page

(c) List **two** possible measures that could have been taken to avoid motion sickness. (2 marks)

One: _____

_____

Two: _____

_____

Question 43 **(6 marks)**

High gravitational (g) loads can incapacitate a pilot through a loss of consciousness. This is known as G-LOC.

(a) Explain why G-LOC occurs. (2 marks)

_____

_____

(b) Give **two** examples of circumstances in which G-LOC may occur. (2 marks)

One: _____

_____

Two: _____

_____

(c) Complete the following statement.

The category and/or type of aircraft that G-LOC would most likely occur in are civilian

_____ aircraft and military _____ aircraft. (2 marks)

Question 44 **(6 marks)**

The threat and error management (TEM) model has become accepted in the aviation industry.

(a) Name the standard industry practice from which the TEM model emerged and **one** aim of the model with regard to aviation. (2 marks)

(b) List **two** major factors that have led to the TEM model becoming accepted in the aviation industry?

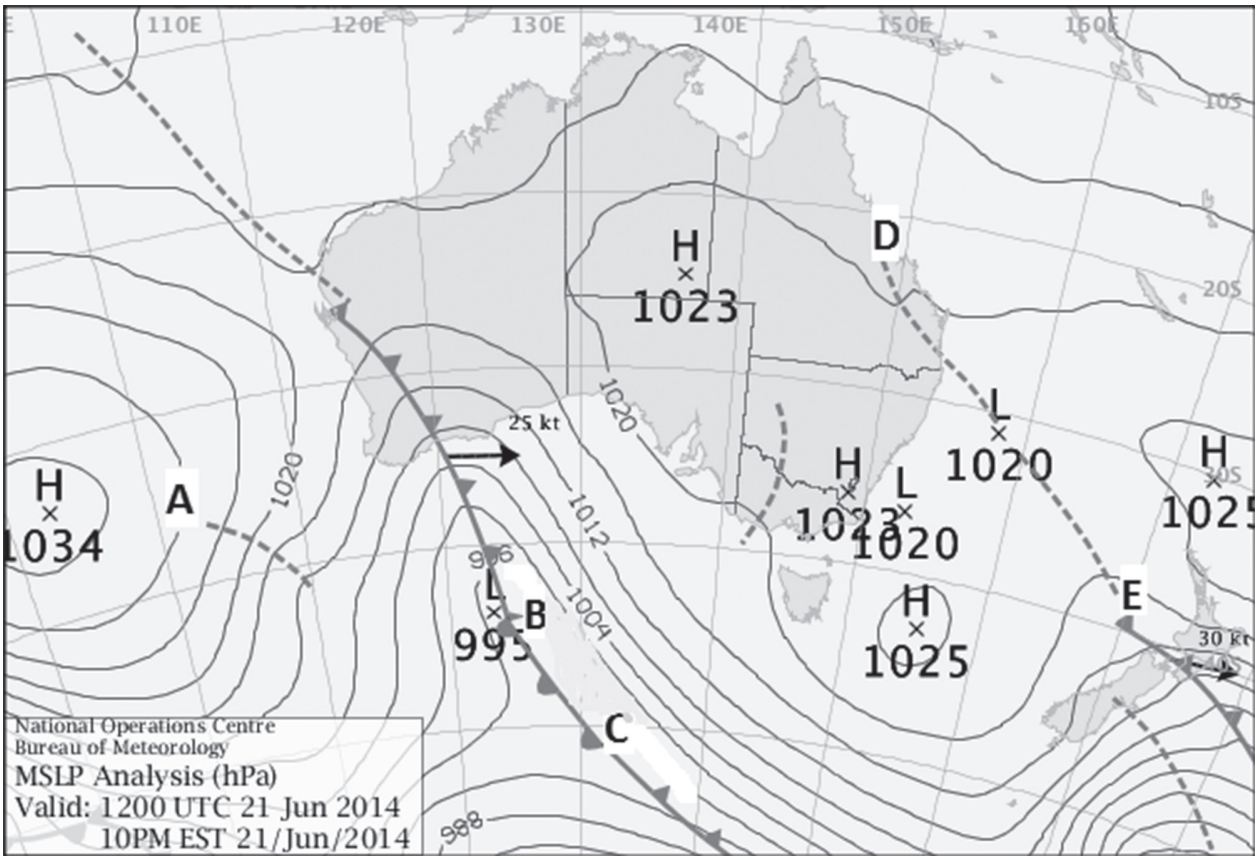
(2 marks)

(c) Explain the importance of incorporating TEM countermeasures into flight training. Provide an example. (2 marks)

See next page

Question 45 **(3 marks)**

The questions below are based on the following weather map:



(a) Which meteorological feature is shown by the line extending between Position B and C? (1 mark)

_____

(b) What is the pressure at Position A? (1 mark)

_____

(c) Which meteorological feature is shown by the dotted line between Positions D and E? (1 mark)

_____

See next page

Question 46 **(10 marks)**

Case Study

A Boeing 747 departed at night with a crew of three pilots in the cockpit. The captain was a very experienced ex air force pilot with 20 000 hours of flight experience. The first officer (FO) had 2500 hours and the second officer (SO) had 500 hours experience.

When the aircraft was approximately halfway through the take-off roll, the crew realised that the primary airspeed indicator (ASI) was indicating zero. As this was observed prior to the decision speed, the aircraft was still capable of aborting the take-off and stopping well before the end of the runway. However despite the primary ASI being a mandatory instrument for flight, the captain decided to continue the take-off as he knew that he had four other ASI systems available in the aircraft. The take-off was completed without further incident.

During the subsequent climb out, the primary ASI appeared to show some functionality. Starting from zero, the indicated speed began to increase and continued to increase as the aircraft climbed, until eventually it indicated that the aircraft was above the maximum operating speed. The overspeed warning system, which relies on the primary ASI, began to sound a loud and persistent warning.

The captain decided to increase the aircraft's attitude in response to this warning in an attempt to slow the aircraft down. However, this had no effect on the primary ASI. The captain then decided, with a 20° nose up attitude and in the climb configuration, to close the power levers to flight idle in an attempt to arrest the speed.

Soon afterwards however, the stall warning devices began to operate, while the overspeed warning continued to sound. The aircraft then stalled and began a rapid descent maintaining a nose high attitude. The FO realised at this stage that the aircraft had a high nose attitude and called "attitude, attitude, attitude!"

The captain did not respond to this warning call and the FO was unwilling to take control of the aircraft despite having a fully functioning set of controls available.

After losing many thousands of feet and repeated warnings to the captain, the FO pushed forward on the control column and increased the power levers to full thrust. The aircraft was then finally recovered, several thousand feet above the terrain.

See next page

Using the threat and error management (TEM) model, answer the following questions.

(a) Describe the three main components of the TEM model and give **one** example of each from the case study on page 26. (6 marks)

One:

Two:

Three:

(b) Describe **two** countermeasures, which, if they had been applied, might have led to the B747 crew avoiding the situation they found themselves in. (4 marks)

One:

Two:

End of questions

Additional working space

Additional working space

Additional working space

Additional working space

Additional working space

Additional working space

Additional working space

Additional working space

ACKNOWLEDGEMENTS

Section Two

Question 33 Diagram of structure of the ear from: Yeo, M., Bowers, G., & Bennett, K. (2001). *Handbook of flight* (2nd ed.). Perth: WestOne Services, p. 280. Not for operational purposes.

Question 36 (b) End of daylight graph from: Yeo, M., Bowers, G., & Bennett, K. (2001). *Handbook of flight* (2nd ed.). Perth: WestOne Services, p. 194. Not for operational purposes.

Question 38 (a)–(c) Chart PA-32RT cruise performance from: Yeo, M., Bowers, G., & Bennett, K. (2001). *Handbook of flight* (2nd ed.). Perth: WestOne Services, p. 170. Not for operational purposes.

Question 40 (a)–(c) Chart from: Airservices Australia. (1998). *WAC Sydney 3456* (Ed. 17). Canberra: Airservices Australia. No part of this work may be reproduced or copied in any form or by any means without the prior consent of Airservices Australia. Not for operational use. All rights reserved.

Question 45 (a)–(c) Bureau of Meteorology. (2014). *MSLP analysis (hPa)* 1200 UTC 21/06/2014 [Chart]. Retrieved June, 2014, from www.bom.gov.au/cgi-bin/charts/charts.browse.pl. Used under a Creative Commons (CC) Attribution 3.0 licence.

This document – apart from any third party copyright material contained in it – may be freely copied, or communicated on an intranet, for non-commercial purposes in educational institutions, provided that it is not changed and that the School Curriculum and Standards Authority is acknowledged as the copyright owner, and that the Authority's moral rights are not infringed.

Copying or communication for any other purpose can be done only within the terms of the *Copyright Act 1968* or with prior written permission of the School Curriculum and Standards Authority. Copying or communication of any third party copyright material can be done only within the terms of the *Copyright Act 1968* or with permission of the copyright owners.

Any content in this document that has been derived from the Australian Curriculum may be used under the terms of the Creative Commons Attribution-NonCommercial 3.0 Australia licence.

Published by the School Curriculum and Standards Authority of Western Australia
303 Sevenoaks Street
CANNINGTON WA 6107