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

ATAR course examination, 2023

Question/Answer booklet

AVIATION

Please place your student identification label in this box

WA 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: up to three calculators, which do not have the capacity to create or store programmes or text, are permitted in this ATAR course 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.

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	22	22	120	138	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 2023: Part II Examinations*. 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 preferably using a blue/black pen. Do not use erasable or gel pens.

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. A pilot observes one white and three red lights on a precision approach path indicator (PAPI). This indicates that the aircraft is

   (a) slightly high.
   (b) on the correct glide slope.
   (c) slightly low.
   (d) unable to receive the correct glide slope.

2. Which of the following is the primary advantage of a head-up display (HUD)?

   (a) reduced time spent reading multiple dials
   (b) reduced cost
   (c) increased information available to pilots
   (d) more reliable aircraft indications

3. As a turning aircraft progresses from straight and level flight to increasing angles of bank, the load factor will

   (a) decrease with decreasing stall speed.
   (b) decrease with increasing stall speed.
   (c) increase with decreasing stall speed.
   (d) increase with increasing stall speed.

4. The primary purpose of TEM in aircraft operations is to identify

   (a) errors.
   (b) threats.
   (c) and respond to threats.
   (d) and respond to threats and errors.

5. Which of the following is a significant factor in limiting the maximum forward airspeed of a conventional single-rotor system helicopter?

   (a) main rotor gearbox reliability
   (b) forward cyclic deflection
   (c) available engine torque
   (d) retreating blade stall

See next page

6. A secondary purpose of a canard is to reduce the

   (a) likelihood of stall.
   (b) lift available.
   (c) aircraft speed.
   (d) aircraft roll rate.

7. A pilot subjected to loud noise over prolonged periods is initially likely to have impaired

   (a) low frequency detection.
   (b) high frequency detection.
   (c) both low and high frequency detection.
   (d) normal speech frequencies.

8. An aircraft occupant experiencing carbon monoxide poisoning will experience

   (a) no effect on vision.
   (b) degraded daytime vision only.
   (c) significant degraded vision at night.
   (d) tunnel vision only.

9. Track made good is the track

   (a) intended for the destination.
   (b) required to an interim position.
   (c) travelled by the aircraft over the ground.
   (d) angle relative to the intended aircraft path.

10. An aircraft which has yawed in the direction of slip does so as a result of

    (a) spiral stability.
    (b) spiral instability.
    (c) longitudinal stability.
    (d) lateral instability.

11. A pilot taking paracetamol is required to

    (a) take no further action.
    (b) advise a designated aviation medical examiner (DAME) immediately.
    (c) advise a designated aviation medical examiner (DAME) if taken for greater than 7 days.
    (d) not exercise their qualification until after a Civil Aviation Safety Authority (CASA) review.

See next page

12. Which force acts parallel to the ground surface and toward the direction of turn on an aircraft established in a balanced turn?

(a) centripetal
(b) centrifugal
(c) lift
(d) weight

13. A pilot completing a negative loop (loop commenced with the aircraft upside down) will experience blood flowing

(a) toward the feet.
(b) toward the head.
(c) toward the head followed by towards the feet.
(d) as normal, no effective change.

14. Indicated airspeed is the aircraft speed

(a) relative to the air.
(b) relative to the ground.
(c) calibrated airspeed corrected for errors.
(d) measured by the pitot-static system.

15. An ammeter in the electrical system displays the

(a) direction of current flow.
(b) direction and magnitude of current flow.
(c) magnitude of current flow.
(d) status of circuit breakers.

16. A pilot experiencing hypoxia takes deep breaths to counter its effects. In the short term, this is likely to result in

(a) hyperventilation.
(b) loss of consciousness.
(c) slowed heart rate.
(d) decompression sickness.

17. The compass of an accelerating aircraft on an Easterly heading in the Southern hemisphere will indicate a turn

(a) towards the North.
(b) to 060°.
(c) to 120°.
(d) towards the South.

See next page

18. An aircraft altimeter set to QFE will indicate height relative to

    (a) mean sea level.
    (b) ground level.
    (c) transition layer.
    (d) 1013 hPa.

19. A pilot who has a passenger on board that experiences motion sickness can **best** alleviate the effects by

    (a) having the passenger sit at the rear of the aeroplane.
    (b) flying at a lower altitude.
    (c) advising the passenger to avoid looking at the horizon, and to look downwards.
    (d) ensuring adequate ventilation.

20. Maintaining situational awareness is critical for aircrew making decisions during all phases of flight. Which of the following is an example of maintaining situational awareness?

    (a) adjusting aircraft heading
    (b) adjusting sunshade to ensure sunlight is not too bright on instruments
    (c) calculating revised estimate of fuel margin expected at the destination
    (d) ensuring air-conditioning settings are optimum for cockpit comfort

End of Section One

See next page

Section Two: Short answer **80% (138 Marks)**

This section has **22** 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 **(4 marks)**

Calculating pressure height and density altitude are essential to identify aircraft performance.

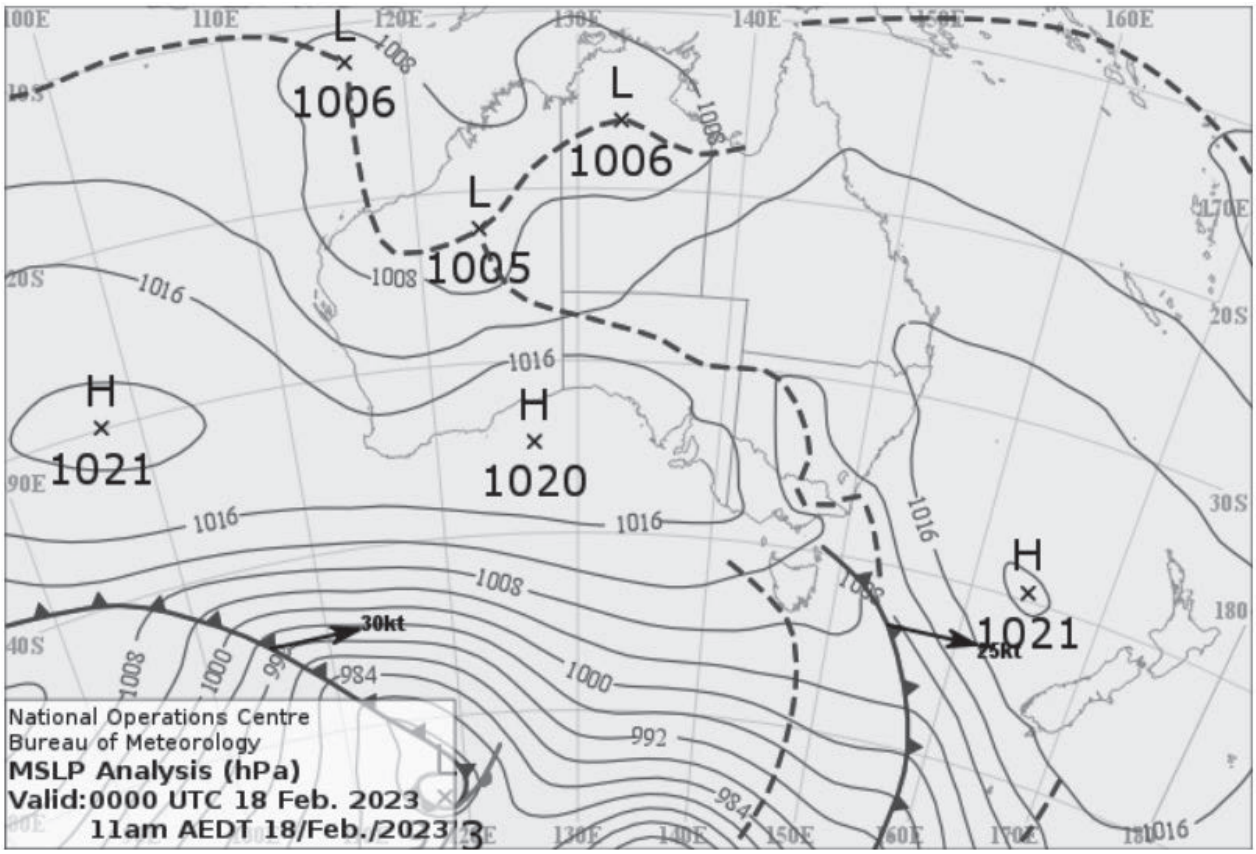
(a) Calculate airfield pressure height, using the following data:
- airfield elevation 1000 ft
- QNH 1020 hPa
- OAT 9 °C.

Show all workings. (2 marks)

(b) Calculate airfield density altitude, given the following data:
- 2000 ft pressure height
- OAT 15 °C.

Show all workings. (2 marks)

Question 22 **(6 marks)**



Using the synoptic chart supplied, determine the following:

(a) The season being experienced in Australia (1 mark)

(b) Forecast QNH at 20°S 160°E (1 mark)

(c) Meaning of the symbol _ _ _ _ _ _ _ _ _ _ (1 mark)

(d) Meaning of the symbol → 30 kt (3 marks)

See next page

Question 23 **(11 marks)**

Visual illusions can have a dramatic impact on pilots and their interpretation of the current aircraft state. An understanding of these illusions is vital to enable pilots to counteract the illusion encountered.

(a) A pilot flying in instrument meteorological conditions (IMC) executes a very slow roll to the left. Suddenly the pilot corrects the aircraft attitude returning to straight and level flight. Explain the illusion the pilot experienced and the associated reasoning for this experience. (4 marks)

(b) An aircraft is flying close to cloud with an operating rotating beacon. Name the illusion likely to be encountered by the crew, the reasoning for the illusion, prevention of the illusion, and **one** side effect. (4 marks)

Name of illusion: _____

Reason: _____

Prevention: _____

Side effect: _____

Question 23 (continued)

(c) A pilot approaching an aerodrome runway will use visual cues to judge an approach in visual meteorological conditions (VMC). Identify the pilot's perception of their approach path in the following approach scenarios. (3 marks)

Flown through smoke: _____

_____

To upsloping runways: _____

_____

Narrow runway: _____

_____

See next page

Question 24 **(9 marks)**

Understanding of atmospheric processes, including the formation of cloud, is important to understand the resulting effects on aircraft.

(a) The temperature on the ground is 27 °C and the environmental lapse rate is 4 °C per 1000 feet. If a parcel of unsaturated air is forced to rise, explain the resulting effect on that air, including its temperature at 1000 feet. (4 marks)

(b) Explain the process of frontal lifting related to cloud formation. (5 marks)

Question 25 **(9 marks)**

Radar is important for the safety and the efficiency of aircraft movements.

Describe the principles of operation for the following kinds of radar.

(a) Primary surveillance radar (PSR). (4 marks)

(b) Secondary surveillance radar (SSR). (5 marks)

See next page

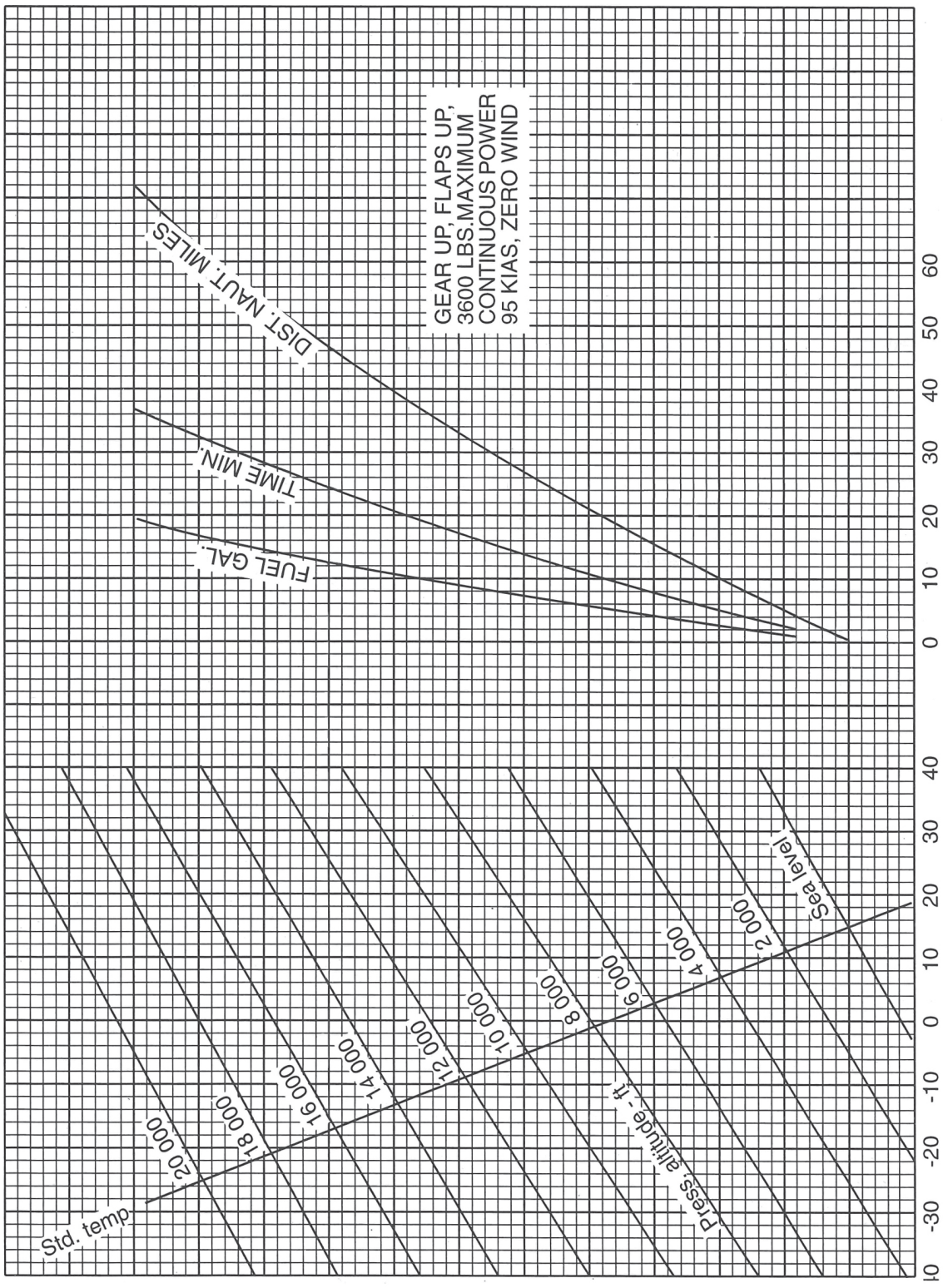
Question 26 **(9 marks)**

An aircraft is flying from Delta aerodrome to Echo aerodrome (distance of 240 nm) using 75% best economy during the cruise. Assuming no wind, cruise fuel flow of 18 gallons per hour and the data set out below, use the charts on pages 14 to 16 to complete the following table.

	Delta	**Cruise**	**Echo**
Pressure altitude (ft)	1000	9000	1000
Temperature (°C)	20	-1	23

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

See next page



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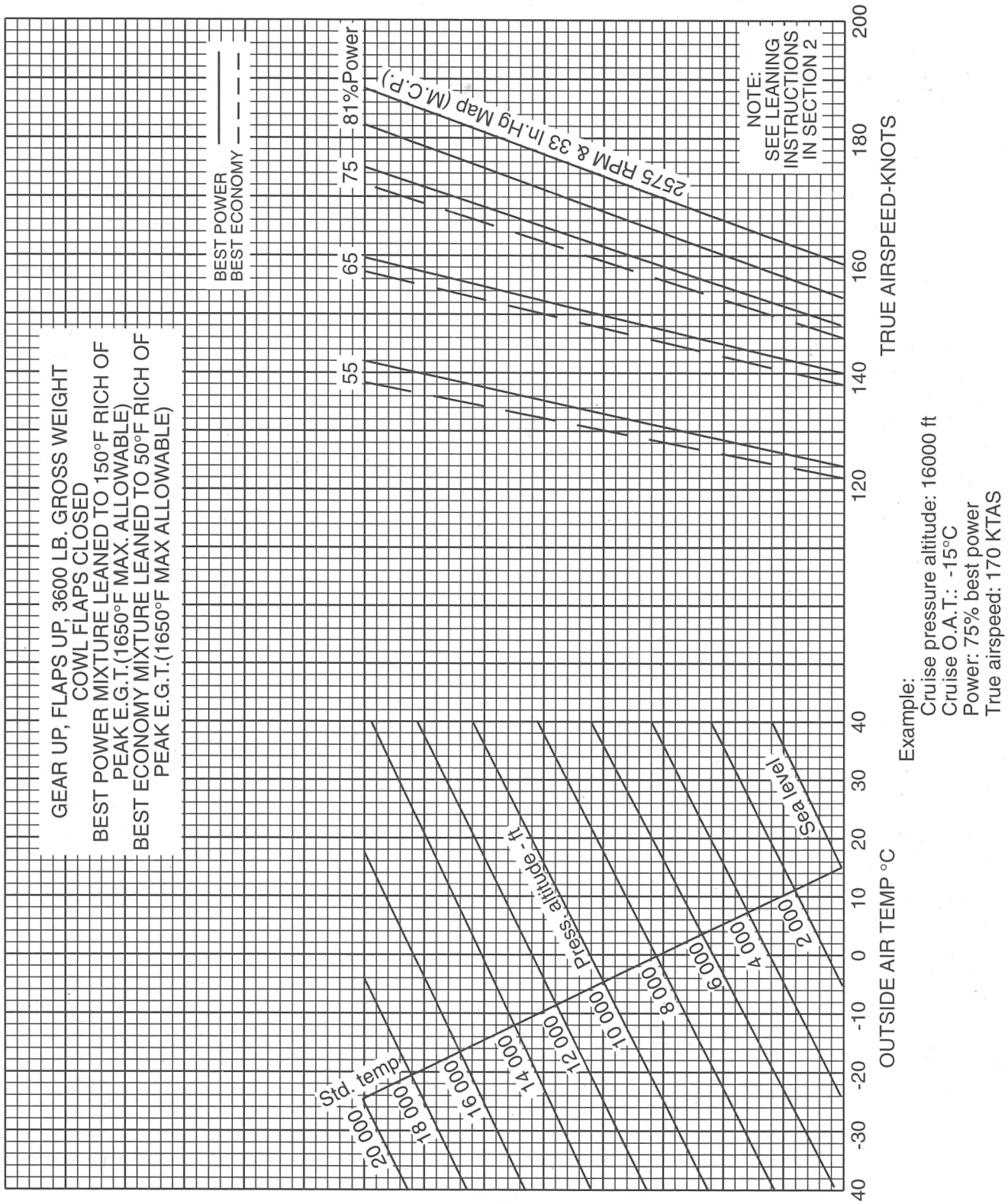
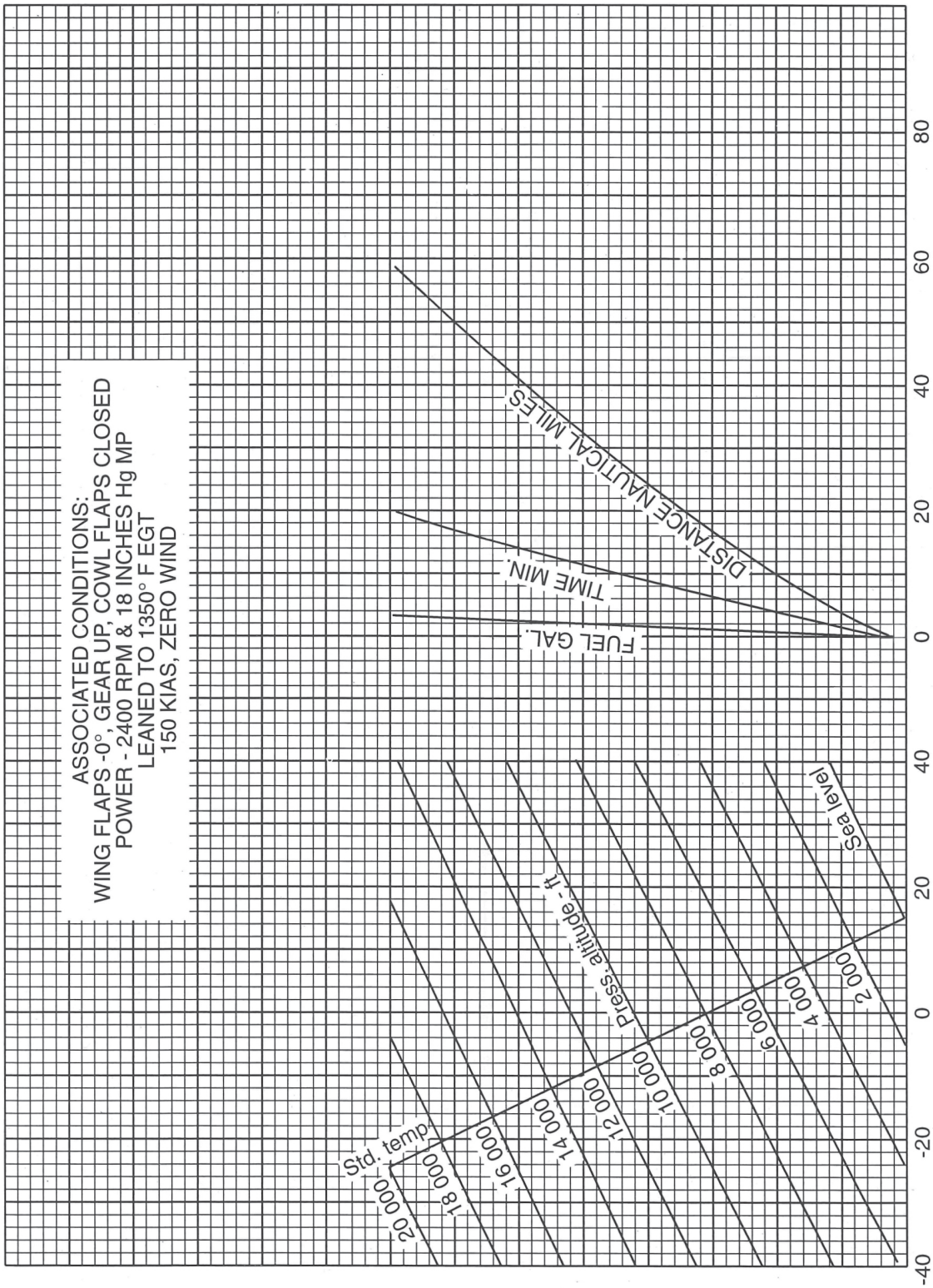


Example:
Cruise pressure altitude: 16000 ft
Cruise O.A.T.: -15°C
Power: 75% best power
True airspeed: 170 KTAS

See next page



Example:
Cruise pressure altitude: 16 000 ft
Cruise OAT: -15°C
Destination airport press. alt.: 400 ft
Destination airport OAT: 24°C

Fuel to descend: 2.5 minus 0.5 = 2 gal
Time to descend: 15.5 minus 1 = 14.5 min
Distance to descend: 45 minus 3 = 42 nm

See next page

Question 27 **(9 marks)**

Aircraft designers incorporate different components to enable different aircraft performance. This is especially true with respect to aircraft engines.

Explain the principles of operation of a:

(a) Constant-speed propeller engine. (5 marks)

(b) Clamshell (or bucket style) thrust reversal system. (4 marks)

Question 28 **(4 marks)**

Identify the:

- current visibility
- amount in oktas and height, including datum, of the lowest cloud layer

using the SPECI below:

SPECI YBRM 050331Z 24025G35KT 1500 RA SCT008 SCT012 OVC040 24/24 Q0995 RMK RF01.0/026.2

See next page

Question 29 **(9 marks)**

Knowing the time for last light at a location is vital to ensure compliance with aviation regulations.

(a) Use the graph on page 20 to calculate the end of daylight time (LMT) for position 16° 53'S, 145° 45'E on 20 December. Show all workings. (2 marks)

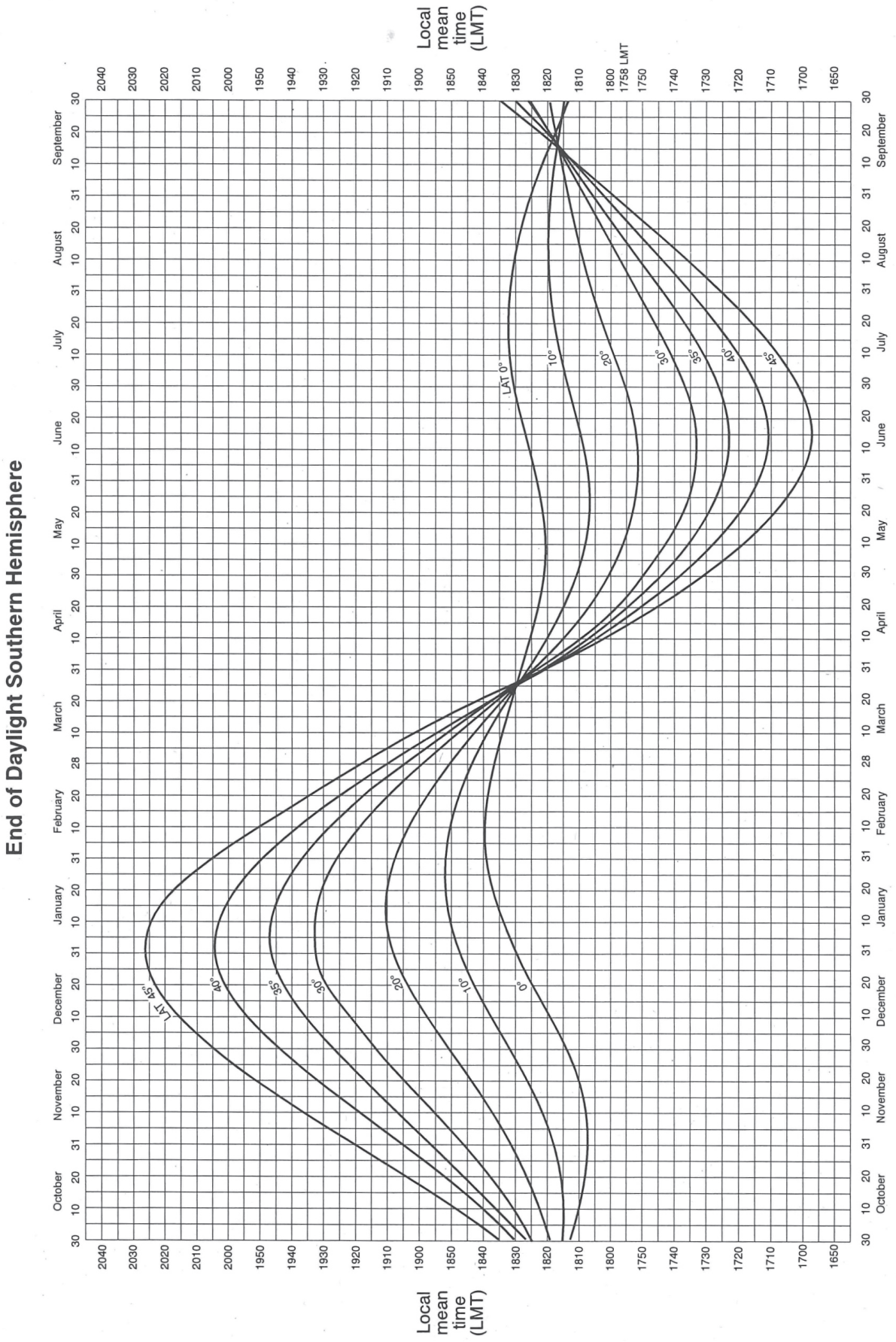
(b) Use the table on page 21 to calculate the end of daylight in Coordinated Universal Time (UTC). Show all workings. (4 marks)

(c) Identify **three** reasons why the end of daylight may be earlier than identified in part (a). (3 marks)

One:

Two:

Three:



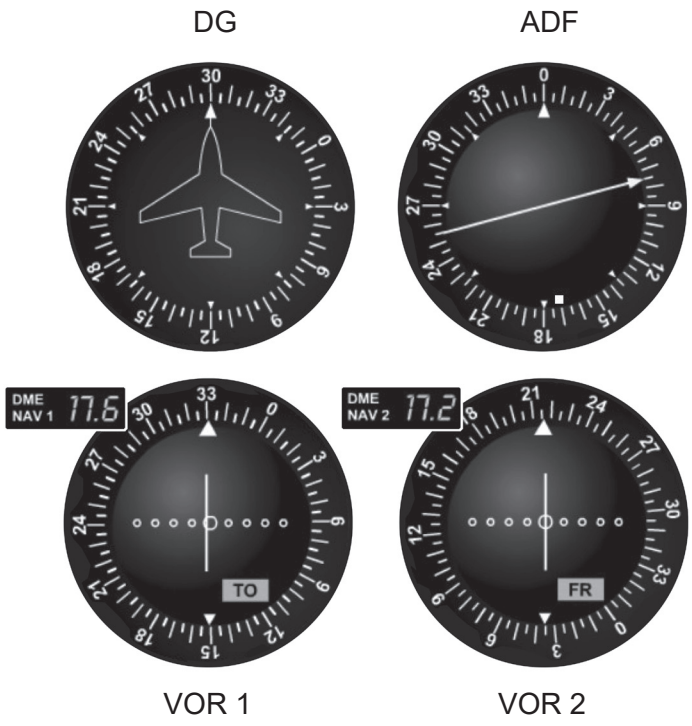
See next page

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 30 **(4 marks)**

Given the following aircraft instrument indication, draw a labelled diagram showing the correct aircraft position relative to the navigation aids.



See next page

Question 31 **(6 marks)**

The introduction of new technologies and other developments in the aviation industry result in other significant impacts.

Explain the likely effect of the following on the aviation industry.

(a) Unmanned aerial vehicle (UAV): (3 marks)

(b) Composite materials: (3 marks)

See next page

Question 32 **(5 marks)**

Aircraft design is imperative to ensure that aircraft are able to perform as expected in all circumstances.

(a) Lateral stability is vital to the controllability of aircraft. Identify **three** features incorporated into aircraft design that have an effect on lateral stability. (3 marks)

One: _____

_____

Two: _____

_____

Three: _____

_____

(b) Identify the purpose and function of speed brakes in an aircraft. (2 marks)

_____

_____

_____

_____

Question 33 **(4 marks)**

Pilot understanding of causal factors in common aircraft accidents is vital to avoid replicating these scenarios. Identify the most likely outcome introduced by the additional risk in the following scenarios.

(a) Flying at an altitude below 500 feet when not on climb or descent. (1 mark)

(b) Not completing checks as per the checklist. (1 mark)

(c) Flight into instrument meteorological conditions (IMC) when not qualified. (1 mark)

(d) Manoeuvring a tailwheel aircraft on the ground. (1 mark)

Question 34 **(5 marks)**

Pilots are required to have good eyesight as a large amount of information is received though vision. Explain the concept of myopia and how it is corrected.

See next page

Question 35 **(3 marks)**

A pilot approaching the destination airport, tunes in to the automatic terminal information service (ATIS) and copies down the following relevant data:

- runway 28 for arrival and departure
- temperature 25 °C
- QNH 1011 hPa
- wind 340°/20 kt.

Using your flight computer for the landing, calculate the:

(a) Headwind component. (1 mark)

(b) Crosswind component and the expected drift direction of the aircraft. (2 marks)

Question 36 **(3 marks)**

A pilot has to maintain a track of 240°, at a true airspeed (TAS) of 150 kt. Given the forecast wind is 280°/20 kt, use your flight computer to calculate the:

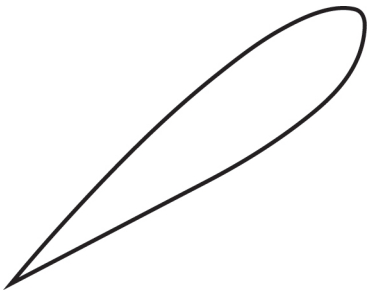
(a) Heading to be flown. (1 mark)

(b) Resulting ground speed. (1 mark)

(c) Amount of fuel used in litres (L), given that the fuel for this leg is calculated to be 8 US gallons. (1 mark)

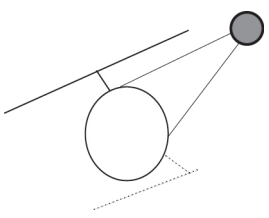
Question 37 **(5 marks)**

Complete and annotate the diagram of an aerofoil below to explain the concept of an aircraft stall, including the aerodynamic characteristics in this situation.



Question 38 **(10 marks)**

A helicopter is established in steady forward, level flight. Using the diagram provided below, draw and label the forces on the helicopter during this phase of flight.



See next page

Question 39 **(6 marks)**

Summarise the developing stage as part of the formation of thunderstorms.

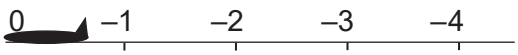
Question 40 **(6 marks)**

Identify the principle of operation and describe the sequence of events taking place within a standard gas turbine engine.

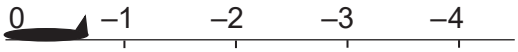
See next page

Question 41 **(5 marks)**

Complete the diagrams below to show the difference in pressure wave disturbances between an aircraft flying at subsonic speed and then at supersonic speed.



Pattern of pressure waves from a subsonic aircraft.



Pattern of pressure waves from a supersonic aircraft.

See next page

Question 42 **(6 marks)**

Compared to the early 2000s, low-cost carriers have become more popular. Outline the effect on the aviation industry, the community and the environment of the increasing numbers of low-cost carriers.

End of questions

Supplementary page

Question number: _____

Supplementary page

Question number: _____

Supplementary page

Question number: _____

Supplementary page

Question number: _____

Supplementary page

Question number: _____

ACKNOWLEDGEMENTS

Question 22

Bureau of Meteorology. (2023). *MSLP Analysis (Manual) Australian Region - 0000 UTC 18/02/2023* [Chart]. Retrieved February, 2023, from http://www.bom.gov.au/australia/charts/synoptic_col.shtml
217PM 18/2/23
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Question 26

Yeo, M., Bowers, G., & Bennett, K. (2001). Fuel, Time and Distance to Climb [Chart]. *Handbook of Flight* (2nd ed.). WestOne Services, p. 169. Not for operational purposes.

Yeo, M., Bowers, G., & Bennett, K., (2001). Cruise Performance [Chart]. *Handbook of Flight* (2nd ed.). WestOne Services, p. 170. Not for operational purposes.

Yeo, M., Bowers, G., & Bennett, K. (2001). Fuel, Time and Distance to Descend [Chart]. *Handbook of Flight* (2nd ed.). WestOne Services, p. 171. Not for operational purposes.

Question 29

Yeo, M., Bowers, G., & Bennett, K. (2001). Daylight and Darkness Graphs. *Handbook of Flight*. WestOne Services, p. 194. Not for operational purposes.

Yeo, M., Bowers, G., & Bennett, K. (2001). Conversion of Arc to Time [Table]. *Handbook of Flight*. WestOne Services, p. 195. Not for operational purposes.

Question 37

Adapted from: Yeo, M., Bowers, G., & Bennett, K. (2001). Fig. 1.74 Turbulent Airflow Over a Stalled Wing [Diagram]. *Handbook of Flight* (2nd ed.). WestOne Services, p. 35. Not for operational purposes.

Question 41

Yeo, M., Bowers, G., & Bennett, K. (2001). Fig. 8.2 Pattern of Waves From a Subsonic Aircraft [Diagram]. *Handbook of Flight* (2nd ed.). WestOne Services, p. 179. Not for operational purposes.

Yeo, M., Bowers, G., & Bennett, K. (2001). Fig. 8.4 Pattern of Waves From a Supersonic Aircraft [Diagram]. *Handbook of Flight* (2nd ed.). WestOne Services, p. 179. Not for operational purposes.

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