



NSW Education Standards Authority

2022 HIGHER SCHOOL CERTIFICATE EXAMINATION

Mathematics Standard 2

General Instructions

- Reading time – 10 minutes
- Working time – 2 hours and 30 minutes
- Write using black pen
- Calculators approved by NESA may be used
- A reference sheet is provided at the back of this paper
- For questions in Section II, show relevant mathematical reasoning and/or calculations

Total marks: 100

Section I – 15 marks (pages 2–8)

- Attempt Questions 1–15
- Allow about 25 minutes for this section

Section II – 85 marks (pages 9–36)

- Attempt Questions 16–38
- Allow about 2 hours and 5 minutes for this section

Section I

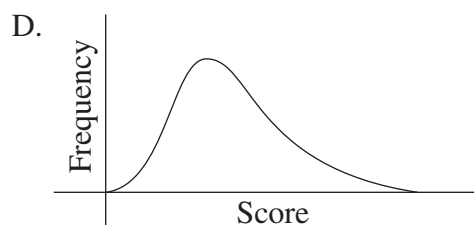
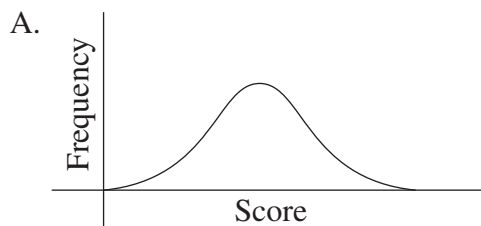
15 marks

Attempt Questions 1–15

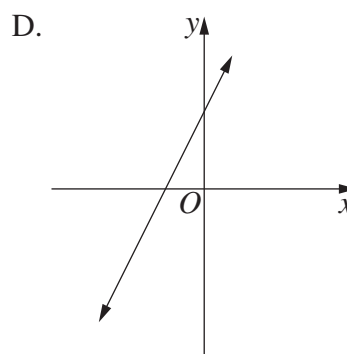
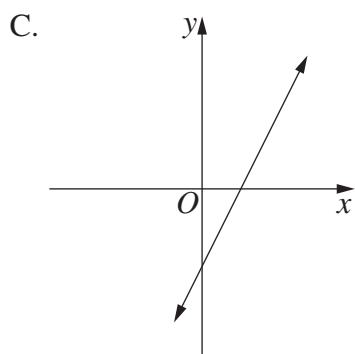
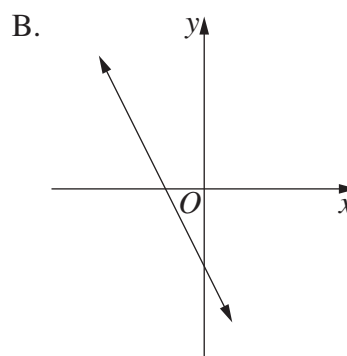
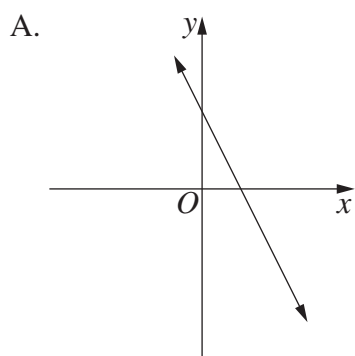
Allow about 25 minutes for this section

Use the multiple-choice answer sheet for Questions 1–15.

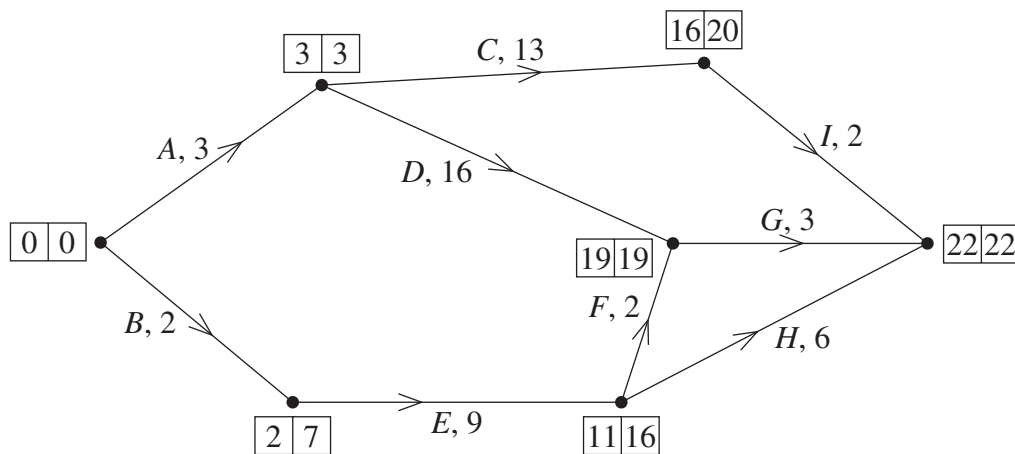
1 Which graph represents a negatively skewed distribution?



2 Which of the following could be the graph of $y = -2x + 2$?



- 3 The network diagram shows the time needed for each step in order to complete a project.



What is the critical path to complete the project?

- A. *ACI*
 - B. *ADG*
 - C. *BEH*
 - D. *BEFG*
- 4 Lily wanted to estimate the number of fish in a lake.

She randomly captured 30 fish, then tagged and released them.

One week later she randomly captured 40 fish from the same lake. She found that 12 of these 40 fish were tagged.

What is the best estimate for the total number of fish in the lake?

- A. 58
- B. 70
- C. 82
- D. 100

- 5 Consider the following dataset.

13 16 17 17 21 24

Which row of the table shows how the median and mean are affected when a score of 5 is added to the dataset?

	<i>Median</i>	<i>Mean</i>
A.	Changes	Changes
B.	Stays the same	Stays the same
C.	Changes	Stays the same
D.	Stays the same	Changes

- 6 What is 20 minutes to one-third of a day, expressed as a ratio in simplest form?

- A. 1 : 8
- B. 1 : 24
- C. 60 : 1
- D. 72 : 1

- 7 Tian is paid \$20.45 per hour, as well as a meal allowance of \$16.20 per day.

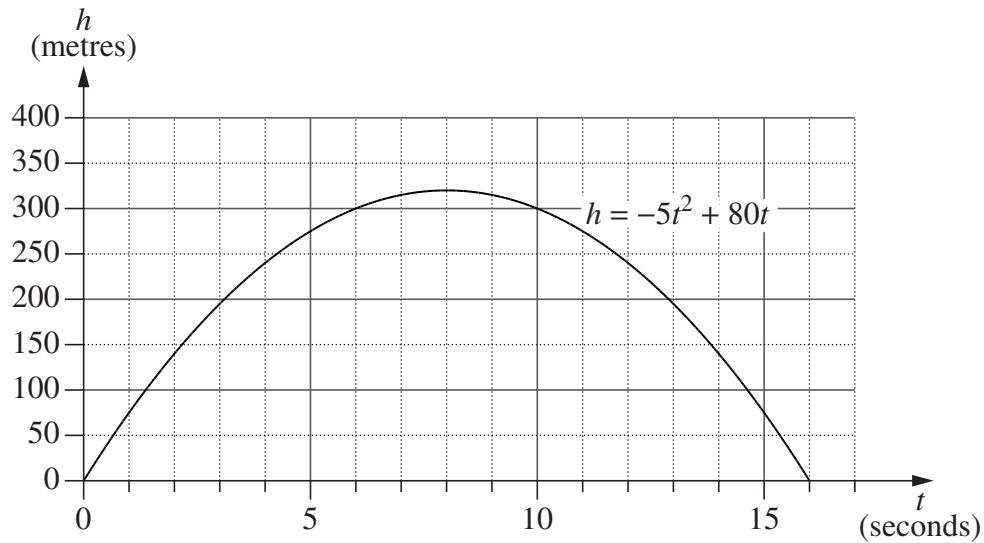
What are Tian's total earnings if she works 9 hours per day for 5 days?

- A. \$329.85
- B. \$936.45
- C. \$1001.25
- D. \$1649.25

- 8 Which true bearing is the same as S48°W?

- A. 132°
- B. 222°
- C. 228°
- D. 312°

- 9 An object is projected vertically into the air. Its height, h metres, above the ground after t seconds is given by $h = -5t^2 + 80t$.



For how long is the object at a height of 300 metres or more above the ground?

- A. 4 seconds
 - B. 6 seconds
 - C. 8 seconds
 - D. 10 seconds
- 10 Alex purchased 800 shares. The total cost was \$2.60 per share. Alex sold the shares one year later for \$3.40 each and paid a fee of \$24.95 for selling the shares.

What profit did Alex make on these shares?

- A. \$590.10
- B. \$615.05
- C. \$640.00
- D. \$664.95

- 11** In ten years, the future value of an investment will be \$150 000. The interest rate is 4% per annum, compounded half-yearly.

Which equation will give the present value (PV) of the investment?

- A. $PV = \frac{150\,000}{(1 + 0.04)^{10}}$
- B. $PV = \frac{150\,000}{(1 + 0.04)^{20}}$
- C. $PV = \frac{150\,000}{(1 + 0.02)^{10}}$
- D. $PV = \frac{150\,000}{(1 + 0.02)^{20}}$
- 12** For a particular course, the recorded data show a relationship between the number of hours of study per week and the marks achieved out of 100.

A least-squares regression line is fitted to this dataset. The equation of this line is given by

$$M = 20 + 3H,$$

where M is the predicted mark and H is the number of hours of study per week.

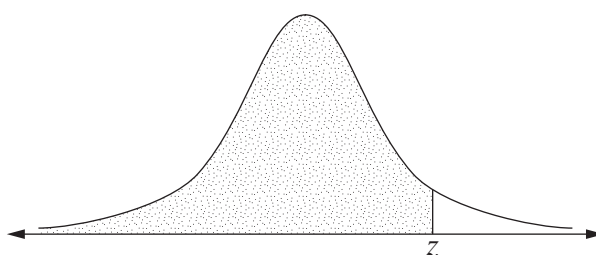
Based on this regression equation, which of the following is correct regarding the predicted mark of a student?

- A. It will be 3 for zero hours of study per week.
- B. It will be 20 for zero hours of study per week.
- C. It will increase by 20 for every additional hour of study per week.
- D. It will increase by 1 for every 3 additional hours of study per week.

- 13** A random variable is normally distributed with mean 0 and standard deviation 1. The table gives the probability that this random variable lies below z for some positive values of z .

z	1.90	1.91	1.92	1.93	1.94	1.95	1.96	1.97	1.98	1.99
Probability	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767

The probability values given in the table are represented by the shaded area in the following diagram.

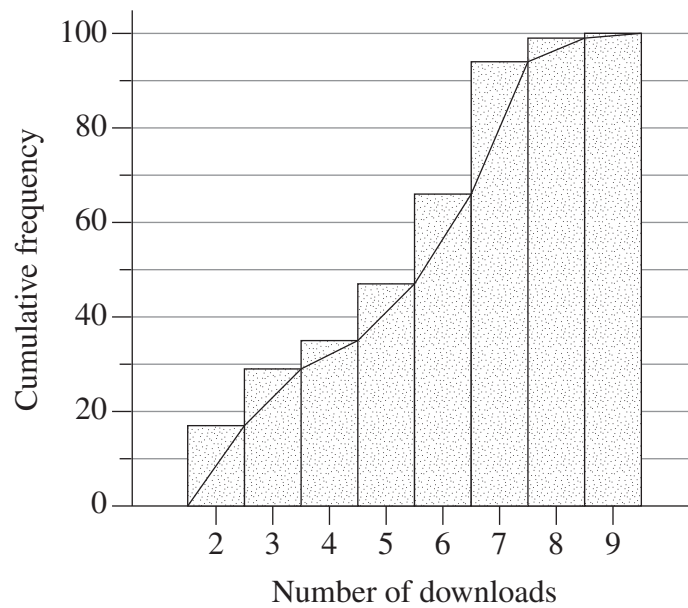


What is the probability that a normally distributed random variable with mean 0 and standard deviation 1 lies between 0 and 1.94?

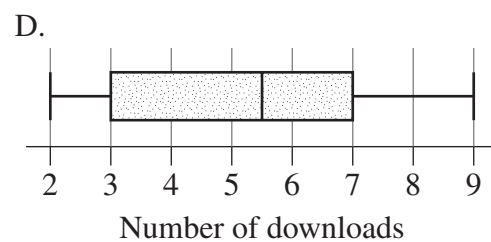
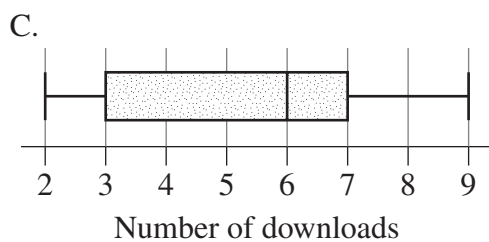
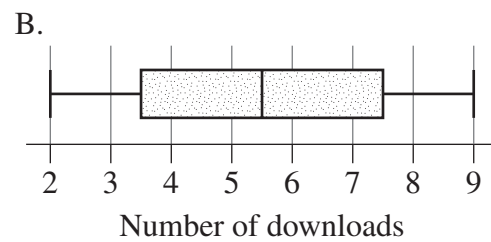
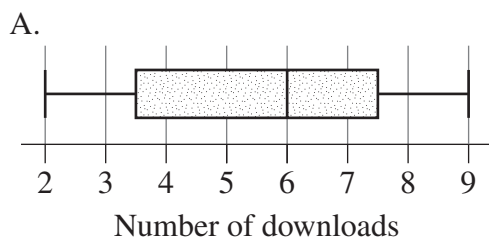
- A. 0.0262
 B. 0.4738
 C. 0.5262
 D. 0.9738
- 14** Which of the following correctly expresses x as the subject of $y = \frac{ax - b}{2}$?

- A. $x = \frac{2y + b}{a}$
 B. $x = \frac{y + b}{2a}$
 C. $x = \frac{2y}{a} + b$
 D. $x = \frac{y}{2a} + b$

- 15 The cumulative frequency graph shows the distribution of the number of movie downloads made by 100 people in one month.



Which box-plot best represents the same data as displayed in the cumulative frequency graph?



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Centre Number

Mathematics Standard 2

Section II Answer Booklet

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Student Number

85 marks

Attempt Questions 16–38

Allow about 2 hours and 5 minutes for this section

Instructions

- Write your Centre Number and Student Number at the top of this page.
- Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.
- Your responses should include relevant mathematical reasoning and/or calculations.
- Extra writing space is provided at the back of this booklet. If you use this space, clearly indicate which question you are answering.

Please turn over

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Question 16 (3 marks)

Tom is 25 years old, and likes to keep fit by exercising.

- (a) Use this formula to find his maximum heart rate (bpm). **1**

$$\text{Maximum heart rate} = 220 - \text{age in years}$$

Tom's maximum heart rate is bpm.

- (b) Tom will get the most benefit from this exercise if his heart rate is between 50% and 85% of his maximum heart rate. **2**

Between what two heart rates should Tom be aiming for to get the most benefit from his exercise?

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Question 17 (3 marks)

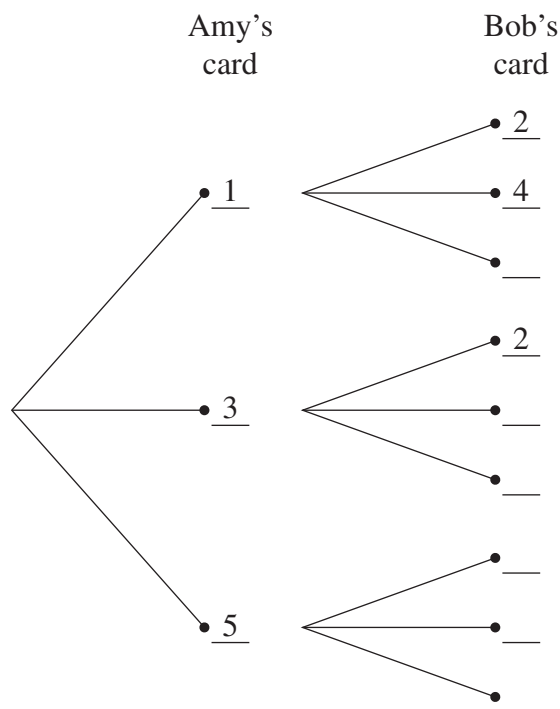
The numbers 1, 2, 3, 4, 5 and 6 are each written on separate cards.

Amy has cards 1, 3 and 5 and Bob has cards 2, 4 and 6.

They play a game in which each person randomly chooses one of their own cards and compares it with the other person's card. The person with the higher card wins.

- (a) A partially completed tree diagram is shown.

2



Complete the tree diagram and find the probability that Bob wins.

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- (b) Suppose Amy and Bob play this game 30 times.

1

How many times would Bob be expected to win?

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Question 18 (2 marks)

The marks in a test were normally distributed. The mean mark was 60 and the standard deviation was 15.

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What was the percentage of marks higher than 90?

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Question 19 (3 marks)

The table shows the types of customer complaints received by an online business in a month.

<i>Type of complaint</i>	<i>Frequency</i>	<i>Cumulative frequency</i>	<i>Cumulative percentage</i>
Stock shortage	98	98	49
Delivery fee	62	A	80
Delivery time	24	184	92
Damaged item	8	192	B
Returns policy	6	198	99
Product information	2	200	100
<i>Total</i>	200		

- (a) What are the values of **A** and **B**?

2

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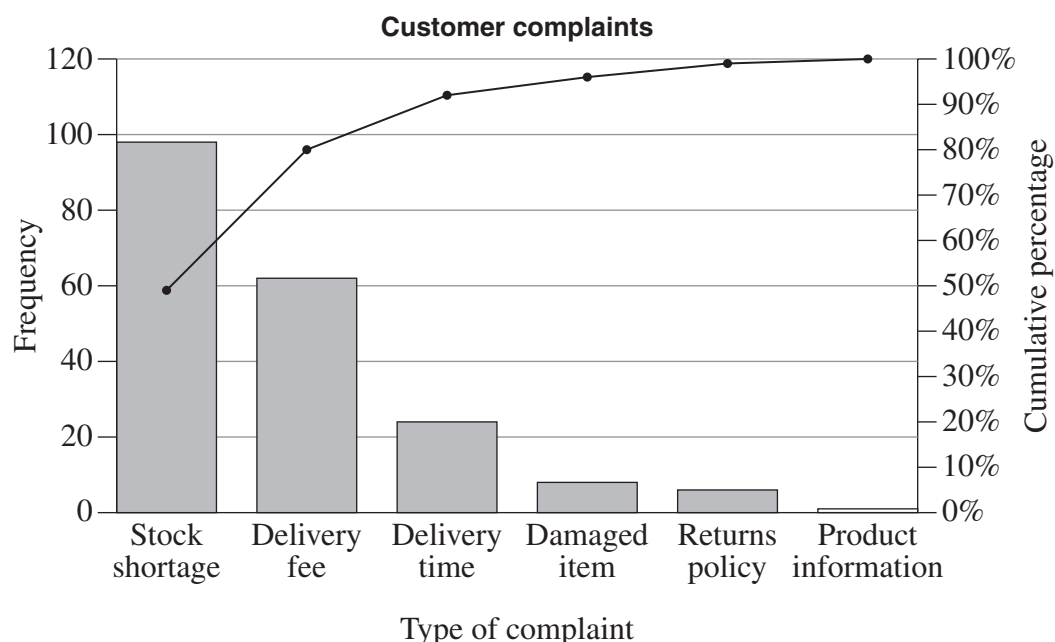
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- (b) The data from the table are shown in the following Pareto chart.

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The manager will address 80% of the complaints.

Which types of complaints will the manager address?

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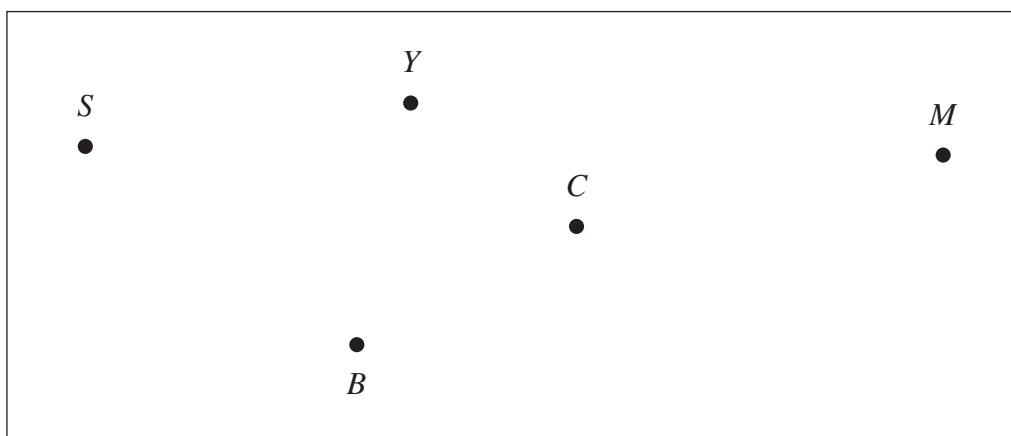
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Question 20 (5 marks)

The table below shows the distances, in kilometres, between a number of towns.

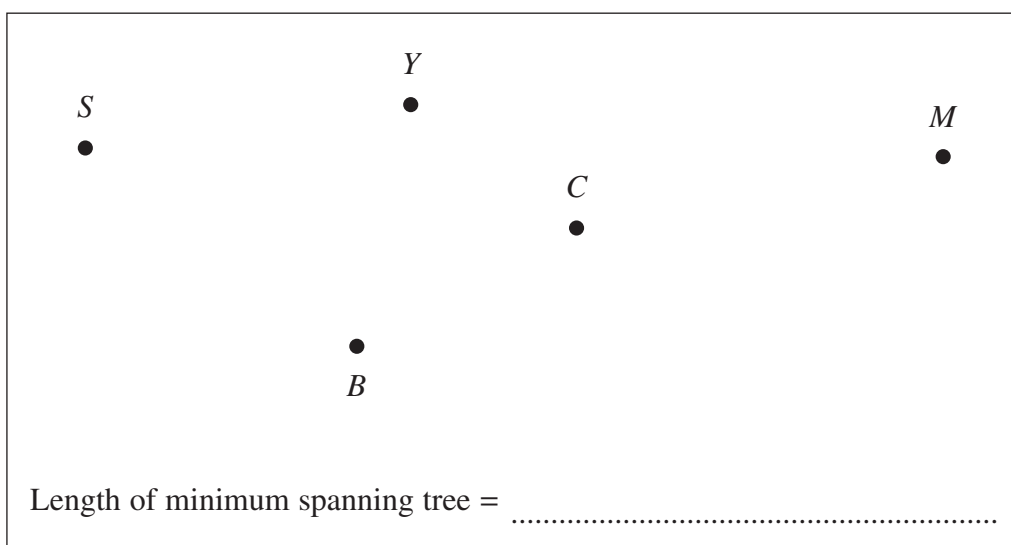
<i>Towns</i>	Snowtown (<i>S</i>)	Clairville (<i>C</i>)	Yuma (<i>Y</i>)	Bosten (<i>B</i>)	Morrella (<i>M</i>)
(<i>S</i>)	–	–	280	275	–
(<i>C</i>)	–	–	60	150	–
(<i>Y</i>)	280	60	–	–	530
(<i>B</i>)	275	150	–	–	790
(<i>M</i>)	–	–	530	790	–

- (a) Using the vertices given, draw a weighted network diagram to represent the information shown in the table. 2



- (b) A tourist wishes to visit each town. 3

Draw the minimum spanning tree which will allow for this AND determine its length.



Question 21 (2 marks)

A real estate agent's commission for selling houses is 2% for the first \$800 000 of the sale price and 1.5% for any amount over \$800 000.

2

Calculate the commission earned in selling a house for \$1 500 000.

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Question 22 (3 marks)

The formula $C = 100n + b$ is used to calculate the cost of producing laptops, where C is the cost in dollars, n is the number of laptops produced and b is the fixed cost in dollars.

- (a) Find the cost when 1943 laptops are produced and the fixed cost is \$20 180. 1

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- (b) Some laptops have some extra features added. The formula to calculate the production cost for these is 2

$$C = 100n + an + 20\,180,$$

where a is the additional cost in dollars per laptop produced.

Find the number of laptops produced if the additional cost is \$26 per laptop and the total production cost is \$97 040.

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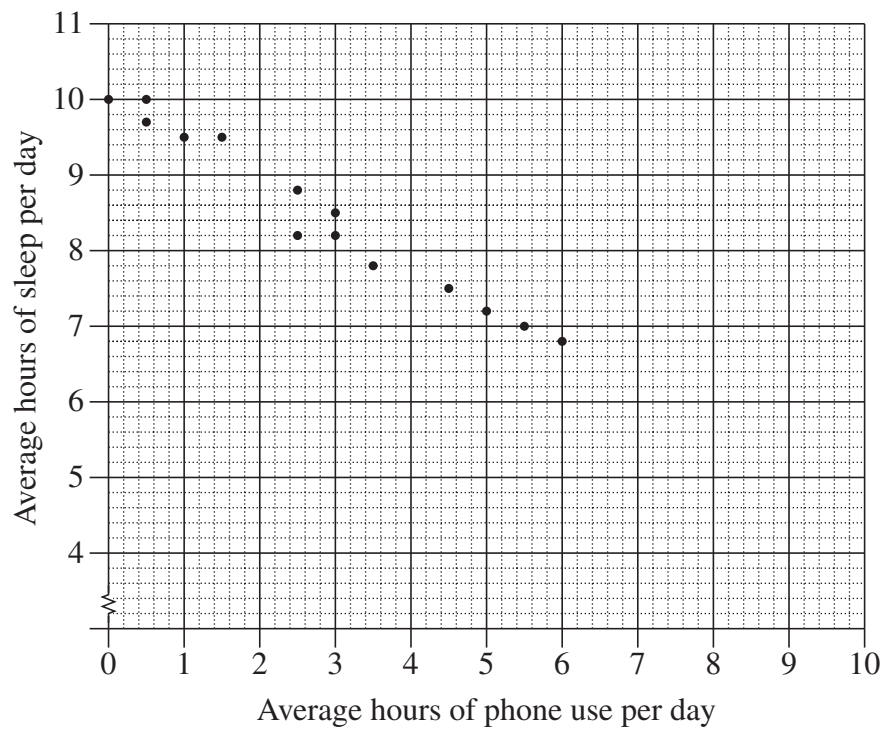
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Question 23 (4 marks)

A teacher surveyed the students in her Year 8 class to investigate the relationship between the average number of hours of phone use per day and the average number of hours of sleep per day.

The results are shown on the scatterplot below.



- (a) The data for two new students, Alinta and Birrani, are shown in the table below. Plot their results on the scatterplot.

	Average hours of phone use per day	Average hours of sleep per day
Alinta	4	8
Birrani	0	10.5

- (b) By first fitting the line of best fit by eye on the scatterplot, estimate the average number of hours of sleep per day for a student who uses the phone for an average of 2 hours per day.

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Question 24 (4 marks)

A student believes that the time it takes for an ice cube to melt (M minutes) varies inversely with the room temperature ($T^{\circ}\text{C}$). The student observes that at a room temperature of 15°C it takes 12 minutes for an ice cube to melt.

- (a) Find the equation relating M and T .

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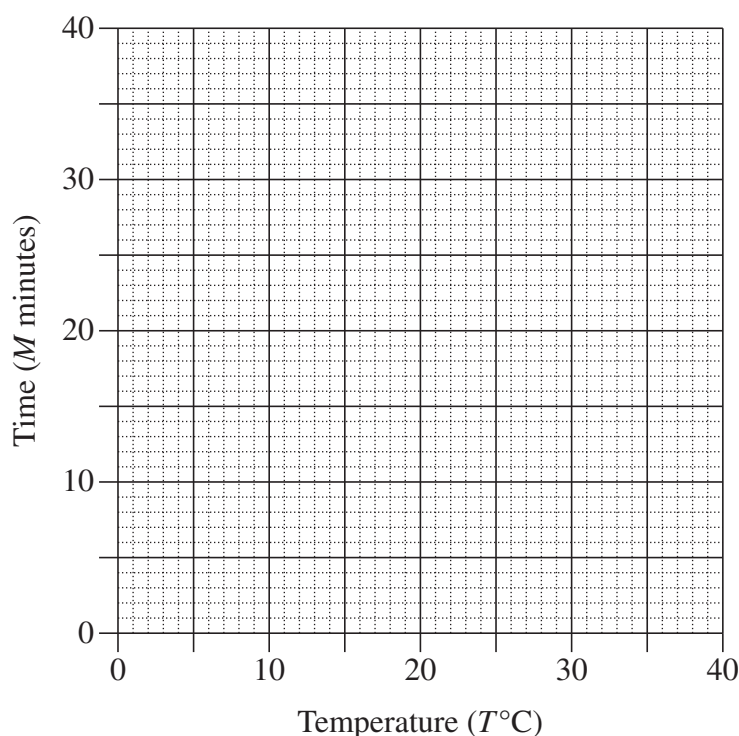
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- (b) By first completing this table of values, graph the relationship between temperature and time from $T = 5^{\circ}\text{C}$ to $T = 30^{\circ}\text{C}$.

2

T	5	15	30
M			



Question 25 (4 marks)

The table shows the future value of an annuity of \$1.

Future values of an annuity of \$1

YEARS	INTEREST RATE PER ANNUM			
	1%	2%	3%	4%
4	4.060	4.122	4.184	4.246
5	5.101	5.204	5.309	5.416
6	6.152	6.308	6.468	6.633

Zal is saving for a trip and estimates he will need \$15 000. He opens an account earning 3% per annum, compounded annually.

- (a) How much does Zal need to deposit every year if he wishes to have enough money for the trip in 4 years time? 2

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- (b) How much interest will Zal earn on his investment over the 4 years? Give your answer to the nearest dollar. 2

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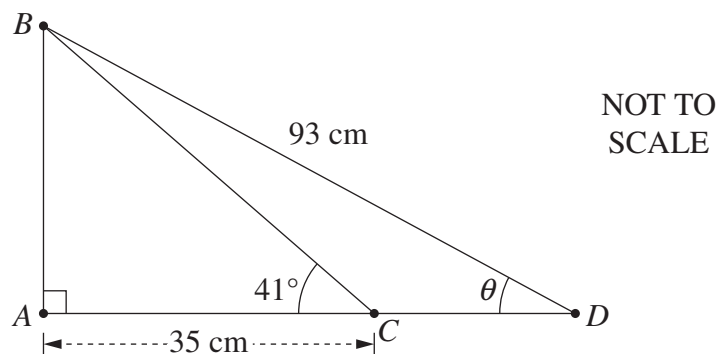
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Question 26 (4 marks)

The diagram shows two right-angled triangles, ABC and ABD ,
where $AC = 35$ cm, $BD = 93$ cm, $\angle ACB = 41^\circ$ and $\angle ADB = \theta$.

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Calculate the size of angle θ , to the nearest minute.

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Question 27 (4 marks)

A company purchases a machine for \$50 000. The two methods of depreciation being considered are the declining-balance method and the straight-line method.

- (a) For the declining-balance method, the salvage value of the machine after n years is given by the formula

$$S = V_0 \times (0.80)^n,$$

where S is the salvage value and V_0 is the initial value of the asset.

- (i) What is the annual rate of depreciation used in this formula?

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- (ii) Calculate the salvage value of the machine after 3 years, based on the given formula.

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- (b) For the straight-line method, the value of the machine is depreciated at a rate of 12.2% of the purchase price each year.

2

When will the value of the machine, using this method, be equal to the salvage value found in part (a) (ii)?

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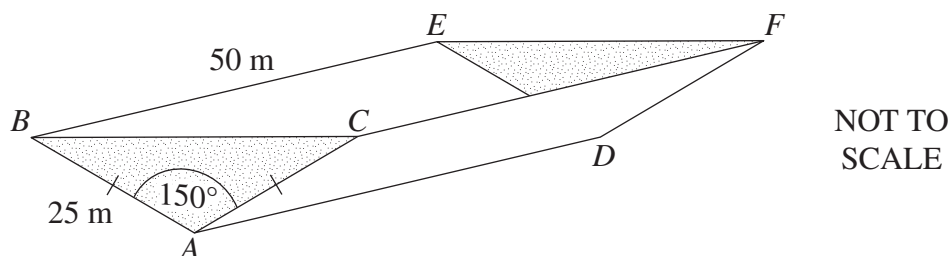
Questions 16–27 are worth 41 marks in total

Question 28 (4 marks)

A dam is in the shape of a triangular prism which is 50 m long, as shown.

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Both ends of the dam, ABC and DEF , are isosceles triangles with equal sides of length 25 metres. The included angles BAC and EDF are each 150° .



Calculate the number of litres of water the dam will hold when full.

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Question 29 (3 marks)

Sydney is 10 hours ahead of Coordinated Universal Time (UTC +10) and New York is 5 hours behind Coordinated Universal Time (UTC –5).

3

Tony travels from Sydney to New York. His plane leaves Sydney at 8:20 pm on Wednesday local time and flies non-stop to New York.

The flight takes 20 hours and 24 minutes.

What time and day is it in New York when the plane lands?

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Question 30 (4 marks)

Eli is choosing between two investment options.

Option 1: Depositing a single amount of \$40 000 today, earning interest of 1.2% per annum, compounded monthly.

Option 2: Depositing \$1000 at the end of each quarter, earning interest of 2.4% per annum, compounded quarterly.

A table of future value interest factors for an annuity of \$1 is shown.

$N \backslash r$	<i>Interest rate per period as a decimal</i>					
	0.002	0.006	0.020	0.024	0.060	0.240
10	10.09048	10.27437	10.94972	11.15211	13.18079	31.64344
20	20.38460	21.18211	24.29737	25.28909	36.78559	303.60062
30	30.88646	32.76227	40.56808	43.20983	79.05819	2640.91639
40	41.60026	45.05630	60.40198	65.92708	154.76197	22 728.80260

- (a) What is the value of Eli's investment after 10 years using Option 1? 2

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- (b) What is the difference between the future values after 10 years using Option 1 and Option 2? 2

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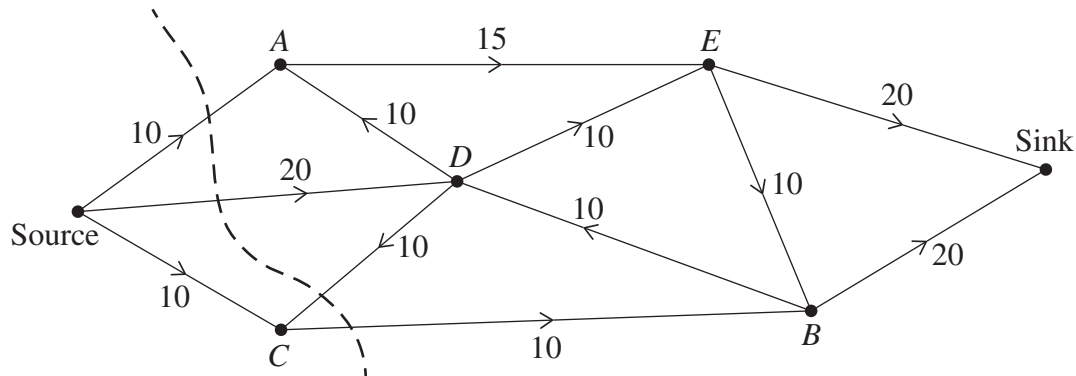
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Question 31 (5 marks)

A wildlife park has 5 main attractions (A, B, C, D, E) connected by directional paths. A simple network is drawn to represent the flow through the park's paths. The number of visitors who can access each path at any one time is also shown.



- (a) What is the flow capacity of the cut shown?

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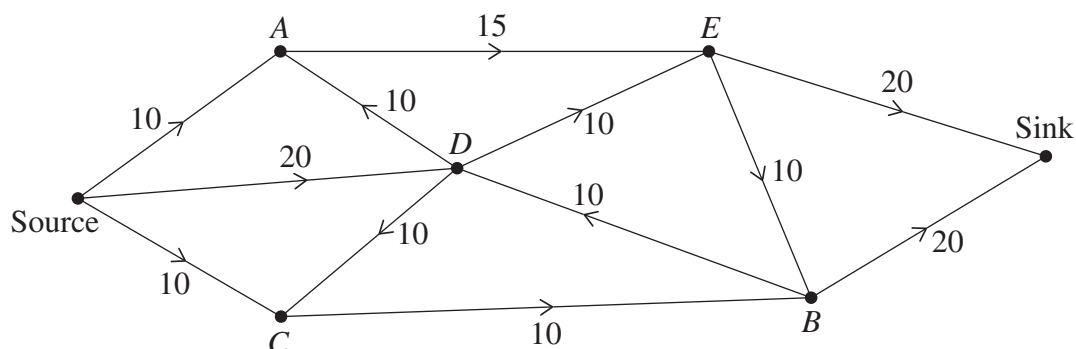
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Question 31 continues on page 27

Question 31 (continued)

- (b) By showing a suitable cut on the diagram below, explain why the network's current maximum flow capacity is less than 40 visitors. 2



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- (c) One path is to be increased in capacity so that the overall maximum flow will be 40 visitors at any one time. 2

Which path could be increased and by how much?

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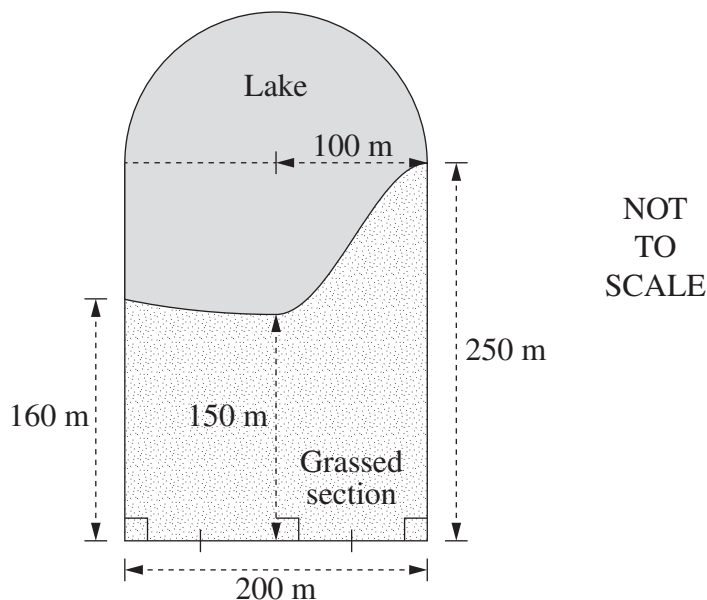
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End of Question 31

Question 32 (4 marks)

The diagram shows a park consisting of a rectangle and a semicircle. The semicircle has a radius of 100 m. The dimensions of the rectangle are 200 m and 250 m.

A lake occupies a section of the park as shown. The rest of the park is a grassed section. Some measurements from the end of the grassed section to the edge of the lake are also shown.



- (a) Using two applications of the trapezoidal rule, calculate the approximate area of the grassed section. 2

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- (b) Hence calculate the approximate area of the lake, to the nearest square metre. 2

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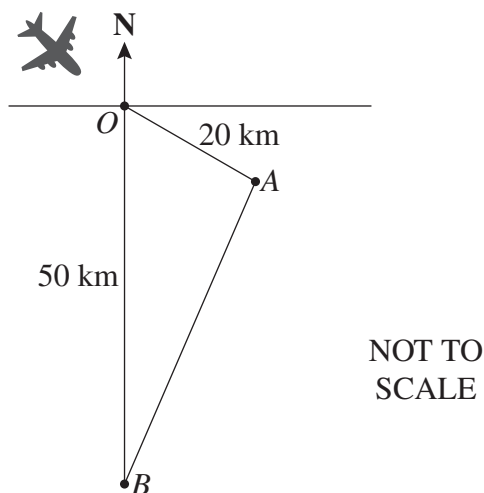
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Question 33 (5 marks)

The diagram shows an aeroplane that was flying towards an airport at A on a bearing of 135°T . When it was at point O , 20 km away from the airport at A , the flight course was changed. The aeroplane landed at an airport at B directly south of O . The distance from O to B is 50 km.



- (a) Show that the distance between the airport at A and the airport at B is 38.5 km, correct to 1 decimal place. 2

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- (b) Use the sine rule to find the angle OBA to the nearest degree. 2

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- (c) What is the bearing of the airport at B from the airport at A ? 1

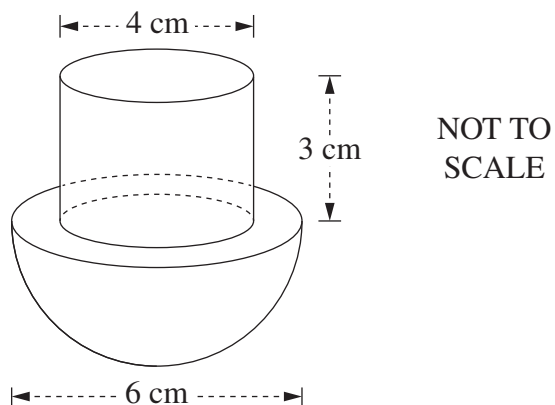
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Question 34 (4 marks)

A composite solid is shown. The top section is a cylinder with a height of 3 cm and a diameter of 4 cm. The bottom section is a hemisphere with a diameter of 6 cm. The cylinder is centred on the flat surface of the hemisphere.

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Find the total surface area of the composite solid in cm^2 , correct to 1 decimal place.

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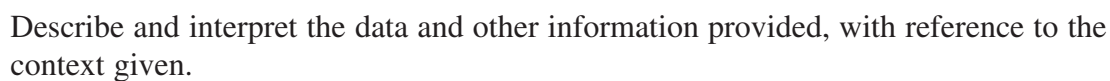
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Question 36 (5 marks)

Frankie borrows \$200 000 from a bank. The loan is to be repaid over 23 years at a rate of 7.2% per annum, compounded monthly. The repayments have been set at \$1485 per month.

The interest charged and the balance owing for the first three months of the loan are shown in the spreadsheet below.

<i>Month</i>	<i>Principal (at start of month)</i>	<i>Interest charged</i>	<i>Monthly repayment</i>	<i>Balance (at end of month)</i>
1	\$200 000	\$1200	\$1485	\$199 715
2	\$199 715	A	\$1485	\$199 428.29
3	\$199 428.29	\$1196.57	\$1485	B

- (a) What are the values of **A** and **B**?

2

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- (b) After 50 months of repaying the loan, Frankie decides to make a lump sum payment of \$40 000 and to continue making the monthly repayments of \$1485. The loan will then be fully repaid after a further 146 monthly repayments.

3

How much less will Frankie pay overall by making the lump sum payment?

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Question 37 (3 marks)

The life span of batteries from a particular factory is normally distributed with a mean of 840 hours and a standard deviation of 80 hours.

3

It is known from statistical tables that for this distribution approximately 60% of the batteries have a life span of less than 860 hours.

What is the approximate percentage of batteries with a life span between 820 and 920 hours?

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Question 38 (3 marks)

A full container has 4.8 L of a mixture of cordial and water in the ratio 1 : 3.

3

After removing 1.2 L of the mixture, more water is added to refill the container.

What is the ratio of cordial to water in the final mixture?

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Section II extra writing space

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Mathematics Standard 1

Mathematics Standard 2

REFERENCE SHEET

Measurement

Limits of accuracy

$$\text{Absolute error} = \frac{1}{2} \times \text{precision}$$

$$\text{Upper bound} = \text{measurement} + \text{absolute error}$$

$$\text{Lower bound} = \text{measurement} - \text{absolute error}$$

Length

$$l = \frac{\theta}{360} \times 2\pi r$$

Area

$$A = \frac{\theta}{360} \times \pi r^2$$

$$A = \frac{h}{2}(a + b)$$

$$A \approx \frac{h}{2}(d_f + d_l)$$

Surface area

$$A = 2\pi r^2 + 2\pi rh$$

$$A = 4\pi r^2$$

Volume

$$V = \frac{1}{3}Ah$$

$$V = \frac{4}{3}\pi r^3$$

Trigonometry

$$\sin A = \frac{\text{opp}}{\text{hyp}}, \quad \cos A = \frac{\text{adj}}{\text{hyp}}, \quad \tan A = \frac{\text{opp}}{\text{adj}}$$

$$A = \frac{1}{2}ab \sin C$$

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$c^2 = a^2 + b^2 - 2ab \cos C$$

$$\cos C = \frac{a^2 + b^2 - c^2}{2ab}$$

Financial Mathematics

$$FV = PV(1 + r)^n$$

Straight-line method of depreciation

$$S = V_0 - Dn$$

Declining-balance method of depreciation

$$S = V_0(1 - r)^n$$

Statistical Analysis

An outlier is a score

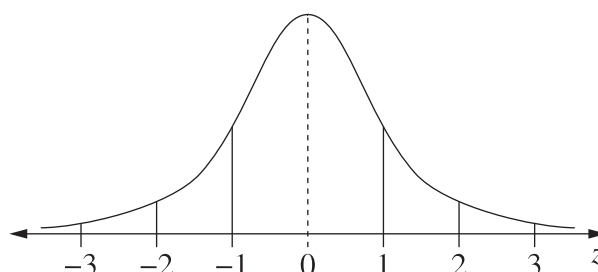
$$\text{less than } Q_1 - 1.5 \times IQR$$

or

$$\text{more than } Q_3 + 1.5 \times IQR$$

$$z = \frac{x - \mu}{\sigma}$$

Normal distribution



- approximately 68% of scores have z -scores between -1 and 1
- approximately 95% of scores have z -scores between -2 and 2
- approximately 99.7% of scores have z -scores between -3 and 3

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2022 HSC Mathematics Standard 2 Marking Guidelines

Section I

Multiple-choice Answer Key

Question	Answer
1	C
2	A
3	B
4	D
5	D
6	B
7	C
8	C
9	A
10	B
11	D
12	B
13	B
14	A
15	C

Section II

Question 16 (a)

Criteria	Marks
• Provides correct answer	1

Sample answer:

$$\begin{aligned}\text{Maximum heart rate} &= 220 - 25 \\ &= 195\end{aligned}$$

Question 16 (b)

Criteria	Marks
• Provides correct answer	2
• Provides a correct percentage	1

Sample answer:

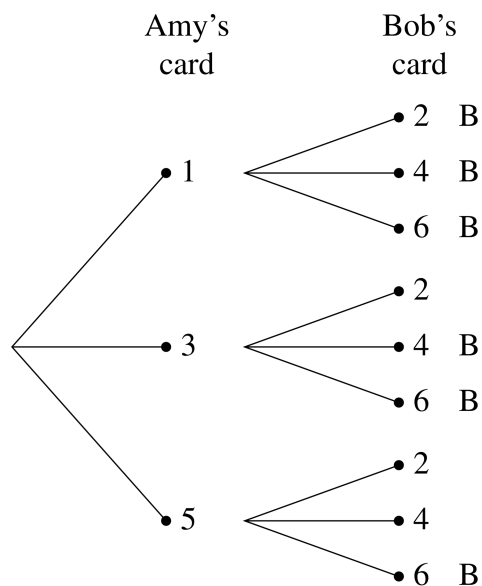
$$50\% \text{ of } 195 = 97.5 \text{ bpm}$$

$$85\% \text{ of } 195 = 165.75 \text{ bpm}$$

Question 17 (a)

Criteria	Marks
• Provides correct solution	2
• Completes the tree diagram, or equivalent merit	1

Sample answer:



Probability Bob wins is $\frac{6}{9} = \frac{2}{3}$

Question 17 (b)

Criteria	Marks
• Provides correct answer	1

Sample answer:

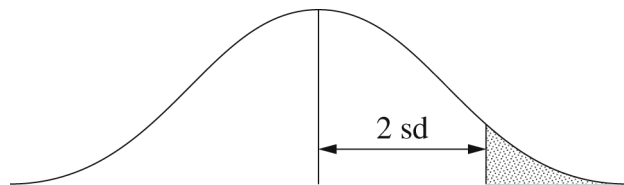
$$\frac{2}{3} \times 30 = 20 \text{ times}$$

Question 18

Criteria	Marks
• Provides correct solution	2
• Finds the z-score, or equivalent merit	1

Sample answer:

$$\mu = 60 \quad \sigma = 15$$



$$z = \frac{90 - 60}{15} = 2$$

$$\% \text{ marks higher: } \frac{1}{2} \times 5\% = 2.5\%$$

2.5% of scores are higher than 90.

Question 19 (a)

Criteria	Marks
• Finds the correct values of A and B	2
• Finds the correct value of A or B	1

Sample answer:

$$A = 98 + 62 = 160$$

$$B = \frac{192}{200} = \frac{96}{100} = 96\%$$

Question 19 (b)

Criteria	Marks
• Provides correct answer	1

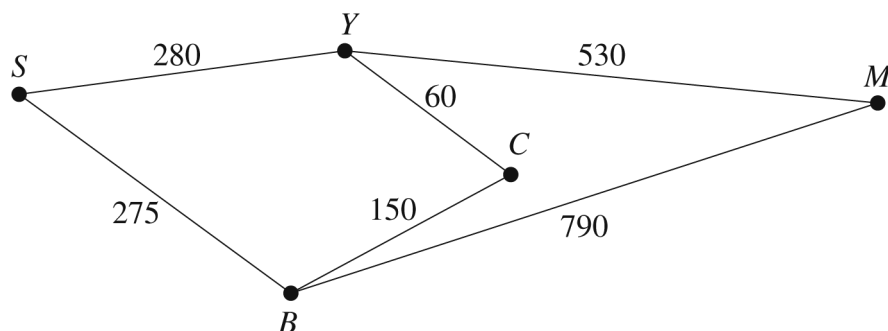
Sample answer:

Stock shortage and delivery fee

Question 20 (a)

Criteria	Marks
• Provides the correct network diagram	2
• Draws a network diagram with vertices shown, or equivalent merit	1

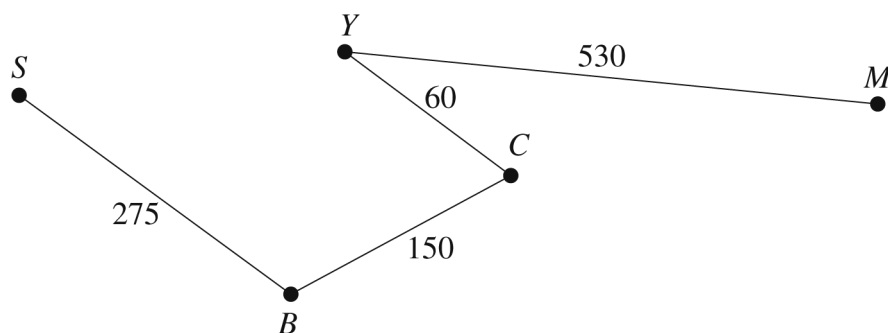
Sample answer:



Question 20 (b)

Criteria	Marks
• Provides correct solution	3
• Draws the minimum spanning tree, or equivalent merit	2
• Draws a spanning tree, or equivalent merit	1

Sample answer:



$$\begin{aligned}
 \text{Length of minimum spanning tree} &= 275 + 150 + 60 + 530 \\
 &= 1015 \text{ km}
 \end{aligned}$$

Question 21

Criteria	Marks
• Provides correct solution	2
• Calculates a correct percentage, or equivalent merit	1

Sample answer:

$$2\% \text{ of } 800\,000 + 1.5\% \text{ of } (1\,500\,000 - 800\,000)$$

$$= 0.02 \times 800\,000 + 0.015 \times 700\,000$$

$$= \$26\,500$$

Question 22 (a)

Criteria	Marks
• Provides correct answer	1

Sample answer:

$$C = 100n + b$$

$$C = 100 \times 1943 + 20\,180 = 214\,480$$

$$\text{Cost} = \$214\,480$$

Question 22 (b)

Criteria	Marks
• Provides correct solution	2
• Makes the correct substitution, or equivalent merit	1

Sample answer:

$$a = 26 \quad C = 97\,040 \quad b = 20\,180$$

$$97\,040 = 100n + 26n + 20\,180$$

$$97\,040 = 126n + 20\,180$$

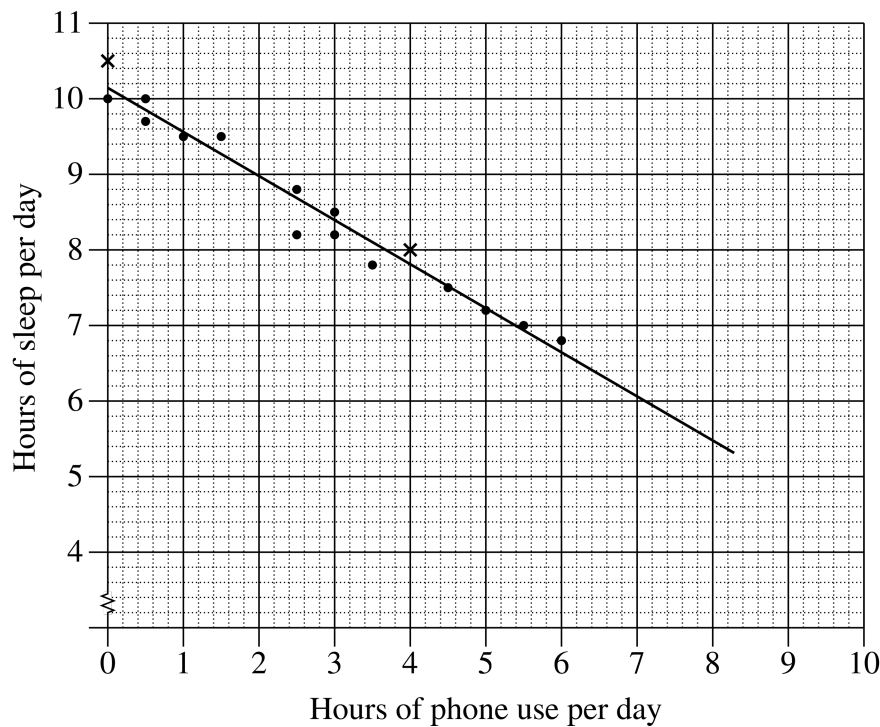
$$76\,860 = 126n$$

$$610 = n$$

Question 23 (a)

Criteria	Marks
• Plots both points correctly	2
• Plots one point correctly, or equivalent merit	1

Sample answer:



Question 23 (b)

Criteria	Marks
• Provides correct solution	2
• Estimates the number of hours of sleep using their line of best fit, or equivalent merit	1

Sample answer:

Line added above.

Student who uses the phone for 2 hours will get 9 hours of sleep per day based on the line of best fit as shown on the scatterplot.

Question 24 (a)

Criteria	Marks
• Provides correct solution	2
• Writes down an equation representing inverse variation, or equivalent merit	1

Sample answer:

$$M = \frac{k}{T}$$

When $T = 15$ $M = 12$

$$12 = \frac{k}{15}$$

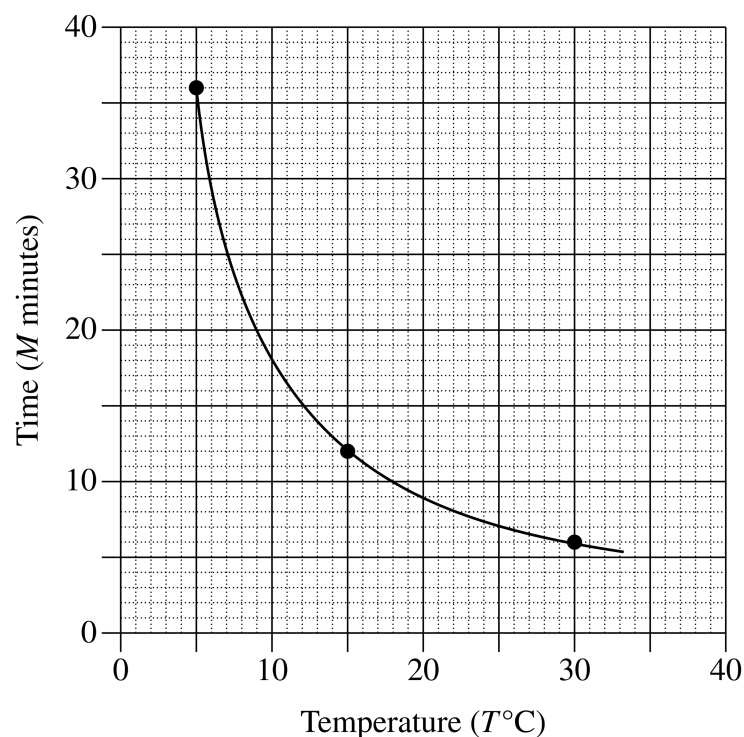
$$k = 15 \times 12 = 180$$

$$M = \frac{180}{T}$$

Question 24 (b)

Criteria	Marks
• Provides correct solution	2
• Completes the table, or equivalent merit	1

Sample answer:



T	5	15	30
M	36	12	6

Question 25 (a)

Criteria	Marks
• Provides correct solution	2
• Finds the correct interest factor, or equivalent merit	1

Sample answer:

$$\$15\,000 \div 4.184 = \$3585.09$$

Question 25 (b)

Criteria	Marks
• Provides correct solution	2
• Finds the total amount deposited, or equivalent merit	1

Sample answer:

$$\text{Amount deposited} = 4 \times \$3585.09 = \$14\,340.36$$

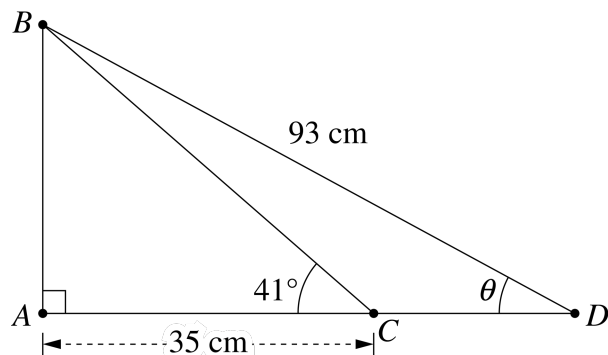
$$\text{Interest} = \$15\,000 - \$14\,340.36 = \$659.64$$

Interest is \$660 (to nearest dollar)

Question 26

Criteria	Marks
• Provides correct solution	4
• Finds the value of $\sin \theta$, or equivalent merit	3
• Finds the length of AB , or equivalent merit	2
• Provides a correct trigonometric ratio related to one of the triangles, or equivalent merit	1

Sample answer:



Using $\triangle ABC$,

$$\tan 41^\circ = \frac{AB}{35}$$

so $AB = 35 \tan 41^\circ$

Using $\triangle ABD$,

$$\sin \theta = \frac{AB}{93}$$

ie $\sin \theta = \frac{35 \tan 41^\circ}{93}$

$$\theta = 19.0959\dots$$

$$\doteq 19^\circ 6' \text{ (to the nearest minute)}$$

Question 27 (a) (i)

Criteria	Marks
• Provides correct answer	1

Sample answer:

$$S = V_0 \times (0.80)^n$$

Rate of depreciation is 20%.

Question 27 (a) (ii)

Criteria	Marks
• Provides correct solution	1

Sample answer:

$$\begin{aligned} S &= 50\,000 \times (0.8)^3 \\ &= 25\,600 \end{aligned}$$

Question 27 (b)

Criteria	Marks
• Provides correct solution	2
• Finds the annual depreciated amount, or equivalent merit	1

Sample answer:

$$\begin{aligned} \text{Annual depreciated amount} &= 12.2\% \times 50\,000 \\ &= \$6100 \end{aligned}$$

$$25\,600 = 50\,000 - 6100n$$

$$-24\,400 = -6100n$$

$$\frac{-24\,400}{-6100} = n$$

$$4 = n$$

$$\therefore n = 4 \text{ years}$$

Question 28

Criteria	Marks
• Provides correct solution	4
• Finds the volume of the dam in m^3 , or equivalent merit	3
• Finds the area of the base triangle, or equivalent merit	2
• Attempts to find the area of the base, or equivalent merit	1

Sample answer:

$$\begin{aligned}
 \text{Area of the triangle} &= \frac{1}{2} ab \sin C \\
 &= \frac{1}{2} \times 25 \times 25 \times \sin 150^\circ \\
 &= 156.25 \text{ m}^2
 \end{aligned}$$

$$\begin{aligned}
 \text{Volume of dam} &= 156.25 \times 50 \\
 &= 7812.5 \text{ m}^3
 \end{aligned}$$

$$1 \text{ m}^3 = 1000 \text{ L}$$

$$\begin{aligned}
 \text{Number of litres} &= 7812.5 \times 1000 \\
 &= 7\,812\,500 \text{ L}
 \end{aligned}$$

Question 29

Criteria	Marks
• Provides correct solution	3
• Finds the time in Sydney when the plane lands in New York, or equivalent merit	2
• Finds the time difference between Sydney and New York, or equivalent merit	1

Sample answer:

$$\text{Time difference} = 10 - -5$$

$$= 15 \text{ hours}$$

8:20 pm on Wednesday (Sydney) plus 20 hours 24 minutes

= 4:44 pm Thursday (Sydney)

4:44 pm – 15 hours = 1:44 am New York

In New York it will be 1:44 am Thursday.

Question 30 (a)

Criteria	Marks
• Provides correct solution	2
• Writes an expression for the future value with some correct element(s), or equivalent merit	1

Sample answer:

$P = 40\,000$, $r = 1.2\%$ pa compounded monthly, $N = 10 \times 12 = 120$

$$FV = 40\,000 \left(1 + \frac{0.012}{12} \right)^{120}$$

$$= \$45\,097.17$$

Question 30 (b)

Criteria	Marks
• Provides correct solution	2
• Calculates the future value using the interest factor table, or equivalent merit	1

Sample answer:

Option 2

10 years quarterly $\Rightarrow N = 10 \times 4 = 40$

$$r = \frac{2.4\%}{4} = \frac{0.024}{4} = 0.006$$

From table: 45.05630

So $FV = 45.05630 \times 1000$

$$= 45\,056.30$$

As Option 1 = \$45 097.17, the difference is \$40.87 .

Question 31 (a)

Criteria	Marks
• Provides correct answer	1

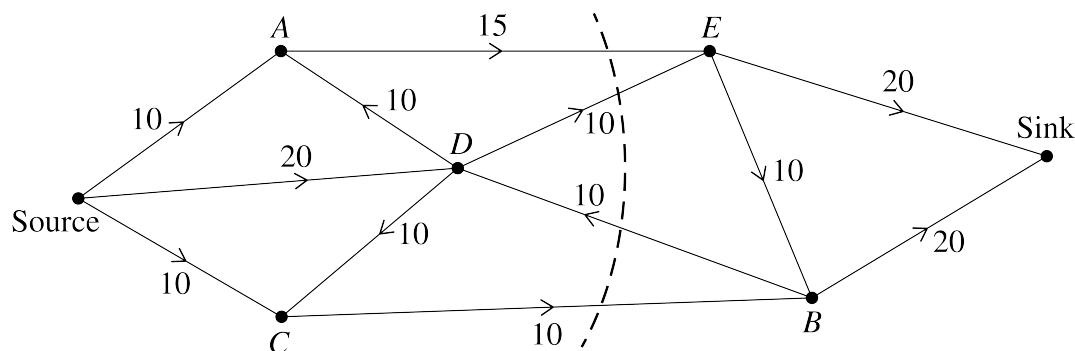
Sample answer:

Capacity of cut is 40.

Question 31 (b)

Criteria	Marks
• Provides correct solution	2
• Shows a cut of less than 40, or equivalent merit	1

Sample answer:



For the maximum flow capacity to be 40, there must be a minimum cut of 40. Since there is a cut of 35 (see above in diagram) then the maximum flow must be less than 40.

Question 31 (c)

Criteria	Marks
• Provides correct solution	2
• Gives the correct path OR the current amount, or equivalent merit	1

Sample answer:

The path from C to B can be increased by 5.

Answers could include:

The path from A to E , increased by 5

The path from D to E , increased by 5

Question 32 (a)

Criteria	Marks
• Provides correct solution	2
• Applies the trapezoidal rule, or equivalent merit	1

Sample answer:

$$A = \frac{1}{2} \times 100 \times (160 + 150) + \frac{1}{2} \times 100 \times (150 + 250)$$

$$= 50 \times 310 + 50 \times 400$$

$$\text{Area} = 35\,500 \text{ m}^2$$

Question 32 (b)

Criteria	Marks
• Provides correct solution	2
• Finds the area of the rectangle and semicircle, or equivalent merit	1

Sample answer:

Total area = rectangle + semicircle

$$= 200 \times 250 + \frac{1}{2} \times \pi \times 100^2$$

$$= 65\,707.96$$

$$\approx 65\,708 \text{ m}^2$$

Lake area = total area – grassed section

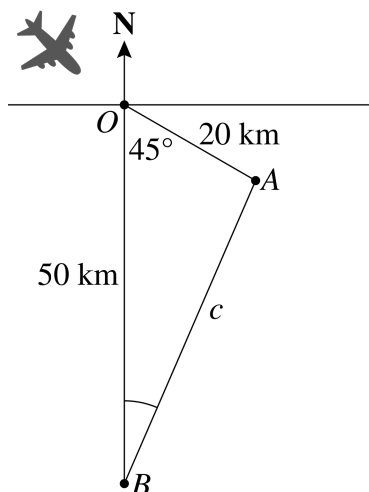
$$= 65\,708 - 35\,500$$

$$= 30\,208 \text{ m}^2$$

Question 33 (a)

Criteria	Marks
• Provides correct solution	2
• Attempts to use the cosine rule, or equivalent merit	1

Sample answer:



Using cosine rule.

$$\begin{aligned}
 c^2 &= a^2 + b^2 - 2ab \cos C \\
 &= 50^2 + 20^2 - 2 \times 20 \times 50 \cos 45^\circ \\
 c^2 &= 1485.78... \\
 c &= 38.5 \text{ (correct to 1 decimal place)}
 \end{aligned}$$

Question 33 (b)

Criteria	Marks
• Provides correct solution	2
• Attempts to use the sine rule	1

Sample answer:

$$\begin{aligned}
 \frac{\sin(\angle OBA)}{20} &= \frac{\sin 45^\circ}{38.5} \\
 \sin(\angle OBA) &= \frac{20 \sin 45^\circ}{38.5} \\
 &= 0.3673... \\
 \angle OBA &= 22^\circ \text{ (nearest degree)}
 \end{aligned}$$

Question 33 (c)

Criteria	Marks
• Provides correct answer	1

Sample answer:

$$180^\circ + 22^\circ = 202^\circ$$

Question 34

Criteria	Marks
• Provides correct solution	4
• Calculates the curved area of the cylinder AND of the hemisphere	3
• Calculates the curved area of the cylinder OR of the hemisphere	2
• Calculates any relevant area	1

Sample answer:

Surface area of:

Sphere = $4\pi r^2$ (diameter of 6 cm so radius of 3 cm)

$$\text{Curved bottom of hemisphere} = \frac{1}{2} \times 4\pi \times 3^2$$

$$\begin{aligned} \text{Top of hemisphere} &= \pi \times 3^2 - (\text{bottom of cylinder}) \\ &= \pi \times 3^2 - \pi \times 2^2 \end{aligned}$$

$$\text{Top of cylinder} = \pi \times 2^2$$

$$\text{Curved side of cylinder} = 2\pi \times 2 \times 3$$

$$\begin{aligned} \text{Total surface area} &= \frac{1}{2} \times 4\pi \times 3^2 + \pi \times 3^2 - \pi \times 2^2 + \pi \times 2^2 + 2\pi \times 6 \\ &= 122.5 \text{ cm}^2 \end{aligned}$$

Question 35

Criteria	Marks
Provides a comprehensive description and interpretation of the data and other information, in the given context	4
Provides a sound description and interpretation of the data and other information, in the given context	3
Provides some description and interpretation of the data and/or other information	2
Provides some relevant information	1

Answers could include:

The data show that:

- The relationship is linear and positive/increasing. The correlation of 0.4564 is weak/moderate.
- As character age increases by 1 year, the actor age increases by almost 2 years.
- The actors playing teenagers do not need to be teenagers themselves. The ages of characters range from 14 to 17 but the ages of actors playing these characters range from 14 to 30. This means that there is no need for just young actors but older people can play teenage characters.
- There are only a few characters of age 14 and they are played by actors ranging in age between 14–23.
- Characters of age 15 is the largest group and they are played by actors with the widest age range (14–27).
- Characters older than 15 are all played by older actors. The youngest actors in the dataset are playing characters close to their own age.

Question 36 (a)

Criteria	Marks
• Provides correct solution	2
• Calculates either A or B	1

Sample answer:

$$r = 7.2\% \text{ pa monthly}$$

$$\begin{aligned} A &= 199\,715 \times 0.006 \\ &= \$1198.29 \end{aligned}$$

$$\begin{aligned} B &= 199\,428.29 + 1196.57 - 1485 \\ &= \$199\,139.86 \end{aligned}$$

Question 36 (b)

Criteria	Marks
• Provides correct solution	3
• Calculates the total amount repaid	2
• Calculates the total repayments under the original arrangements OR finds the total number of repayments made	1

Sample answer:

$$\begin{aligned} \text{Number of repayments} &= 50 + 146 \\ &= 196 \end{aligned}$$

$$\begin{aligned} \text{Total amount repaid} &= 196 \times \$1485 + \$40\,000 \\ &= \$331\,060 \end{aligned}$$

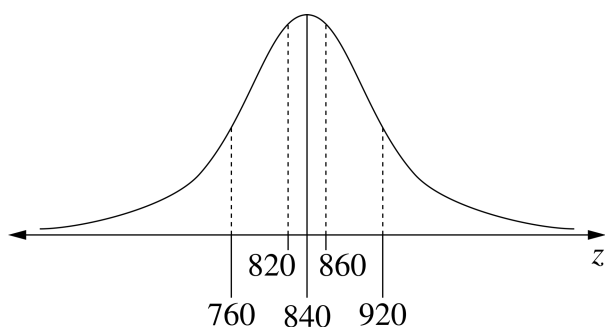
$$\begin{aligned} \text{Repayment under original conditions} &= 23 \times 12 \times \$1485 \\ &= \$409\,860 \end{aligned}$$

$$\begin{aligned} \text{Frankie saves} &= \$409\,860 - \$331\,060 \\ &= \$78\,800 \end{aligned}$$

Question 37

Criteria	Marks
• Provides correct solution	3
• Recognises that 34% have a life span between 840 and 920 AND attempts to use the information given regarding the statistical tables	2
• Recognises that 68% have a life span between 760 and 920, or equivalent merit	1

Sample answer:



60% have a life span < 860 .

$\therefore$ 10% have a life span between 840 and 860.

$\therefore$ 10% have a life span between 820 and 840.

68% have a life span between 760 and 920.

$\therefore$ 34% have a life span between 840 and 920.

$\therefore$ percentage with life span between 820 and 920 hours is $10\% + 34\% = 44\%$.

Question 38

Criteria	Marks
• Provides correct solution	3
• Calculates the amount of cordial and of water in the mixture of 3.6 L	2
• Attempts to apply the ratio 1 : 3 to the mixture of 3.6 L	1

Sample answer:

4.8 L cordial to water 1 : 3

Remove 1.2 L

3.6 L in ratio 1 : 3

$$\frac{3.6}{4} \text{ L of cordial} = 0.9 \text{ L cordial}$$

$$\frac{3.6 \times 3}{4} \text{ L of water} = 2.7 \text{ L water}$$

Add 1.2 L of water

$$\begin{aligned} \text{New ratio} &= 0.9 \text{ L cordial} : 3.9 \text{ L water} \\ &= 3 \text{ cordial} : 13 \text{ water} \end{aligned}$$

3 : 13 cordial to water.

2022 HSC Mathematics Standard 2 Mapping Grid

Section I

Question	Marks	Content	Syllabus outcomes
1	1	MS-S1 Data Analysis	MS11-2
2	1	MS-A2 Linear Relationships	MS11-2
3	1	MS-N3 Critical Path Analysis	MS2-12-8
4	1	MS-M7 Rates and Ratios	MS2-12-3
5	1	MS-S1 Data Analysis	MS11-7
6	1	MS-M7 Rates and Ratios	MS2-12-3
7	1	MS-F1 Money Matters	MS11-10
8	1	MS-M6 Non-right-angled Trigonometry	MS2-12-4
9	1	MS-A4 Types of Relationships	MS2-12-6
10	1	MS-F4 Investments and Loans	MS2-12-5
11	1	MS-F4 Investments and Loans	MS2-12-5
12	1	MS-S4 Bivariate Data Analysis	MS2-12-2
13	1	MS-S5 The Normal Distribution	MS2-12-7
14	1	MS-A1 Formulae and Equations	MS11-1
15	1	MS-S1 Data Analysis	MS11-2

Section II

Question	Marks	Content	Syllabus outcomes
16 (a)	1	MS-M7 Rates and Ratios	MS2-12-3
16 (b)	2	MS-M7 Rates and Ratios	MS2-12-3
17 (a)	2	MS-S2 Relative Frequency and Probability	MS11-8
17 (b)	1	MS-S2 Relative Frequency and Probability	MS11-8
18	2	MS-S5 The Normal Distribution	MS2-12-7
19 (a)	2	MS-S1 Data Analysis	MS11-2
19 (b)	1	MS-S1 Data Analysis	MS11-2
20 (a)	2	MS-N2 Network Concepts	MS2-12-8
20 (b)	3	MS-N2 Network Concepts	MS2-12-8
21	2	MS-F1 Money Matters	MS11-5
22 (a)	1	MS-A2 Linear Relationships	MS11-6

Question	Marks	Content	Syllabus outcomes
22 (b)	2	MS-A2 Linear Relationships	MS11-6
23 (a)	2	MS-S4 Bivariate Data Analysis	MS2-12-2
23 (b)	2	MS-S4 Bivariate Data Analysis	MS2-12-10
24 (a)	2	MS-A4 Types of Relationships	MS2-12-6
24 (b)	2	MS-A4 Types of Relationships	MS2-12-6
25 (a)	2	MS-F5 Annuities	MS2-12-5
25 (b)	2	MS-F5 Annuities	MS2-12-5
26	4	MS-M6 Non-right-angled Trigonometry	MS2-12-4
27 (a) (i)	1	MS-F4 Investments and Loans	MS2-12-5
27 (a) (ii)	1	MS-F4 Investments and Loans	MS2-12-5
27 (b)	2	MS-F4 Investments and Loans	MS2-12-5
28	4	MS-M6 Non-right-angled Trigonometry	MS2-12-4
29	3	MS-M2 Working with Time	MS11-10
30 (a)	2	MS-F4 Investments and Loans	MS2-12-10
30 (b)	2	MS-F5 Annuities	MS2-12-10
31 (a)	1	MS-N3 Critical Path Analysis	MS2-12-8
31 (b)	2	MS-N3 Critical Path Analysis	MS2-12-8
31 (c)	2	MS-N3 Critical Path Analysis	MS2-12-8
32 (a)	2	MS-M7 Rates and Ratios	MS2-12-4
32 (b)	2	MS-M7 Rates and Ratios	MS2-12-4
33 (a)	2	MS-M6 Non-right-angled Trigonometry	MS2-12-4
33 (b)	2	MS-M6 Non-right-angled Trigonometry	MS2-12-4
33 (c)	1	MS-M6 Non-right-angled Trigonometry	MS2-12-4
34	4	MS-M1 Applications of Measurement	MS2-11-4
35	4	MS-S4 Bivariate Data Analysis	MS2-12-10
36 (a)	2	MS-F5 Annuities	MS2-12-5
36 (b)	3	MS-F5 Annuities	MS2-12-10
37	3	MS-S5 The Normal Distribution	MS2-12-7
38	3	MS-M7 Rates and Ratios	MS2-12-3