



Western Australian Certificate of Education Examination, 2015

Question/Answer Booklet

AVIATION Stage 3

Please place your student identification label in this box

Student Number: In figures

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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.

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	25	25	120	127	64
				Total	80

Instructions to candidates

- The rules for the conduct of Western Australian external examinations are detailed in the *Year 12 Information Handbook 2015*. Sitting this examination implies that you agree to abide by these rules.
- 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.

- Working or reasoning should be shown clearly when calculating or estimating answers.
- 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.
- 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. Calibrated air speed is
 - (a) ground speed corrected for density.
 - (b) indicated air speed corrected for position and instrument error.
 - (c) indicated air speed corrected for density.
 - (d) always disregarded, as it is equal to the indicated air speed.

2. An aircraft flying at an altitude of 5500 ft has a ground speed of 198 knots. Allowing for a 30 knot headwind, the actual air speed would be equivalent to
 - (a) 228 knots indicated air speed.
 - (b) 228 knots calibrated air speed.
 - (c) 228 knots true air speed.
 - (d) 168 knots calibrated air speed.

3. In supersonic flight, which of the following is an **incorrect** statement about the behaviour of air passing through an expansion wave?
 - (a) The air behind the wave maintains direction.
 - (b) The air behind the wave decreases in temperature.
 - (c) The air behind the wave accelerates.
 - (d) The air behind the wave decreases in pressure.

4. To achieve maximum endurance in a piston-engined, propeller-driven aircraft, it should be flown at the speed that is also the speed for
 - (a) minimum power.
 - (b) best angle of climb.
 - (c) minimum thrust.
 - (d) best lift/drag ratio.

5. To convert coordinated universal time (UTC) into local mean time (LMT), which of the following **must** be taken into account?
 - (a) any designated daylight saving period that may exist
 - (b) the longitude of the LMT position
 - (c) the difference in latitude between the UTC and LMT positions
 - (d) the current standard time zone, so it can be added or subtracted as required

See next page

6. Terrain effect is an error commonly associated with non-directional beacons (NDB). Which of the following correctly states the reason why terrain effect occurs?
- (a) Greater attenuation has increased the range of the signal well beyond normal theoretical distance.
 - (b) Salt water, having high conductivity with less attenuation, results in a shorter signal range.
 - (c) Sandy/rocky terrain has high conductivity, greater attenuation and shorter signal range.
 - (d) Sandy/rocky terrain has lower conductivity, greater attenuation and shorter signal range.
7. Which of the following would **not** help to trigger a thunderstorm?
- (a) broken cumulus cloud
 - (b) a strong rise in ground surface temperature
 - (c) air flowing over steeply rising terrain
 - (d) a surface pressure convergence
8. Katabatic winds
- (a) flow stronger at the top of an ice-covered mountainside on a clear night.
 - (b) form mostly on warm overcast nights on the coast.
 - (c) would be stronger at the base of a steep mountain than at the top.
 - (d) rely on a high-pressure system pushing in toward a north-south orientated mountain range.
9. An aircraft flying beneath virga is likely to encounter
- (a) dry microburst.
 - (b) rotors.
 - (c) reduced visibility.
 - (d) heavy rain and hail.
10. CAVOK in an airfield/airport TAF means
- (a) cloud and visibility are OK, within a radius of 15 nm.
 - (b) ceiling and visibility are OK.
 - (c) cloud and visibility at the airfield/airport are OK.
 - (d) ceiling and visibility are unlimited.
11. Flight with true air speeds above the point at which the first shock waves appear up until all local airflow is above the speed of sound is known as
- (a) hypersonic.
 - (b) subsonic.
 - (c) supersonic.
 - (d) transonic.

12. The base of the tropopause
- (a) is at a higher altitude over the polar regions than over the tropics.
 - (b) is at a lower altitude over the mid latitudes than over the tropics.
 - (c) commences at an altitude of 36 090 ft.
 - (d) only occurs once the outside air temperature reduces to -56.5°C .
13. Which of the following statements is **false**?
- (a) Water evaporates when air is cooled to its dew point.
 - (b) The dew point increases as precipitation evaporates into the air.
 - (c) Frost is likely if the air is cooled to its below freezing dew point.
 - (d) A high value of relative humidity implies a low temperature/dew point spread.
14. After undertaking a scuba dive that did not require any decompression stops, it is recommended that the diver then **not** undertake any flying above 300 m/1000 ft for a period of at least
- (a) 24 hours.
 - (b) 12 hours.
 - (c) 4 hours.
 - (d) 1 hour.
15. In a helicopter, the lift differential that exists between the advancing blade and the retreating blade is known as
- (a) coning.
 - (b) Coriolis effect.
 - (c) dissymmetry of lift.
 - (d) translational lift.
16. Carbon monoxide (CO) is a toxic gas. Its harmful effects on our body are due to the CO binding with
- (a) white blood cells and displacing oxygen.
 - (b) red blood cells and displacing carbon dioxide.
 - (c) white blood cells and displacing carbon dioxide.
 - (d) red blood cells and displacing oxygen.
17. Which of the following does **not** form part of the Instrument Landing System (ILS)?
- (a) localiser
 - (b) glide path
 - (c) marker beacons
 - (d) VHF Omnidirectional radio range

18. There are two different types of light-sensitive cells in the retina. These are the
- (a) rods, which are more sensitive to colour, and the cones, which are more sensitive to dim light.
 - (b) rods, which are more sensitive to dim light, and the cones, which are more sensitive to colour.
 - (c) rods and cones, which are both equally sensitive to most lighting conditions.
 - (d) rods, which are concentrated in the fovea area of the retina, and cones, which are concentrated in the outer regions of the retina.
19. The tail rotor on a helicopter is
- (a) used to counteract any Coriolis effect.
 - (b) necessary for it to be able to fly sideways.
 - (c) not a requirement if contra-rotating rotors are fitted.
 - (d) essential to counteract gyroscopic precession.
20. Geostrophic winds in the Southern Hemisphere flow
- (a) along straight isobars.
 - (b) along curved isobars.
 - (c) at an angle of 10° towards the higher pressure over land.
 - (d) at an angle of 30° towards the lower pressure over land.

End of Section One

See next page

Section Two: Short answer

64% (127 Marks)

This section has 25 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 210° M and maintaining 180 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 25 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 120° M/25 kt? (1 mark)

- (c) Use the 1 in 60 rule to determine the magnitude of the track error after travelling 90 nm if the actual track made good (TMG) was 222° M. (2 marks)

Distance off track:

Direction of drift:

Question 22

(2 marks)

Carry out the following calculations.

- (a) Determine the ground speed of an aircraft if it flies 425 nm in 115 minutes. (1 mark)

- (b) The usable fuel on board (ignore reserves) is 275 litres and the fuel flow is 59 litres per hour. Determine the endurance of this aircraft (in minutes). (1 mark)

Question 23

(4 marks)

A VFR aircraft is tracking 270° M and passes overhead its initial way point at UTC 0505. It is estimated that the aircraft will be at the next way point at UTC 0551. The winds are forecast to remain constant and the distance between the way points is 235 nm.

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

- (b) Determine the track error and direction of drift experienced if, after travelling 45 miles, the aircraft is located 6 miles south of the planned track. (2 marks)

Track error: _____

Direction of drift: _____

Terrain and cloud separation requirements have determined that this flight must be conducted somewhere between 3500 ft and 6000 ft.

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

Question 24

(4 marks)

Circle the correct alternative given in bold in the following statement to clarify accurately what the following phrase would imply when read from an area forecast.

Wind: 250/25KT

Wind is **forecasted** / **reported** to be blowing **to** / **from** the **true** / **magnetic** direction of 250° at a **minimum** / **mean** / **maximum** speed of 25 knots per hour.

Question 25

(5 marks)

The pilot of an aircraft flying at 3000 ft is trying to tune, identify and test a fully-functioning VOR at night at a distance well inside the theoretical range of the station.

Explain why a fully-functioning and correctly-tuned aircraft VOR receiver might **not** receive a fully-functioning VOR station. Draw and label a diagram to clarify your explanation.

Question 26

(4 marks)

Terms commonly associated with aviation pressure readings are QNH and QFE.

- (a) Define QNH. (1 mark)

- (b) Explain the effects of a pilot utilising QNH while conducting standard circuits at an aerodrome with an elevation of 1000 ft. (1 mark)

- (c) Define QFE. (1 mark)

- (d) Provide an example of a situation when QFE is appropriate. (1 mark)

Question 27

(7 marks)

A trigger is necessary for a thunderstorm to form. One of these triggers is orographic lifting.

- (a) Define orographic lifting. (1 mark)

- (b) Describe how orographic lifting could trigger the formation of a thunderstorm. (3 marks)

- (c) Thunderstorms, once triggered, do not necessarily rise up into the atmosphere to any great altitude. Provide **one** example of a trigger and **two** environmental conditions that will produce a low-level thunderstorm. (3 marks)

Trigger: _____

Environmental conditions:

One: _____

Two: _____

Question 28

(8 marks)

It is recommended that while in flight pilots and passengers move their legs and feet for three to four minutes every hour and move around the cabin occasionally to allow the circulatory system to operate unimpeded. The circulatory system carries out six vital functions in the human body. State **four** of these six functions and provide a brief explanation of each selected function.

Function one: _____

Explanation: _____

Function two: _____

Explanation: _____

Function three: _____

Explanation: _____

Function four: _____

Explanation: _____

Question 29

(5 marks)

The following statements relate to the magnetic compass. Either complete each of the statements (a), (b) and (c) **or** circle the correct alternatives given in bold to make the statements true.

- (a) A pilot creating a flight plan from a Visual Navigation Chart needs to allow for _____ in order to ascertain an appropriate magnetic track. (2 marks)

- (b) Calculating a heading suitable for initial planning also needs to take into account the current winds from a suitable forecast. These winds are provided as **magnetic** / **true** and **do** / **do not** need to be corrected for the area of operation prior to use. (2 marks)

- (c) Once on board the aircraft, consideration also needs to be given to another compass error that can occur in mounting the direct reading compass in an aircraft. This error is known as _____ and correction may need to be applied to the planned heading to give the required heading. (1 mark)

Question 30

(5 marks)

- (a) Explain the reasoning behind the international aviation industry adopting UTC/Zulu as a worldwide standard. (2 marks)

- (b) In addition to pilots, list **two** specific groups, either within aviation or otherwise, that provide direct information and/or services to the aviation industry in UTC rather than local time. (2 marks)

One: _____

Two: _____

- (c) Select **one** of your answers in part (b) and outline the benefit of this information being provided directly in UTC. (1 mark)

Question 31**(6 marks)**

Answer the following questions regarding vertigo.

- (a) (i) Define 'flicker vertigo'. (1 mark)

- (ii) Give **one** pilot-based example. (1 mark)

- (b) Which part of the human body is influenced by flicker vertigo? (1 mark)

- (c) (i) Define 'pressure vertigo'. (1 mark)

- (ii) Give **one** pilot-based example. (1 mark)

- (d) Which part of the human body is influenced by pressure vertigo? (1 mark)

Question 32**(2 marks)**

One official set of documents produced for the Australian aviation industry provides details of aerodromes, navigation aids, air traffic services, ground services, public facilities available and any special procedures.

- (a) What is the full name of this publication? (1 mark)

- (b) This publication is often referred to by using the acronym: (1 mark)

Question 33

(4 marks)

An aircraft, after being rapidly accelerated during the take-off run, enters the take-off climb. After a few moments, the pilot, having no external visual reference, commences to push forward on the controls until the aircraft is in a dive and accelerating towards the ground.

- (a) Why might a pilot in this situation continue to push the control column forward to put the aircraft into an undesired state? (2 marks)

- (b) State the name of the illusion the pilot is experiencing. (1 mark)

- (c) Which parts of the vestibular system are affected when a person suffers from this illusion? (1 mark)

Question 34

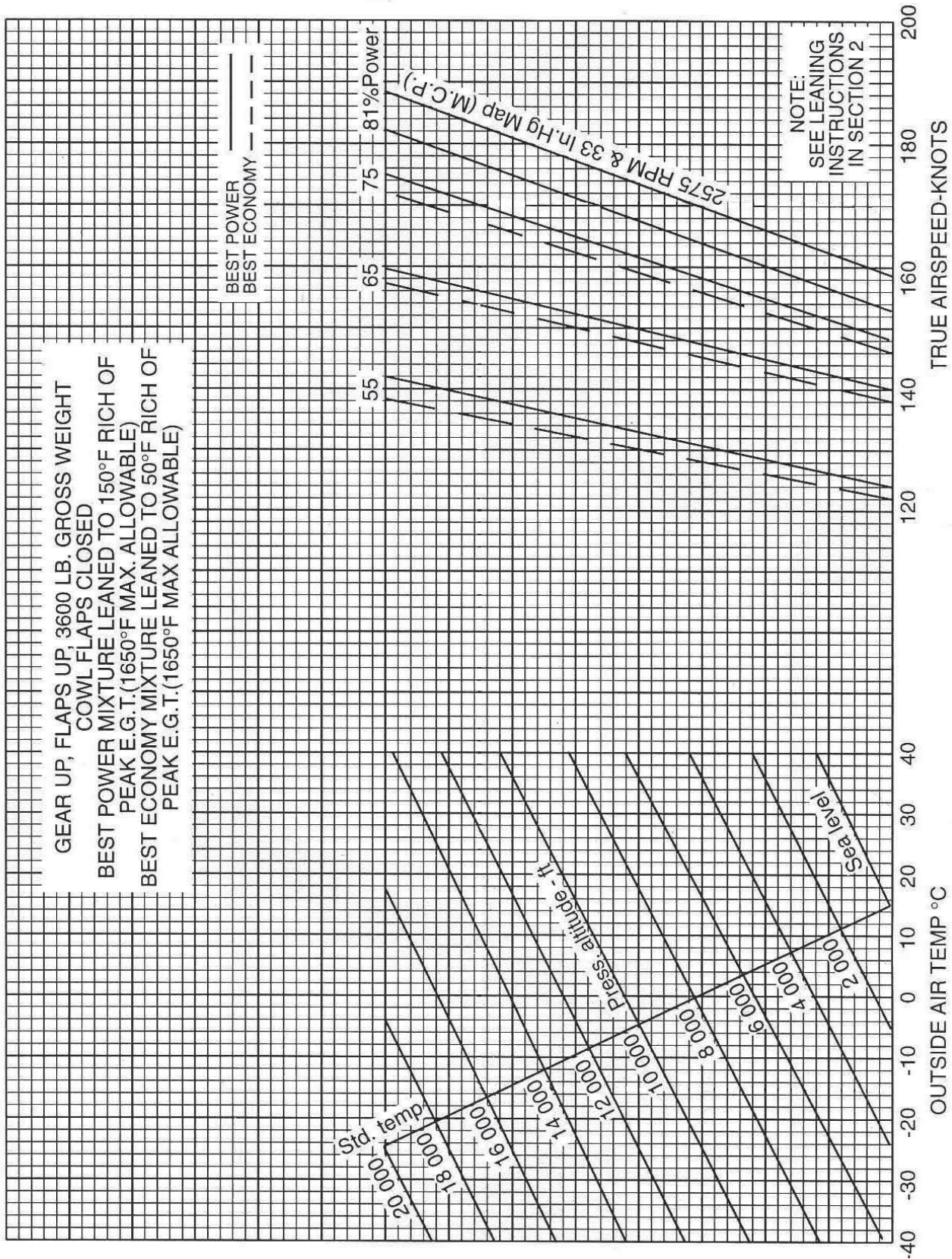
(3 marks)

Sue is planning a VFR flight from Perth to Kalgoorlie at an altitude of 6000 ft. The outside temperature is 25 °C. With a power setting of 75%, use the PA-32RT performance chart on page 15 to determine the answers to part (a), (b) and (c).

- (a) What is the TAS for the flight conducted at best power? (1 mark)

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

- (c) Determine the new TAS if power is reduced to 65% best power setting. (1 mark)



Question 35

(8 marks)

The following questions compare advection fog and radiation fog.

(a) Fog formation

In the table below, state **three** examples of conditions that will allow advection fog to form that do not apply to the formation of radiation fog, and **three** examples of conditions that will allow radiation fog to form that do not apply to the formation of advection fog. An example has been done for you. (6 marks)

	Advection Fog	Radiation Fog
Example	Does not require high pressure or a Col to form only a stable atmosphere	Requires a high pressure or a Col to form
One		
Two		
Three		

(b) Fog dispersement

In the table below, state **one** example of a condition that will cause advection fog to disperse and will not cause radiation fog to disperse, and **one** example of a condition that will disperse radiation fog and will not disperse advection fog. (2 marks)

Condition for advection fog dispersion only	Condition for radiation fog dispersion only

Question 36

(8 marks)

Refer to the TAF extract shown below.

TAF YPJT 071135Z 0712/0800 18015KT 9999 FEW 005 BKN020
TEMPO 0715/0719 2000 – SHSN BKN005 OVC020
RMK T 03 00 M02 M04 Q 1008 1007 1006 1006

- (a) State clearly the validity period of this forecast by showing date and time of start, and date and time of end. (1 mark)

- (b) Explain the significance of the validity period to operational requirements. (1 mark)

- (c) Describe the worst-case conditions forecast as likely to be experienced at 1640 UTC. Do **not** use abbreviations in your answers. (6 marks)

Wind: _____

Visibility: _____

Precipitation: _____

Cloud: _____

Temperature: _____

QNH: _____

Question 37

(3 marks)

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

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

Question 38**(5 marks)**

Describe the fundamental differences between the geographic poles and the magnetic poles in relation to the Earth and explain how these differences affect basic navigation. Use a labelled diagram to assist with your explanation.

Question 39**(2 marks)**

- (a) What is the purpose of establishing 10 minute markers on charts and maps used for visual navigation? (1 mark)

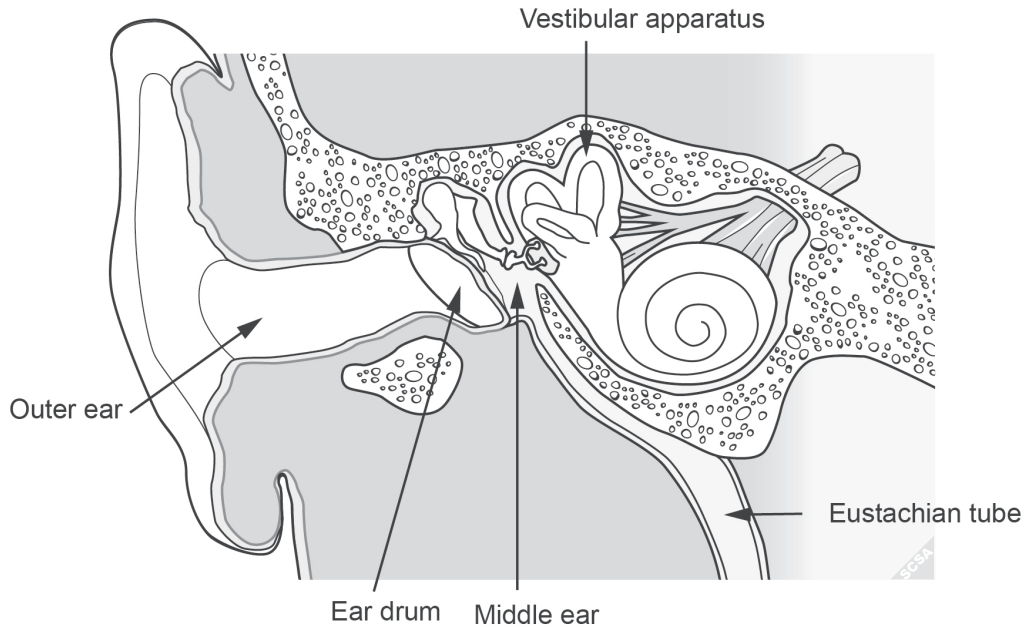
- (b) State **one** benefit of the 10 minute markers. (1 mark)

See next page

Question 40

(6 marks)

Structure of the ear



Refer to the above diagram to answer the following parts of this question.

- (a) What is the function of the eustachian tube? (2 marks)

- (b) Describe a situation in flying where the eustachian tube function is impeded and causes discomfort and possible pain. (2 marks)

- (c) (i) Give a simple self-administered method of alleviating the problem outlined in part (b). (1 mark)

- (ii) How does this method work? (1 mark)

Question 41

(8 marks)

Using the information table below together with the Take-off chart and Performance charts provided on pages 21, 22 and 23, complete the following questions that relate to a proposed flight in a Piper PA-32RT-300T Turbo Lance from Alpha to Bravo.

Conditions	Alpha	Bravo	En-route	
Pressure height	980 ft	550 ft	Distance	235 nm
Runway surface	Short dry grass	Bitumen	Cruise level	FL 120
Runway slope	1% down	Nil	Fuel flow	15.7 gph
Take-off weight	1630 kg		Headwind	Nil
Temperature	30 °C	35 °C	OAT	Minus 3 °C
Wind	Nil	Nil	TAS	170 kt

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

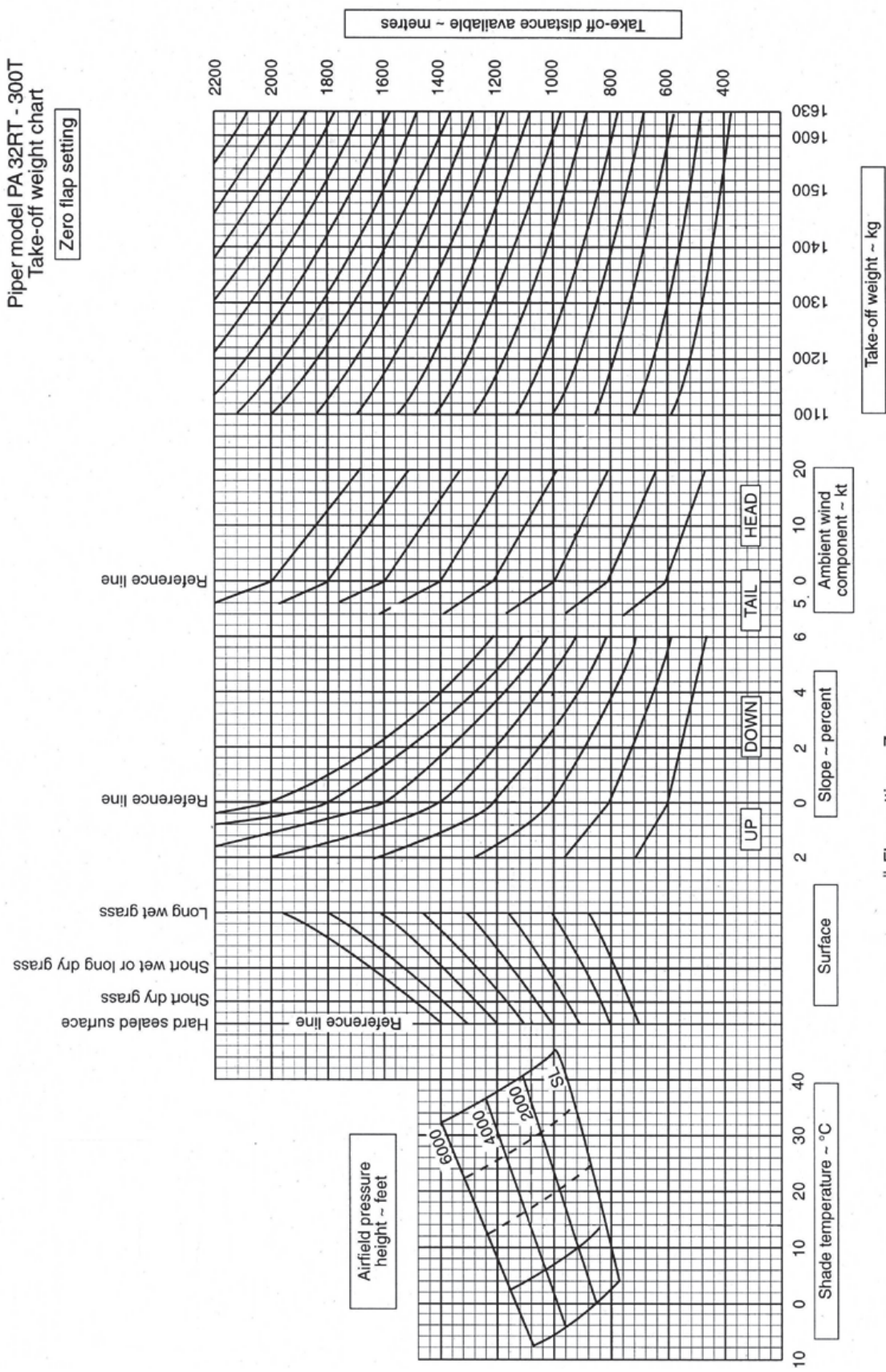
- (b) Determine climb, cruise and descent data to complete the table below to find the
- (i) total flight time.
 - (ii) total flight fuel required, i.e. excluding reserves, taxi and unusable fuel.

Ignore all winds in the climb, cruise and descent. Show **all** your workings clearly on the appropriate charts. (6 marks)

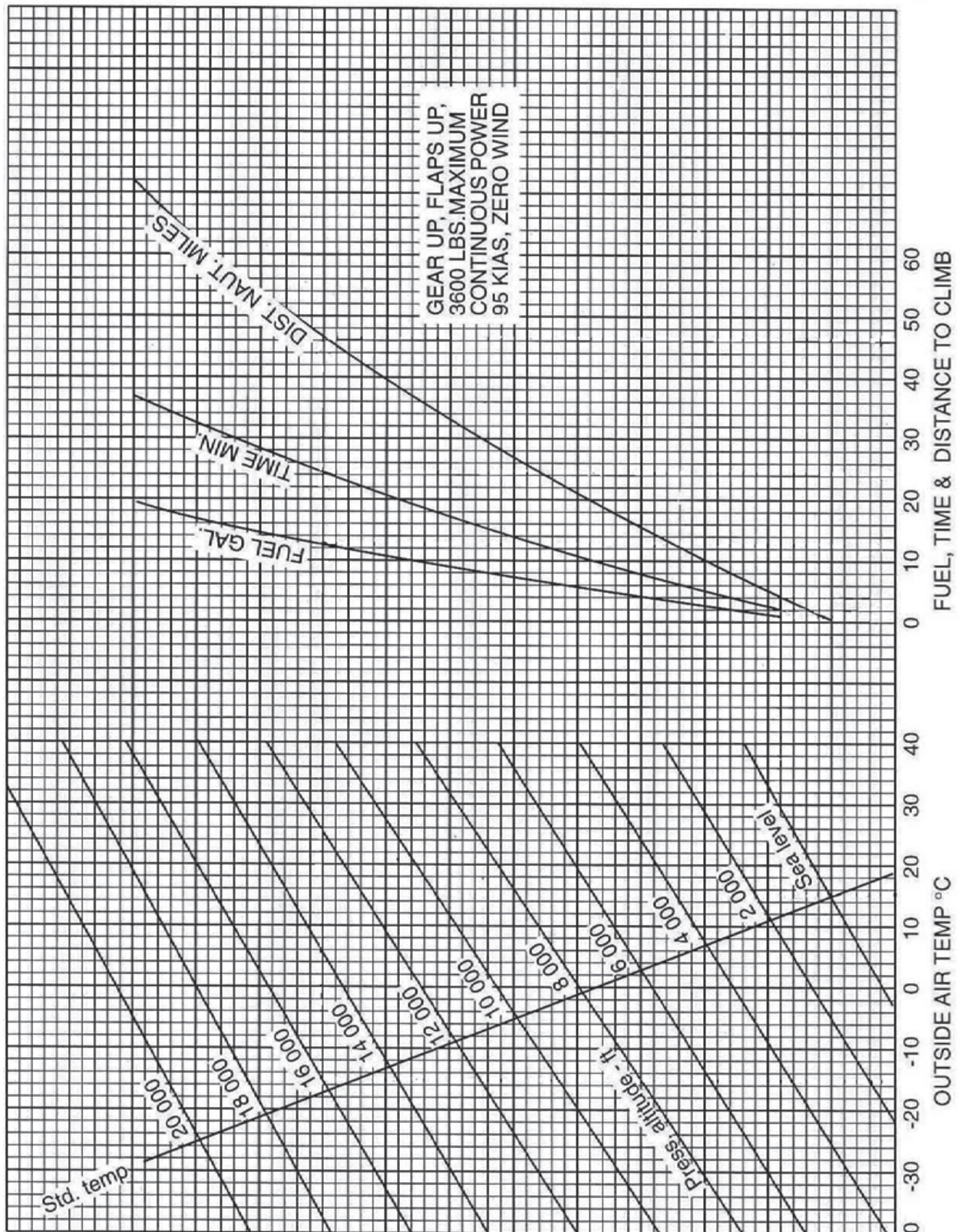
	Climb	Cruise	Descent	Total
Fuel (gal)				
Time (min)				
Distance (nm)				235 nm

Piper model PA 32RT - 300T
Take-off weight chart

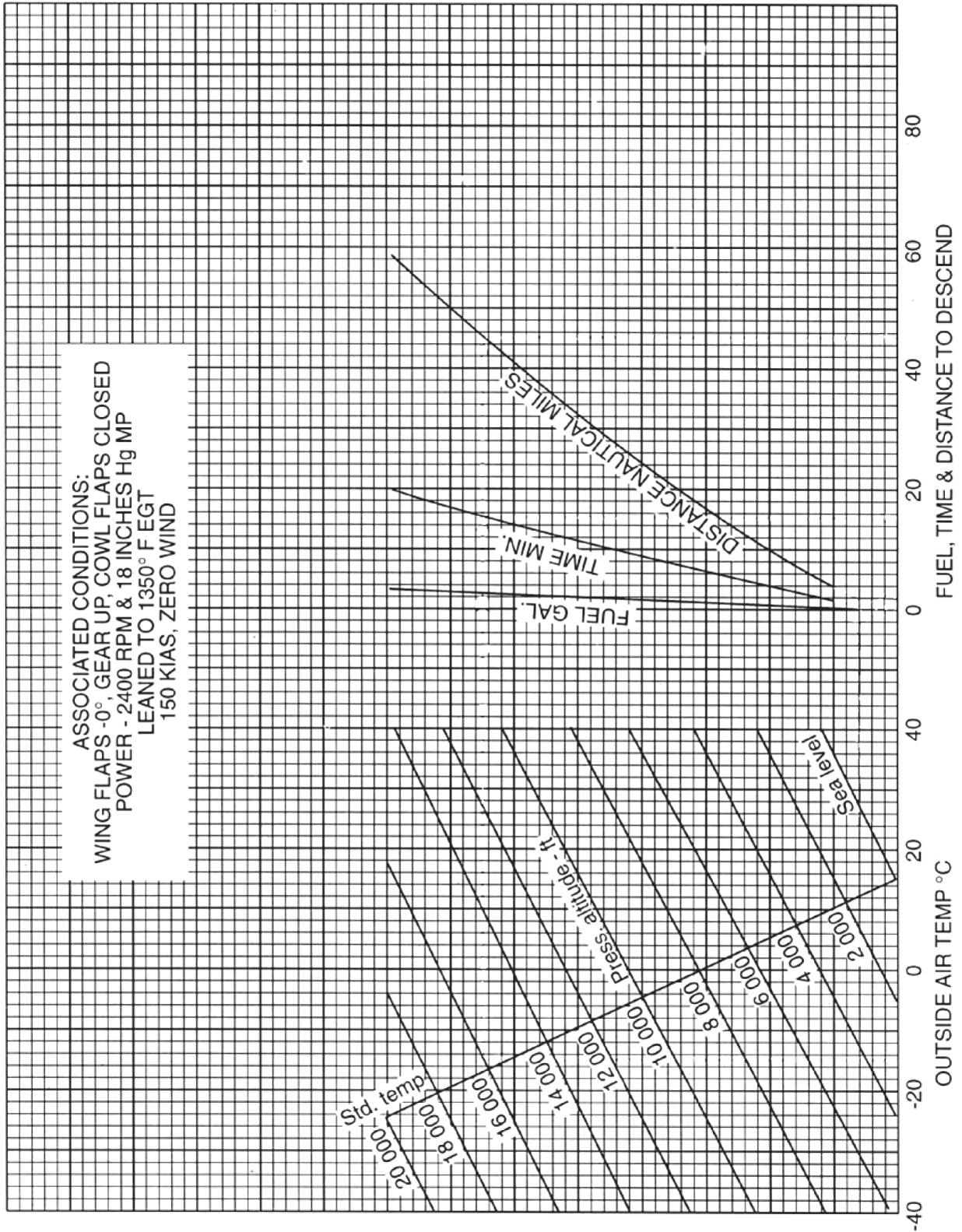
Zero flap setting



Flap setting ~ Zero
 Take-off safety speed 78 kt IAS
 Power setting ~ Take-off
 ~ RPM 2700
 Chart distance factor 1:15



See next page



See next page

Question 42

(5 marks)

A cyclone that forms over the Indian Ocean has distinct characteristics.

- (a) What is the rotational direction of the pressure system? (1 mark)

- (b) What is the region of strongest winds? (1 mark)

- (c) Explain what would happen to the intensity of a cyclone if it moved from over land back out over the ocean. (3 marks)

Question 43

(2 marks)

Before take-off at Jandakot Airport, a pilot orders fuel for his aircraft.

For the aircraft to remain within performance limitations, the **maximum fuel** that can be carried in its fuel tanks (capacity 212 L) cannot exceed 105 kg.

Given that Avgas has a density of 0.72 kg/L, determine the maximum number of litres that may be ordered so as to **not** exceed this performance limitation. Show **all** workings.

Question 44

(7 marks)

The Threat and Error Management (TEM) model has become accepted in the aviation industry. On the basis on this model answer the following:

- (a) Define 'threat'. (1 mark)

- (b) Provide **one** clear example of a threat and describe why it meets the requirements to be classified as such. (2 marks)

- (c) Define 'error'. (1 mark)

- (d) Provide **one** clear example of an error and describe why it meets the requirements to be classified as such. (2 marks)

- (e) Define what is meant by the phrase 'undesired aircraft state'. (1 mark)

Question 45**(10 marks)****Case Study**

A light aircraft which was fully registered and compliant with all the required regulations was loaded early in the morning in preparation for a night flight to a remote (fully-serviceable) aerodrome. On inspection the aircraft was low on oil.

The private pilot was to fly with an additional three male colleagues. Hence the aircraft needed fuel to be added to meet the flight and planned alternate requirements.

Taking into account the combined weight of all persons, plus the tools and equipment already loaded on the aircraft, the total came just within the performance specifications for all operational requirements for this minimum fuel flight.

The pilot worked for his own construction company during the day and was anxious to get back to the office to complete a full day's work prior to the flight. To get things done quickly he got a friend to order the fuel. When his friend asked 'How much fuel do you need?', he responded by stating 'I'll be needing 130 litres total' as he hurried towards the aircraft to top up the oil.

Later that evening the pilot collected his three passengers and arrived back at the airport. Although in a rush, the pilot took the time to conduct a quick check of the current weather and to review his flight plan before going out to the aircraft.

At the aircraft the pilot rechecked the oil and handed one of his passengers (also a private pilot) the fuel dipstick and drain bottle and requested he check the fuel. The pilot continued to prepare for the flight by arranging the other two passengers safely into the aircraft.

Fuel tanks were dipped and the test revealed a nominal amount of water, which was then drained away in the correct manner.

The passenger who checked the fuel reported later that he was a bit surprised to be handed the fuel dipstick to check the fuel quantities on board, as he found both tanks full on opening the filler cap. As a pilot he had only ever flown with full tanks and therefore did not comment.

The flight commenced. Taxi and clearances all proceeded to plan. The take-off speed was slow to build but this was to be expected for maximum weight flight. The distance covered down the runway increased with no sign of the aircraft attaining flying speed let alone becoming airborne. This clearly concerned the pilot. He closed the throttles and applied brakes. However the stopping distance was no longer sufficient and the aircraft ran off the end of the runway into the sandy clearway.

There were no injuries. A subsequent investigation revealed that the aircraft was overweight by 72 kilograms. When interviewed, the aircraft refueller confirmed adding 130 litres in total to the aircraft as per request, which coincidentally brought it to full tanks.

Use the Threat and Error Model (TEM) to answer the following questions.

- (a) Identify the threats that appear in this case study. (2 marks)

- (b) Select **one** clear example of a threat from your answer to part (a) and describe why it meets the requirements to be classified as a threat. (1 mark)

- (c) Identify **two** errors that appear in the case study. (2 marks)

One: _____

Two: _____

- (d) Select **one** clear example of an error and describe why it meets the requirements to be classified as an error. (1 mark)

- (e) Determine the undesired aircraft state. (1 mark)

- (f) Summarise the main cause for the aircraft accident and identify the key components that would need to change for the course of events to be different. (3 marks)

End of questions

ACKNOWLEDGEMENTS

Section Two

Question 34 Piper PA-32RT cruise performance chart from: Yeo, M., Bowers, G., & Bennett, K. (2001). *Handbook of flight* (2nd ed.) West Perth, WA: WestOne Services, p. 170.
Not for operational purposes.

Question 41 Piper PA-32RT take-off weight chart from: Yeo, M., Bowers, G., & Bennett, K. (2001). *Handbook of flight* (2nd ed.). West Perth, WA: WestOne Services, p. 149.
Not for operational purposes.

Piper PA-32RT fuel, time and distance to climb chart from: Yeo, M., Bowers, G., & Bennett K. (2001). *Handbook of flight* (2nd ed.). West Perth, WA: WestOne Services, p. 169.
Not for operational purposes.

Piper PA-32RT fuel, time and distance to descend chart from: Yeo, M., Bowers, G., & Bennett, K. (2001). *Handbook of flight* (2nd ed.). West Perth, WA: WestOne Services, p. 171.
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