Name……..

Teacher's Name……

Pymble Ladies' College

Mathematics Standard 2
HSC Trial Examination
Term 3 2023

General Instructions

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

Total marks 100

Section 1 – 15 marks (pages 1 - 6)

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

Section II – 85 marks (pages 7 - 30)

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

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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 A car travels 960 metres in 1 minute 20 seconds.
What is its average speed to the nearest kilometre per hour?

(A) 7 km/h

(B) 34 km/h

(C) 43 km/h

(D) 260 km/h

2 The equation $189b + 356$ models a sandwich shop's costs. The 356 could represent which of the following?

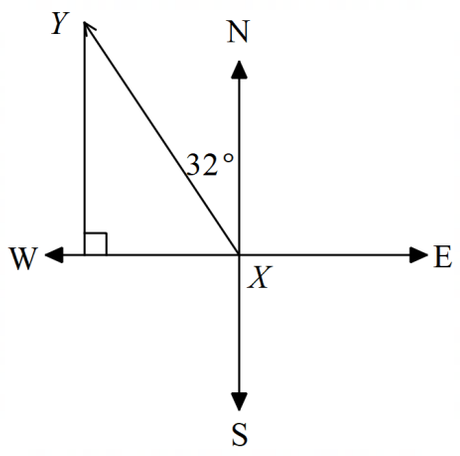
(A) Number of sandwiches sold

(B) Fixed costs

(C) The cost per sandwich

(D) Number of sandwiches made

3 The compass bearing of Y from X, as shown in the diagram, is $\text{N}32°\text{W}$.
What is the compass bearing of X from Y?



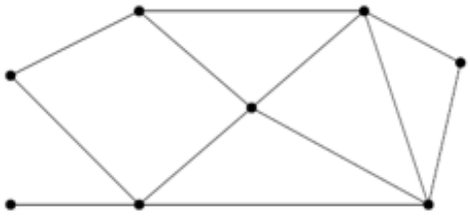
(A) N32°W

(B) N58°E

(C) S32°E

(D) S58°W

4 A network diagram is shown below.



How many odd vertices does this network contain?

(A) 1

(B) 2

(C) 3

(D) 4

5 In a survey to find the main causes of lateness in a factory work force, a random sample of 200 employees who were late for work were asked the reason why.
The Pareto chart below shows the results.



What is the minimum number of causes that accounts for the top 80% of the problem?

(A) 1

(B) 2

(C) 3

(D) 4

6 The weights of a particular bug species are normally distributed with mean 700 g and standard deviation 20 g.
What percentage of bugs have a mass exceeding 740 g?

(A) 2.5%

(B) 5%

(C) 16%

(D) 34%

7 Corby had 3000 CDL shares valued at $182 560 and received a dividend of $2.67 per share.
What was the dividend yield, correct to 2 decimal places?

(A) 4.39%

(B) 5.6%

(C) 8.9%

(D) 10.2%

8 Sally's six year old daughter is prescribed cough medicine with an adult dose of 11 mL.
Using Young's formula, calculate the amount of cough medicine Sally should give to her daughter.

$$Young's\ Formula = \frac{age\ of\ child\ in\ years \times adult\ dosage}{age\ of\ child\ in\ years + 12}.$$

(A) 0.92 mL

(B) 3.67 mL

(C) 11 mL

(D) 66 mL

9 One card is selected at random from a pack of cards labelled 1 to 50. Find the probability that the card is an odd number and a number greater than 40.

(A) 0.1

(B) 0.58

(C) 0.6

(D) 0.7

10 A 140 cm television with an energy rating of 7 stars, consumes 213 kWh/year.
The same size television with an energy rating of 3 stars, consumes 520 kWh/year.

If energy costs are 28.55 cents/kWh, what is the approximate saving in energy over a 10-year period by using the 7-star rated television, compared to the 3-star rated television?

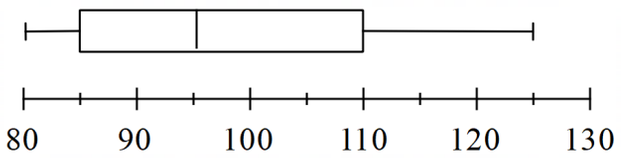
(A) \$876

(B) \$1020

(C) \$1142

(D) \$3500

11



Paulo and Yan make the following statements about the box-and-whisker plot above.

Paulo: "The interquartile range is 25 and the mean is 95".

Yan: "The range is 25 and the median is 95".

Whose statement is correct?

(A) Paulo only

(B) Yan only

(C) Paulo and Yan

(D) Both statements were incorrect

12 The area of a sector is given by the formula $A = \frac{\theta}{360} \times \pi r^2$. Rearranging this formula to make *r* the subject gives:

(A) $r = \sqrt{\frac{360A}{\pi\theta}}$

(B) $r = \sqrt{A - \frac{\pi\theta}{360}}$

(C) $r = \frac{\sqrt{360A}}{\pi\theta}$

(D) $r = \sqrt{360A - \pi\theta}$

13 James invests $5000 at 3% per annum simple interest for 2 years, while Sally invests $5000 at 3% per annum compounded annually for 2 years.

For the given investments which of the following statements is TRUE?

(A) James earns more interest than Sally.

(B) Sally earns more interest than James.

(C) James and Sally earn the same amount of interest.

(D) There is not enough information to compare the interest earned by James and Sally.

14 Use the table of future values of $1 to find the future value of $2630 invested per year at 5% p.a. for 6 years, with interest compounded annually.

Future value interest factors (Future value of an annuity with a contribution of $1 at the end of each period)							
Period	**Interest rate per period**						
	1%	**2%**	**3%**	**4%**	**5%**	**6%**	**8%**
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	2.0100	2.0200	2.0300	2.0400	2.0500	2.0600	2.0800
3	3.0301	3.0604	3.0909	3.1216	3.1525	3.1836	3.2464
4	4.0604	4.1216	4.1836	4.2465	4.3101	4.3746	4.5061
5	5.1010	5.2040	5.3091	5.4163	5.5256	5.6371	5.8666
6	6.1520	6.3081	6.4684	6.6330	6.8019	6.9753	7.3359
7	7.2135	7.4343	7.6625	7.8983	8.1420	8.3938	8.9228
8	8.2857	8.5830	8.8923	9.2142	9.5491	9.8975	10.6366
9	9.3685	9.7546	10.1591	10.5828	11.0266	11.4913	12.4876
10	10.4622	10.9497	11.4639	12.0061	12.5779	13.1808	14.4866

(A) $387

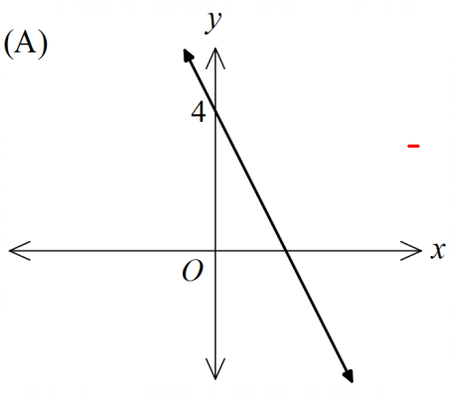
(B) $3419

(C) $17 889

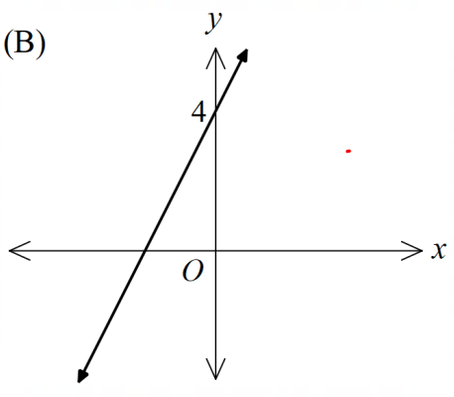
(D) $25 089

15 Which of the following best represents the graph of $y = -3x + 4$?

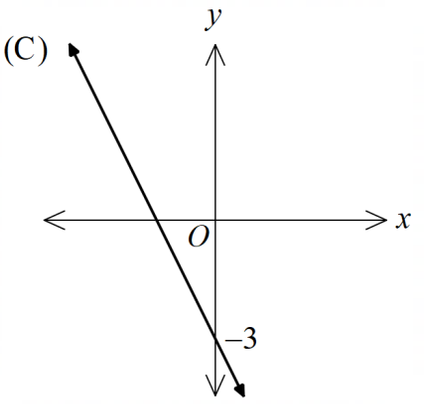
(A)



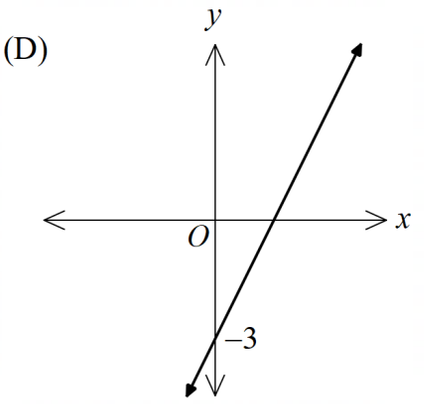
(B)



(C)



(D)



End of Section I

Name……..

Teacher's Name……

Mathematics Standard 2
Section II

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

Instructions

- Answer in the spaces provided. These spaces provide guidance for the expected length of the answer.
- Your responses should include relevant mathematical reasoning and/or calculations.
- Extra writing space is provided at the end of this booklet.

Marks

Question 16 (3 marks) **3**

Solve the equation

$$4x + 3 = \frac{10x}{3} + 5.$$

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Question 17 (2 marks) **2**

The five-number summary of a dataset is given.

Lowest score $= 1$

Lower quartile $\left(Q_1\right) = 4$

Median $\left(Q_2\right) = 7$

Upper quartile $\left(Q_3\right) = 10$

Highest score $= 20$

Is 20 an outlier? Justify your answer with calculations.

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Marks

Question 18 (4 marks)

A class is going on an overnight excursion by bus. The students were asked to each pack one bag for the trip. The bags were weighed, and the mass of the bags in kilograms were listed as follows:

9 10 11 11 16 19 23 26 27 28 30 42

(a) Determine the median mass of the bags. **1**

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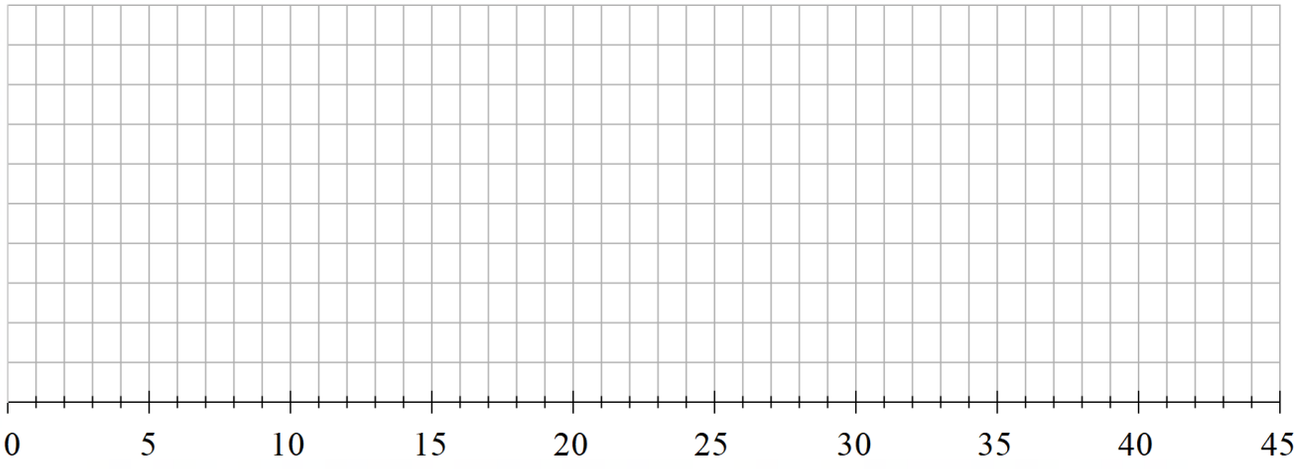
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(b) Determine the interquartile range of the bags' masses. **1**

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(c) Construct an accurate box-and-whisker plot to represent this data. **2**



Marks

Question 19 (2 marks) **2**

The amount of time, T, required to demolish a building varies inversely with the number of people, n, in the demolition team.

If it takes 8 people 3 days to demolish a factory, how many people will be needed to complete the same demolition in 4 days?

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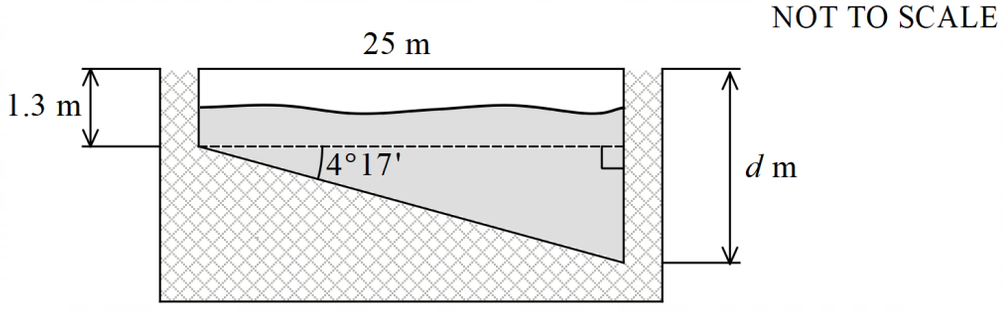
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Question 20 (2 marks)

The floor of a swimming pool inclines at 4°17' to the horizontal. The shallow end is 1.3 m deep and the pool is 25 m long. **2**

What is the depth d m, to the nearest 0.1 m, at the deep end?



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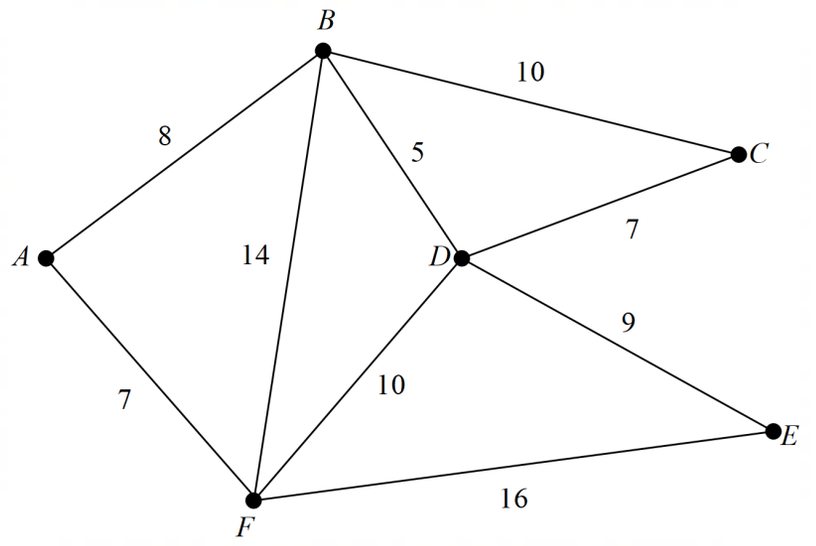
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Marks

Question 21 (2 marks) **2**

Consider the network diagram below.



Use an appropriate algorithm to show the minimum spanning tree on the network above. Hence, find the minimum value of the spanning tree.

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Question 22 (4 marks)

The formula below can be used to estimate the blood alcohol content (BAC) for males.

$$BAC_{\text{male}} = \frac{10N - 7.5H}{6.8M}$$

where N = number of standard drinks consumed
H = number of hours spent drinking
M = person's weight in kilograms.

Barrack, who weighs 85 kg, is at a party and consumes four "Purple Wombat" drinks.
He starts drinking at 6.00 pm and finishes a fourth can at 8.30 pm.



(a) Calculate his blood alcohol content after he finishes his fourth drink. **2**
Answer correct to 4 decimal places.

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(b) To legally take charge of the free world, Barrack must have a BAC of zero. **2**
The number of hours required for a person to reach a zero BAC after they stop drinking alcohol is given by the formula:

$$\text{Number of hours for } BAC \text{ to reach zero} = \frac{BAC}{0.015}.$$

At what time will Barrack be able to resume control of the free world (i.e. have a BAC of zero)?

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Marks

Question 23 (4 marks)

Arabella's business purchased equipment for $370 000 at the start of 2019. The equipment has a useful life of 5 years and will reach the end of its useful life at the end of 2024.

(a) For the first two years of its life the value of the equipment depreciated by $70 000 per year. **2**

What was the value of the equipment at the end of 2021?

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(b) After the first two years, the depreciation method was changed to the declining balance method. For the remainder of the useful life of the equipment, the salvage value depreciated by 20% per year. **2**

What is the value of the equipment when it reaches the end of its useful life?

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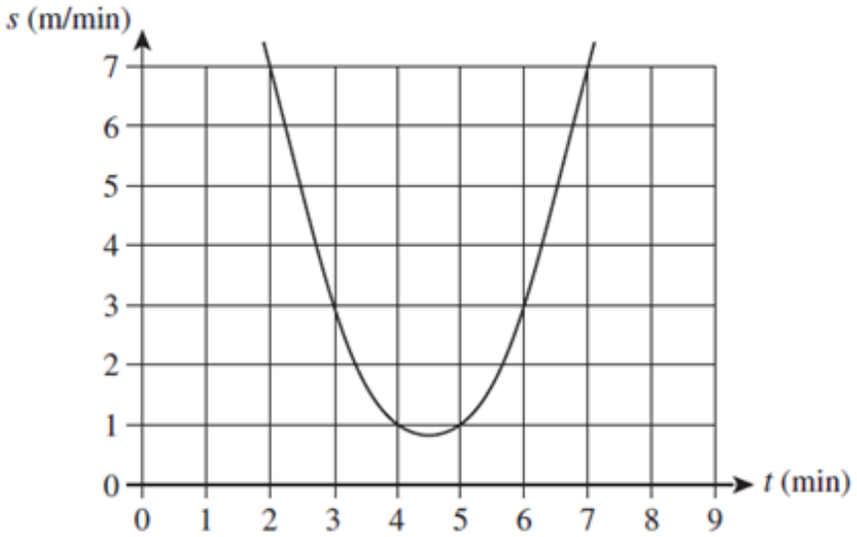
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Marks

Question 24 (3 marks)

The relationship between speed (s) and time (t) is modelled by the formula $s = t^2 - 9t + 21$, as shown in the graph.



(a) What is the speed when the time is 2.5 minutes? **1**

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(b) At what time is speed the lowest? **1**

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(c) Determine the time/s required to achieve a speed of 3 metres per minute. **1**

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Marks

Question 25 (4 marks)

Alan borrowed $310 000 at 7.9% per annum reducible interest. The interest is charged monthly and the monthly repayment is $2370. The table below shows the amounts owed during the first three months.

Months	*Principal*	*Interest*	$P + I$	$P + I - R$
1	$310 000.00	$2040.83	$312 040.83	$309 670.83
2		$2038.67	$311 709.50	
3	$309 339.50			

(a) What is the principal at the beginning of the second month? **1**

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(b) How much is owed at the end of the second month? **1**

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(c) Calculate the interest to be paid in the third month. **2**

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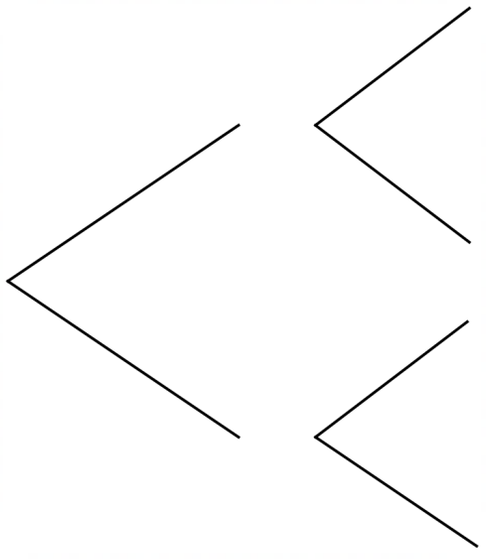
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Marks

Question 26 (4 marks)

In a raffle 50 tickets are sold and there is one first prize and one second prize. Jody buys 15 tickets in a raffle. The first prize is drawn then the second prize.

(a) Complete the probability tree diagram below, showing all outcomes. **2**



(b) What is the probability that Jody wins the first prize, but not the second? **1**

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(c) Find the probability that Jody wins at least one prize? **1**

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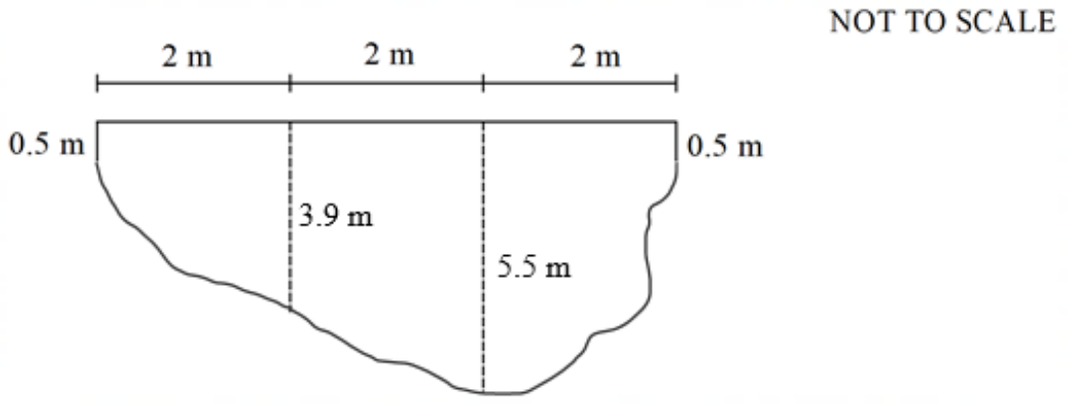
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Marks

Question 27 (2 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.



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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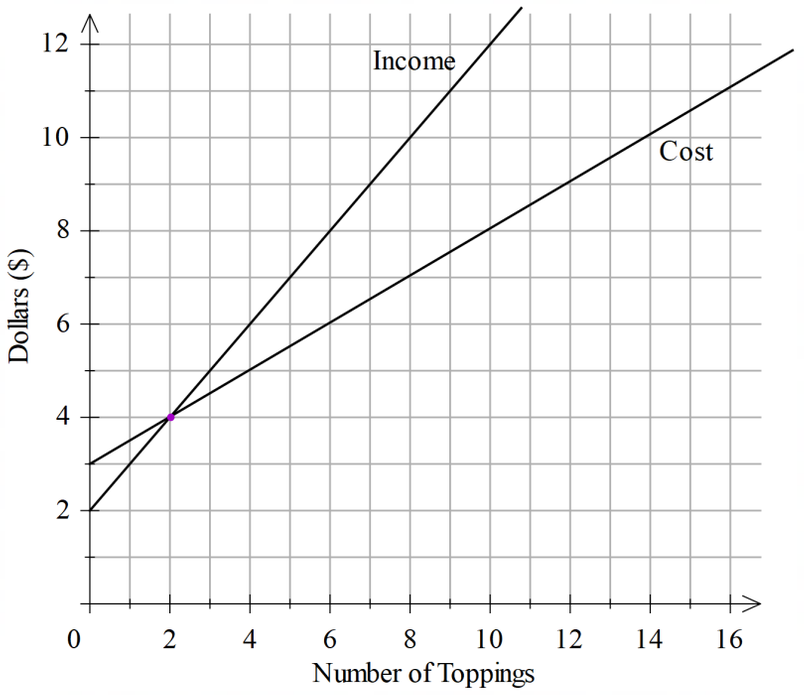
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Marks

Question 28 (3 marks)

The graph below shows the cost of making pizzas depending on the number of toppings and the amount of income made from their sale.



(a) Let the income received be $\$l$ and the number of toppings be n. **1**
Write a formula for the income.

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(b) Let the costs of making a pizza be $\$C$ and the number of toppings sold be n. **1**
Write a formula for the costs.

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(c) What is the minimum number of toppings needed on a pizza to break even? **1**

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Marks

Question 29 (2 marks) **2**

Lachlan did a class test in three topics. The class scores on each test were normally distributed. The table shows the topics and Lachlan's scores as well as the mean and standard deviation of the class score on each test.

Topic	Lachlan's score	Mean	Standard deviation
Algebra	80	60	10
Measurement	90	81	6
Statistics	88	73	5

Relative to the rest of the class, which is Lachlan's strongest topic?
Show calculations to justify your answer

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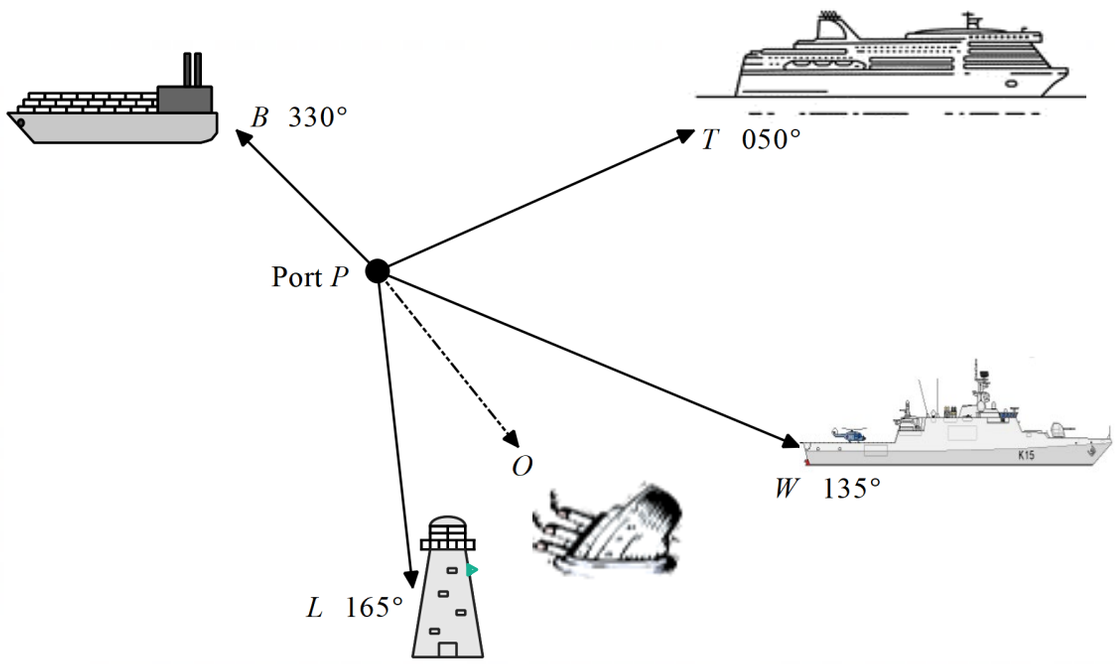
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Marks

Question 30 (10 marks)

The diagram below shows three ships travelling in different directions. The table indicates the distance of each ship eight hours after leaving port *P*.

Ship		Distance from Port *P*
Bandaid Bulk	*(B)*	240 km
Tasmanian Express	*(T)*	320 km
HMAS Wollongong	*(W)*	360 km
Oruvian Oil	*(O)*	200 km
Lighthouse	*(L)*	300 km



NOT TO SCALE

(a) Determine $\angle BPT$. **1**

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Question 30 continues on next page

Marks

Question 30 continued.

(b) Show that $TW = 460$ km to the nearest kilometre. **3**

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(c) 8 hours after leaving port, the Tasmanian Express urgently needs to head towards the HMAS Wollongong *(W)*. Determine $\angle PTW$ to the nearest degree. **1**

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(d) Determine the True bearing of Port *P* from the lighthouse (*L*). **2**

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(e) The Oruvian Oil (*O*) was on a bearing of 140° before hitting an iceberg and sinking. **3**
Determine the search area ΔPWL, giving your answer in scientific notation.

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Marks

Question 31 (3 marks) **3**

City *A* is in Sweden and is located at $58°\text{N}, 16°\text{E}$. Sydney, in Australia, is located at $33°\text{S}, 151°\text{E}$.

Robert lives in Sydney and needs to give an online presentation to his colleagues in City *A,* starting at 5.00 pm Thursday, local time in Sweden.

At what time and on which day, in Sydney, should Robert start his presentation?

It is given that $15° = 1$ hour time difference. Ignore daylight saving.

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Marks

Question 32 (4 marks)

The table below shows the future value of a $1 annuity.

Future value of an annuity with a contribution of $1						
Period	**Interest rate per period**					
	1%	**2%**	**3%**	**4%**	**5%**	**6%**
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	2.0100	2.0200	2.0300	2.0400	2.0500	2.0600
3	3.0301	3.0604	3.0909	3.1216	3.1525	3.1836
4	4.0604	4.1216	4.1836	4.2465	4.3101	4.3746

(a) An annuity of $14 800 is invested every half-year at 6% per annum, compounded six-monthly for 2 years. What is the future value of the annuity? **2**

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(b) Sonia aims to have a deposit for an apartment of at least $180 000 in 3 years-time by investing in an annuity. The annuity has an interest rate of 2% p.a. compounded annually. **2**
Calculate Sonia's yearly contribution to achieve the deposit.
Answer to the nearest dollar.

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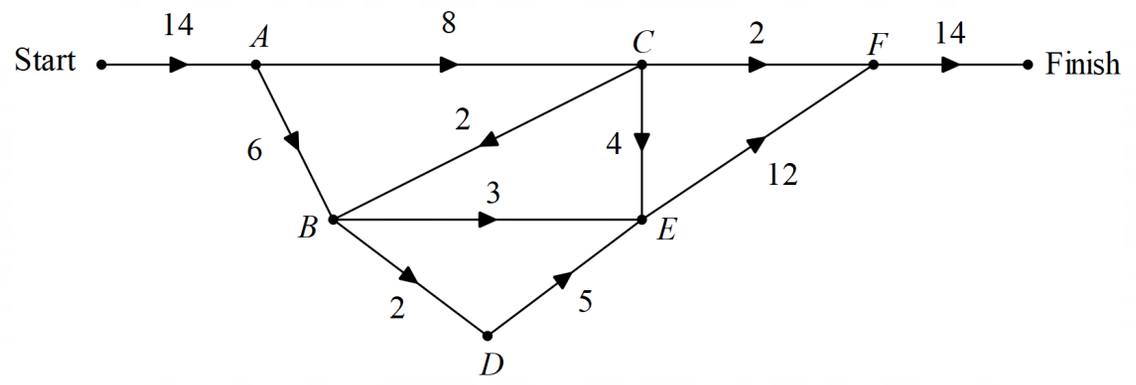
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Marks

Question 33 (4 marks)

The network diagram shows a system of pipes with the capacities for each pipe in litres per second.



(a) Determine the maximum flow of the network. **2**

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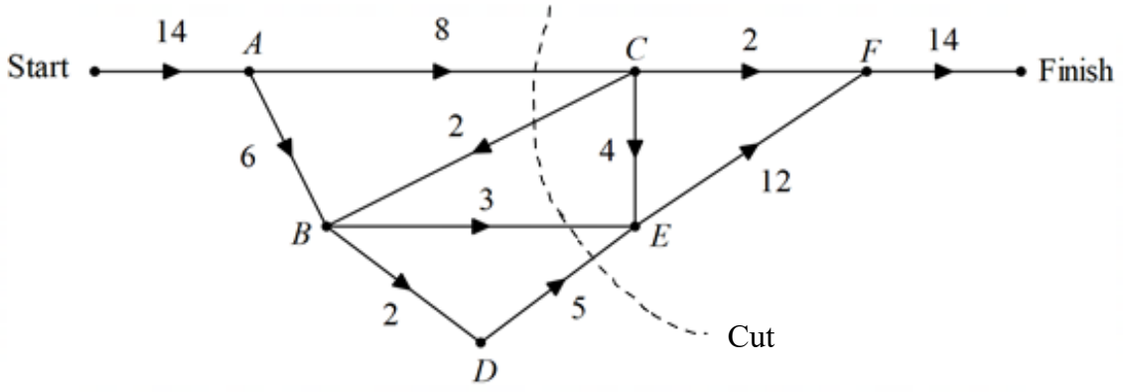
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(b) A cut is added to the network as shown. What is the capacity of this cut? **1**



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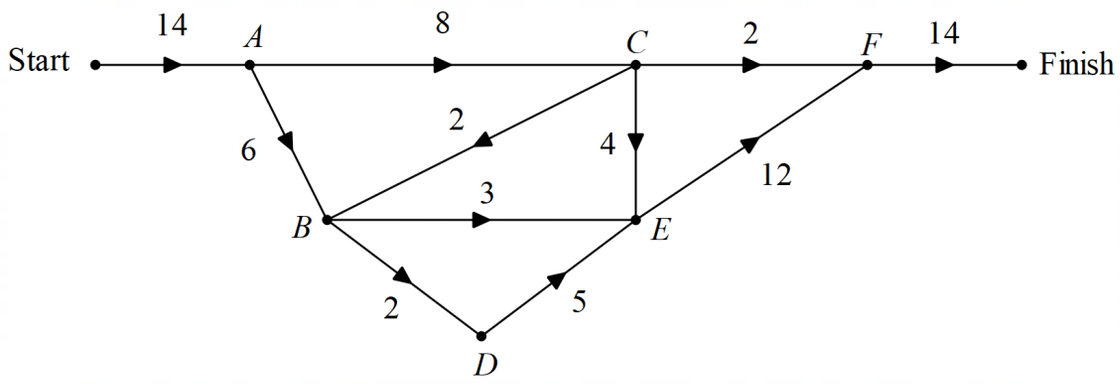
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Question 33 continues on next page

Marks

Question 33 continued.

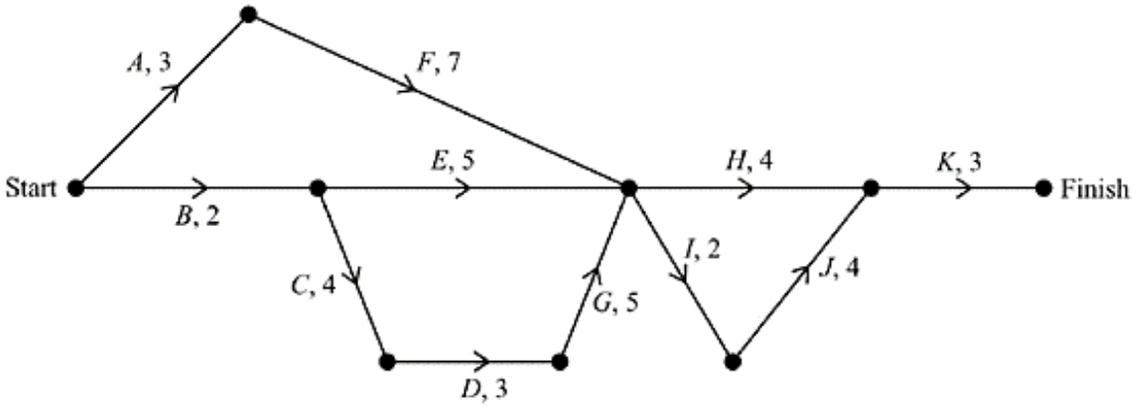
(c) Draw the minimum cut for this network on the diagram below. **1**



Marks

Question 34 (6 marks)

The network diagram shows tasks that must be completed to finish a project.
Each edge weight represents the time taken to complete the task, in days.



(a) What is the earliest start time (EST) of activity *H*? **2**

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(b) What is the minimum completion time for the project? **1**

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(c) What is the critical path for the project? **2**

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(d) What is the float time of activity E? **1**

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Marks

Question 35 (5 marks)

A fund had investments in property, shares and overseas accounts in the ration 7:4:2.
At the end of last year, the fund had total investments amounting to $520 million.

(a) At the beginning of this year, the fund manager decided to transfer half of the amount invested in overseas accounts into property. **3**

How much would have been invested in property at the beginning of this year as a result of this investment change?

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(b) Write the new simplified ratio of investments for the beginning of this year. **2**

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Marks

Question 36 (3 marks) **3**

At a school carnival the final heights jumped by Year 12 competitors were found to be normally distributed with a mean of 5.54 metres and a standard deviation of 3 meters.

The standard normal distribution table is shown. The values in the table represent the area under the normal curve to the left of the z-score.

z	*0.00*	*0.01*	*0.02*	*0.03*	*0.04*	*0.05*	*0.06*	*0.07*	*0.08*	*0.09*
0.0	0.50000	0.50399	0.50798	0.51197	0.51595	0.51994	0.52392	0.52790	0.53188	0.53586
0.1	0.53983	0.54380	0.54776	0.55172	0.55567	0.55966	0.56360	0.56749	0.57142	0.57535
0.2	0.57926	0.58317	0.58706	0.59095	0.59483	0.59871	0.60257	0.60642	0.61026	0.61409
0.3	0.61791	0.62172	0.62552	0.62930	0.63307	0.63683	0.64058	0.64431	0.64803	0.65173
0.4	0.65542	0.65910	0.66276	0.66640	0.67003	0.67364	0.67724	0.68082	0.68439	0.68793
0.5	0.69146	0.69497	0.69847	0.70194	0.70540	0.70884	0.71126	0.71566	0.71904	0.72240
0.6	0.72575	0.72907	0.73237	0.73565	0.73891	0.74215	0.74537	0.74857	0.75175	0.75490
0.7	0.75804	0.76115	0.76424	0.76730	0.77035	0.77337	0.77637	0.77935	0.78230	0.78524
0.8	0.78814	0.79103	0.79389	0.79673	0.79955	0.80234	0.80511	0.80785	0.81057	0.81327
0.9	0.81594	0.81859	0.82121	0.82381	0.82639	0.82894	0.83147	0.83398	0.83646	0.83891
1.0	0.84134	0.84375	0.84614	0.84849	0.85083	0.85314	0.85543	0.85769	0.85993	0.86214

Using standardised scores and the standard normal distribution table, find the probability that a randomly chosen competitor achieves height between 5.99 and 6.59 metres.

Give your answer correct to three decimal places.

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Marks

Question 37 (5 marks)

Lauren spends $6000 on a new photocopier for her business.
She uses the declining-balance method to calculate the depreciation of the photocopier.
She can only claim the depreciation for that particular year as a tax deduction.

(a) If the rate of depreciation is 26% per annum, show that the depreciation she can claim in the second year is equal to $1154, rounded correct to the nearest dollar. **2**

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(b) Lauren earned $110 000 for the last financial year. The depreciation for her photocopier in part (a) is the only tax deduction she claims. **3**

Using the tax table below and ignoring the Medicare Levy, calculate the amount of tax she needs to pay.

Taxable income	Tax payable on this income
0 – $18 200	Nil
$18 201 – $37 000	19c for each $1 over $18 200
$37 001 – $90 000	$3572 plus 32.5c for each $1 over $37 000
$90 001 – $180 000	$20 797 plus 37c for each $1 over $90 000
$180 001 and over	$54 097 plus 45c for each $1 over $180 000

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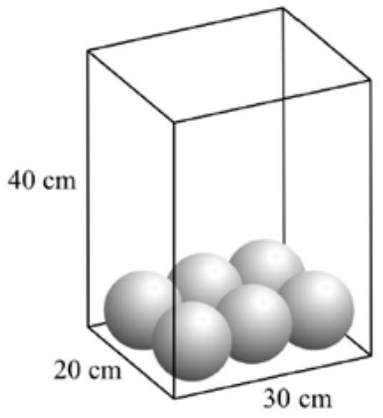
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Marks

Question 38 (4 marks) **4**

Solid spherical balls of diameter 10 cm are packed inside a box as shown below.
The box is in the shape of a rectangular prism such that 6 balls will fit snugly in each layer.



The balls are packed in the same manner as in the bottom layer until the box is full.

Calculate the percentage of the box that is empty space.
Give your answer correct to the nearest percentage.

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END OF PAPER

Section II extra writing space.

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NSW Education Standards Authority

2021 **HIGHER SCHOOL CERTIFICATE EXAMINATION**

Mathematics Standard 1
Mathematics Standard 2

REFERENCE SHEET

Measurement

Limits of accuracy

Absolute error = $\frac{1}{2}$ × precision

Upper bound = measurement + absolute error

Lower bound = measurement – 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

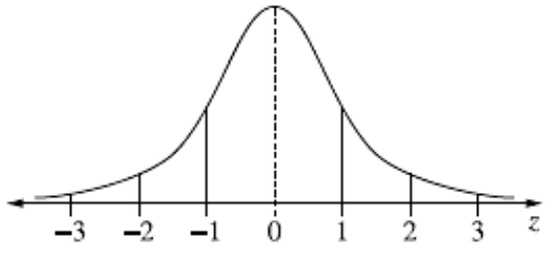
less than $Q_1 - 1.5 \times IQR$

or

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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Name……Marking…Criteria……..

Teacher's Name……

Mathematics Standard 2
HSC Trial Examination
Term 3 2023

General Instructions

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

Total marks 100

Section 1 – 15 marks (pages 1 - 6)

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

Section II – 85 marks (pages 7 - 30)

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

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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 A car travels 960 metres in 1 minute 20 seconds.
What is its average speed to the nearest kilometre per hour?

(A) 7 km/h

(B) 34 km/h

(C) 43 km/h

(D) 260 km/h

$$\text{Speed} = \frac{\text{distance}}{\text{time}}$$
$$= \frac{0.96\text{ km}}{0°1°2°}$$
$$= 43.2$$
$$\approx 43\text{ km/h}$$

2 The equation $189b + 356$ models a sandwich shop's costs. The 356 could represent which of the following?

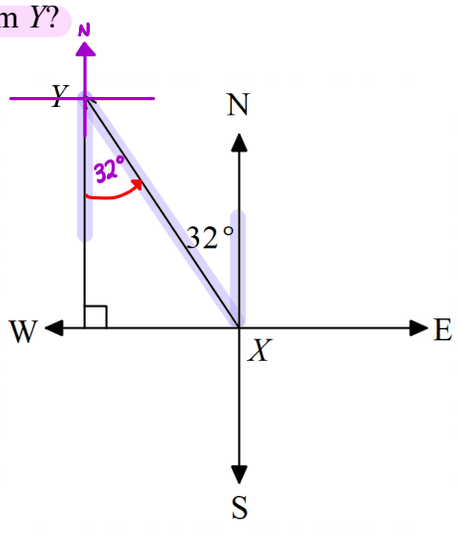
(A) Number of sandwiches sold

(B) Fixed costs

(C) The cost per sandwich

(D) Number of sandwiches made

3 The compass bearing of Y from X, as shown in the diagram, is N32°W .
What is the compass bearing of X from Y?



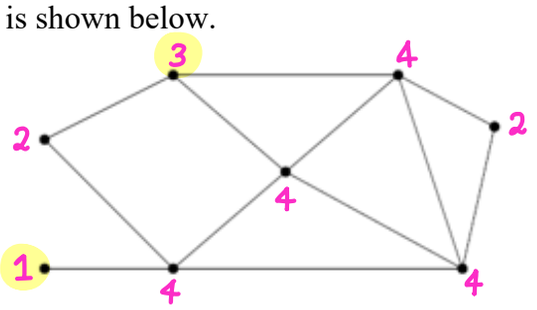
(A) N32°W

(B) N58°E

(C) S32°E

(D) S58°W

4 A network diagram is shown below.



How many odd vertices does this network contain?

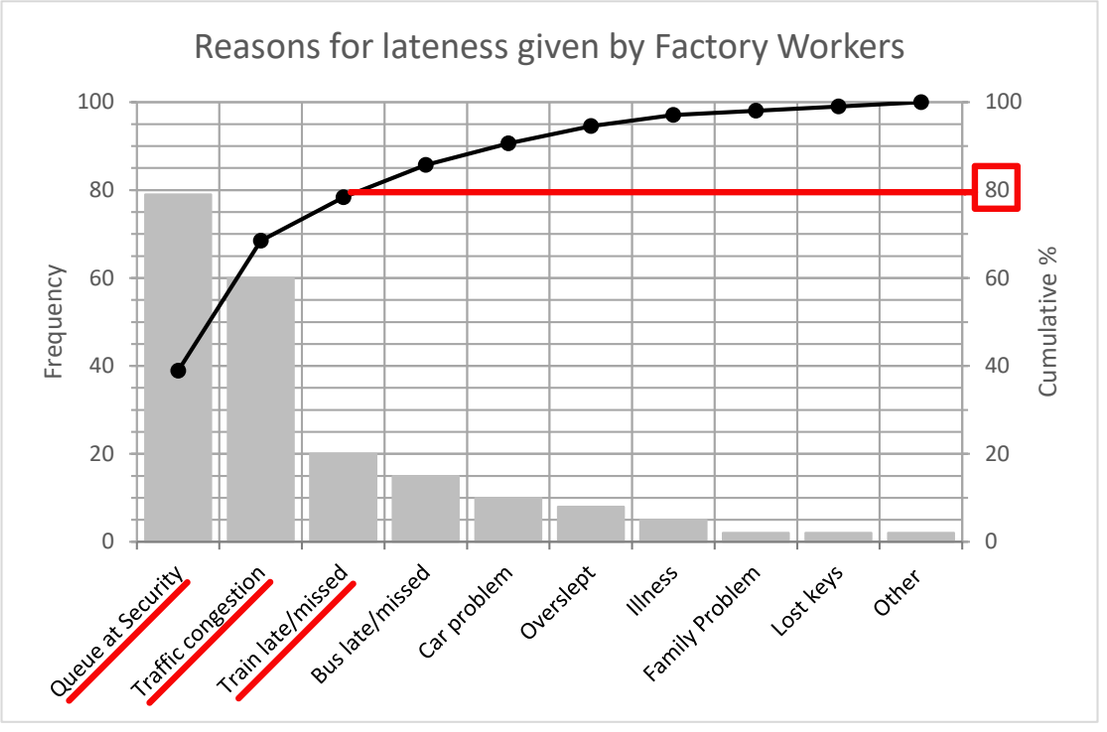
(A) 1

(B) 2

(C) 3

(D) 4

5 In a survey to find the main causes of lateness in a factory work force, a random sample of 200 employees who were late for work were asked the reason why.
The Pareto chart below shows the results.



What is the minimum number of causes that accounts for the top 80% of the problem?

(A) 1

(B) 2

(C) 3

(D) 4

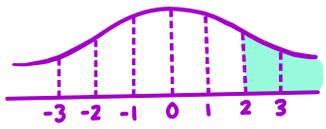
6 The weights of a particular bug species are normally distributed with mean 700 g and standard deviation 20 g.
What percentage of bugs have a mass exceeding 740 g?

(A) 2.5%
(B) 5%
(C) 16%
(D) 34%

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

$z = \frac{740-700}{20}$

$= 2$



$\therefore$ 2.35% + 0.15% = 2.5%

7 Corby had 3000 CDL shares valued at $182 560 and received a dividend of $2.67 per share.
What was the dividend yield, correct to 2 decimal places?

(A) 4.39%
(B) 5.6%
(C) 8.9%
(D) 10.2%

Market price per share $= \frac{182\,560}{3000}$

$= 60.8533...$

$\approx \$60.85$

Dividend yield $= \frac{\text{dividend}}{\text{market price}} \times 100$

$= \frac{2.67}{60.85} \times 100$

$= 4.3878....$

$\approx 4.39\%$

8 Sally's six year old daughter is prescribed cough medicine with an adult dose of 11 mL.
Using Young's formula, calculate the amount of cough medicine Sally should give to her daughter.

$$Young's\ Formula = \frac{age\ of\ child\ in\ years \times adult\ dosage}{age\ of\ child\ in\ years + 12}.$$

(A) 0.92 mL
(B) 3.67 mL
(C) 11 mL
(D) 66 mL

Dosage $= \frac{6 \times 11}{6+12}$

$= \frac{66}{18}$

$= 3.666....$

≈ 3.67 mL

9 One card is selected at random from a pack of cards labelled 1 to 50. Find the probability that the card is an odd number and a number greater than 40.

(A) 0.1
(B) 0.58
(C) 0.6
(D) 0.7

41, 42, 43, 44, 45, 46, 47, 48, 49, 50

P(odd and >40) $= \frac{5}{50}$

$= 0.1$

10 A 140 cm television with an energy rating of 7 stars, consumes 213 kWh/year.
The same size television with an energy rating of 3 stars, consumes 520 kWh/year.

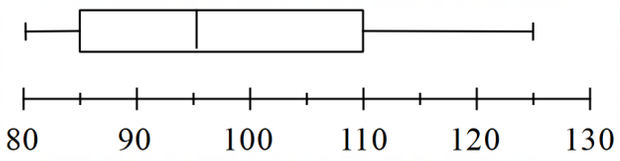
If energy costs are 28.55 cents/kWh, what is the approximate saving in energy over a 10-year period by using the 7-star rated television, compared to the 3-star rated television?

(A) $876
(B) $1020
(C) $1142
(D) $3500

Energy saved = $(520-213) \times 10$ years
= 3070 kWh

Money saved = $3070 \times 0{\cdot}2855$
= $876{\cdot}485$
≈ $876

11



Paulo and Yan make the following statements about the box-and-whisker plot above.

Paulo: "The interquartile range is 25 and the mean is 95".

Yan: "The range is 25 and the median is 95".

IQR = $Q_3 - Q_1$
= 110 − 85
= 25 ✓

Mean: can not determine from box plot ×

Whose statement is correct?

Range = 125 − 80
= 45 ×

Median = 95 ✓

(A) Paulo only
(B) Yan only
(C) Paulo and Yan
(D) Both statements were incorrect

12 The area of a sector is given by the formula $A = \frac{\theta}{360} \times \pi r^2$. Rearranging this formula to make r the subject gives:

(A) $r = \sqrt{\frac{360A}{\pi\theta}}$
(B) $r = \sqrt{A - \frac{\pi\theta}{360}}$
(C) $r = \frac{\sqrt{360A}}{\pi\theta}$
(D) $r = \sqrt{360A - \pi\theta}$

$360A = \theta\pi r^2$

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

$\sqrt{\frac{360A}{\theta\pi}} = r$

13 James invests $5000 at 3% per annum simple interest for 2 years, while Sally invests $5000 at 3% per annum compounded annually for 2 years.

For the given investments which of the following statements is TRUE?

(A) James earns more interest than Sally.

(B) Sally earns more interest than James.

(C) James and Sally earn the same amount of interest.

(D) There is not enough information to compare the interest earned by James and Sally.

14 Use the table of future values of $1 to find the future value of $2630 invested per year at 5% p.a. for 6 years, with interest compounded annually.

Future value interest factors (Future value of an annuity with a contribution of $1 at the end of each period)							
Period	**Interest rate per period**						
	1%	**2%**	**3%**	**4%**	**5%**	**6%**	**8%**
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	2.0100	2.0200	2.0300	2.0400	2.0500	2.0600	2.0800
3	3.0301	3.0604	3.0909	3.1216	3.1525	3.1836	3.2464
4	4.0604	4.1216	4.1836	4.2465	4.3101	4.3746	4.5061
5	5.1010	5.2040	5.3091	5.4163	5.5256	5.6371	5.8666
6	6.1520	6.3081	6.4684	6.6330	6.8019	6.9753	7.3359
7	7.2135	7.4343	7.6625	7.8983	8.1420	8.3938	8.9228
8	8.2857	8.5830	8.8923	9.2142	9.5491	9.8975	10.6366
9	9.3685	9.7546	10.1591	10.5828	11.0266	11.4913	12.4876
10	10.4622	10.9497	11.4639	12.0061	12.5779	13.1808	14.4866

(A) $387

(B) $3419

(C) $17 889

(D) $25 089

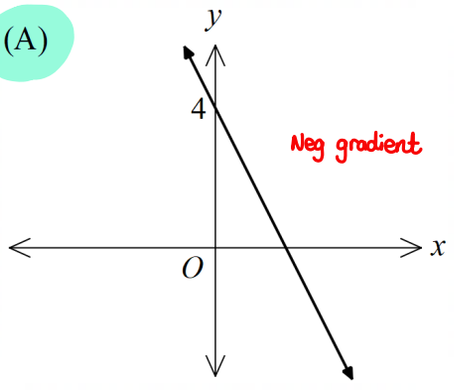
$FV = 2630 \times 6.8019$
$= 17\,888.997$
$= \$17\,889$

15 Which of the following best represents the graph of $y = -3x + 4$?

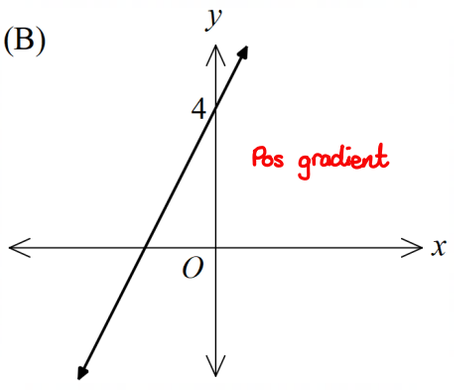
Neg gradient

y-intercept

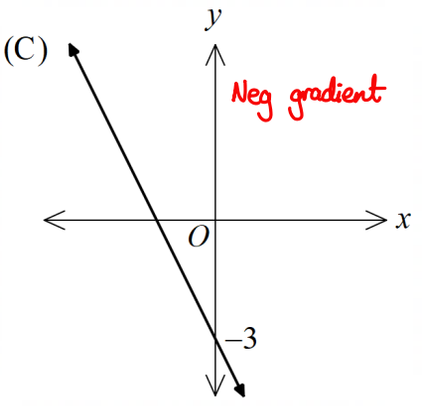
(A)



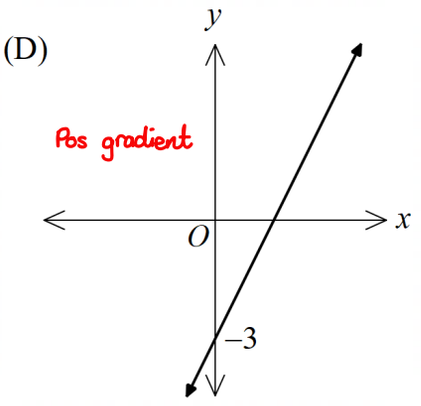
(B)



(C)



(D)



End of Section I

Name……..

Teacher's Name……

Mathematics Standard 2
Section II

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

Instructions

- Answer in the spaces provided. These spaces provide guidance for the expected length of the answer.
- Your responses should include relevant mathematical reasoning and/or calculations.
- Extra writing space is provided at the end of this booklet.

Marks

Question 16 (3 marks) **3**

Solve the equation

$$4x+3=\frac{10x}{3}+5.$$

$4x-2=\frac{10x}{3}$

$3(4x-2)=10x$ ③ Correct answer

$12x-6=10x$ ② One error } base one per error

$-6=-2x$ ① Two errors }

$x=3$

Question 17 (2 marks) **2**

The five-number summary of a dataset is given.

Lowest score $=1$

Lower quartile $(Q_1)=4$

Median $(Q_2)=7$

Upper quartile $(Q_3)=10$

Highest score $=20$

Is 20 an outlier? Justify your answer with calculations.

$IQR=Q_3-Q_1$ $Q_3+1{\cdot}5\times IQR=10+1{\cdot}5\times 6$

$=10-4$ $=10+9$

$=6$ $=19$

$\therefore$ Since $20>19$, 20 is an outlier

② Provides correct solution + states $20>19$

① Attempts to use $Q_3+1{\cdot}5\times IQR$ or calculates interquartile range

Marks

Question 18 (4 marks)

A class is going on an overnight excursion by bus. The students were asked to each pack one bag for the trip. The bags were weighed, and the mass of the bags in kilograms were listed as follows:

9 10 11 | 11 16 19 | 23 26 27 | 28 30 42

Q_1 Q_2 Q_3

(a) Determine the median mass of the bags. **1**

Median $= \frac{19+23}{2} = 21$ kg

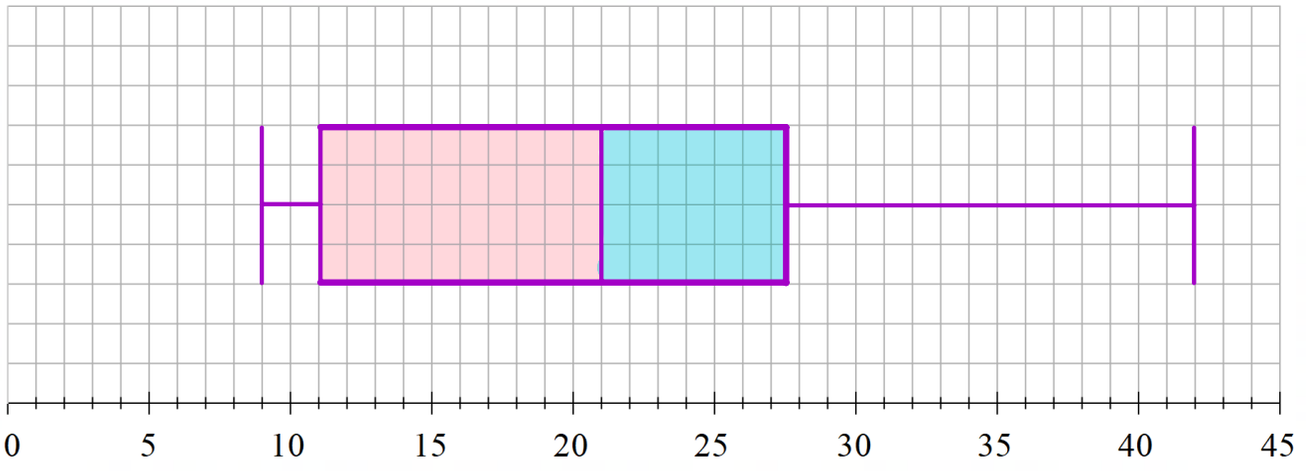
① Correct answer

(b) Determine the interquartile range of the bags' masses. **1**

$Q_1 = 11$ IQR $= 27.5 - 11$

$Q_3 = \frac{27+28}{2} = 27.5$ $= 16.5$ ① Correct answer

(c) Construct an accurate box-and-whisker plot to represent this data. **2**



② Correct answer from (a)+(b)
① One error - loose one per error

Marks

Question 19 (2 marks) **2**

The amount of time, T, required to demolish a building varies inversely with the number of people, n, in the demolition team.

If it takes 8 people 3 days to demolish a factory, how many people will be needed to complete the same demolition in 4 days?

$T = \frac{k}{n}$ sub $T=3$, $n=8$ sub $T=4$ $\therefore$ 6 people

$3 = \frac{k}{8}$ $4 = \frac{24}{n}$

$k = 3 \times 8$ $4n = 24$

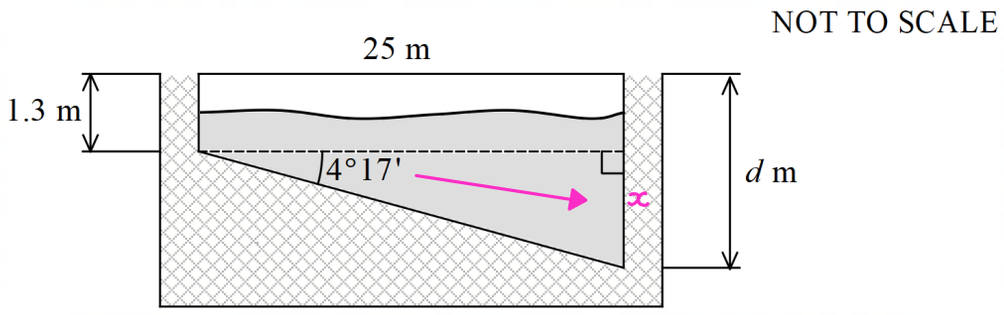
$k = 24$ $\therefore T = \frac{24}{n}$ $n = \frac{24}{4}$ ② Provides correct solution

$n = 6$ ① MUST write down equation representing inverse variation, or equivalent merit.

Question 20 (2 marks)

The floor of a swimming pool inclines at 4°17' to the horizontal. The shallow end is 1.3 m deep and the pool is 25 m long. **2**

What is the depth d m, to the nearest 0.1 m, at the deep end?



$\tan 4°17' = \frac{x}{25}$ $d = 1.3 + 1.9$

$= 3.2$ m

$x = 25 \times \tan 4°17'$

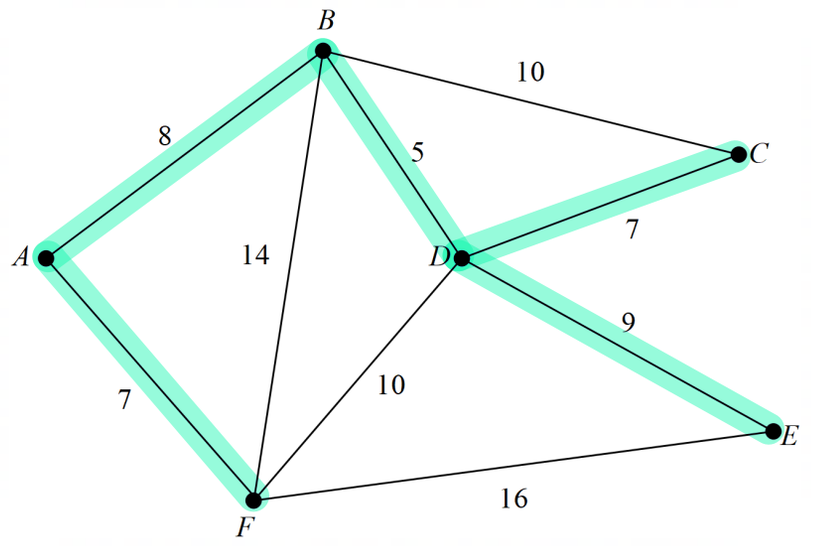
$x = 1.87244...$ ② Provides correct solution

$x = 1.9$ m ① Provides correct trig ratio

Marks

Question 21 (2 marks) **2**

Consider the network diagram below.



Use an appropriate algorithm to show the minimum spanning tree on the network above. Hence, find the minimum value of the spanning tree.

Min spanning tree = 5+7+7+8+9

= 36

② Provides correct min span tree + 36

① One error in min span tree

Question 22 (4 marks)

The formula below can be used to estimate the blood alcohol content (BAC) for males.

$$BAC_{\text{male}} = \frac{10N - 7.5H}{6.8M}$$

where N = number of standard drinks consumed
H = number of hours spent drinking
M = person's weight in kilograms.

Barrack, who weighs 85 kg, is at a party and consumes four "Purple Wombat" drinks.
He starts drinking at 6.00 pm and finishes a fourth can at 8.30 pm.



(a) Calculate his blood alcohol content after he finishes his fourth drink. **2**
Answer correct to 4 decimal places.

N: $4 \times 1{\cdot}6 = 6{\cdot}4$
H: 8:30 pm − 6 pm = 2·5 hours
M: 85

$BAC = \frac{10 \times 6{\cdot}4 - 7{\cdot}5 \times 2{\cdot}5}{6{\cdot}8 \times 85}$
$= 0{\cdot}0782871\ldots$
$\approx 0{\cdot}0783$

② Correct answer
① Correct substitution

(b) To legally take charge of the free world, Barrack must have a BAC of zero. **2**
The number of hours required for a person to reach a zero BAC after they stop drinking alcohol is given by the formula:

$$\text{Number of hours for } BAC \text{ to reach zero} = \frac{BAC}{0.015}.$$

At what time will Barrack be able to resume control of the free world (i.e. have a BAC of zero)?

Number of hours $= \frac{0{\cdot}0783}{0{\cdot}015}$
$= 5{\cdot}22$
$= 5$ hours 13 mins

8:30 pm + 5 hours 13 mins = 1:43 am

② Provides correct solution – accept 1·42 or 1·44
① Shows correct substitution

Marks

Question 23 (4 marks)

Arabella's business purchased equipment for $370 000 at the start of 2019. The equipment has a useful life of 5 years and will reach the end of its useful life at the end of 2024.

(a) For the first two years of its life the value of the equipment depreciated by $70 000 per year. **2**

What was the value of the equipment at the end of 2021?

Value after 2 yrs = 370 000 − (2 × 70 000)

= $230 000

② Correct solution

① 370 000 − 70 000

(b) After the first two years, the depreciation method was changed to the declining balance method. For the remainder of the useful life of the equipment, the salvage value depreciated by 20% per year. **2**

What is the value of the equipment when it reaches the end of its useful life?

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

$= 230\,000(1-0.2)^3$

= $117 760

② Provides correct solution

① Subs $n = 5$

Marks

Question 24 (3 marks)

The relationship between speed (s) and time (t) is modelled by the formula $s = t^2 - 9t + 21$, as shown in the graph.



(a) What is the speed when the time is 2.5 minutes? **1**

from graph 5m/s OR

$s = (2.5)^2 - 9(2.5) + 21$ ① Correct answer from substitution/

$= 4.75$ m/min correct reading of graph

(b) At what time is speed the lowest? **1**

4.5 mins

① Correct answer

(c) Determine the time/s required to achieve a speed of 3 metres per minute. **1**

$t = 3$ mins and $t = 6$ mins

① Correct answer

Marks

Question 25 (4 marks)

Alan borrowed $310 000 at 7.9% per annum reducible interest. The interest is charged monthly and the monthly repayment is $2370. The table below shows the amounts owed during the first three months.

Months	*Principal*	*Interest*	$P + I$	$P + I - R$
1	$310 000.00	$2040.83	$312 040.83	$309 670.83
2	$309 670·83	$2038.67	$311 709.50	$309 339·50
3	$309 339.50			

(a) What is the principal at the beginning of the second month? **1**

$309 670·83

① Correct answer

(b) How much is owed at the end of the second month? **1**

309 670·83 + 2038·67 − 2370 = $309 339·50

① Correct answer from (a)

(c) Calculate the interest to be paid in the third month. **2**

Rate : $\frac{0·079}{12}$ Interest = $\frac{0·079}{12} \times 309\,339·50$

② Correct answer

= 2036·485042 ① $0·079 \times 309339·50$

≈ $2036·49

Marks

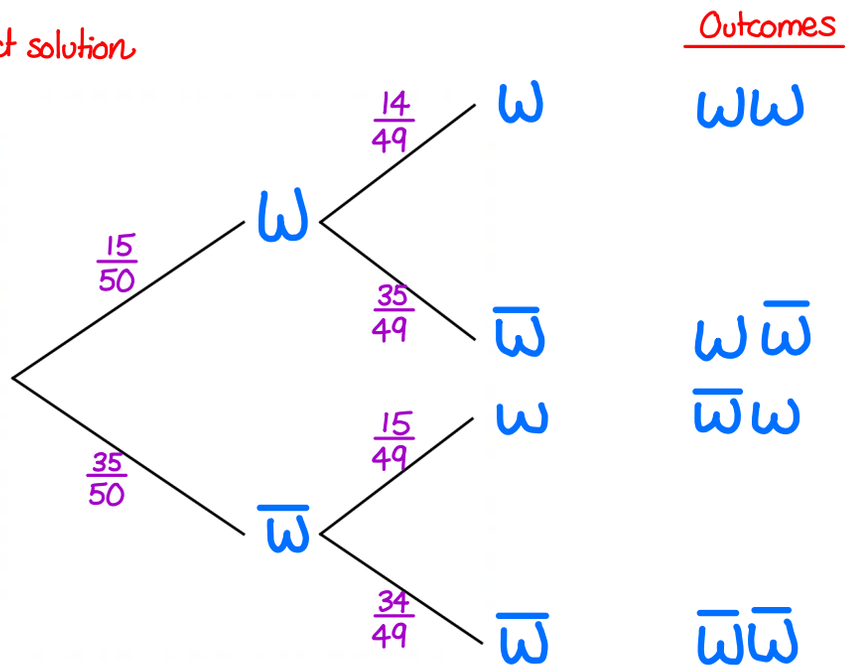
Question 26 (4 marks)

In a raffle 50 tickets are sold and there is one first prize and one second prize. Jody buys 15 tickets in a raffle. The first prize is drawn then the second prize.

(a) Complete the probability tree diagram below, showing all outcomes. **2**

② Provides correct solution

① One error



(b) What is the probability that Jody wins the first prize, but not the second? **1**

$P(W\bar{W}) = \frac{15}{50} \times \frac{35}{49}$

$= \frac{3}{14}$

① Correct answer from part (a)

(c) Find the probability that Jody wins at least one prize? **1**

$P(\text{at least one win}) = 1 - P(\bar{W}\bar{W})$

$= 1 - \left(\frac{35}{50} \times \frac{34}{49}\right)$

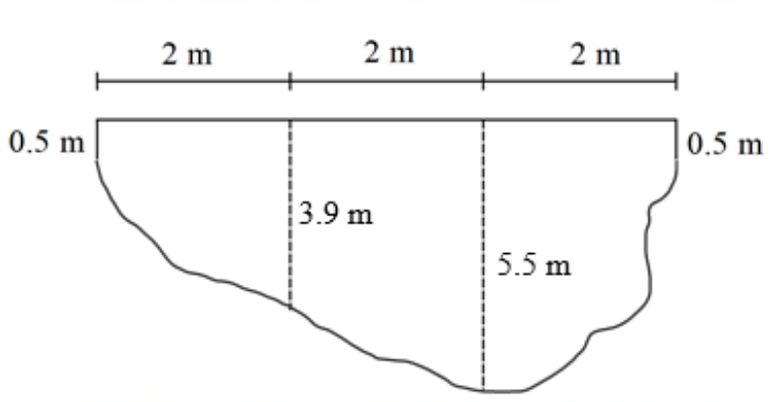
$= \frac{18}{35}$

① Correct answer from part (a)

Marks

Question 27 (2 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.



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

Area $= \frac{2}{2}(0.5+3.9) + \frac{2}{2}(3.9+5.5) + \frac{2}{2}(5.5+0.5)$

$= 4.4 + 9.4 + 6$

$= 19.8\ m^2$

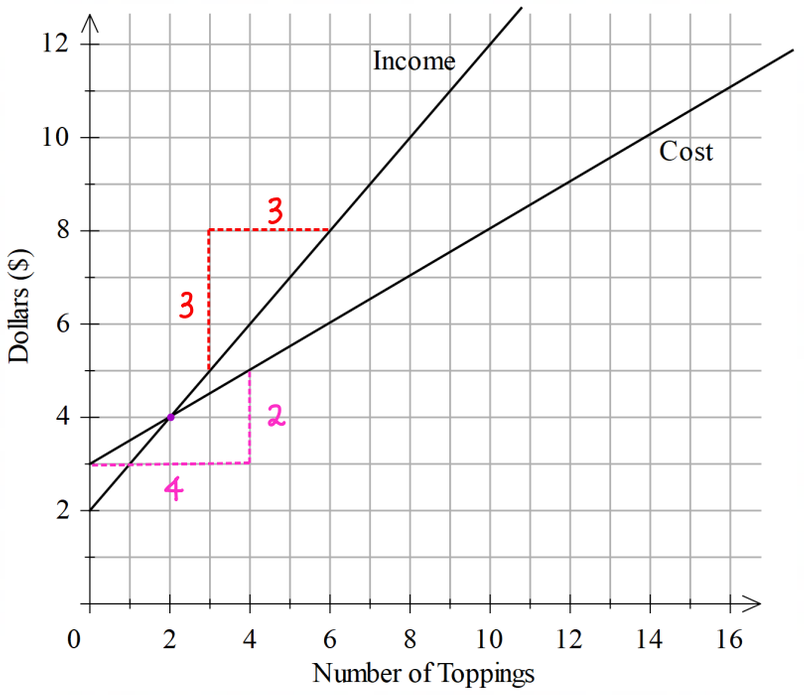
② Correct answer

① One correct trapezodial with correct h

Marks

Question 28 (3 marks)

The graph below shows the cost of making pizzas depending on the number of toppings and the amount of income made from their sale.



y=mx+c

(a) Let the income received be $\$I$ and the number of toppings be n. **1**
Write a formula for the income.

$I = n + 2$ ① Correct equation

(b) Let the costs of making a pizza be $\$C$ and the number of toppings sold be n. **1**
Write a formula for the costs.

$C = \frac{n}{2} + 3$ OR $C = 0.5n + 3$ ① Correct equation

(c) What is the minimum number of toppings needed on a pizza to break even? **1**

2 toppings

① Correct answer

Marks

Question 29 (2 marks) **2**

Lachlan did a class test in three topics. The class scores on each test were normally distributed. The table shows the topics and Lachlan's scores as well as the mean and standard deviation of the class score on each test.

Topic	Lachlan's score	Mean	Standard deviation
Algebra	80	60	10
Measurement	90	81	6
Statistics	88	73	5

Relative to the rest of the class, which is Lachlan's strongest topic?
Show calculations to justify your answer

Algebra: $z = \frac{80-60}{10}$ Measurement: $z = \frac{90-81}{6}$ Statistics: $z = \frac{88-73}{5}$

$= 2$ $= 1.5$ $= 3$

Lachlan's z-score in Stastics is higher than his z-score in Algebra and measurement

$\therefore$ He performed better in Statistics

② Provides correct solution and justification

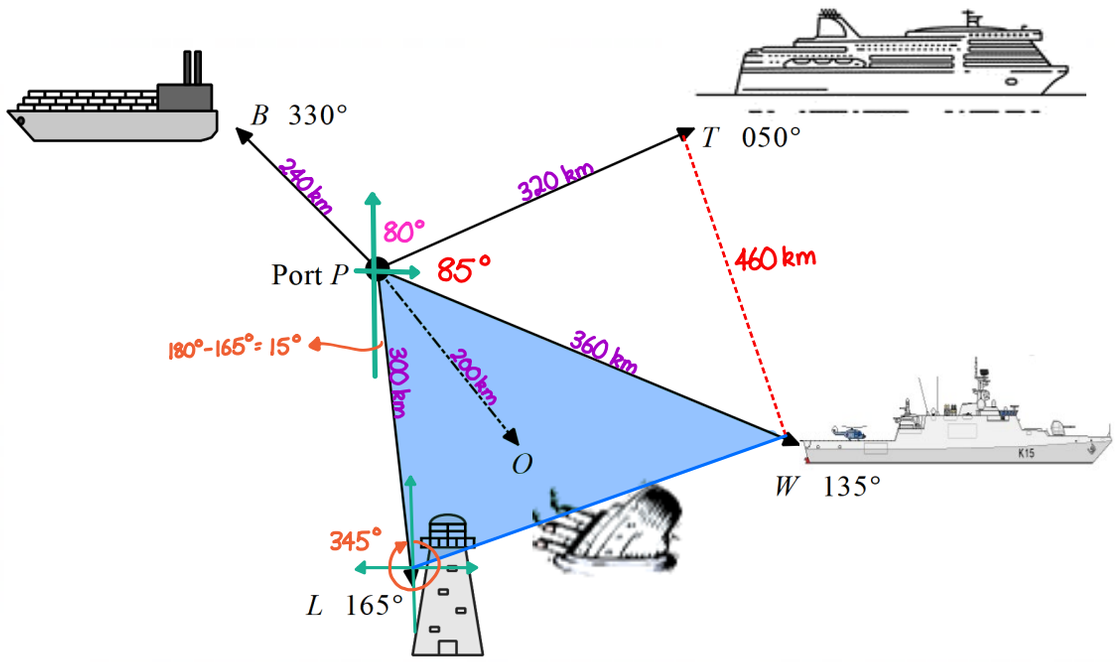
① Calculates two z-scores correctly

Marks

Question 30 (10 marks)

The diagram below shows three ships travelling in different directions. The table indicates the distance of each ship eight hours after leaving port *P*.

Ship		Distance from Port *P*
Bandaid Bulk	*(B)*	240 km
Tasmanian Express	*(T)*	320 km
HMAS Wollongong	*(W)*	360 km
Oruvian Oil	*(O)*	200 km
Lighthouse	*(L)*	300 km



NOT TO SCALE

(a) Determine $\angle BPT$. **1**

$\angle BPT = (360° - 330°) + 50°$

$= 80°$

① Correct answer

Question 30 continues on next page

Marks

Question 30 continued.

(b) Show that $TW = 460$ km to the nearest kilometre. **3**

$\angle TPW = 135° - 50°$

$= 85°$

$TW^2 = 320^2 + 360^2 - 2 \times 320 \times 360 \times \cos 85°$

$TW = \sqrt{320^2 + 360^2 - 2 \times 320 \times 360 \times \cos 85°}$

$= 460.3469...$

≈ 460 km

(c) 8 hours after leaving port, the Tasmanian Express urgently needs to head towards the HMAS Wollongong *(W)*. Determine $\angle PTW$ to the nearest degree. **1**

$\frac{\sin \angle PTW}{360} = \frac{\sin 85°}{460}$ OR $\cos \angle PTW = \frac{320^2 + 460^2 - 360^2}{2 \times 320 \times 460}$

$\angle PTW = \sin^{-1}\left(\frac{\sin 85°}{460} \times 360\right)$ $\angle PTW = \cos^{-1}\left(\frac{320^2 + 460^2 - 360^2}{2 \times 320 \times 460}\right)$

$= 51°13'$ $= 51°13'$

$\approx 51°$ $\approx 51°$

(d) Determine the True bearing of Port P from the lighthouse (L). **2**

$180° - 165° = 15°$

$360° - 15° = 345°$

$\therefore T345°$

(e) The Oruvian Oil (O) was on a bearing of 140° before hitting an iceberg and sinking. **3**
Determine the search area ΔPWL, giving your answer in scientific notation.

$\angle WPL = 165 - 50 - 85$

$= 30°$

Area $\triangle PWL = \frac{1}{2} \times 360 \times 300 \times \sin 30°$

$= 27\,000$ km^2

$= 2.7 \times 10^4$ km^2

Marks

Question 31 (3 marks) **3**

City *A* is in Sweden and is located at 58°N, 16°E. Sydney, in Australia, is located at 33°S, 151°E.

Robert lives in Sydney and needs to give an online presentation to his colleagues in City *A*, starting at 5.00 pm Thursday, local time in Sweden.

At what time and on which day, in Sydney, should Robert start his presentation?

It is given that 15° = 1 hour time difference. Ignore daylight saving.

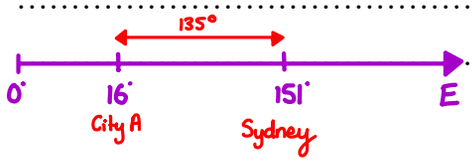
Difference in longitudes = 151 - 16 = 135°

Time difference = 135 ÷ 15 = 9 hours → Syd is ahead

City A: Thursday 5 p.m. + 9 hours

Sydney: Friday 2:00am

∴ Robert will need to start his presentation on Friday at 2:00am



③ Correct day + time

② Finds the time in Sydney.

① Finds the time difference between City A and Sydney

Marks

Question 32 (4 marks)

The table below shows the future value of a $1 annuity.

Future value of an annuity with a contribution of $1						
Period	**Interest rate per period**					
	1%	**2%**	**3%**	**4%**	**5%**	**6%**
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	2.0100	2.0200	2.0300	2.0400	2.0500	2.0600
3	3.0301	3.0604	3.0909	3.1216	3.1525	3.1836
4	4.0604	4.1216	4.1836	4.2465	4.3101	4.3746

(a) An annuity of $14 800 is invested every half-year at 6% per annum, compounded six-monthly for 2 years. What is the future value of the annuity? **2**

Rate: $\frac{6\%}{2} = 3\%$ FV = 4·1836 × 14800

= $61917·28

n: 2×2 = 4 ② Correct answer

Table factor: 4·1836 ① 4·1836

(b) Sonia aims to have a deposit for an apartment of at least $180 000 in 3 years-time by investing in an annuity. The annuity has an interest rate of 2% p.a. compounded annually. **2**

Calculate Sonia's yearly contribution to achieve the deposit.

Answer to the nearest dollar.

Rate: 2% Yearly contribution = 180 000 ÷ 3·0604

n: 3 = 58 815·84107

Table factor: 3·0604 ≈ $58 816

FV: $180 000

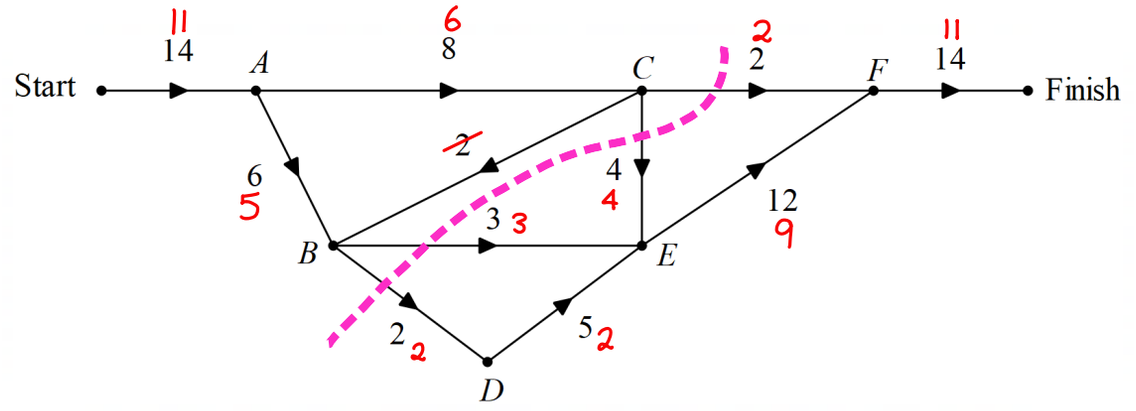
② Correct answer

① 3·0604

Marks

Question 33 (4 marks)

The network diagram shows a system of pipes with the capacities for each pipe in litres per second.



(a) Determine the maximum flow of the network. **2**

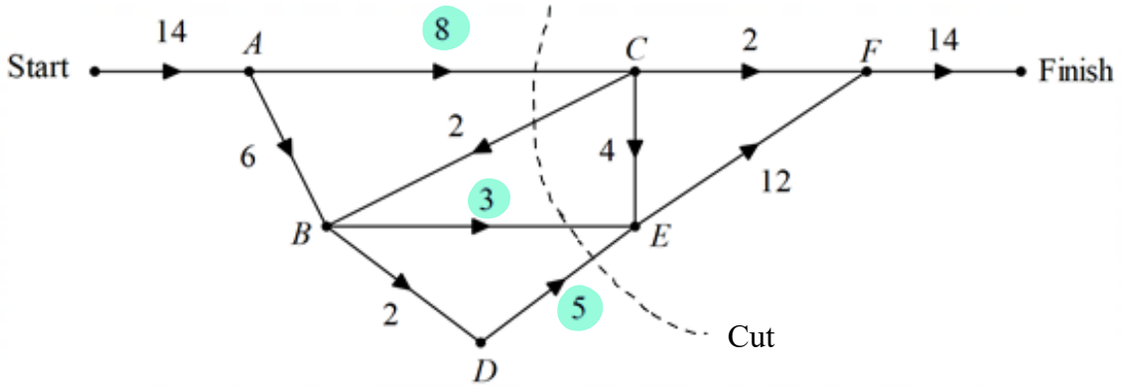
11 L/second

② Correct answer

① Shows min 3 cuts but incorrect max flow

⓪ Incorrect answer with less than 3 cuts

(b) A cut is added to the network as shown. What is the capacity of this cut? **1**



Capacity of cut = 8 + 3 + 5

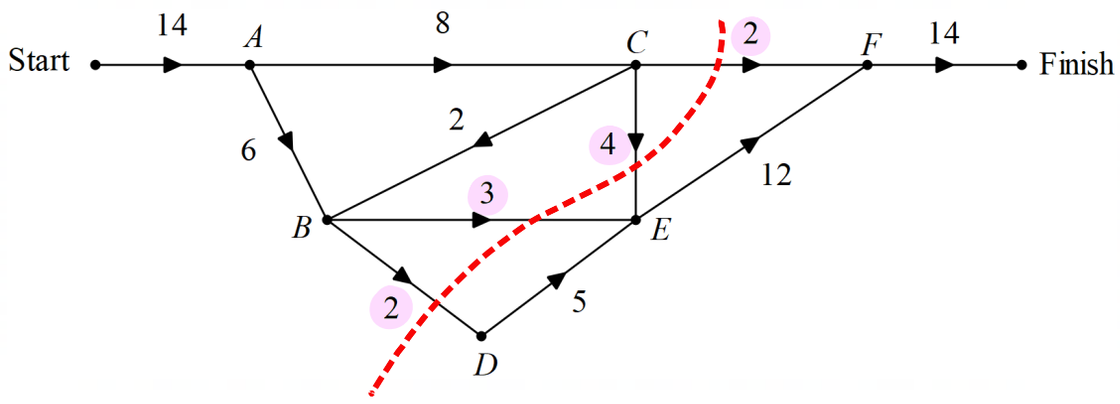
= 16 L/second ① Correct answer

Question 33 continues on next page

Marks

Question 33 continued.

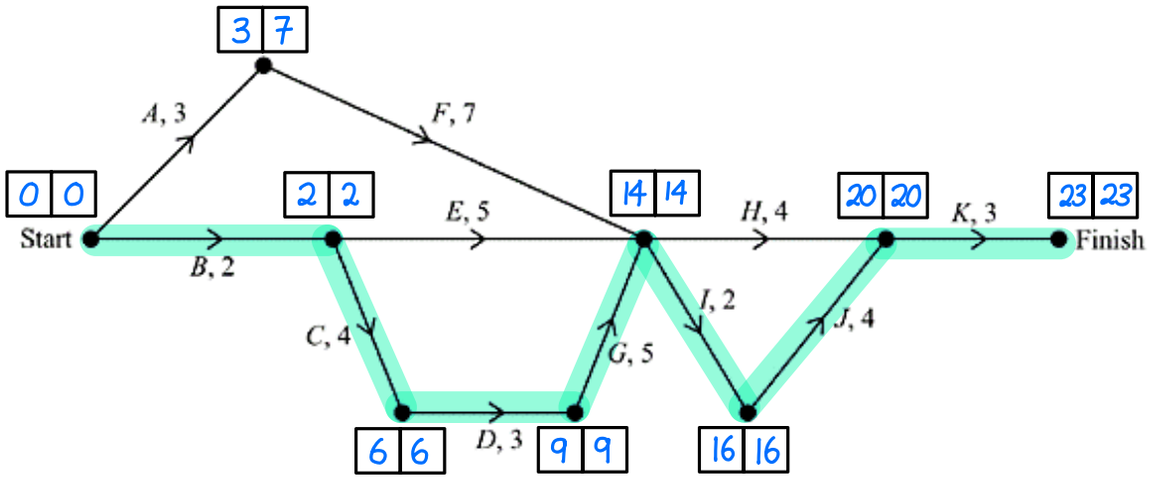
(c) Draw the minimum cut for this network on the diagram below. ① Correct answer **1**



Marks

Question 34 (6 marks)

The network diagram shows tasks that must be completed to finish a project.
Each edge weight represents the time taken to complete the task, in days.



(a) What is the earliest start time (EST) of activity *H*? **2**

14 days

② Correct answer

① One error

(b) What is the minimum completion time for the project? **1**

23 days

① Correct answer

(c) What is the critical path for the project? **2**

B-C-D-G-I-J-K

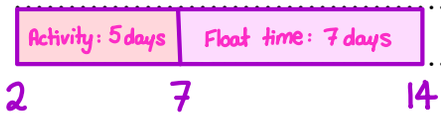
② Correct answer

① Critical path correct from their working.

(d) What is the float time of activity E? **1**

Float time = 14 - 5 - 2

= 7 days



① Correct answer from their forward/backward scan

Marks

Question 35 (5 marks)

A fund had investments in property, shares and overseas accounts in the ration 7:4:2.
At the end of last year, the fund had total investments amounting to $520 million.

(a) At the beginning of this year, the fund manager decided to transfer half of the amount invested in overseas accounts into property. **3**

How much would have been invested in property at the beginning of this year as a result of this investment change?

P:S:O ..... 7+4+2 = 13 parts .....

7:4:2 ..... ÷13 ($520 000 000 = 13 parts) ÷13 .....

$40 000 000 = 1 part .....

.....

Overseas : 2 × 40 000 000 .....

= $80 000 000 .....

.....

Property = (7 × 40 000 000) + (40 000 000) .....

= $320 000 000 .....

.....

(b) Write the new simplified ratio of investments for the beginning of this year. **2**

Property : $320 000 000 ..... ÷40 (320 : 160 : 40) ÷40 .....

Shares : 4 × 40 000 000 = $160 000 000 ..... 8 : 4 : 1 .....

Overseas : $40 000 000 .....

.....

Marks

Question 36 (3 marks) **3**

At a school carnival the final heights jumped by Year 12 competitors were found to be normally distributed with a mean of 5.54 metres and a standard deviation of 3 meters.

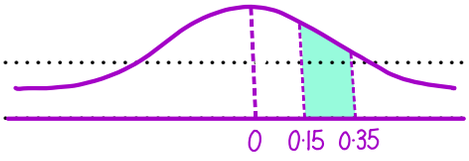
The standard normal distribution table is shown. The values in the table represent the area under the normal curve to the left of the z-score.

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.50000	0.50399	0.50798	0.51197	0.51595	0.51994	0.52392	0.52790	0.53188	0.53586
0.1	0.53983	0.54380	0.54776	0.55172	0.55567	0.55966	0.56360	0.56749	0.57142	0.57535
0.2	0.57926	0.58317	0.58706	0.59095	0.59483	0.59871	0.60257	0.60642	0.61026	0.61409
0.3	0.61791	0.62172	0.62552	0.62930	0.63307	0.63683	0.64058	0.64431	0.64803	0.65173
0.4	0.65542	0.65910	0.66276	0.66640	0.67003	0.67364	0.67724	0.68082	0.68439	0.68793
0.5	0.69146	0.69497	0.69847	0.70194	0.70540	0.70884	0.71126	0.71566	0.71904	0.72240
0.6	0.72575	0.72907	0.73237	0.73565	0.73891	0.74215	0.74537	0.74857	0.75175	0.75490
0.7	0.75804	0.76115	0.76424	0.76730	0.77035	0.77337	0.77637	0.77935	0.78230	0.78524
0.8	0.78814	0.79103	0.79389	0.79673	0.79955	0.80234	0.80511	0.80785	0.81057	0.81327
0.9	0.81594	0.81859	0.82121	0.82381	0.82639	0.82894	0.83147	0.83398	0.83646	0.83891
1.0	0.84134	0.84375	0.84614	0.84849	0.85083	0.85314	0.85543	0.85769	0.85993	0.86214

Using standardised scores and the standard normal distribution table, find the probability that a randomly chosen competitor achieves height between 5.99 and 6.59 metres.

Give your answer correct to three decimal places.

$z = \frac{5.99 - 5.54}{3}$ $z = \frac{6.59 - 5.54}{3}$



$= 0.15$ $= 0.35$

$P(0.15 < z < 0.35) = (P < 0.35) - (P < 0.15)$

$= 0.63683 - 0.55966$

$= 0.07717$

≈ 0.077 or 7.717%

③ Correct answer / ignore rounding

② Shows evidence (recognising z-scores) and subtraction of probabilities from table with some error

① Shows evidence (recognise z-scores) and makes some progress

Marks

Question 37 (5 marks)

Lauren spends $6000 on a new photocopier for her business.
She uses the declining-balance method to calculate the depreciation of the photocopier.
She can only claim the depreciation for that particular year as a tax deduction.

(a) If the rate of depreciation is 26% per annum, show that the depreciation she can claim in the second year is equal to $1154, rounded correct to the nearest dollar. **2**

First year: $S = 6000(1-0.26)^1$ Second year: $S = 6000(1-0.26)^2$

$= \$4440$ $= \$3285.60$

Depreciation in second year $= 4440 - 3285.60$

$= \$1154.40$

$\approx \$1154$

② Correct answer

① Value of 1st AND 2nd year

(b) Lauren earned $110 000 for the last financial year. The depreciation for her photocopier in part (a) is the only tax deduction she claims. **3**

Using the tax table below and ignoring the Medicare Levy, calculate the amount of tax she needs to pay.

Taxable income	Tax payable on this income
0 – $18 200	Nil
$18 201 – $37 000	19c for each $1 over $18 200
$37 001 – $90 000	$3572 plus 32.5c for each $1 over $37 000
$90 001 – $180 000	$20 797 plus 37c for each $1 over $90 000
$180 001 and over	$54 097 plus 45c for each $1 over $180 000

Taxable income $= 110\,000 - 1154$

$= \$108\,846$

Tax payable $= 20\,797 + 0.37(108\,846 - 90\,000)$

$= \$27\,770.02$

③ Correct answer

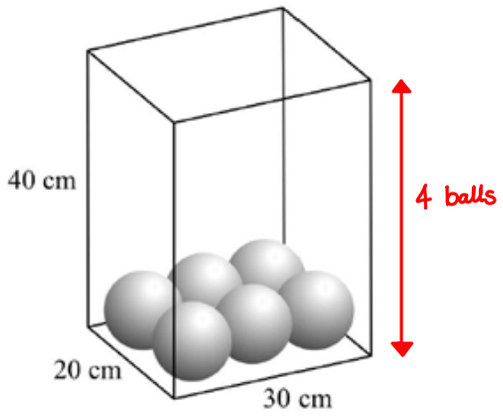
② One error

① Working towards

Marks

Question 38 (4 marks) **4**

Solid spherical balls of diameter 10 cm are packed inside a box as shown below.
The box is in the shape of a rectangular prism such that 6 balls will fit snugly in each layer.



The balls are packed in the same manner as in the bottom layer until the box is full.

Calculate the percentage of the box that is empty space.
Give your answer correct to the nearest percentage.

Total number of balls = 6×4

$= 24$ balls

Volume of spheres = $24 \times \left(\frac{4}{3}\pi \times 5^3\right)$

$= 12566.37061 \text{ cm}^3$ (1)

Volume of rectangular box = $20 \times 30 \times 40$

$= 24000 \text{ cm}^3$ (1)

Volume of space = $24000 - 12566.37061$

$= 11433.62939 \text{ cm}^3$ (1)

Percentage of space = $\frac{11433.62939}{24000} \times 100$

$= 47.64012244$

$\approx 48\%$ (1)

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NSW Education Standards Authority

2021 **HIGHER SCHOOL CERTIFICATE EXAMINATION**

Mathematics Standard 1
Mathematics Standard 2

REFERENCE SHEET

Measurement

Limits of accuracy

Absolute error = $\frac{1}{2}$ × precision

Upper bound = measurement + absolute error

Lower bound = measurement – 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

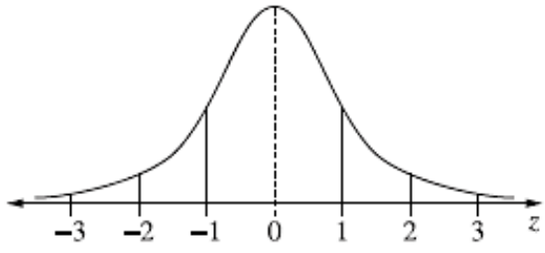
less than $Q_1 - 1.5 \times IQR$

or

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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