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

ATAR course examination, 2018

Question/Answer booklet

AVIATION

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: 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 this examination, 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 material. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.

Ref: 18-008

Structure of the examination

The Aviation ATAR course examination consists of a written component and a practical (performance) component.

Structure of this paper

Section	Number of questions available	Number of questions to be answered	Suggested working time (minutes)	Marks available	Percentage of written examination
Section One Multiple-choice	20	20	30	20	20
Section Two Short answer	26	26	120	123	80
				Total	100

Instructions to candidates

1. The rules for the conduct of the Western Australian external examinations are detailed in the *Year 12 Information Handbook 2018*. 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. Do not use erasable or gel pens. 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 answers to the specific questions asked and to follow any instructions that are specific to a particular question.

5. Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

See next page

Section One: Multiple-choice **20% (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. Do not use erasable or gel pens. 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.

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1. Which of the following distribution of forces applies to an aircraft in a steady state climb?

   (a) L > W and T < D
   (b) L = W and T = D
   (c) L > D and W < T
   (d) L < W and T > D

2. A high-speed stall is most likely to occur when

   (a) entering a high-speed descent.
   (b) entering a high-speed climb.
   (c) in a high-speed level turn at an angle of bank greater than 20°.
   (d) quickly levelling out after a high-speed steep descent.

3. Wing loading of an aircraft is calculated using

   (a) wing area and weight.
   (b) wing area and the calculated differential pressure between the top and bottom of the wing.
   (c) lift divided by weight.
   (d) the difference between the manufacturer's maximum take-off weight and the aircraft's empty weight at the time of manufacture.

4. Which of the following would qualify as high-lift devices when fitted to an aircraft?

   (a) spoilers
   (b) low aspect ratio wings
   (c) elevons
   (d) vortex generators

See next page

5. In addition to the last light tables, which of the following are required to calculate first light as a local mean time at a given place on the surface of the Earth?

   (a) longitude, month and year
   (b) latitude, day and month
   (c) day, month and year
   (d) longitude and the season

6. Which of the following is required for the formation of a convection thunderstorm to occur?

   (a) orographic uplift
   (b) a strong surface heating
   (c) the formation of a radiation fog
   (d) the convergence of two similar air masses

7. Vfe is the

   (a) maximum permissible speed for flight with flaps extended.
   (b) maximum speed for selecting full flap.
   (c) minimum speed required for operating the flaps.
   (d) maximum speed for flying for best endurance.

8. A piston-engined aircraft wanting to achieve best endurance needs to fly

   (a) as high as possible at the speed for maximum surplus thrust.
   (b) as low as practical with the speed for minimum thrust.
   (c) as low as practical with the speed for minimum power.
   (d) as high as practical while maintaining the lowest possible speed for minimum straight and level flight.

9. When supersonic airflow changes direction while flowing over the upper surface of a wing, it will

   (a) decrease in temperature.
   (b) increase in density.
   (c) increase in pressure.
   (d) decrease in speed.

10. Extent of cloud is reported in aviation using the term OKTAS. This refers to

   (a) whether the cloud is okay to fly through on a scale of 1 to 8 and the speed (TAS) at which it is moving.
   (b) the cloud coverage of the visible sky on a scale of 1 to 8.
   (c) the direction of cloud from the observer using 015° intervals, for example 1 OKTAS is cloud between 360° M and 015° M.
   (d) the type of cloud and likelihood of severe windshear and turbulence.

See next page

11. The greatest hazard that thunderstorms in the vicinity of an airport pose to landing aircraft is the possible presence of

(a) heavy rain.
(b) hail and snow.
(c) microbursts.
(d) severe turbulence.

12. The position of the North Magnetic pole is

(a) continually varying but the annual change will not normally cause a significant navigational error and is ignored in Australia.
(b) continually varying and this variation must always be adjusted for whenever it is applied to a true track.
(c) a fixed point on the earth's surface.
(d) continually varying and deviation must be accounted for whenever it is applied to a true track.

13. A force applied to a gyroscopic instrument that acts 90° in the direction of rotation is known as

(a) wander.
(b) tilt.
(c) drift.
(d) precession.

14. Hypermetropia is the inability of a person to

(a) maintain a normal body temperature.
(b) focus their vision on close objects.
(c) hear sounds from a distance.
(d) maintain a normal blood pressure.

15. If an aircraft is tracking 045° T and the variation is 6° E, the magnetic track is

(a) 051° M.
(b) 045° M.
(c) 039° M.
(d) cannot be calculated without the wind direction and strength.

16. The tail rotor on a helicopter is used to

(a) nullify the Coriolis effect.
(b) make the helicopter fly sideways.
(c) eliminate gyroscopic precession.
(d) counteract any torque effect.

See next page

17. Updrafts are a feature of thunderstorms. In the 'life' of a thunderstorm, updrafts are **most** likely to exist in

    (a) the developing and mature stages.
    (b) the mature and dissipating stages.
    (c) the developing stage only.
    (d) all stages.

18. Which of the following statements is true regarding an aircraft that is on a collision course with your aircraft? The other aircraft will appear to

    (a) move downward in the windscreen relative to your aircraft.
    (b) move upward in the windscreen relative to your aircraft.
    (c) remain stationary in the windscreen relative to your aircraft.
    (d) move in any direction relative to your aircraft.

19. Radiation fog in the hills will normally clear and rise up to become

    (a) stratus cloud.
    (b) nimbostratus cloud.
    (c) cumulus cloud.
    (d) cumulonimbus cloud.

20. The main issue of an ageing aircraft fleet in Australia is related to the impact on safety resulting from which of these concerns?

    (a) new pilots trained on more modern aircraft may not being able to manage instruments/operating systems of older aircraft
    (b) older aircraft are not compatible with the new fuels being introduced
    (c) increased probability of aircraft accidents as a result of structural failure due to metal fatigue
    (d) the lower costs associated with buying and insuring newer aircraft when compared with older aircraft and the losses aircraft owners may face if they cannot sell their old aircraft

End of Section One

See next page

Section Two: Short answer **80% (123 Marks)**

This section has **26** questions. Answer **all** questions. Write your answers in the spaces provided.

Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

Suggested working time: 120 minutes.

Question 21 **(2 marks)**

Given the following data:
- airfield elevation 1525 ft
- QNH 1007
- OAT 33 °C.

Calculate airfield pressure altitude. Show **all** workings.

Question 22 **(2 marks)**

Given the following data:
- airfield pressure height 175 ft
- QNH 1001
- OAT 35 °C.

Calculate airfield density altitude. Show **all** workings.

Question 23 **(2 marks)**

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

- fuel tank capacity 230 L
- AVGAS specific gravity 0.72.

In order for the aircraft to remain within performance limitations, the maximum additional fuel that can be loaded into the tank cannot exceed 93 kg.

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

Question 24 **(2 marks)**

An aircraft is tracking 175° M and maintaining 120 kt TAS.

Actual winds 125° M/25 kt.

Assume no compass errors exist.

Use your flight computer to resolve the following:

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

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

Question 25 **(4 marks)**

An aircraft is flying between two known points with the following data:

- distance 180 nm
- TAS 120 kt
- forecast winds 235° M/20 kt
- flight planned track 090° M
- heading flown 095° M.

After travelling 75 nm, the aircraft has drifted 5 nm to the right of track.

(a) Using **only** the 1 in 60 rule, determine the actual Track Made Good (TMG). Show **all** workings. (2 marks)

(b) On the basis of the data provided, describe the most plausible reason why the aircraft is off track at the 75 nm point. (2 marks)

Question 26 **(7 marks)**

Answer the question parts below using the PA-32RT performance chart on page 11 and the following data:

- outside air temperature 0 °C
- pressure altitude 4000 ft
- power setting 55%.

(a) Determine the TAS for the flight conducted for best economy. Show **all** workings on the chart. (2 marks)

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

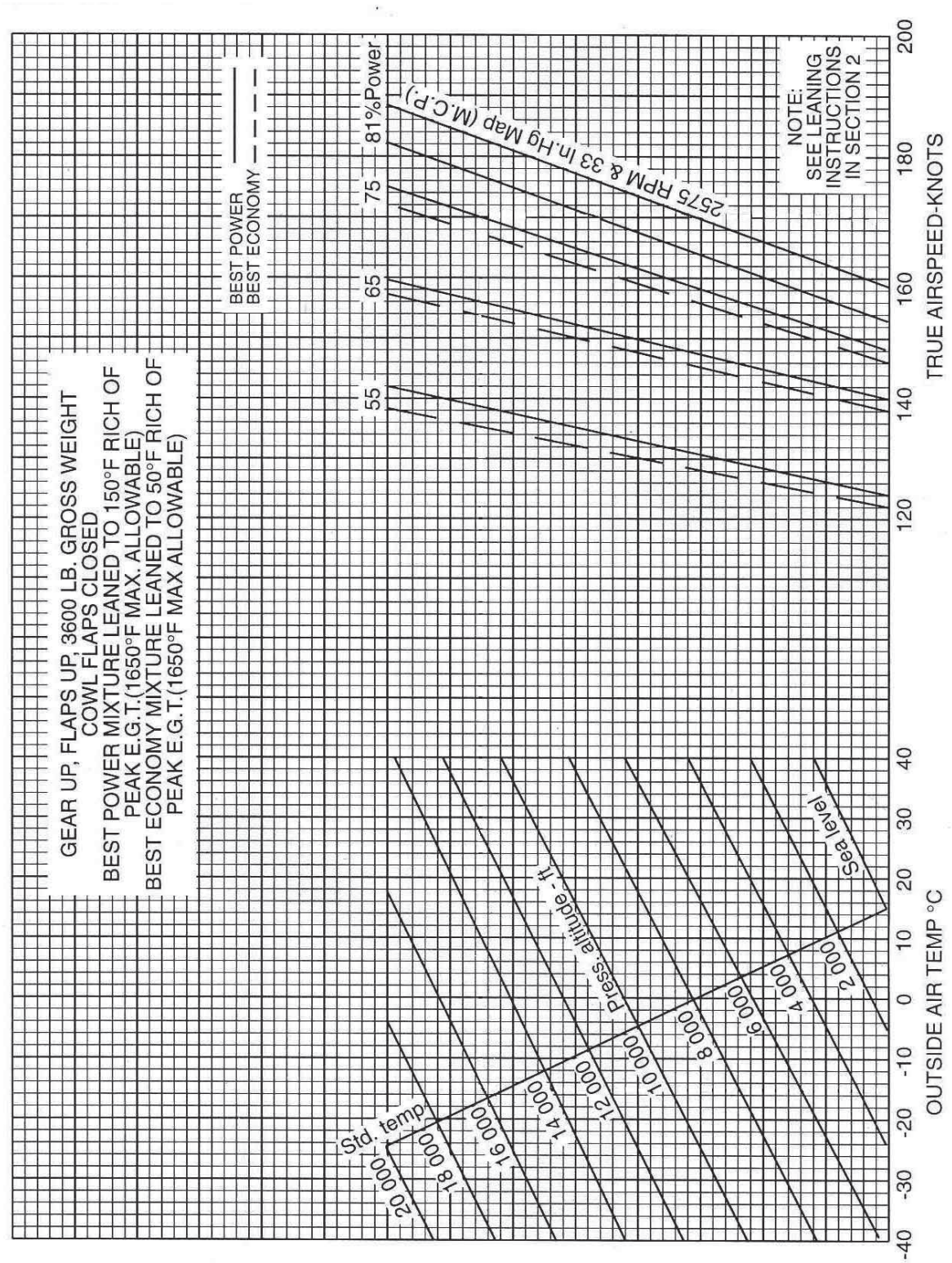
(c) The RPM and Manifold Absolute Pressure (MAP) limitations for Maximum Continuous Power (M.C.P) at 8000 ft pressure altitude in ISA would be: (3 marks)

RPM: _____

MAP: _____

The resulting TAS would be closest to: _____

See next page



See next page

Question 27 **(3 marks)**

A VFR aircraft is travelling south holding a constant heading of 180° M. The aircraft passes over its initial waypoint at UTC 0425 and has estimated its next waypoint at UTC 0615. The winds are forecast to remain constant and the distance between waypoints is 260 nm.

(a) Calculate the planned ground speed. Give the correct unit of measurement. (1 mark)

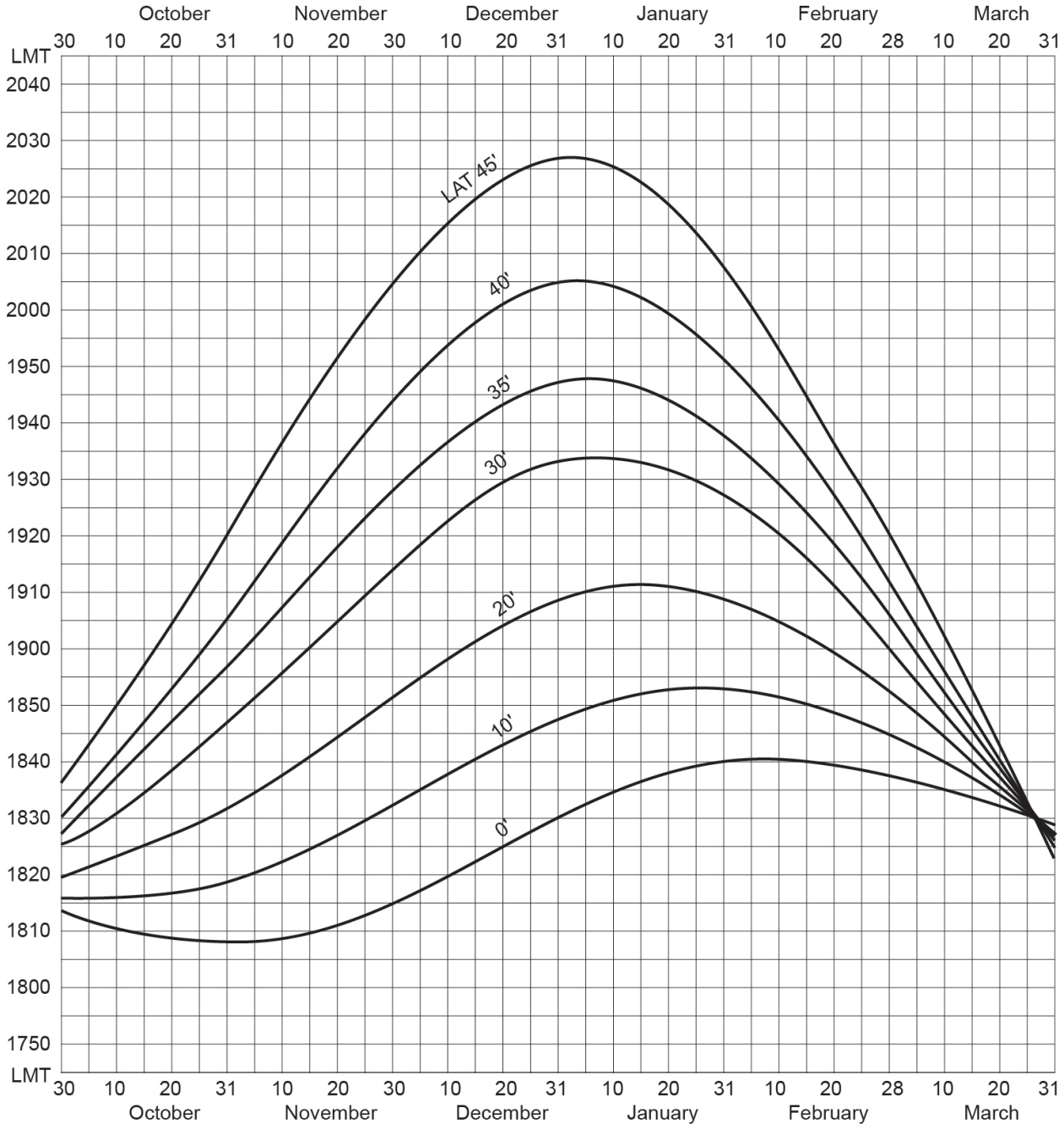
(b) The aircraft arrives over its second waypoint at UTC 0600. Calculate the actual ground speed (to the nearest whole unit) achieved for this flight. (2 marks)

See next page

Question 28 **(3 marks)**

Using the End of daylight chart below, calculate last light in LMT on 10 October for Albany (34° 57’ S, 117° 49’ E). Show **all** workings.

End of daylight



See next page

Question 29 **(4 marks)**

The following data apply to an aircraft:

- TAS 120 kt
- altitude 6500 ft
- fuel policy – fixed reserve 45 minutes
  – taxi fuel 5 litres
  – climb and descent requirements are to be ignored
  – planned fuel consumption for this flight 45 litres per hour.

Determine the minimum onboard fuel requirements (in litres) at start up for a flight 276 nm at a planned ground speed of 150 kt. Show **all** workings.

See next page

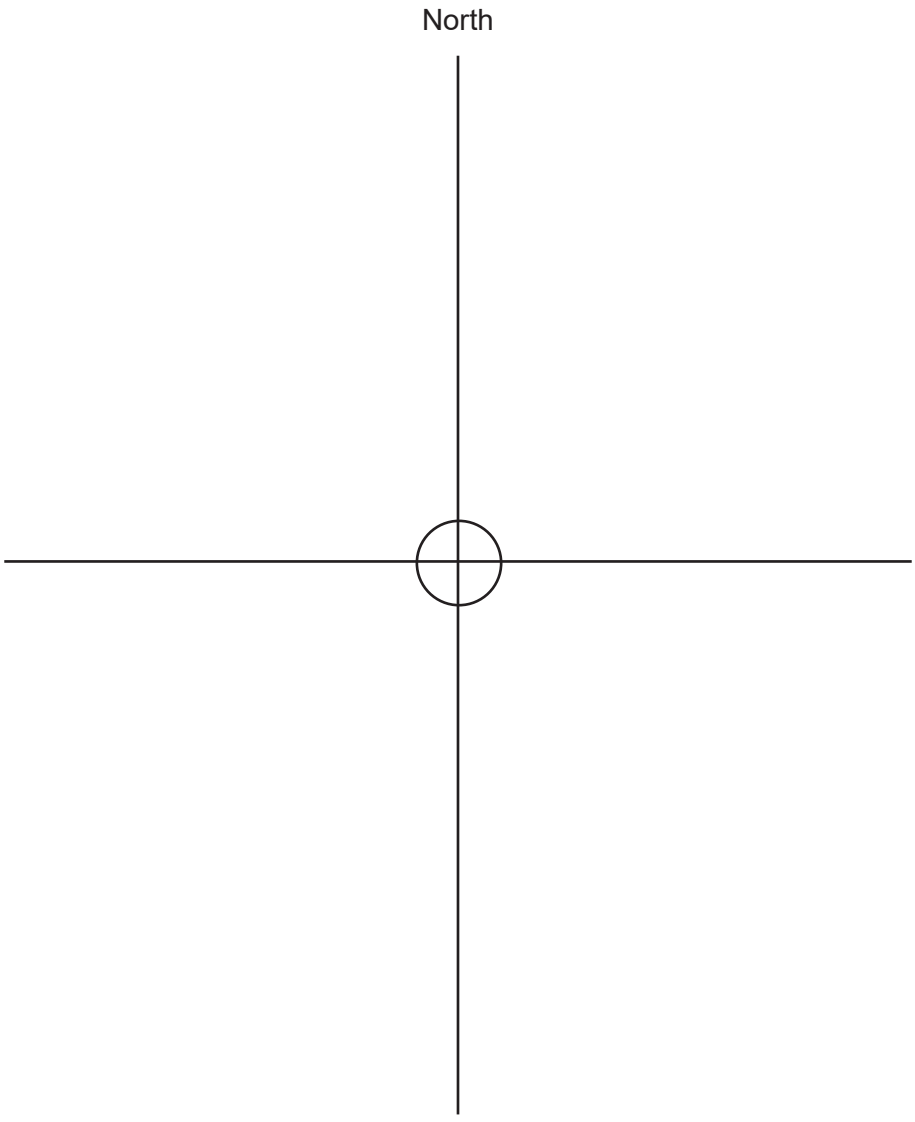
Question 30 **(3 marks)**

The following data apply to an aircraft:

- heading 180° M
  magnetic variation nil
- navigation instrumentation
  DME – 35 nm
- VOR information
  OBI 180
  flag shows FROM
  CDI – centred.

Plot the aircraft's position and orientation as accurately as possible using your navigational plotter and WAC scale ruler (1: 1 000 000) on the basic orientation diagram below.

Note: Circle represents collocated VOR/DME.



See next page

Question 31 **(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
145 kt	140°	025/25				

Question 32 **(11 marks)**

Using the information table below and the Take-off and Performance charts provided on pages 17–19, complete the following question parts 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	Sea level	2000 ft	Distance	355 nm
Runway surface	Long dry grass	Short wet grass	Cruise level	Alt 4500 ft
Runway slope	2° down	nil	Fuel flow	13.7 gph
Take-off weight	1630 kg		Headwind	Nil
Temperature	10° C	15° C	OAT	10° C
Wind	nil	nil	TAS	145 kt

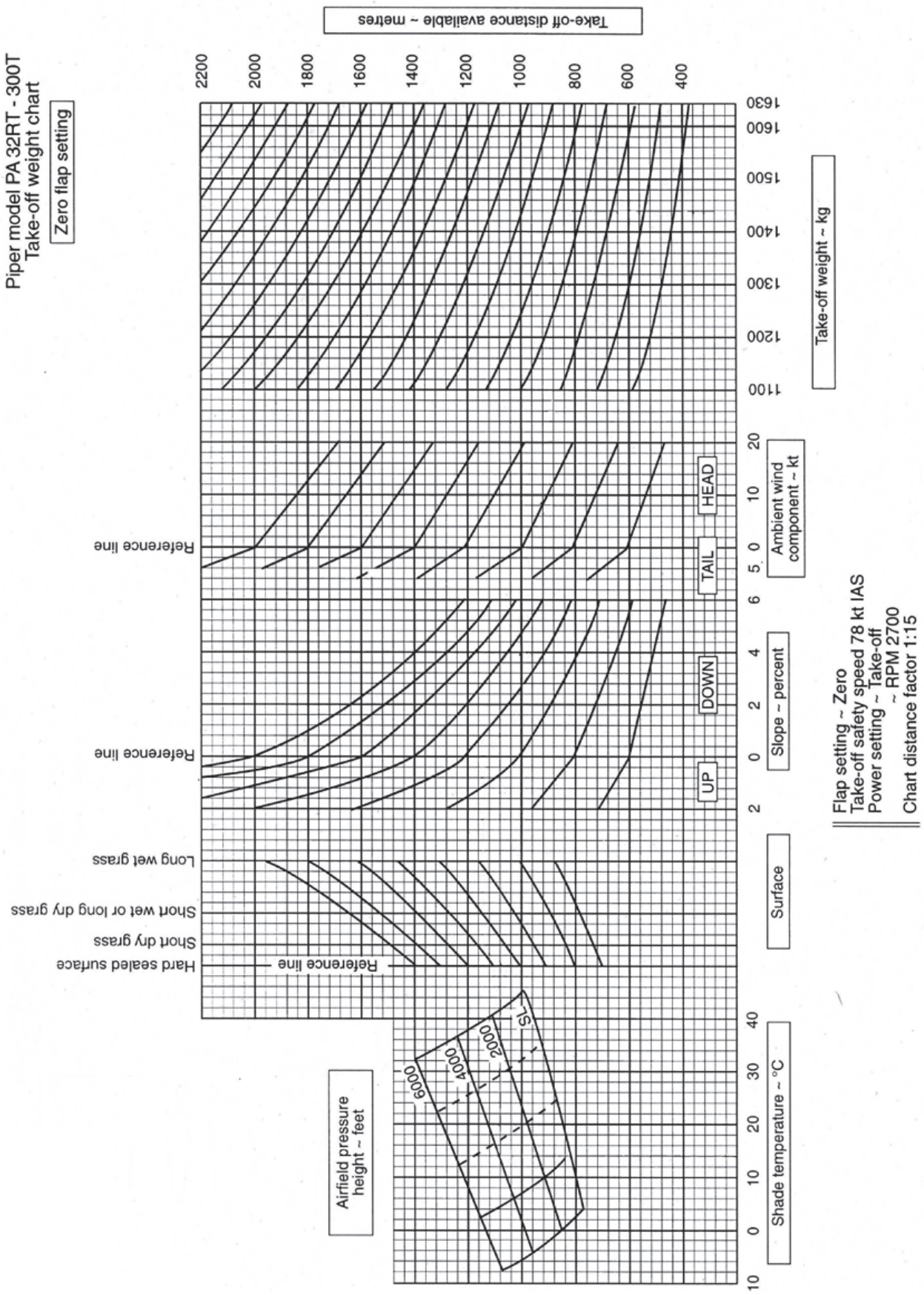
(a) Determine the minimum take-off distance required at Alpha. Show **all** workings clearly on the appropriate chart. (2 marks)

(b) Determine climb, cruise and descent data to complete the table below to find the
- total flight time.
- 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 chart. (9 marks)

	Climb	Cruise	Descent	Total
Fuel (gal)				
Time (min)				
Distance (nm)				355 nm

See next page



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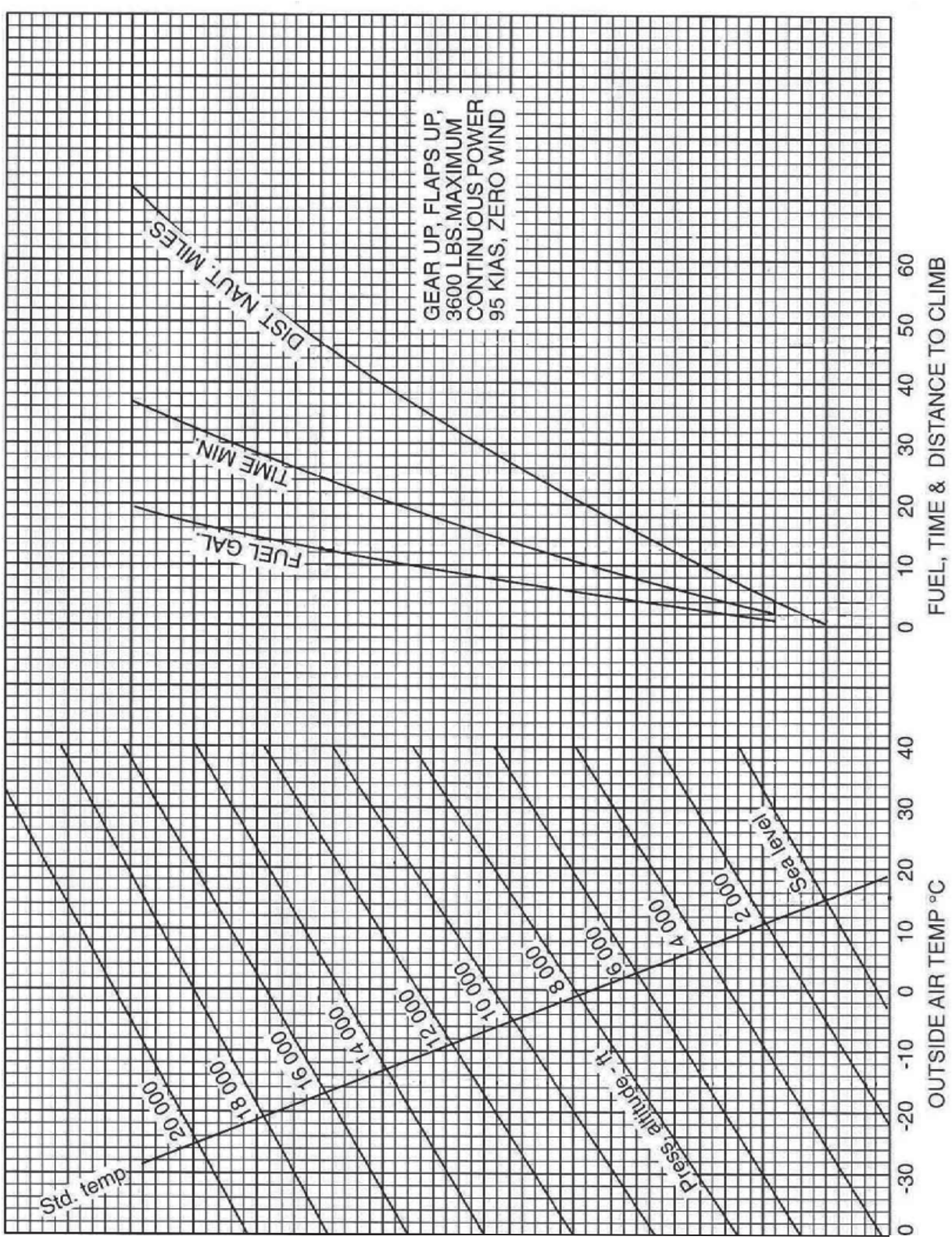
Question 32 (continued)



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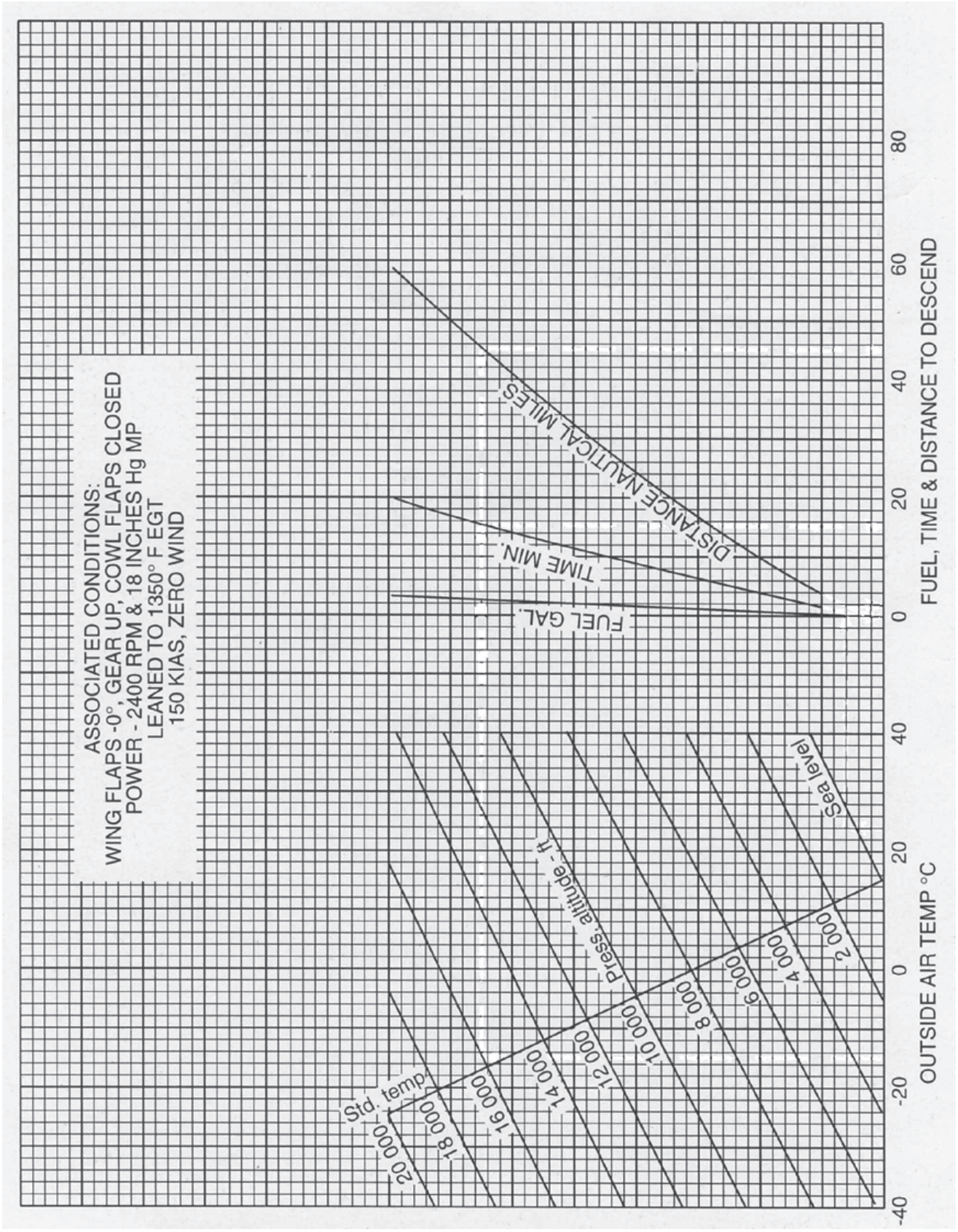


See next page

Question 33 **(4 marks)**

Weight and balance are important parameters for aircraft.

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.

Position	Weight (lb)	Arm (in)	Moment (lb/in)
Aircraft (BEW)	2335.8		195086.0
Front row	322.0	85.5	
Centre row	225.0	118.1	
Rear row	140.0	157.6	
Forward baggage	5.0	42.0	
Aft baggage	50.0	178.7	
Zero fuel weight			

See next page

Question 34 **(5 marks)**

An aircraft needs to be balanced in all stages of flight.

(a) Complete the table below to show the position of centre of gravity and moment for the aircraft at ramp prior to taxi. (2 marks)

Position	Weight (lb)	Arm (in)	Moment (lb/in)
Zero fuel weight	2950	93.0	274350
Fuel	325	93.6	30420
Ramp weight	3275		

(b) In which direction does the loading of fuel move the centre of gravity on this occasion? Justify your answer. (3 marks)

Direction of movement: _____

Justification: _____

_____

_____

_____

Question 35 **(3 marks)**

Given a time of 1129 Local Mean Time (LMT) and a position of 15° 25’ S 134° 20’ E, use the Conversion of Arc to Time chart below to convert LMT to Coordinated Universal Time (UTC). Show **all** workings.

CONVERSION OF ARC TO TIME											
DEGREES						**MINUTES**					
	Time			**Time**			**Time**			**Time**	
Long Deg	**Hours**	**Min**	**Long Deg**	**Hours**	**Min**	**Long Min**	**Min**	**Sec**	**Long Min**	**Min**	**Sec**
110	7	20	140	9	20	0	0	00	30	2	00
111	7	24	141	9	24	1	0	04	31	2	04
112	7	28	142	9	28	2	0	08	32	2	08
113	7	32	143	9	32	3	0	12	33	2	12
114	7	36	144	9	36	4	0	16	34	2	16
115	7	40	145	9	40	5	0	20	35	2	20
116	7	44	146	9	44	6	0	24	36	2	24
117	7	48	147	9	48	7	0	28	37	2	28
118	7	52	148	9	52	8	0	32	38	2	32
119	7	56	149	9	56	9	0	36	39	2	36
120	8	00	150	10	00	10	0	40	40	2	40
121	8	04	151	10	04	11	0	44	41	2	44
122	8	08	152	10	08	12	0	48	42	2	48
123	8	12	153	10	12	13	0	52	43	2	52
124	8	16	154	10	16	14	0	56	44	2	56
125	8	20	155	10	20	15	1	00	45	3	00
126	8	24	156	10	24	16	1	04	46	3	04
127	8	28	157	10	28	17	1	08	47	3	08
128	8	32	158	10	32	18	1	12	48	3	12
129	8	36	159	10	36	19	1	16	49	3	16
130	8	40				20	1	20	50	3	20
131	8	44				21	1	24	51	3	24
132	8	48				22	1	28	52	3	28
133	8	52				23	1	32	53	3	32
134	8	56				24	1	36	54	3	36
135	9	00				25	1	40	55	3	40
136	9	04				26	1	44	56	3	44
137	9	08				27	1	48	57	3	48
138	9	12				28	1	52	58	3	52
139	9	16				29	1	56	59	3	56

See next page

Question 36 **(4 marks)**

An aircraft is loaded and balanced for flight at zero fuel weight and for take-off weight as shown in the table below.

	Weight (lb)	Arm (in)	Moment (lb/in)
Gross Zero fuel weight	2950	92.8	273760
Gross Take-off weight	3300	94.8	312840

A passenger has arrived with unexpected extra baggage that can only go in the aft baggage compartment.

Using the formula provided, determine the **maximum** theoretical amount of additional baggage that could be added to the aft baggage compartment for both zero fuel weight and take-off weight to load the aircraft to a desired maximum aft centre of gravity position of 96 in. Show **all** workings.

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

The aft baggage loading station is located at 178.7 in.

The aft limit for this aircraft is not to exceed 96 in.

Ignore all maximum weight limitations for this question.

Zero fuel weight: _____

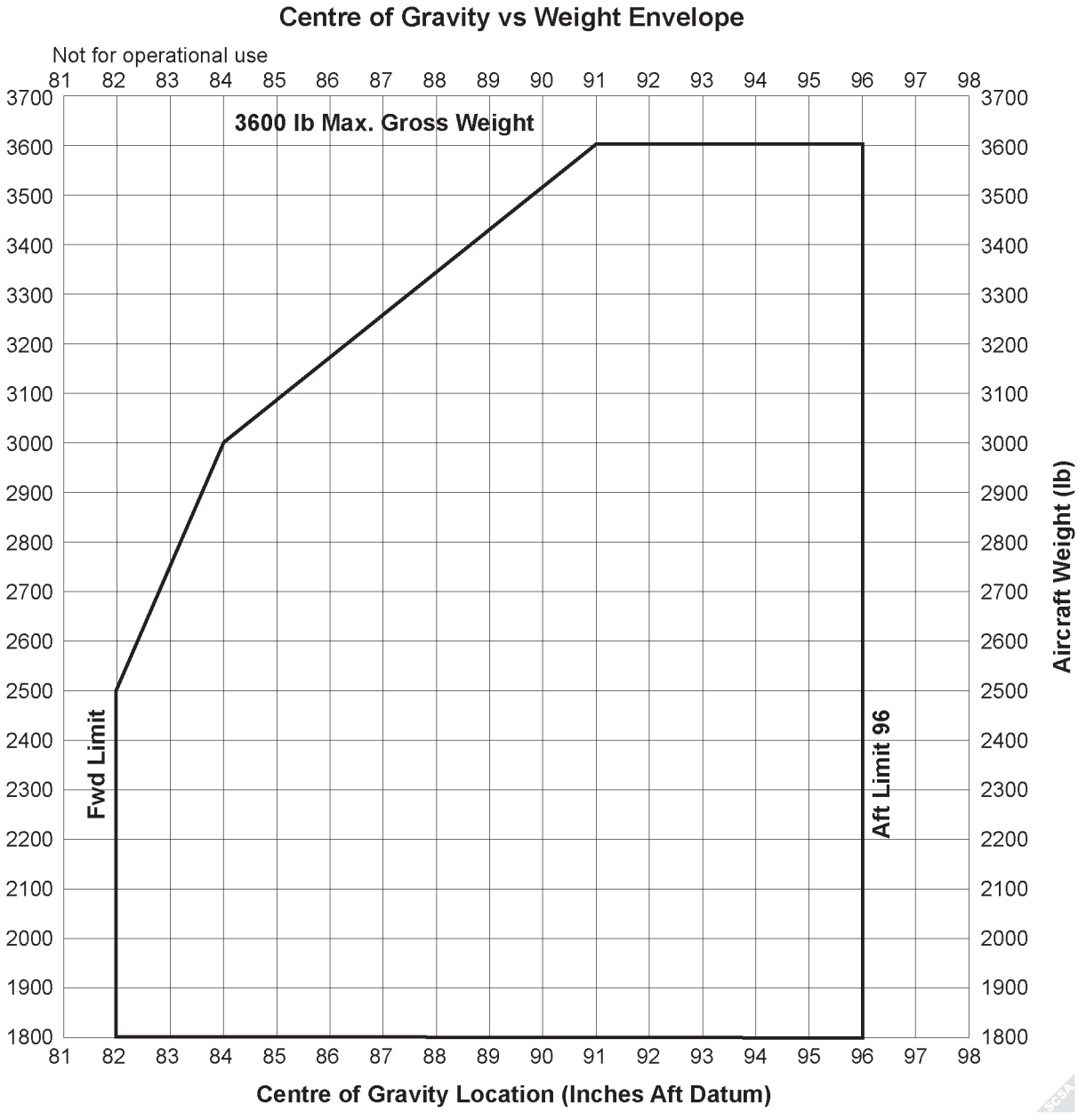
Take-off weight: _____

See next page

Question 37 **(3 marks)**

(a) Use the centre of gravity vs weight chart provided to plot and label both the zero fuel weight (1) and proposed zero fuel weight (2). (2 marks)

	Weight (lb)	Arm (in)	Moment (lb/in)
Zero fuel weight (1)	3100	95	294500
Proposed zero fuel weight (2)	3400	97	329800



(b) Purely on the basis of your observation from the positions plotted on the graph, determine the maximum permissible zero fuel weight for this aircraft if the weight was adjusted so the aircraft remained loaded to the maximum aft limit only. (1 mark)

See next page

Question 38 **(4 marks)**

Anhedral is an aerodynamic design feature fitted to some aircraft.

(a) State the purpose of this design feature. (1 mark)

(b) Explain why an anhedral would be required to be fitted to a high wing heavy transport aircraft with sweptback wings such as the Antonov AN-225. Use diagrams to assist with your answer. (3 marks)

See next page

Question 39 **(3 marks)**

Calibrated air speed (CAS) is a term referred to in the aviation environment.

(a) What is CAS? (1 mark)

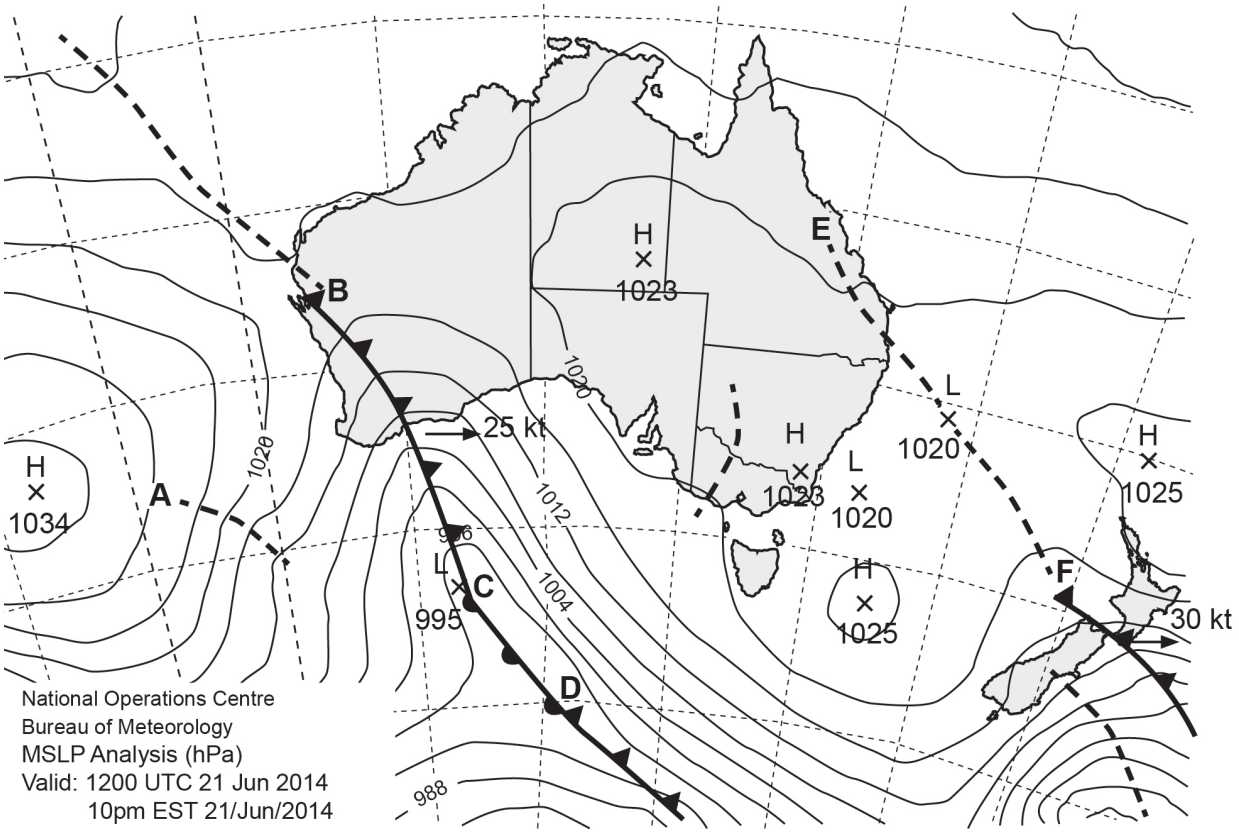
(b) What **two** factors need to be taken into consideration in order to calculate a CAS on a light general aviation fixed-wing propeller driven aircraft? (2 marks)

One: _____

Two: _____

Question 40 **(8 marks)**

On the basis of the synoptic chart below, identify the features and extract the relevant information to answer the question parts on page 27.



See next page

(a) What is the pressure at position A? (1 mark)

(b) Which meteorological feature is shown by the dashed line between positions E and F? (1 mark)

(c) The frontal system passing over central New Zealand, below position F, is moving in which direction and at what speed? (1 mark)

Direction: _____

Speed: _____

(d) Describe the frontal system incorporating the line from position C to position D. (2 marks)

(e) Identify the system and describe conditions associated with the feature between positions B and C as it passes over the south-west of Western Australia. (3 marks)

See next page

Question 41 **(4 marks)**

Good ergonomic design performs a pivotal role in assisting with aviation safety.

(a) What is meant by the term ‘ergonomics’. (1 mark)

(b) Using an example, explain how the implementation of ergonomic principles can enhance safety. (3 marks)

See next page

Question 42 **(11 marks)**

Cyclones are a serious hazard to aviation in the Southern Hemisphere.

(a) Outline **three** prerequisite conditions necessary for the formation of a cyclone in the Southern Hemisphere. (3 marks)

One: _____

_____

Two: _____

_____

Three: _____

_____

(b) Describe conditions within a cyclone and the area immediately around it (out to 50 nm) as the cyclone travels over an ocean and overland. In each of your answers outline what happens to its intensity and why these changes occur.

(i) Ocean: (4 marks)

_____

_____

_____

_____

_____

_____

_____

_____

(ii) Overland: (4 marks)

_____

_____

_____

_____

_____

_____

_____

_____

See next page

Question 43 **(9 marks)**

Visual illusions and other natural tendencies of the human eye can cause problems for pilots in flight. Explain the effects of the following, including how they occur and how they may be reasonably managed.

(a) Empty-field myopia: (3 marks)

(b) Auto kinesis: (3 marks)

(c) False horizon: (3 marks)

See next page

Question 44 **(4 marks)**

Some aircraft are fitted with an engine manifold pressure gauge.

(a) What does the manifold pressure gauge actually measure and where is the measurement taken? (2 marks)

(b) Describe how manifold air pressure would be adjusted/controlled by the pilot. (2 marks)

Question 45 **(7 marks)**

Carbon monoxide poisoning poses a real risk to pilots.

(a) Explain how carbon monoxide affects the body. (2 marks)

(b) Give **two** symptoms a pilot could experience if exposed for prolonged periods to carbon monoxide. (2 marks)

One:

Two:

(c) How can a pilot detect carbon monoxide in flight? (2 marks)

(d) What would be the best immediate treatment for a person suffering from carbon monoxide poisoning? (1 mark)

See next page

Question 46 **(7 marks)**

Research continues into practical alternative means of operating an aircraft's motor.

Discuss the factors influencing the ongoing development of both alternative fuels and implementation of electric aircraft motors. Highlight the likely positive and negative impact these developments might have on the aviation industry.

End of questions

Supplementary page

Question number: _____

Supplementary page

Question number: _____

ACKNOWLEDGEMENTS

Question 26 Piper PA-32RT cruise performance chart from: Yeo, M., Bowers, G., & Bennett, K. (2001). *Handbook of flight* (2nd ed.). Perth: WestOne Services, p. 170. Not for operational purposes.

Question 28 End of daylight chart from: Airservices Australia. (2016). *Aeronautical information package (AIP): AIP book* (General: GEN 2.7 – 5: 25 Nov 04: End of daylight). Canberra: Airservices Australia. Retrieved May, 2016 from www.airservicesaustralia.com/aip/aip.asp?pg=20&vdate=26-May-2016&ver=2
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Question 32 PA-32RT take-off weight chart from: Yeo, M., Bowers, G., & Bennett, K. (2001). *Handbook of flight* (2nd ed.). Perth: WestOne Services, p. 149. Not for operational purposes.

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

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