Name: _____

2024

Hurlstone Agricultural High School
Year 12
Trial HSC Examination
HSC Assessment Task 4

Mathematics Standard 2

Examiner:

General Instructions

- Working time – 2 hours 30 minutes.
- Reading time – 10 minutes.
- Write using black or blue pen.
- NESA approved calculators 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 2–9)

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

Section II – 85 marks (pages 11–39)

- 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.

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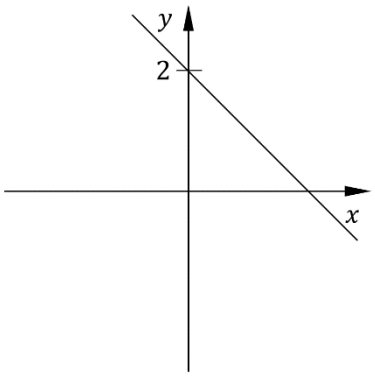
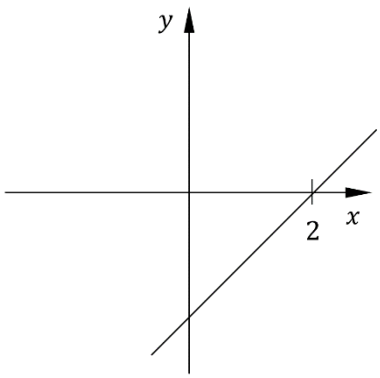
1 Which of the following could be the graph of $y = 2x - 1$?

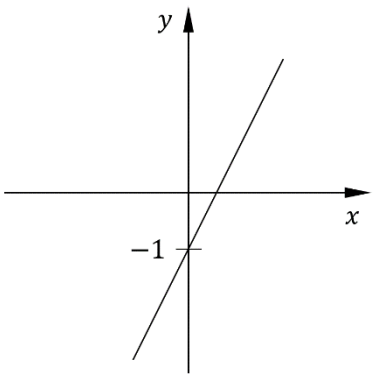
A.



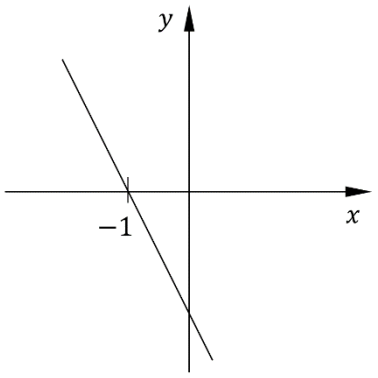
B.



C.



D.



2 What is 34 827 368.12 expressed in scientific notation with two significant figures?

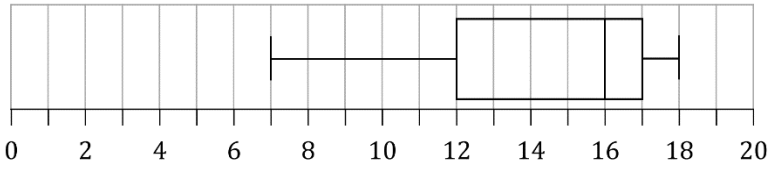
A. 3.48×10^{7}

B. 3.48×10^{-7}

C. 3.5×10^{7}

D. 3.5×10^{-7}

3 The box-plot shows the age of students attending a hockey carnival.



What is the interquartile range of this dataset?

A. 5

B. 7

C. 11

D. 16

4 Deborah needs to share 140 grams of birdseed equally between five canaries.

One of Deborah's birdcages has two canaries in it.

How much birdseed should she place in the feeder in that birdcage?

A. 28 grams

B. 56 grams

C. 84 grams

D. 112 grams

5 Cruz checks his bank balance and sees that it is $1060.90.

He knows that he opened the account exactly two years ago with a deposit of $1000, and hasn't deposited or withdrawn any funds since then.

What is the interest rate (per annum) on the account?

A. 3.000% per annum compounded annually

B. 3.045% per annum compounded annually

C. 6.000% per annum compounded annually

D. 6.090% per annum compounded annually

6 Sydney in New South Wales is 10 hours ahead of Coordinated Universal Time (UTC). Paris in France is 2 hours ahead of UTC.

When it is 8am in Paris, what time is it in Sydney?

A. 4 pm

B. 12 pm

C. 4 am

D. 12 am

7 Kabir earns an hourly rate of \$32.46 before he gets a 3.2% pay rise.

What is Kabir's new hourly rate? (to the nearest cent)

A. \$1.04

B. \$33.50

C. \$35.66

D. \$42.85

8 An electrician charges a call-out fee of \$120, as well as \$1.50 per minute while working.

Suppose the electrician works for t hours.

Which equation expresses the amount the electrician charges, $\$C$, as a function of time, t, hours?

A. $C = 120t + 90$

B. $C = 120t + 1.5$

C. $C = 90t + 120$

D. $C = 1.5t + 120$

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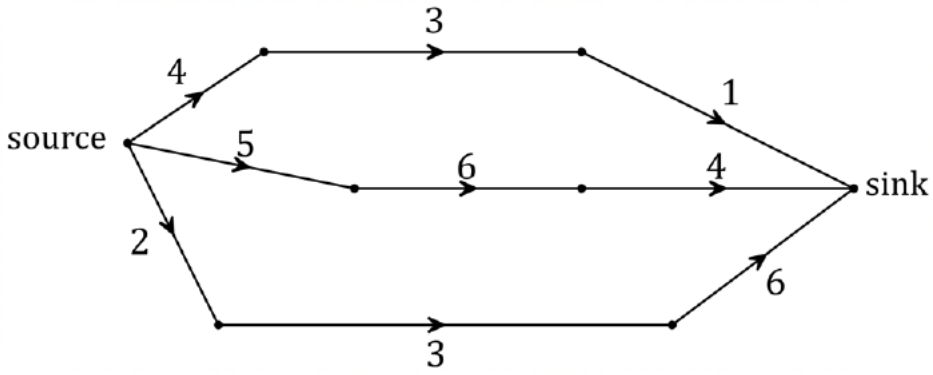


What is the maximum flow from source to sink through the network shown above?

A. 5

B. 6

C. 7

D. 11

10 Consider the following dataset.

20 22 22 23 24 27 28

Which of the following statements is CORRECT?

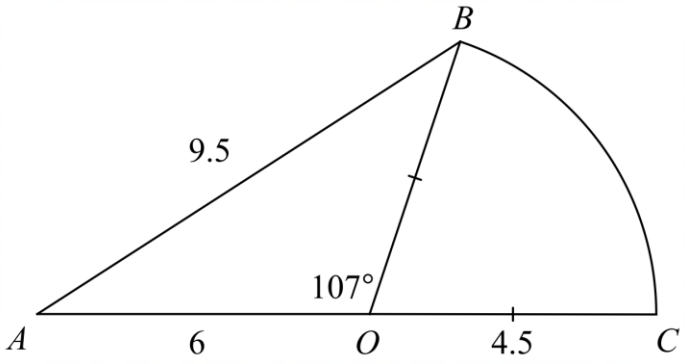
A. The score of 24 is the closest score to the mean

B. The mean is less than the median

C. The range is 3 less than the interquartile range

D. There is at least one outlier

11 A shape consisting of a triangle and a sector is shown.



Which calculation will give the area of this shape?

A. $A = \frac{1}{2} \times 4.5 \times 6 \times \sin 107° + \frac{73}{360} \times \pi \times 4.5^2$

B. $A = \frac{1}{2} \times 4.5 \times 6 \times \sin 73° + \frac{107}{360} \times \pi \times 4.5^2$

C. $A = \frac{1}{2} \times 4.5 \times 9.5 \times \sin 73° + \frac{107}{360} \times \pi \times 4.5^2$

D. $A = \frac{1}{2} \times 4.5 \times 9.5 \times \sin 107° + \frac{73}{360} \times \pi \times 4.5^2$

12 Bria is on a yacht in Fiji at (18°S, 178°E) and sails to Hawaii (21°N, 158°W) by the shortest route.

Which of the following best describes Bria's journey from Fiji to Hawaii?

A. Bria sailed 3° north and 336° west

B. Bria sailed 3° north and 336° east

C. Bria sailed 39° north and 24° west

D. Bria sailed 39° north and 24° east

13 Aubriella invests a principal of $\$P$, which earns 4% per annum interest, compounded annually.

At the end of 3 years she withdraws the future value of her investment, $\$A$, and buys a used car for exactly that amount.

The used car depreciates using the declining balance method of depreciation at a rate of 4% per annum for 3 years, having a salvage value of $\$S$ at the end of this time.

Which row in the table below shows the smallest and largest values?

	Smallest Value	*Largest Value*
A.	Salvage value, $\$S$	Future value, $\$A$
B.	Principal, $\$P$	Salvage value, $\$S$
C.	Future value, $\$A$	Principal, $\$P$
D.	Principal, $\$P$	Future value, $\$A$

14 Macy and Kassidy share a sum of money. Kassidy receives 60% more money than Macy.

If Kassidy receives \$176, what is the total amount of money that they share between them?

A. \$246.40

B. \$286.00

C. \$457.60

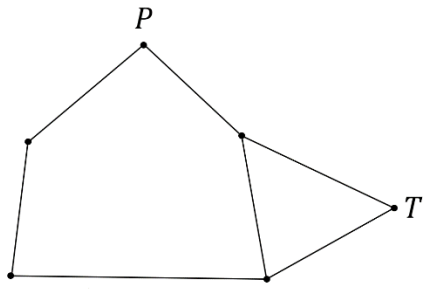
D. \$616.00

15 Six towns are linked by a road network. Two of the towns have roads leading directly to three other towns, while all other towns have roads leading directly to two other towns.

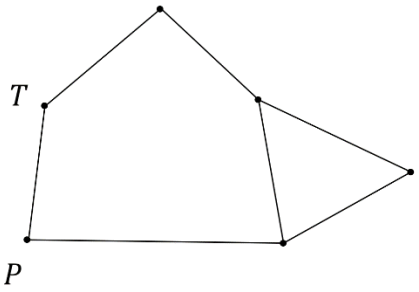
- From town P, roads lead to towns Q and U only.
- From town Q, roads lead to towns P, R and S only.

Which of the following network diagrams could represent the positions of towns P and T on the road network linking the six towns?

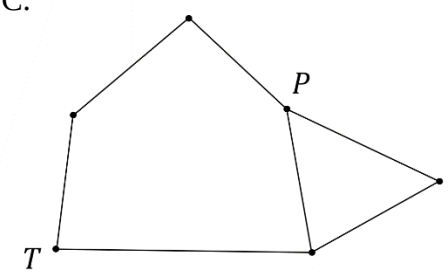
A.



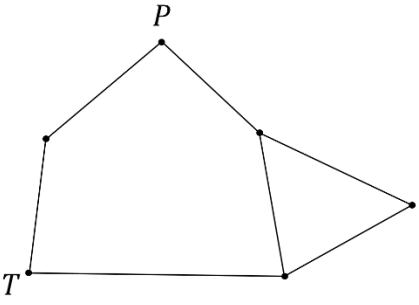
B.



C.



D.



End of Section I

Mathematics Standard 2

Student Name

Section II

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

Instructions

- Write your name 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.
  If you use this space, clearly indicate which question you are answering.

Please turn over

Question 16 (2 marks)

The five-number summary for the dataset representing the height of a group of Year 12 students is given. **2**

Minimum	154 centimetres
Lower quartile (Q_1)	172 centimetres
Median (Q_2)	175 centimetres
Upper quartile (Q_3)	182 centimetres
Maximum	192 centimetres

Show that the shortest person must be an outlier.

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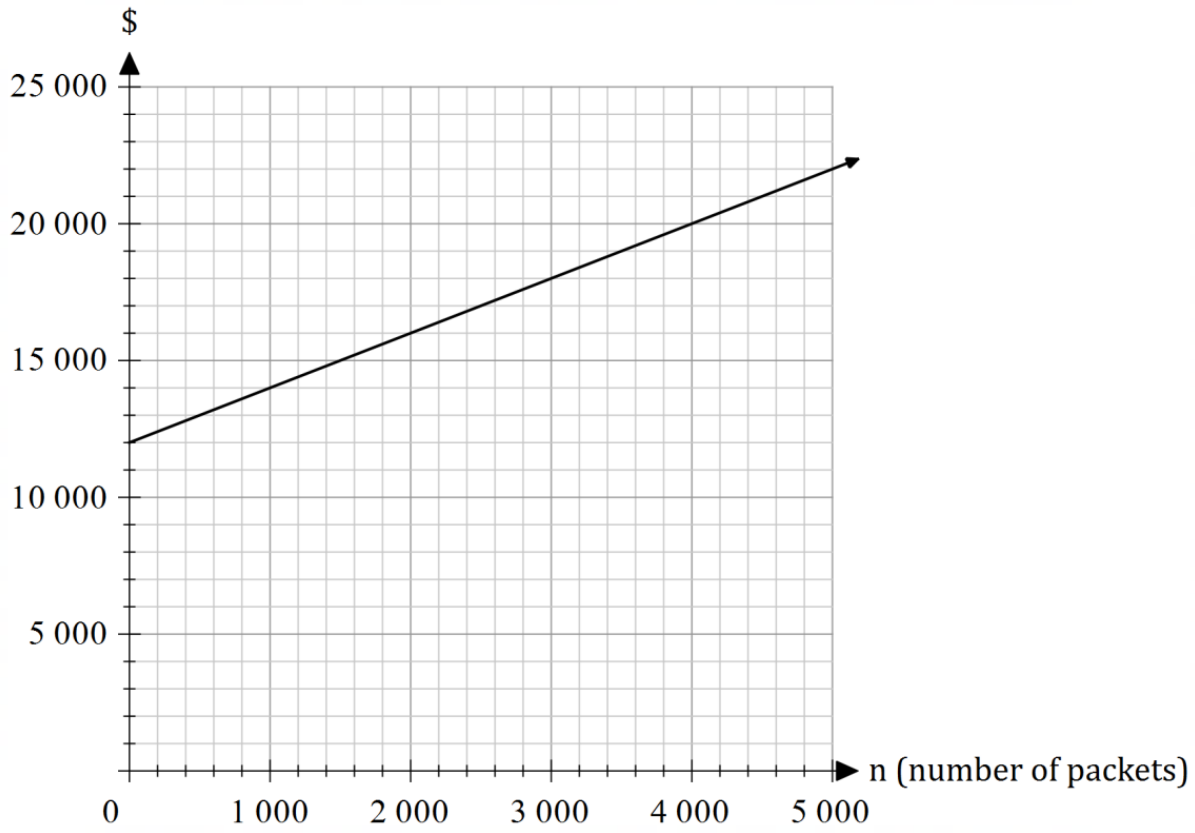
Question 17 (5 marks)

A supermarket chain is considering producing a new biscuit. The cost to produce each packet of biscuits is shown on the graph below, where the vertical axis represents the cost, in dollars, and the horizontal axis represents the number of packets produced.



(a) Determine the fixed cost to produce the biscuits and the production cost per packet. **2**

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Question 17 continues next page

Question 17 (continued)

(b) The revenue from selling the packets of biscuits varies directly with the number of packets sold. When 2000 packets are sold, the revenue is $12 000. **3**

On the previous page, graph a line representing the revenue from selling the packets of biscuits and determine the break-even point for the supermarket.

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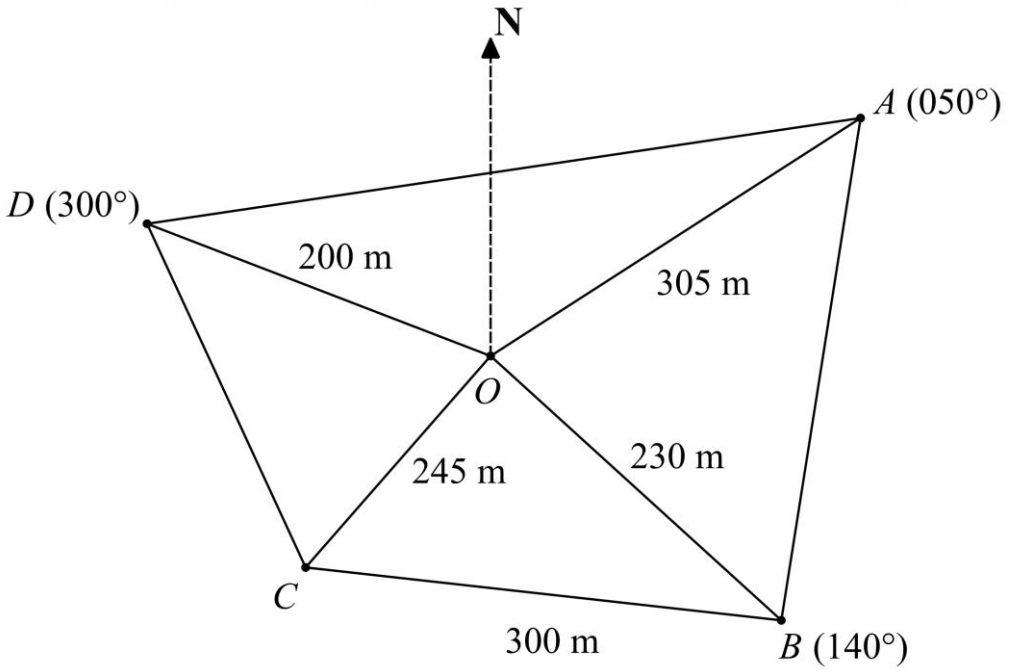
Question 18 (7 marks)

Richie has inherited a large plot of land from a distant relative. The radial survey of the plot is shown below.



(a) Find the size of $\angle AOD$. **2**

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(b) Find the area of triangle AOB, correct to the nearest square metre. **2**

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Question 18 continues next page

Question 18 (continued)

(c) Richie stands at point C. Find the bearing of O from where Richie is standing. Give your answer to the nearest degree. **3**

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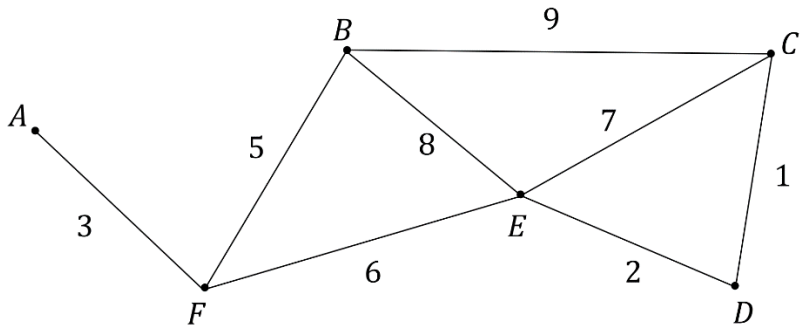
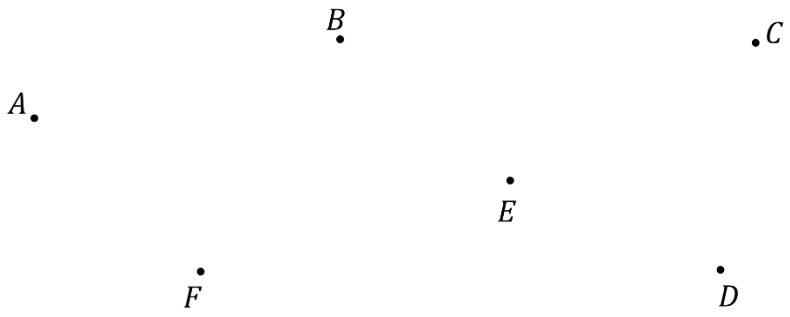
Question 19 (4 marks)

The diagram represents a network with weighted edges.



(a) Draw a minimum spanning tree for this network in the space below and determine its length. **3**

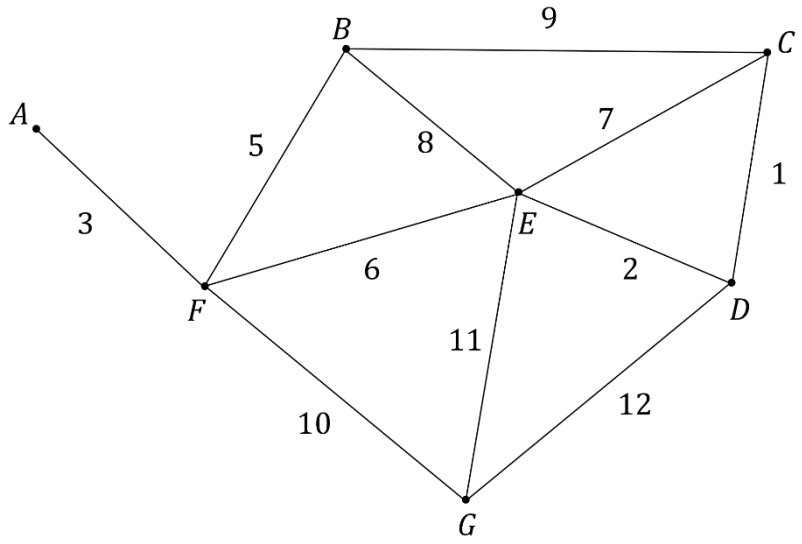


Minimum length of spanning tree = ...

Question 19 continues the next page

Question 19 (continued)

(b) The network is revised by adding another vertex, G. Edge FG has a weight of 10, edge EG has a weight of 11 and edge DG has a weight of 12, as shown. **1**



What is the length of the minimum spanning tree for this revised network?

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Question 20 (3 marks)

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

Type of complaint	*Frequency*	*Cumulative frequency*	*Cumulative percentage*
Stock shortage	102	102	51
Delivery fee	56	***A***	79
Delivery time	20	178	89
Damaged item	10	188	***B***
Returns policy	8	196	98
Product information	4	200	100
Total	200		

(a) What are the values of ***A*** and ***B***? **2**

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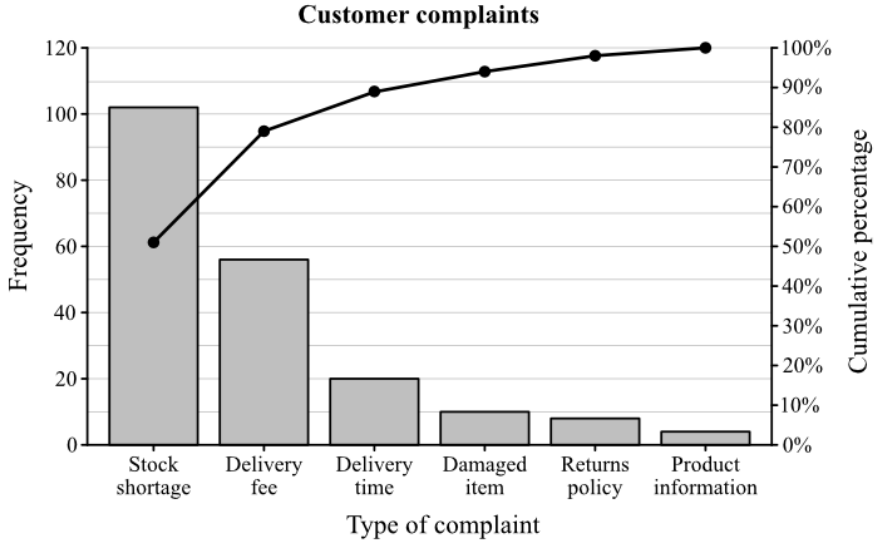
(b) The data from the table are shown in the following Pareto chart. **1**



The manager will address 80% of the complaints.

Which types of complaints will the manager address?

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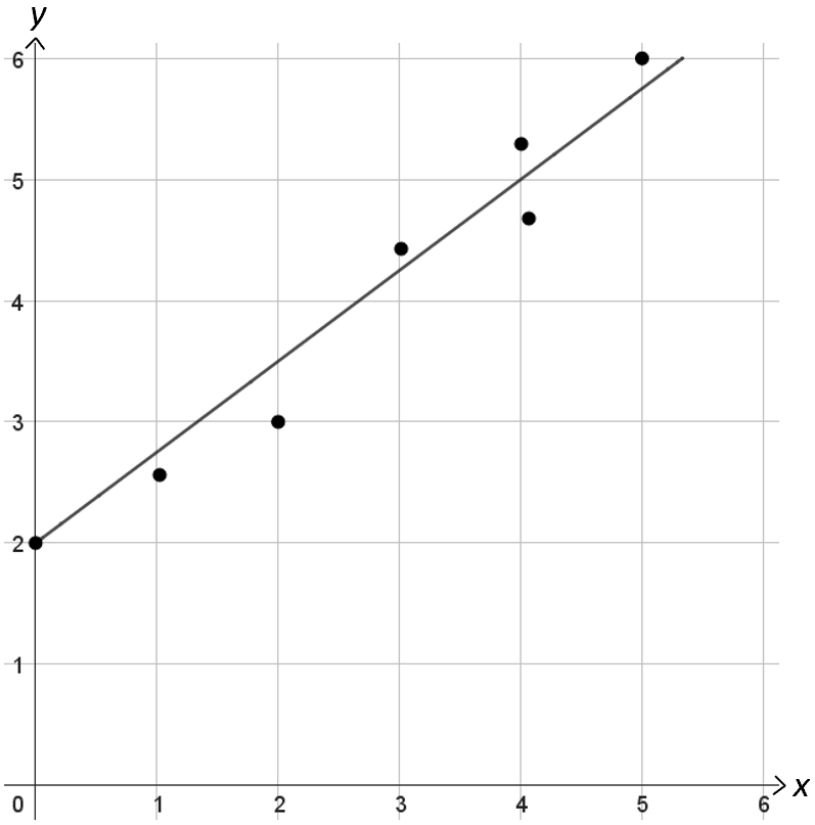
Question 21 (3 marks)

Consider the bivariate data shown in the scatterplot below.



(a) Describe the strength of the relationship between x and y as strong, moderate or weak. **1**

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(b) Find the equation of the line of best fit that is drawn on the scatterplot. **2**

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Question 22 (2 marks)

The table below shows the present value of an annuity of $1. **2**

Table of present value interest factors

Number of periods	*Interest rate per period as a decimal*				
	0.001	0.00125	0.0015	0.00175	0.002
300	259.0707	250.0398	241.4379	233.2418	226.3477
330	280.9577	270.2690	260.1353	250.5239	240.7211
360	302.1982	289.7541	278.0106	266.9228	258.9154
390	325.2961	309.6290	297.0981	283.6291	261.9432

Thomas borrows $600 000 to purchase a home, with interest charged at 1.5% per annum, compounding monthly.

He agrees to repay the loan by making equal monthly payments over a 30-year period.

By using the table, calculate Thomas' monthly payment.
(correct to the nearest cent)

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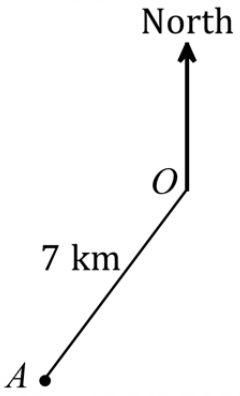
Question 23 (4 marks)

A yacht, *A*, is 7 km from a lighthouse, *O*, on a bearing of 210° as shown below.



(a) A ferry can also be seen from the lighthouse. The ferry is 3 km from *O* on a bearing of 135°. On the diagram above, label the position of the ferry, *B*, and show an angle to indicate its bearing. **1**

(b) Determine the angle between *OA* and *OB*. **1**

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(c) Calculate the distance, in km, between the ferry and the yacht correct to one decimal place. **2**

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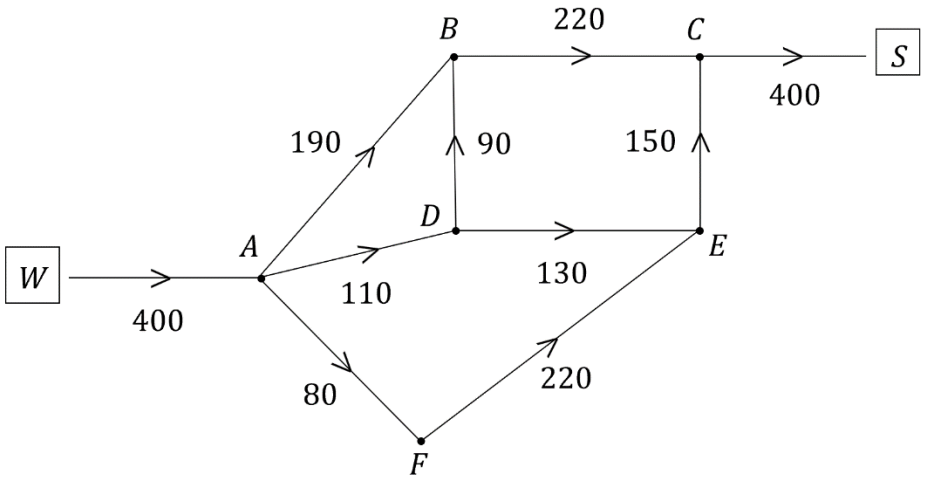
Question 24 (3 marks)

A local council is planning the supply of water to a new subdivision.

Water starts at the Water Treatment Plant, W, and passes through the existing network of water pipes through the town, to arrive at the new subdivision, S. The capacity of each pipe is noted in kilolitres per hour (kL/h) on the network diagram.



(a) What is the maximum flow of water that can currently reach the subdivision, S? **1**

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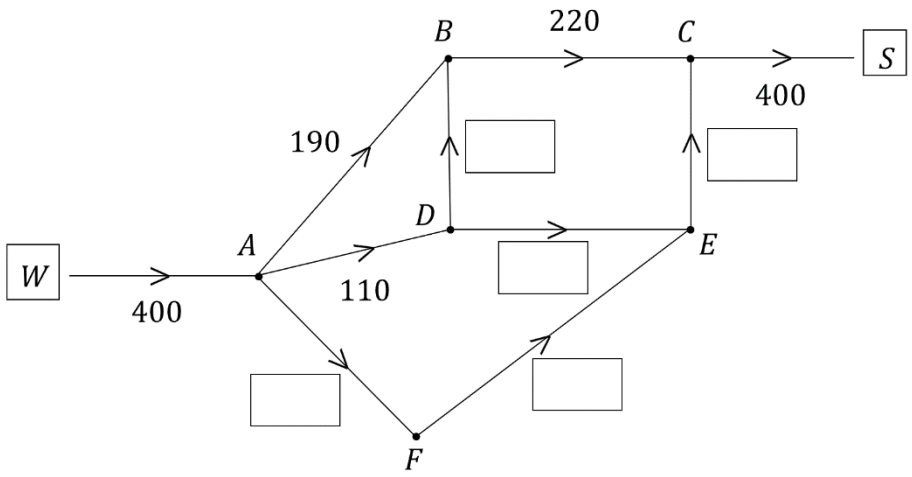
Question 24 continues the next page

Question 24 (continued)

(b) Council engineers determine that if the capacity of pipe AF is increased by 20 kL/h, and the capacity of pipe EC is increased by 30 kL/h, that the flow of water to the subdivision can reach 400 kL/h. (Do NOT prove this.) **2**

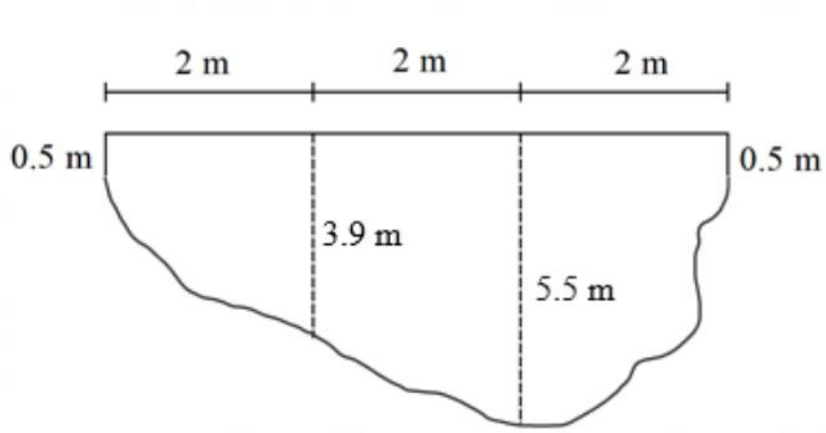
The diagram below shows 400 kL/h leaving the Water Treatment Plant and 400 kL/h arriving at the subdivision.

On the network diagram below write the minimum flow rate through pipes AF, FE, DE, BD and EC that allows water to reach the subdivision at 400 kL/h.



Question 25 (4 marks)

The diagram shows the cross-section of a river at the exact point where it feeds into a dam. The depths of the river are marked at 2 m intervals.



(a) Using three applications of the trapezoidal rule, approximate the area of the cross-section of the river to one decimal place. **2**

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Question 25 continues the next page

(b) The water in the river is moving at a rate of 0.4 metres per second. **2**

What is the volume of water that flows into the dam in an hour?

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Question 26 (2 marks)

In NSW, stamp duty is payable on all vehicles purchased at a rate of $3 per $100 or part thereof the vehicle's purchase price. **2**

Calculate the stamp duty payable on a car purchased for $49 920.

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Question 27 (3 marks)

Andrew spent a total of $131.98 at the supermarket, which included 10% GST on some of the items he bought. **3**

Andrew found that the total value of the items which did NOT have GST added was $40.35.

What was the total amount Andrew paid at the supermarket, excluding GST?

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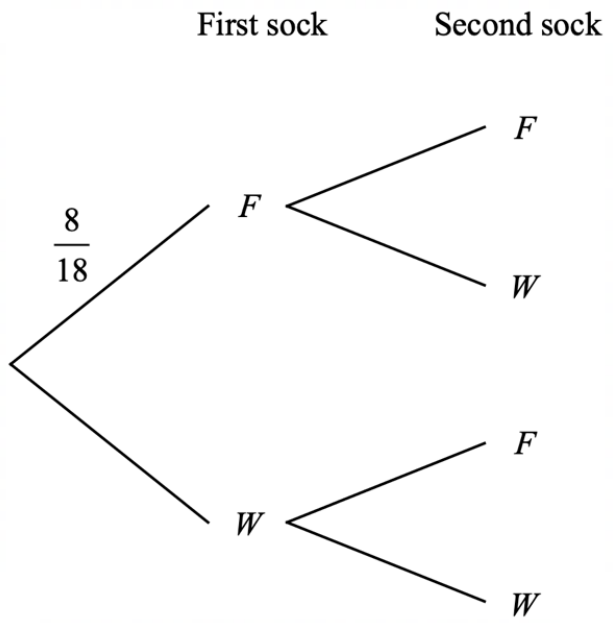
Question 28 (4 marks)

Brandon's sock drawer contains eight football socks (F) and ten workwear socks (W). Every morning he randomly selects two socks from the drawer, without replacement. The partial tree diagram below shows the outcomes and some probabilities.



(a) Complete the tree diagram above. **2**

(b) Find the probability that Brandon selects a matching pair of socks. **2**

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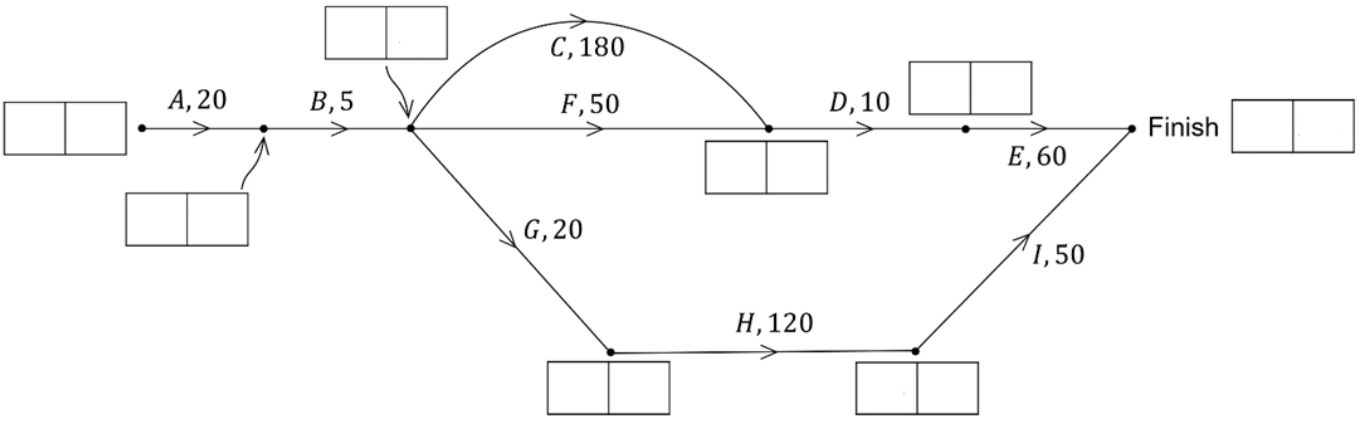
Question 29 (3 marks)

Cade is making a cup of tea and some toast after he gets home from school. **3**
To do this he needs to complete 9 tasks $A,\ B,\ C,\ \ldots,\ I$.

A network diagram giving the completion time for each task, in seconds, is shown.



When task E is finished Cade's cup of tea is ready to drink. Task H is toasting the bread in the toaster, while task I is spreading butter on the toast. Cade spreads his butter as soon as the toaster is finished.

Cade wants his buttered toast ready at exactly the same time that his tea is ready to drink, so that they are both as hot as possible.

By performing forward and backward scanning, find the EST and LST of each activity and mark it in the diagram above. Hence find the minimum time it will take Cade to make his tea and toast, and what is the latest time after starting task A he should start task H.

Minimum time = ……..

(LST for task H) Latest time to start task H = ……..

Question 30 (3 marks)

The table shows the future value of a $1 annuity at different interest rates over different time periods. The contributions are made at the end of each period.

Future values of a $1 annuity

Time period	*Interest rate*			
	1%	2%	3%	4%
1	1.0000	1.0000	1.0000	1.0000
2	2.0100	2.0200	2.0300	2.0400
3	3.0301	3.0604	3.0909	3.1216
4	4.0604	4.1216	4.1836	4.2465
5	5.1010	5.2040	5.3091	5.4163
6	6.1520	6.3081	6.4684	6.6330
7	7.2135	7.4343	7.6625	7.8983
8	8.2857	8.5830	8.8923	9.2142

(a) An annuity account is opened and contributions of $5000 are made at the end of each year for 8 years. **1**
For the first 6 years, the interest rate is 4% per annum, compounding annually.
Using the table above, what is the amount in the account after 6 years?

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(b) For the 7th and 8th year, the interest rate decreases to 3% per annum, compounding annually. **2**
Using the table above or otherwise, calculate the amount in the account immediately after the 8th contribution is made.

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Question 31 (5 marks)

The table shows the individual income tax rates in Australia for the 2023–24 financial year.

Taxable Income	**Tax on this income**
0 – $18,200	Nil
$18,201 – $45,000	19 cents for each $1 over $18,200
$45,001 – $120,000	$5,092 plus 32.5 cents for each $1 over $45,000
$120,001 – $180,000	$29,467 plus 37 cents for each $1 over $120,000
$180,001 and over	$51,667 plus 45 cents for each $1 over $180,000

Cameron is a teacher and his gross annual income is $108 000. He paid a total of $26 200 in Pay As You Go (PAYG) tax during the 2023–24 financial year. His tax deductions include the purchase of teaching resources valued at $342 and teacher union fees of $674. Cameron must also pay a Medicare levy of 2% of his taxable income.

(a) Calculate Cameron's taxable income and Medicare levy. **2**
Give your answers correct to the nearest dollar.

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(b) Calculate Cameron's tax payable, including the Medicare levy. **2**
Give your answer correct to the nearest dollar.

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(c) Given that Cameron paid $26 200 in PAYG tax, determine the amount of his tax refund or tax debt owed to the Australian Taxation Office. **1**

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Question 32 (3 marks)

Hunter bought 20 000 shares in KSH Mining for $0.31 each, and 100 000 shares in PSK Mining for 0.2 cents each. **3**

While he owned the shares, Hunter received total dividends from the two companies of $590.

When Hunter sold all of the shares, he received $0.26 per share for the KSH Mining shares and 1.1 cents per share for the PSK Mining shares.

Hunter did not have to pay any other fees when he bought or sold the shares.

What percentage profit or loss did Hunter make from owning the shares? Answer as a percentage correct to 2 decimal places.

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Question 33 (3 marks)

The mean and standard deviations for the Under 17s Girls 100 metre and 400 metre foot races at a school athletics carnival are shown in the table below.

Race	Mean	Standard Deviation
100 metres	14.2	0.9
400 metres	84.9	4.6

(a) Tara ran the 100 metres in 12.8 seconds and the 400 metres in 79.2 seconds. **2**

Compared with the rest of the Under 17s Girls, is Tara better at the 100 metres or the 400 metres? Justify your answer.

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(b) The winning time in the 400 metres was 2.5 standard deviations less than the mean. **1**

How long did the winner take to finish the 400 metre race?

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Question 34 (5 marks)

A punch is made from orange juice, lemonade and mango juice in the ratio 8 : 5 : 1 respectively.

(a) How much lemonade is needed if the punch is to contain 2 litres of orange juice? **2**

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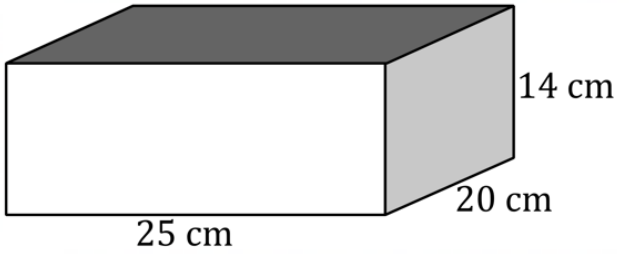
(b) The internal dimensions of a container, in the shape of a rectangular prism, are shown below. **3**



Not to scale

Some of the punch is poured into the container above, until it is full. How many litres of orange juice will there be in the container?

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Question 35 (3 marks)

A wooden puzzle piece is made by joining a solid cube of side length 6cm and a solid rectangular prism with dimensions 12cm x 6cm x 6cm. **3**

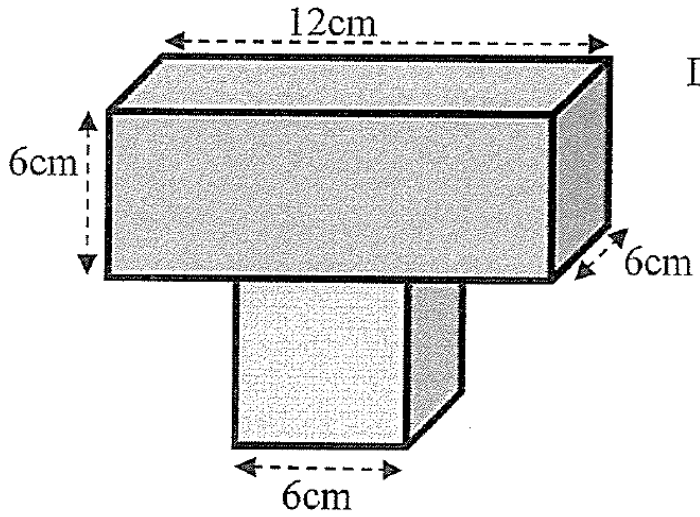

DIAGRAM NOT TO SCALE

Determine the surface area of the wooden puzzle piece.

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Question 36 (5 marks)

A business produces bottles of cola whose capacity is normally distributed with a mean capacity of 600 mL and a standard deviation of 2 mL.

(a) Between what limits will the capacity of bottles of cola almost certainly lie? **2**

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(b) What percentage of bottles lie between 598 mL and 604 mL? **3**

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Question 37 (5 marks)

Holly is an experienced driver who has a reaction time of 1.2 seconds.
She is travelling at 95.7 km/h when she applied her breaks and stops after 75.9 m.

(a) Using the formula $d = kv^2$, where d is the braking distance in metres, and v km/h is the initial speed of the car when applying the brakes. Calculate the value of k, using the given information to 2 significant figures. **2**

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(b) Calculate Holly's braking distance (d), when travelling at 63.4 km/h to the nearest metre. **1**

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(c) Find Holly's total stopping distance when travelling at 63.4 km/h to the nearest metre. **2**

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Question 38 (4 marks)

Jelena borrows \$24 000 through a reducing balance loan.
Interest is calculated monthly (with each month considered as $\frac{1}{12}$ of a year).
Repayments of \$800.00 are deducted each month after the interest is added.
Jelena uses the spreadsheet below, to show the progress of the loan.

	A	B	C	D	E
1	N	P	I	$P + I$	$P + I - R$
2	1	\$24,000.00	\$160.00	\$24,160.00	\$23,360.00
3	2	\$23,360.00	\$155.73	\$23,515.73	\$22,715.73
4	3	\$22,715.73	\$151.44	\$22,867.17	\$22,067.17
5	4	\$22,067.17	\$147.11	\$22,214.29	\$21,414.29
6	5				
7	6				X

(a) What is the annual percentage interest rate? **2**

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(b) Complete the next two rows to find the amount X, which would appear in cell E7. **2**

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End of Paper

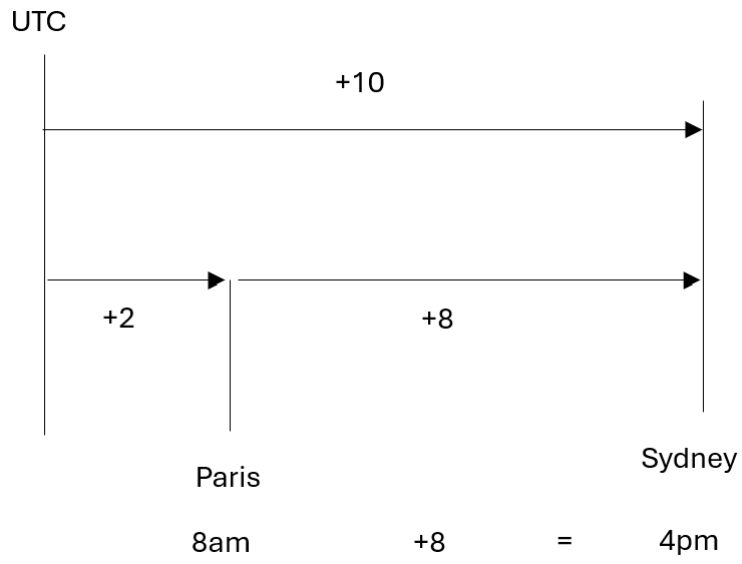
Year 12 Mathematics Standard 2	Assessment Task 4 2024

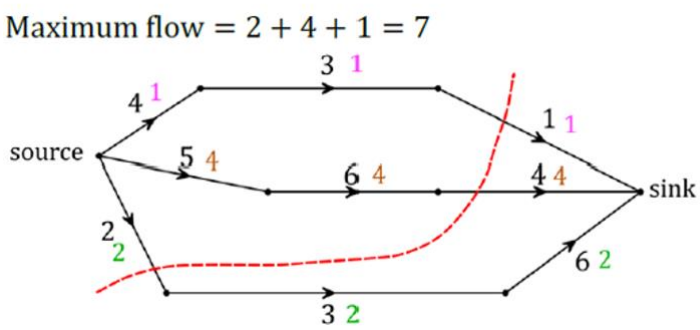
Solutions and Marking Guidelines

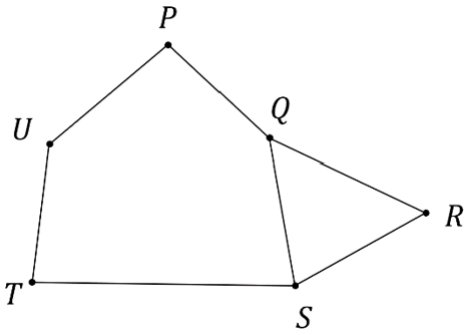
Outcomes assessed in task 4

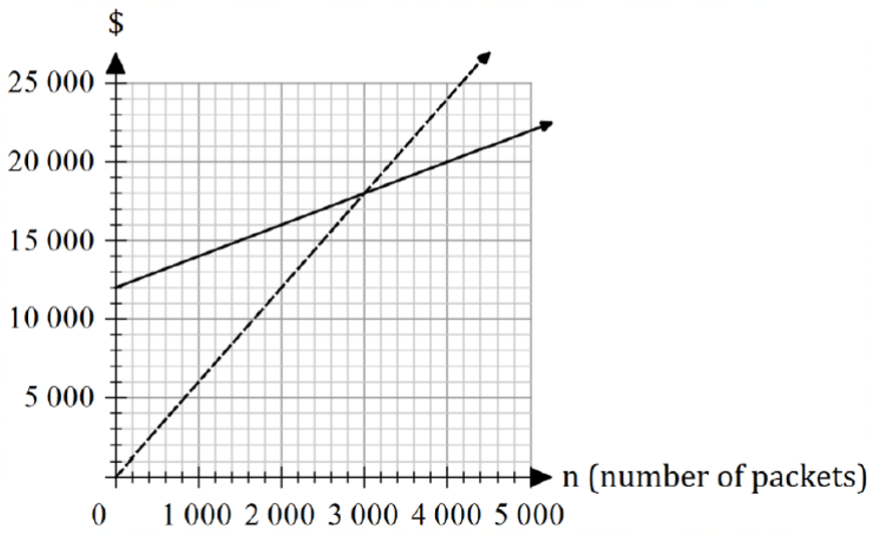
MS11-8
solves probability problems involving multistage events.
MS2-12-1
uses detailed algebraic and graphical techniques to critically evaluate and construct arguments in a range of familiar and unfamiliar contexts.
MS2-12-2
analyses representations of data in order to make inferences, predictions and draw conclusions.
MS2-12-3
interprets the results of measurements and calculations and makes judgements about their reasonableness, including the degree of accuracy and the conversion of units where appropriate.
MS2-12-4
analyses two-dimensional and three-dimensional models to solve practical problems.
MS2-12-5
makes informed decisions about financial situations, including annuities and loan repayments.
MS2-12-6
solves problems by representing the relationships between changing quantities in algebraic and graphical forms.
MS2-12-7
solves problems requiring statistical processes, including the use of the normal distribution and the correlation of bivariate data.
MS2-12-8
solves problems using networks to model decision-making in practical problems.
MS2-12-10
uses mathematical argument and reasoning to evaluate conclusions, communicating a position clearly to others and justifying a response.

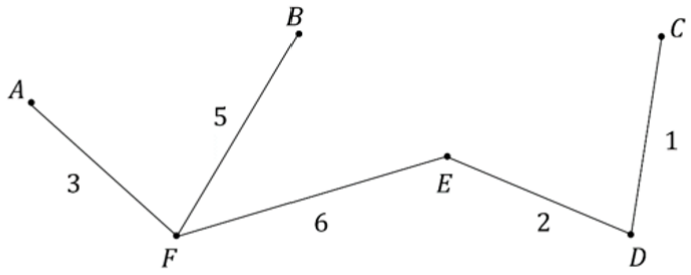
Outcome	Solution	Marking Guidelines
MS2-12-1	1. The gradient is positive, so the line moves up from left to right, so eliminate A and D. The y-intercept is -1, so the answer is C. When $x = 2, y = 2(2) - 1 = 3$, so B is not a possible answer. ANSWER: C	1 Mark awarded for correct answer
MS2-12-3	2. Round to two significant figures first, to get 35 000 000, then express this in standard form as 3.5×10^7. ANSWER: C	1 Mark awarded for correct answer
MS2-12-2	3. IQR $= Q_3 - Q_1$ $= 17 - 12$ $= 5$ ANSWER: A	1 Mark awarded for correct answer
MS2-12-3	4. Each canary receives $\frac{140}{5} = 28$ grams. Two canaries receive $28 \times 2 = 56$ grams. ANSWER: B	1 Mark awarded for correct answer

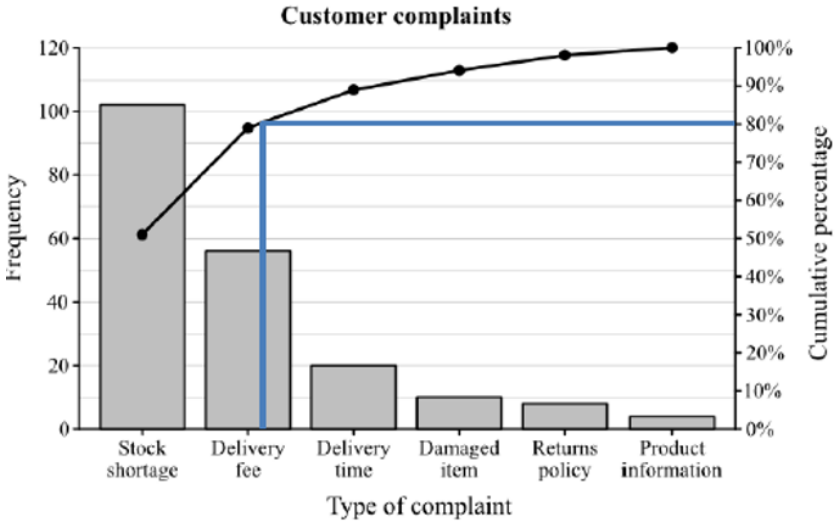
MS2-12-5	5. By trial and error: A: $FV = 1000 \times (1 + 0.03)^2 = \$1060.90$ Alternative I $1060.90 = 1000 \times (1 + r)^2$ $1.0609 = (1 + r)^2$ $1 + r = \sqrt{1.0609}$ $= 1.03$ $r = 0.03$ $= 3\ \%$ Alternative II The compound interest rate will be a bit less than the simple interest rate, so $r\% < \frac{60.90}{2 \times 1000} \times 100 = 3.045\%$ pa, so try 3% pa compounded annually. $FV = 1000 \times 1.03^2 = \$1060.90$, so A is correct. ANSWER: A	1 Mark awarded for correct answer
MS2-12-3	6.  ANSWER: A	1 Mark awarded for correct answer
MS2-12-5	7. $32.46 \times 1.032 = 33.49872$ $= \$33.50$ ANSWER: B	1 Mark awarded for correct answer

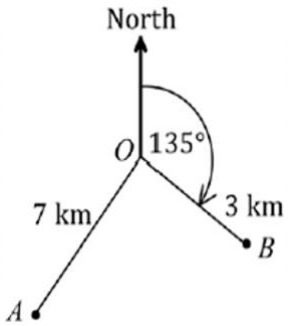
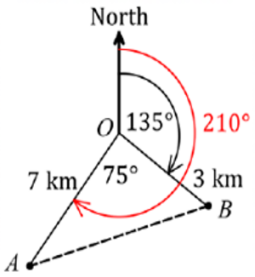
MS2-12-6	8. $1.50 per minute is $90 per hour. The constant term is the call-out fee of $120. The gradient is the rate per hour, $90. $\therefore C = 90t + 120$ ANSWER: C	1 Mark awarded for correct answer
MS2-12-8	9.  ANSWER: C	1 Mark awarded for correct answer
MS2-12-2	10. The mean is $\frac{20+22+22+23+24+27+28}{7} = 23.71$, so the closest score to the mean is 24, so A is CORRECT. The mean (23.71) is greater than the median (23), so B is incorrect. The range can never be less than the IQR, so C is incorrect. If students calculate them then the range is $28 - 20 = 8$ and the interquartile range is $27 - 22 = 5$, so the range is 3 more than the interquartile range, not 3 less, so C is incorrect. The boundaries for outliers are $22 - 1.5 \times 5 = 14.5$ and $27 + 1.5 \times 5 = 34.5$ so there are no outliers, so D is incorrect. ANSWER: A	1 Mark awarded for correct answer
MS2-12-4	11. Using Area of a triangle $= \frac{1}{2}abSinC$ and Area of a Sector $= \frac{\theta}{360}\pi r^2$, so A is the correct answer. ANSWER: A	1 Mark awarded for correct answer
MS2-12-4	12. Latitude: since Fiji and Hawaii are in different hemispheres we add their latitudes, so $18 + 21 = 39°$, and since she went from the southern hemisphere to the northern hemisphere, she travelled 39° north. Longitude: since Fiji and Hawaii are in different hemispheres we add their longitudes, so $178 + 158 = 336°$. Since this is more than 180°, and Bria took the shortest route, we subtract this from 360° to get 24°. Since Bria started in the far end of the eastern hemisphere then crossed the International Dateline she is heading east, so she travelled 24° east. ANSWER: D	1 Mark awarded for correct answer

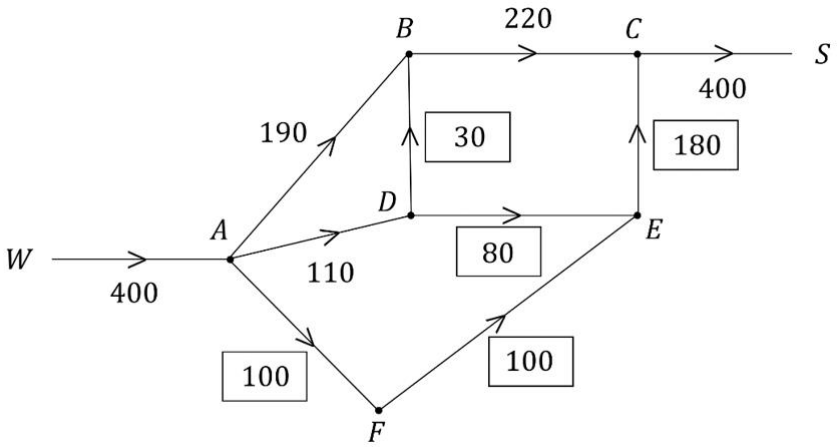
MS2-12-5	13. $A = P \times 1.04^3$ $= 1.124864P$ $S = A \times 0.96^3$ $= 1.124864P \times 0.96^3$ $\approx 0.995208P$ $\therefore S < P < A$, so A. ANSWER: A	1 Mark awarded for correct answer
MS2-12-5	14. Since Kassidy receives 60% more than Macy her amount is 160% of Macy's amount. 160% × Macy ≡ \$176 1% × Macy ≡ \$1.10 100% × Macy ≡ \$110 Macy receives \$110. The total they share is $176 + 110 = \$286$. Alternative I $176 = M \times 1.6$ $M = 110$ Total $= 176 + 110$ $= \$286$ ANSWER: B	1 Mark awarded for correct answer
MS2-12-8	15.  By elimination From the 1st clue: since roads from P lead to Q and U only: • we can eliminate B, as there cannot be a road directly from P to T • we can eliminate C, as P needs to be on a vertex of degree 2, not of degree 3 From the 2nd clue: Q needs to be on a vertex of degree 3 with no roads leading directly to T: • we can eliminate A, as both vertices of degree 3 have a road leading directly to T. One possible network linking the towns is shown, which matches D. ANSWER: D	1 Mark awarded for correct answer

MS2-12-2	16. Lower boundary $= 172 - 1.5 \times (182 - 172)$ $= 157$ centimetres $\therefore$ 154 centimetres is an outlier since it is less than 157 centimetres.	2 Marks awarded for complete correct solution 1 mark awarded for attempting to find the lower boundary, or finds IQR, or equivalent merit.
MS2-12-1	17a). Fixed cost: \$12,000 Cost per packet: $\frac{\$2000}{1000} = \$2$ 17b). $R = kn$ $1200 = k(200)$ Divide both sides by 200: $k = 6$ $R = 6n$  Break-even: 3000 packets	2 marks awarded for correctly finding both the fixed cost and the cost per packet 1 mark awarded for correctly finding either the fixed cost or the cost per packet 3 marks awarded for complete correct solution 2 marks awarded for significant progress towards a correct solution with only one minor error 1 mark for any correct working that could lead to a correct solution

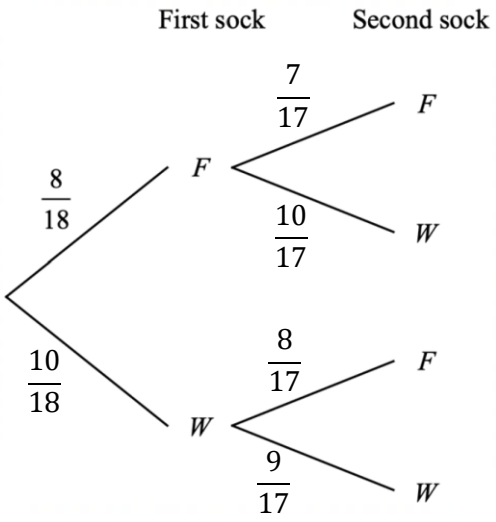
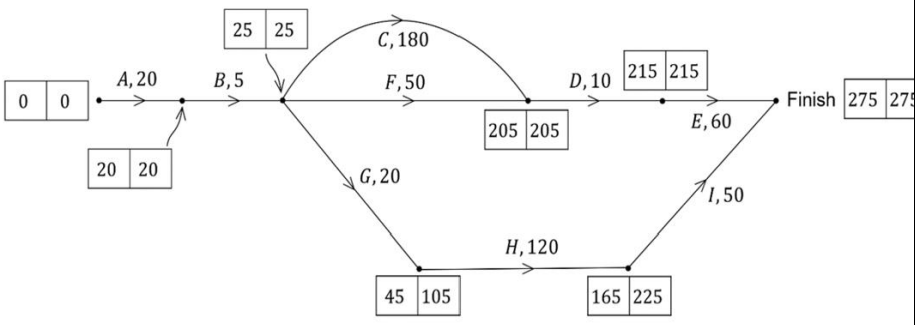
MS2-12-4	18a) $\angle AOD = \angle DON + \angle NOA$ $= 60^\circ + 50^\circ$ $= 110^\circ$	2 marks awarded for complete correct solution 1 mark for finding the size of $\angle DON$, or equivalent merit
MS2-12-4	18b) $\angle AOB = 140^\circ - 50^\circ = 90^\circ$ $\text{Area} = \frac{1}{2} \times 305 \times 230 \times \sin 90^\circ$ $= 35\,075 \text{ m}^2$	2 marks awarded for complete correct solution 1 mark for finding the size of $\angle AOB$
MS2-12-4	18c) Let $\angle COB = \theta$ $\cos\theta = \frac{230^2 + 245^2 - 300^2}{2 \times 230 \times 245}$ $\theta = \cos^{-1}\left(\frac{230^2 + 245^2 - 300^2}{2 \times 230 \times 245}\right)$ $\therefore \theta = 78^\circ$ (to the nearest degree) Hence, the bearing of C from O is $140^\circ + 78^\circ = 218^\circ$. Therefore, the bearing of O from C is 038°.	3 marks awarded for complete correct solution 2 marks awarded for finding the bearing of C from O. 1 mark for finding the size of $\angle COB$
MS2-12-8	19a)  Minimum length of spanning tree = 1 + 2 + 3 + 5 + 6 = 17.	3 marks awarded for complete correct solution 2 marks awarded for drawing a spanning (which is not minimum) and calculates its length, or equivalent merit. 1 mark for providing correct length based on diagram drawn, or equivalent merit.

MS2-12-8	19b) Minimum length of revised spanning tree $= 17 + 10 = 27$	1 mark awarded for adding 10 to their answer in a).
MS2-12-2	20a). $A = 102 + 56$ $= 158$ $B = \frac{188}{200} \times 100$ $= 94$	2 marks awarded for correctly finding both A and B 1 mark awarded for correctly finding either the A or B
MS2-12-2	20b).  Answer: Stock shortage and Delivery Fee	1 mark awarded for correct answer
MS2-12-7	21a) Answer: Strong	1 mark awarded for correct answer
MS2-12-7	21b) Using the points on the diagram (0,2) and (4,5), the gradient is $\frac{3}{4}$ and the y-intercept is 2. Hence the equation is $y = \frac{3}{4}x + 2$	2 marks awarded for finding the correct equation. 1 mark awarded for correctly finding either the gradient or the y-intercept

MS2-12-5	22. 30 years × 12 = 360 months 1.5%pa = $\frac{0.015}{12}$ per month = 0.00125 per month From Table present value interest factor is 289.7541 Monthly payment= $\frac{600\ 000}{289.7541}$ = \$2070.72	2 marks awarded for complete correct solution (Accepted \$2070.73) 1 mark awarded for correctly converting years to months and percentage pa to percentage per month
MS2-12-4	23a)  	1mark awarded for correct answer
MS2-12-4	23b) $\angle AOB = 210° - 135°$ $= 75°$  	1mark awarded for correct answer
MS2-12-4	23c) $AB^2 = 7^2 + 3^2 - 2 \times 7 \times 3 \times \cos 75°$ $AB = 6.8651\ldots\ldots$ ≈ 6.9 km ∴ Distance between the ferry and the yacht is 6.9 km.	2marks awarded for correct solution 1 mark awarded for using the cosine rule with one correct value

MS2-12-8	24a). The minimum cut passes through BC and EC. $220 + 150 = 370$ kL/h Alternative I Starting with the flow of 400 along WA, we see that at most 380 can flow through AB, AD and AF. Splitting that (there are multiple ways to do this) we eventually find that BC and CE restrict the flow to 370, which then all flows to S. The minimum flow is 370 kL/h	1 mark awarded for correct answer
MS2-12-8	24b).  Explanation (not needed for marks): All cuts must equal 400, so for the cut through AB, AD and AF $190 + 110 + AF = 400$ $\therefore AF = 100$. The cut through BC and EC must equal 400, so $220 + EC = 400 \ \therefore EC = 180$. The only water that can flow through FE is that which has flowed through AF, so $FE = 100$. The water flow through DE and FE is at most the 180 kL/h through EC, so $DE + 100 = 180$, $\therefore DE = 80$. The water flow through BD and AB is at most the 220 kL/h through BC, so $BD + 190 = 220$, $\therefore BD = 30$. Alternative explanation • The original capacity of AF and EC increase by the specified amount, to 100 and 180 respectively. • This allows everything from the source to flow out. • $ABCS$ remains unchanged. • 100 kL from AF flows into FE, changing the capacity from 220 to 100. • This leaves space for 80 kL in EC, so 80 of the 110 kL from AD flows into DE. Combined with FE, this is 180 kL. • The remaining 30 kL from AD flows into DB. This combines with the 190 from AB to give the 220 kL in BC.	2 marks awarded for correct solution 1 mark awarded for finding one correct value

MS2-12-4	25a). Area $= \frac{2}{2}(0.5 + 3.9) + \frac{2}{2}(3.9 + 5.5) + \frac{2}{2}(5.5 + 0.5)$ $= 4.4 + 9.4 + 6$ $= 19.8\ \text{m}^2$	2 marks awarded for correct solution 1 mark awarded for finding one correct trapezoidal with correct h
MS2-12-3	25b). Volume that flows into the dam in an hour$= 19.8m^2 \times \frac{0.4m}{1sec} \times \frac{60sec}{1min} \times \frac{60min}{1hour}$ $= 28512m^3$	2 marks awarded for correct solution 1 mark awarded for correctly converting 0.4m/s to m/h
MS2-12-5	26. $49920 \div 100 = 499.2$ Round up to 500 to include "part thereof" $500 \times 3 = \$1500$	2 marks awarded for correct solution 1 mark awarded for $49920 \div 100 \times 3$ $=\$1497.60$ (Did not round to include "part therof")
MS2-12-5	27. Total cost of other items including GST $= 131.98 - 40.35 = \$91.63.$ Total GST $= \frac{10}{110} \times 91.63 = \$8.33.$ Total receipt if no GST was added $= 131.98 - 8.33 = \$123.65.$	3 marks awarded for complete correct solution 2 mark awarded for finding the total GST charged, or equivalent merit 1 mark awarded for calculating the total cost of the items on which GST was charged plus the GST, or equivalent merit.

MS11-8	28 a).  	2 marks awarded for complete correct tree diagram 1 mark awarded for correctly finding the first outcome $\frac{10}{18}$
MS11-8	28b) $\frac{8}{18} \times \frac{7}{17} + \frac{10}{18} \times \frac{9}{17} = \frac{73}{153}$	2 marks awarded for complete correct solution 1 mark awarded for correctly finding either $\frac{8}{18} \times \frac{7}{17}$ *or* $\frac{10}{18} \times \frac{9}{17}$
MS2-12-8	29.  The minimum time to make his tea and toast is 275 seconds (4 minutes 35 seconds), which is the time for the critical path $ABCDE$. He should start task H 105 seconds (1 minute 45 seconds) after starting task A, which is the LST for task H.	3 marks awarded for complete correct solution 2 marks awarded for completing the EST and LST for each activity and finds either the minimum time to complete all tasks or the time to start task *H.* 1 marks awarded for completing the EST and LST for each activity.

MS2-12-5	30a). $5000\times 6.633 = \$33165$	1 mark awarded for correct answer
MS2-12-5	30b). $33165(1.03)^2 + 5000(1.03) + 5000$ $= \$45334.75$	2 marks awarded for complete correct solution 1 mark awarded for significant progress that could lead a correct solution
MS2-12-5	31a). Taxable income $= \$108\,000 - \$342 - \$674$ $= \$106\,984$ Medicare levy $= 2\% \times \$106\,984$ $= \$2140$ (to nearest \$) [Accept \$2139.68]	2 marks awarded for complete correct solution 1 mark awarded for correctly finding either the taxable income or Medicare levy
MS2-12-5	31b). Tax Payable$= \$5\,092 + \$0.325(106984 - 45\,000) + 2\,140$ $= \$27\,377$(to nearest \$) [Accept \$27 376.48]	2 marks awarded for complete correct solution 1 mark awarded for significant progress that could lead to a correct solution
MS2-12-5	31c). Since tax payable is greater than PAYG then: Tax Debt owing $= \$27\,377 - \$26200$ $= \$1177$	1 mark awarded for correct answer

MS2-12-5	32. Total cost of shares $= 20\,000 \times 0.31 + 100\,000 \times 0.002 = \$6400$ Total from sale of shares $= 20\,000 \times 0.26 + 100\,000 \times 0.011 = \$6300$ Profit $= 6300 + 590 - 6400 = \$490$ Percentage $= \frac{490}{6400} \times 100\% = 7.66\%$ (2 dp).	3 marks awarded for complete correct solution 2 marks awarded for finding the profit for owning the shares, or equivalent merit. 1 marks awarded for attempting to find the cost of the shares, or equivalent merit.
MS2-12-10 MS2-12-7	33a). $z_{100} = \frac{12.8 - 14.2}{0.9} = -1.56$ $z_{400} = \frac{79.2 - 84.9}{4.6} = -1.24$ Since her time for the 100 metres is more standard deviations below the mean it is the better result. 33b) $t = \mu + z\sigma$ $= 84.9 - 2.5 \times 4.6$ $= 73.4$ s	2 marks awarded for complete correct solution 1 mark awarded for finding one z-score, or equivalent merit. 1 mark awarded for correct solution
MS2-12-3	34a). Total parts $= 8 + 5 + 1 = 14$ 8 parts $= 2$ litres 1 part $= \frac{2 \text{ litres}}{8} = 0.25$ L 5 parts $= 5 \times 0.25$ L $= 1.25$ L $\therefore$ 1.25 litres of lemonade is needed for the punch.	2 marks awarded for complete correct solution 1 mark awarded for identifying relevant ratio or equivalent merit

MS2-12-3	34b). Capacity of the container $V = Ah$ $= 25 \times 20 \times 14$ $= 7000\ \text{cm}^3$ $= 7\ \text{L}$ Total number of parts equals the capacity of the container 14 parts = 7 litres $1\ \text{part} = \frac{7\ \text{litres}}{14}$ $= 0.5\ \text{L}$ Amount of orange juice required 8 parts $= 8 \times 0.5\ \text{L}$ $= 4\ \text{L}$ $\therefore$ 4 litres of orange juice is needed to fill container with punch.	3 marks awarded for complete correct solution 2 marks awarded for finding the correct volume of the container and attempts to calculate the amount of orange juice required 1 marks awarded for finding the correct volume of the container, or equivalent merit.
MS2-12-3	35. Surface area of the cube is 5 x 6cm x 6cm= 180cm^3 Surface area of the rectangular prism is the area of: (Front and back surfaces + top surface + 2 end surfaces + underside surface) = (3 x 12cm x 6cm) + (2 x 6cm x 6cm) + (12cm x 6cm – (6cm x 6cm)) $=324\text{cm}^2$ Total surface area of the puzzle piece $= 180\text{cm}^2 + 324\text{cm}^2$ $=504\text{cm}^2$	3 marks awarded for complete correct solution 2 marks awarded for significant progress that could lead to a correct solution with only one error 1 mark awarded any correct working out
MS2-12-3	36a). 99.7% have a z-score almost certainly between 3 and –3. Lower limit $z = \frac{x - \mu}{\sigma}$ $-3 = \frac{x - 600}{2}$ $x = -3 \times 2 + 600$ $= 594\ \text{mL}$ Upper limit $z = \frac{x - \mu}{\sigma}$ $3 = \frac{x - 600}{2}$ $x = 3 \times 2 + 600$ $= 606\ \text{mL}$ $\therefore$ Lower limit is 594 mL and upper limit is 606 mL.	2 marks awarded for answer 1 mark awarded for showing some understanding

	36b). For 598 mL $z = \frac{x-\mu}{\sigma}$ $= \frac{598-600}{2}$ $= -1$ For 604 mL $z = \frac{x-\mu}{\sigma}$ $= \frac{604-600}{2}$ $= 2$ Scores between – 1 and 2 $= \frac{68\%}{2} + \frac{95\%}{2}$ $= 81.5\%$ $\therefore$ Percentage of bottles between 598 mL and 604 mL is 81.5%	3 marks awarded for correct answer 2 marks awarded for significant progress towards the correct solution 1 mark awarded for finding the correct z-score of limit or equivalent merit.
MS2-12-6	37a) $d = kv^2$ $75.9 = k \times 95.7^2$ $k = 0.008287 \ldots$ $k = 0.0083$ (correct to 2 significant figures)	2 marks awarded for complete correct solution with correct rounding 1 mark awarded for correctly substituting into the formula
MS2-12-6	37b) $d = kv^2$ $d = 0.0083 \times 63.4^2$ $d = 33.3623 \ldots$ $d = 33$m	1 mark awarded for correct answer
MS2-12-6	37c) stopping distance = reaction distance + braking distance $= 1.2$s $\times$ 63.4km/h + 33m $= 1.2$s $\times$ (63.4 ÷ 3600)km/s + 33m $= 1.2$s $\times$ 0.0176111 … km/s + 33m $= 1.2$s $\times$ (0.0176111 … ÷ 1000)m/s + 33m $= 1.2$s $\times$ 17.6111 … m/s + 33m $= 21.1333 \ldots$ m + 33m $= 54.1333 \ldots$ m $= 54$m (To nearest metre)	2 marks awarded for complete correct solution 1 mark awarded for significant progress towards a correct solution

MS2-12-5

38a).

For first month, $P = 24000$ and I $= 160$ and $N = 1$

$I = PRN$

$160 = 24000 \times R \times 1$

$160 = 24000 \times R \times 1$

$I = \frac{160}{24000} = 0.00666667$

Monthly rate $= 0.666\%$ per month

Annual rate $= 0.00666667 \times 12 = 0.08000004$

Interest Rate $= 0.800 = 8\%$ pa (nearest percent)

2 marks awarded for complete correct solution

1 mark awarded for significant progress towards a correct solution

MS2-12-5

38b)

6	$21,414.29	$142.76	$21,557.08	$20,757.05
7	$20,757.05	$138.38	$20,895.43	**$20,095.43**

2 marks for cells completed correctly with correct value in cellE7

1 mark for some correct values in the leading cells