Name…….....

Student Number

Teacher's Name…….....

Mathematics Standard 2
HSC Trial Examination
Term 3 2024

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 - 42
- 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 Amanda administered her "public opinion" questionnaire to a sample of people by phoning every 100th person in the phone book.

What type of sample did Amanda use?

(A) Systematic

(B) Stratified

(C) Random

(D) Categorical

2 There are three spoons and five forks in a picnic basket.

What is the percentage probability of randomly picking a fork from the basket?

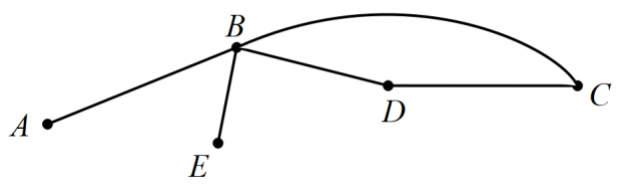
(A) 37.5%

(B) 50%

(C) 60%

(D) 62.5%

3 Five cities are connected by this network diagram.



What is the total sum of degrees in the network?

(A) 5

(B) 6

(C) 8

(D) 10

4 What is the scale ratio if 3 centimetres on a scale drawing represents an actual distance of 75 metres?

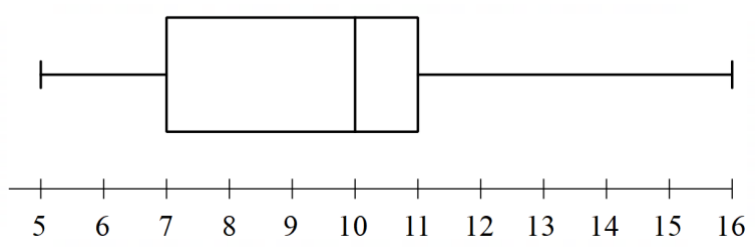
(A) 1 : 2500

(B) 2 : 550

(C) 2 : 250

(D) 1 : 350

5



What is the interquartile range of the data displayed in the box-and-whisker plot?

(A) 1

(B) 3

(C) 4

(D) 11

6 Lake Baikal in Siberia is one of the coldest places on Earth. Its typical winter temperature is $-76°\text{F}$.

Use the formula $F = \frac{9}{5}C + 32,$ where C = degrees Celsius and F = degrees Fahrenheit, to determine the typical winter temperature at Lake Baikal in degrees Celsius.

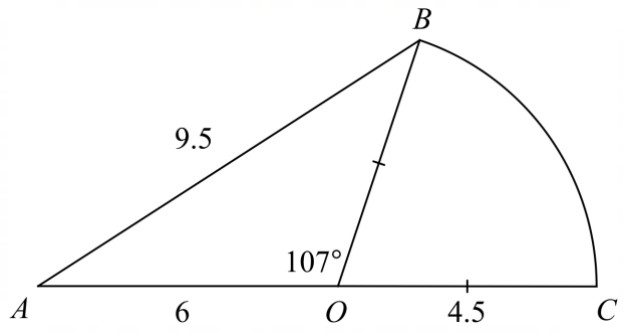
(A) $-24.4°\text{C}$

(B) $-60.0°\text{C}$

(C) $-104.8°\text{C}$

(D) $-194.4°\text{C}$

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



Which calculation will give the area of this shape?

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

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

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

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

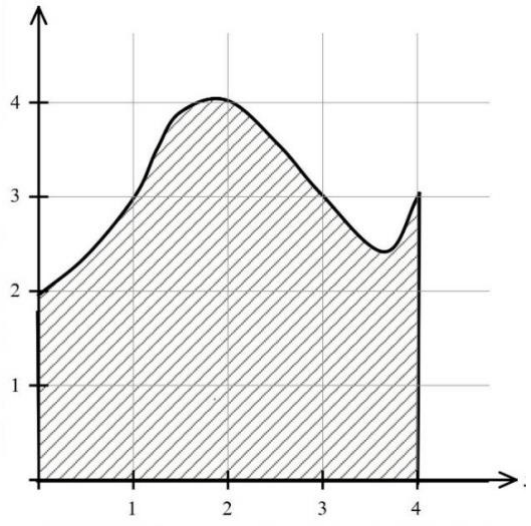
8 Using two applications of the Trapezoidal rule, find an estimate for the area of the irregular shape shown. (Each square on the grid is one square unit.)

(A) 12 square units

(B) 12.5 square units

(C) 13 square units

(D) 13.5 square units



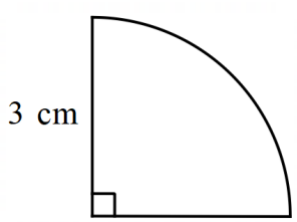
9 What is the perimeter of the quadrant shown below, to the nearest centimetre?

(A) 7 cm

(B) 8 cm

(C) 10 cm

(D) 11 cm



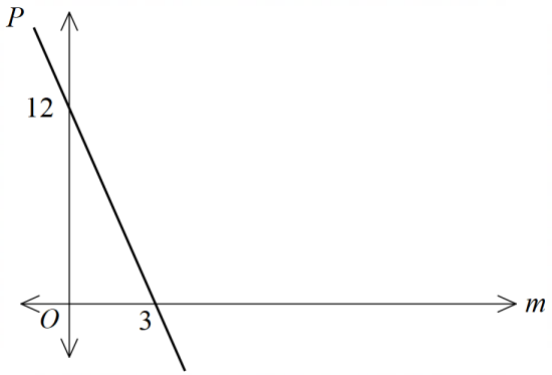
10 What is the equation of this line?

(A) $m = 12 - 4P$

(B) $P = 12 - 4m$

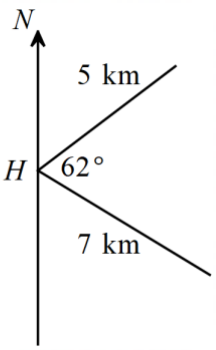
(C) $P = 3m + 12$

(D) $P = 4m + 12$

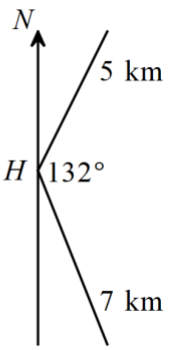


11 Two rescue groups left their headquarters, *H*, to search for a lost bushwalker.
Both groups walked in a straight line. One group walked for 5 km on a bearing of 062°.
The other group walked for 7 km on a bearing of 132°.
Which diagram correctly shows this information?

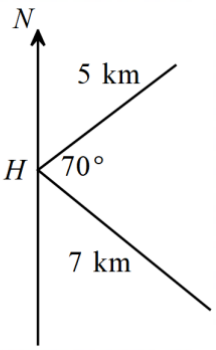
(A)



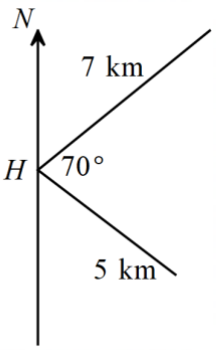
(B)



(C)



(D)



12 Kyrie plays in three basketball leagues. He wishes to compare the number of points he scored per game with the number of points per game scored by the other players in the leagues.

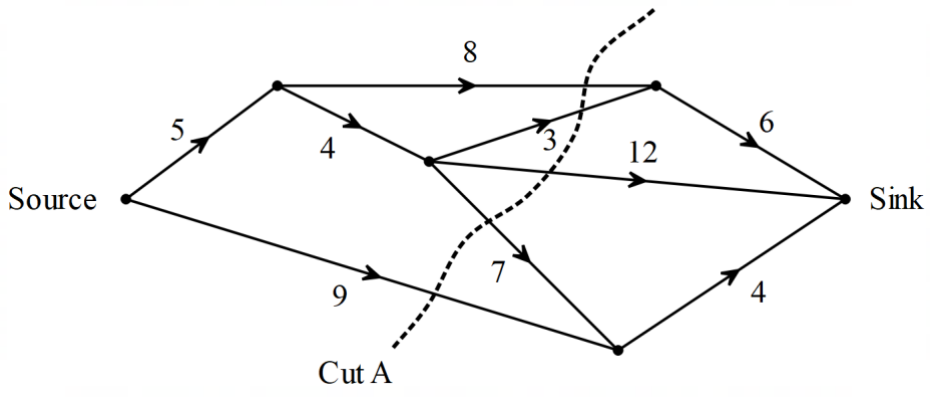
The number of points scored in each league are normally distributed. The table shows Kyrie's scores in each of the leagues he plays in, as well as the mean and standard deviation of the points scored per game in each league.

League	*Kyrie's points per game*	*Mean*	*Standard deviation*
School league	35	25	10
NSW league	28	30	4
National league	20	18	4

Relative to the rest of the players in each league, which row of the table below shows Kyrie's strongest performance and his weakest performance?

	Strongest performance	*Weakest performance*
(A)	School league	NSW league
(B)	School league	National league
(C)	NSW league	School league
(D)	National league	NSW league

13 The network below shows the flow of water through a series of pipes. The edge numbers, in litres per minute, indicate the maximum flow through each pipe.



What is the capacity of cut A, in litres per minute?

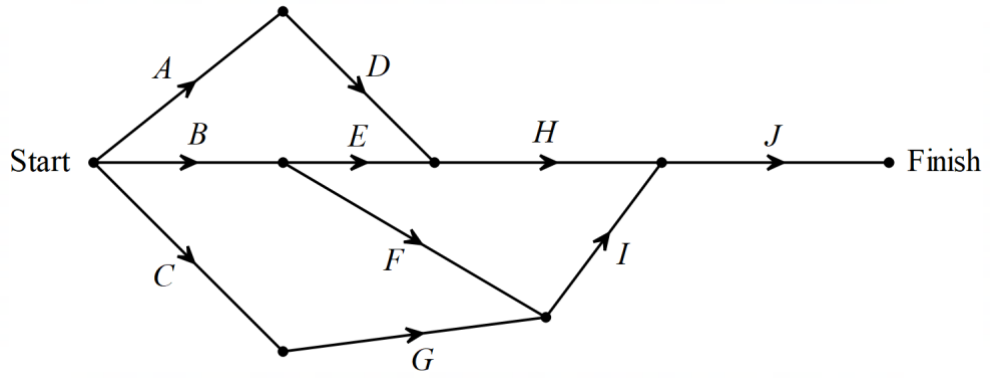
(A) 12

(B) 19

(C) 29

(D) 39

14 The directed graph shown below indicates the sequence of activities needed to complete a project.



How many activities have exactly two immediate predecessors?

(A) 1

(B) 2

(C) 3

(D) 4

15 Carol bought a triangular block of land with sides of length 9, 5 and 10 metres respectively. What is the area of her land in square metres?

(A) $14 \sin 86°11'$

(B) $22.5 \sin 86°11'$

(C) $20 \sin 106°36'$

(D) $45 \sin 106°36'$

End of Section I

Name…….....

Student Number | |

Teacher's Name…….....

Mathematics Standard 2
Section II

85 marks
Attempt Questions 16 - 42
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.

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Marks

Question 16 (2 marks) **2**

Solve the equation

$$2x-5=\frac{2x-7}{3}.$$

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Question 17 (1 mark) **1**

What is the average fuel consumption of a scooter that uses 8 litres of fuel to travel 182 km?

Give your answer in L/100 km, correct to one decimal place.

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Question 18 (2 marks) **2**

Emily watches television for 3 hours every day. Her television uses 350 watts per hour and her electricity is charged at 37.56 cents per kWh.

How much does it cost Emily to run her television for a year?

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Marks

Question 19 (2 marks) **2**

Rearrange the following equation to make *a* the subject.

$$S = ut + \frac{1}{2}at^2$$

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Question 20 (2 marks) **2**

Charlie has completed three assessment tasks for Mathematics with a mean mark of 76%.

What mark out of 100 does he need to achieve in his next assessment task to increase his mean mark to 80%?

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Question 21 (2 marks) **2**

The masses of tennis balls produced in a factory are normally distributed with a mean of 58 grams and a standard deviation of 1.2 grams.

Tennis balls with a mass below 56.8 grams are rejected and not packaged for sale.
If the factory produces 4000 tennis balls per day, how many of them are rejected?

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Marks

Question 22 (2 marks) **2**

Kim develops a fashion application worth $40 000. Due to advancements in technology, the app depreciates by 22% each year. She then sells the app after using it for 5 years.

Calculate the price at which Kim sells her app, correct to the nearest cent.

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Question 23 (4 marks)

The table below shows the present value interest factors for some monthly interest rates and loan periods in months.

Present value of $1				
Period	**0.0060**	**0.0065**	**0.0070**	**0.0075**
46	40.09350	39.64965	39.21263	38.78231
47	40.84841	40.38714	39.93310	39.48617
48	41.59882	41.11986	40.64856	40.18478
49	42.34475	41.84785	41.35905	40.87820

Gurnoor borrows $22 000 for a car. He arranges to repay the loan with monthly repayments over 4 years. He is charged 7.8% per annum interest.

(a) Find Gurnoor's monthly repayment, correct to the nearest cent. **2**

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(b) Calculate the amount of interest Gurnoor will pay over the term of the loan, correct to the nearest cent. **2**

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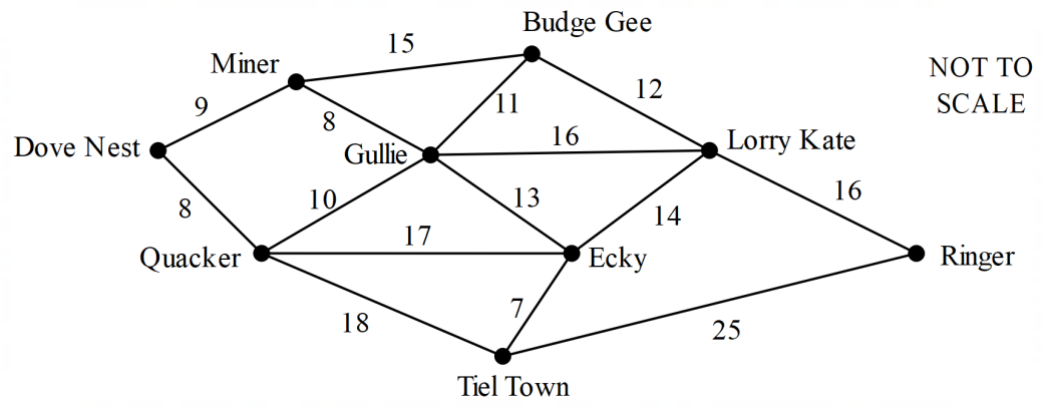
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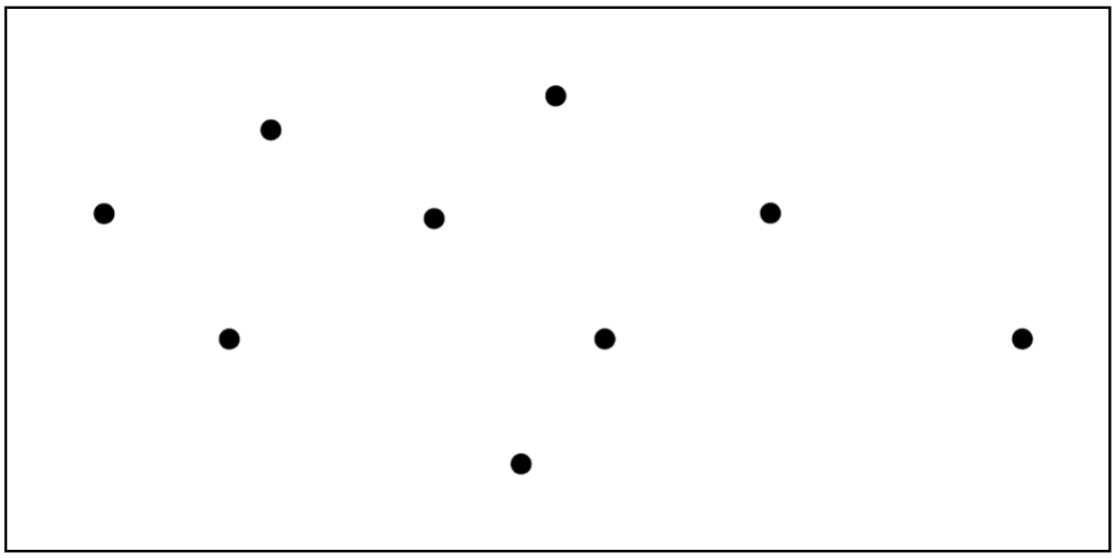
Marks

Question 24 (3 marks)

The Green Council wants to improve the NBN connection cables to various suburbs.
The network diagram shows the distance between suburbs in kilometres.



(a) Sketch the minimum spanning tree. **2**



(b) Find the length of the minimum spanning tree that connects all the suburbs. **1**

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Marks

Question 25 (2 marks) **2**

Uncle Charlie wanted to know how many yabbies were in his dam. While considering how to do this, he discovers an article in a magazine about how to estimate yabby numbers by using the capture-recapture technique.

Using this technique:

- He initially caught 15 yabbies
- He tagged them before releasing them back into the dam.
- A week later he caught 30 yabbies from the dam. Of those that were caught, only 2 were tagged.

Calculate Uncle Charlie's estimate for the number of yabbies in his dam.

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Marks

Question 26 (4 marks)

Over the ten weeks of summer the number of people rescued each weekend at Diamond Bay and Herons Beach are shown on this back-to-back stem-and-leaf plot.

Diamond Bay					Herons Beach				
6	5	4	1	0	2	6	6	9	
4	3	3	2	1	0	1	5	5	5
		1	0	2					
				3	0				

(a) Calculate the mean, mode and range of the number of rescues at Diamond Bay during this 10-week period. **2**

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(b) One of the scores at Herons Beach is an outlier. Which score is it and justify with calculations. **2**

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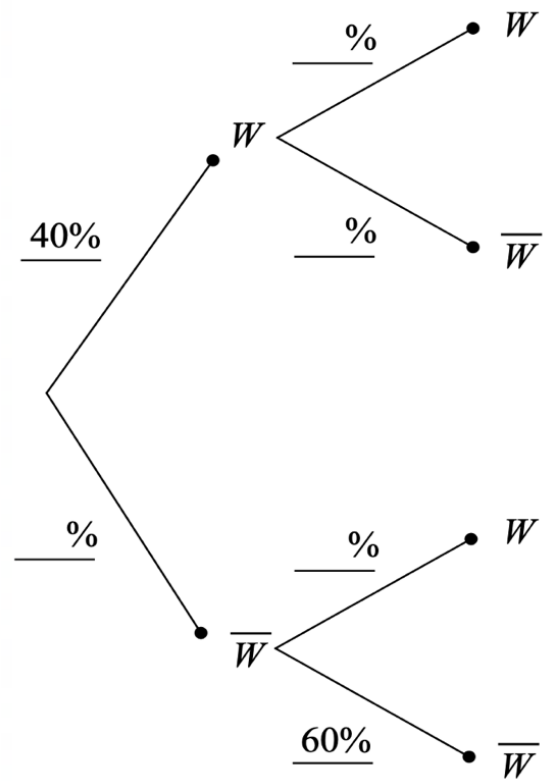
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Marks

Question 27 (3 marks)

At a local fast-food restaurant, the probability, W, of the ice cream machine working on any given day is 40%. Ronald visits the restaurant on two consecutive days attempting to order an ice cream.

(a) A partially completed tree diagram is shown. Complete the tree diagram below. **1**



(b) Find the probability that the ice cream machine is not working on at least one of the days when Ronald visits. **1**

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(c) Find the probability that Ronald successfully orders an ice cream on exactly one out of two visits to the restaurant. **1**

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Marks

Question 28 (3 marks) **3**

The table below shows the income tax rates for the 2023-2024 financial year.

Taxable income	**Tax on this income**
0 – $18,200	Nil
$18 201 – $45 000	19c for each $1 over $18,200
$45 001 – $120 000	$5092 plus 32.5c for each $1 over $45 000
$120 001 – $180 000	$29 467 plus 37c for each $1 over $120 000
$180 001 and over	$51 667 plus 45c for each $1 over $180 000

For the 2023-2024 financial year, Scott had a taxable income of $76 400. During the year he paid $405 per week in Pay As You Go (PAYG) tax.
Scott is also required to pay the 2% Medicare levy.

Calculate whether Scott is required to pay more income tax, or receive a refund and by how much?

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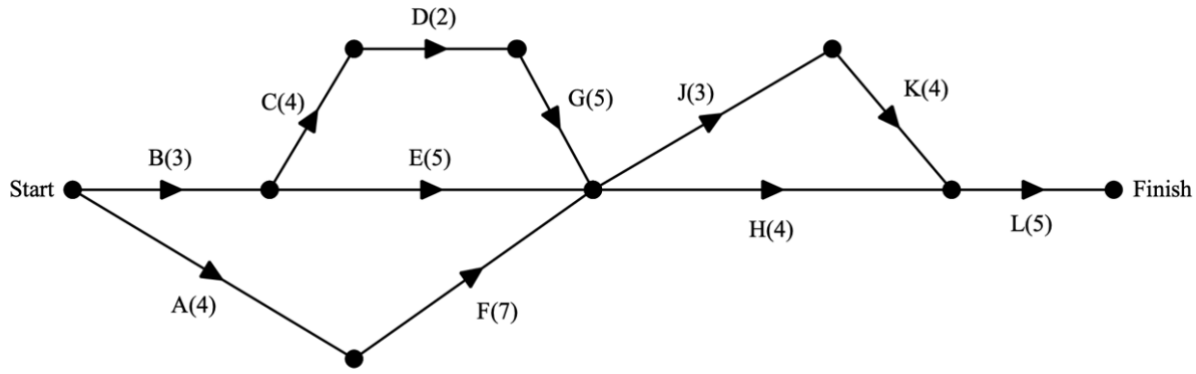
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Marks

Question 29 (5 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) Complete a forward and backward scan of the network and state the minimum completion time of the project. **2**

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(b) State the critical path for this project. **1**

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(c) Which activity has the greatest float time? Justify your answer by calculating the float times of all non-critical activities. **2**

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Marks

Question 30 (3 marks) **3**

Henry invests $22 000 in a savings account. Interest is paid at a fixed monthly rate.
At the end of each month, after monthly interest is added, Henry makes a deposit of $700.

Henry has created a spreadsheet to show the activity in his savings account.
The details for the first 6 months are show below.

Month	Amount in account at beginning of month	Monthly interest	Deposit	Amount in account at the end of month
1	22 000.00	55.00	700	22 755.00
2	22 755.00	56.89	700	23 511.89
3	23 511.89	58.78	700	24 270.67
4	24 270.67	60.68	700	25 031.35
5	25 031.35	62.58	700	25 793.93
6	25 793.93	64.48	700	26 558.41
7			700	

By finding the monthly rate of interest, complete the final row above for the 7^{th} month.

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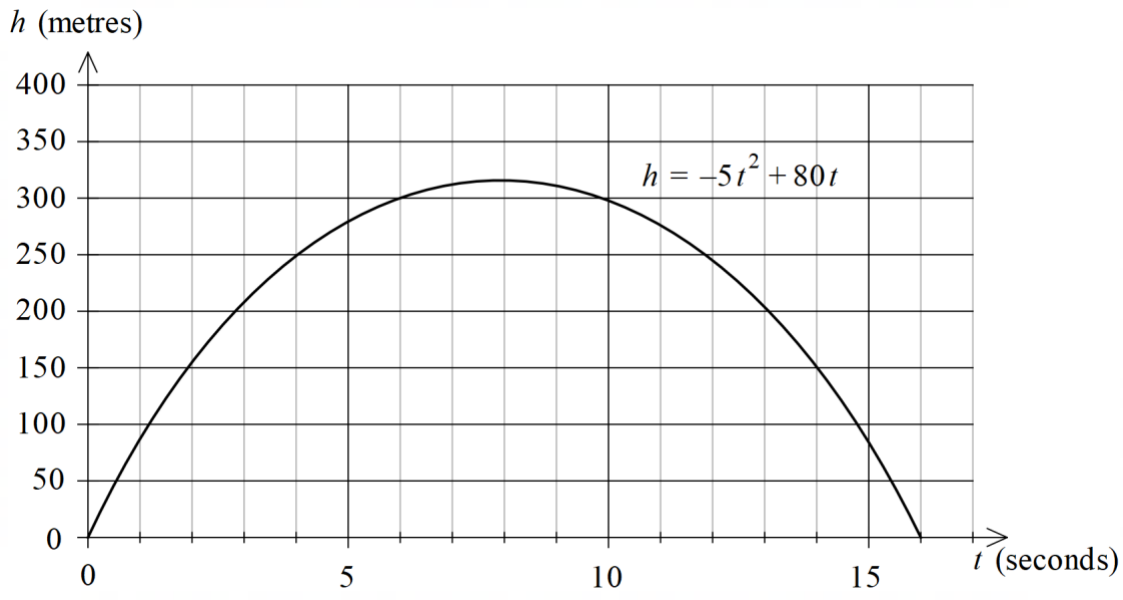
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Marks

Question 31 (2 marks) **2**

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

A graph of this non-linear function is shown below.



Using the graph and a calculation, find the maximum height of the object above the ground.

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Marks

Question 32 (3 marks) **3**

The time, t seconds, that a car takes to travel 100 m is inversely related to s, the speed of the car in km/h. When a car is travelling at a speed of 60 km/h it takes 6 seconds to travel 100 m. Ali's car travelled 100 m in 3.5 seconds.

At what speed, in km/h, was Ali's car travelling? Answer to the nearest kilometre per hour.

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Question 33 (3 marks) **3**

The formula below is used to calculate an estimate for the blood alcohol content (*BAC*) of 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.

Stephen weighs 98 kilograms. He consumed 6.5 standard drinks between 6.00 pm and 9.45 pm. He then stopped drinking alcohol.

His *BAC* reached zero at 1.15 am. Calculate the rate at which his body metabolised the alcohol, in terms of *BAC* per hour. Give your answer correct to four decimal places.

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Marks

Question 34 (4 marks) **4**

Roger's flight itinerary is shown below. It details the departure and arrival time of the flights on his journey from Sydney to London. Only local times are shown in the table and all departures and arrivals occur on the same Sunday.

	Depart		***Arrive***	
Flight Number	**City**	**Time**	**City**	**Time**
1	Sydney	06:00 Sunday	Dubai	13:20 Sunday
2	Dubai	16:05 Sunday	London	20:00 Sunday

Roger knows that Sydney is 7 hours ahead of Dubai, and that Dubai is 3 hours ahead of London. How long did Roger spend flying?

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Marks

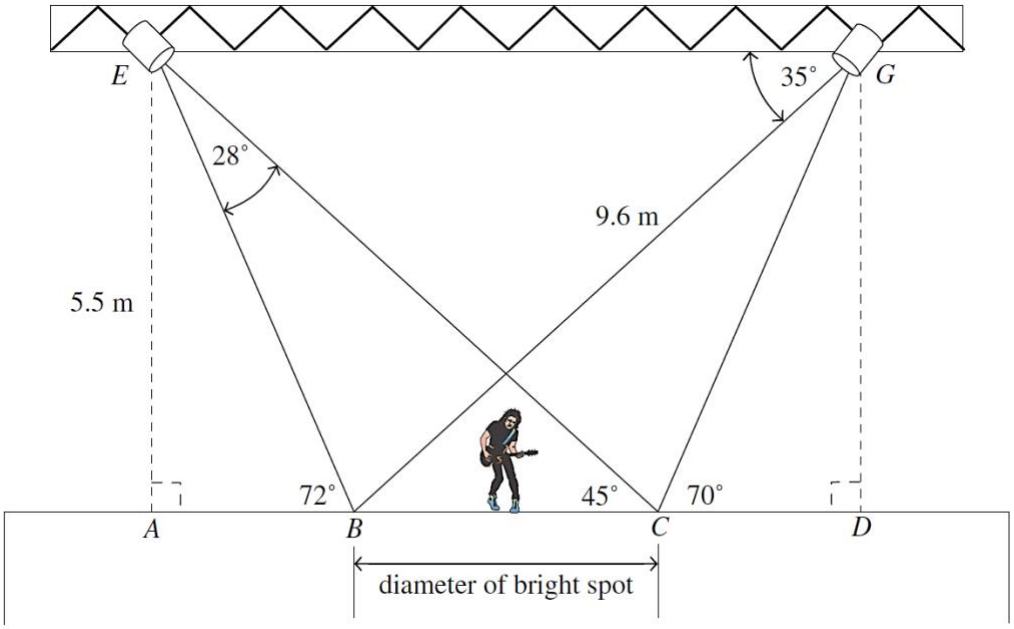
Question 35 (8 marks)

Two spotlights, E and G are directed onto a performer in a concert.
The frame holding the spotlights is parallel to the stage.

$\angle BEC = 28°$, $\angle EGB = 35°$, $\angle ECB = 45°$, $\angle EBA = 72°$, $\angle GCD = 70°$,

$\angle GCD = \angle CGE$ and $\angle EBA = \angle BEG$ and $\angle EGB = \angle GBD$.

A bright spot appears on the stage where the two beams of light overlap. The length of the beam BG is 9.6 m and the height of the frame above the stage is 5.5 m.



(a) Calculate the size of $\angle BCG$ and $\angle BGC$. **2**

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(b) Use the sine rule for ΔBCG to show that the diameter of the bright spot is 5.86 m (accurate to 2 decimal places). **2**

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Question 35 continued on page 23

Marks

Question 35 continued.

(c) Calculate the length of EB (to one decimal place). **1**

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(d) Calculate the size of $\angle EBG$. **1**

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(e) Use the cosine rule to calculate the distance between the two spotlights at E and G to the nearest whole metre. **2**

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Marks

Question 36 (4 marks)

Marley plans to invest $25 000 for 2 years. She is offered two different investment options.

Option *A*: Interest is paid at 7.24% per annum compounded monthly.
Option *B*: Interest is paid at r% per annum simple interest.

(a) Calculate the future value of Marley's investment after 2 years if she chooses Option *A*. **2**

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(b) Find the value of r in Option *B* that would give Marley the same future value after 2 years as for Option *A*.
Give your answer as a percentage correct to two decimal places. **2**

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Marks

Question 37 (2 marks) **2**

The population of rabbits in a town is estimated to be 1000 in the year 2000. The population increases by 80% each year. The population of the rabbits after *n* years is given by

$$P = a^n \times 1000$$

Where *P* is the population of the rabbits and a is a constant.

Find the population of rabbits in the year 2009, correct to three significant figures.

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Question 38 (3 marks) **3**

Louie is a Real Estate Agent earning a retainer of $600 per week.
Every month Louie also earns a commission at a rate of *R*% on the first $500 000 of his sales, and then at half of that rate on any sales above $500 000.
Louie's monthly income after selling $750 000 worth of property is $17 600.

Find the value of *R*.

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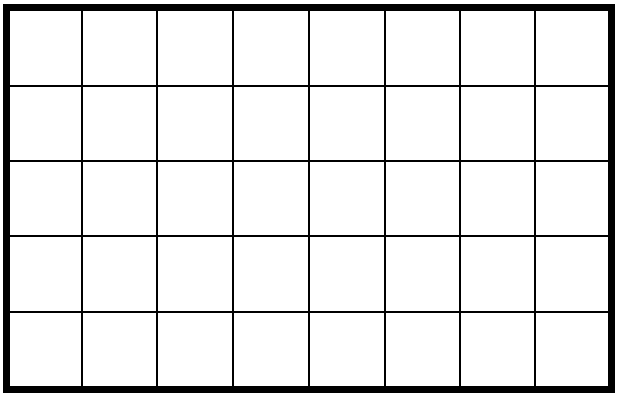
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Marks

Question 39 (4 marks) **4**

A rectangular sports ground has been drawn to scale on a 1 cm by 1 cm grid as shown below.
The scale used is 1 : 2500.



Alita took 15 minutes to walk around the perimeter of this sports ground.
What was Alita's average speed in kilometres per hour?

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Marks

Question 40 (4 marks) **4**

Aisha has no debt on her credit card. She then used it to buy 1500 shares at a price of $7.50 per share. A brokerage fee of 1.2% was also charged on the purchase.

At the end of her first year owning the shares, she collected an annual dividend at a yield of 5.5%. She then used this dividend to pay back part of her credit card debt.

Calculate the amount Aisha still owes on her credit card given that the interest rate on the credit card is 20% per annum, compounded daily for 365 days. Answer to the nearest dollar.

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Marks

Question 41 (5 marks) **5**

A company stocks two different grades of timber.
Grade *A* sells for \$6 per square metre. Grade *B* sells for \$2 per square metre.

Harry, a carpenter, purchases 30 m^2 of timber, including some of each grade.
The total cost is \$84.

Let x represent the number of square metres of grade *A* timber purchased and y represent the number of square metres of grade *B* timber purchased.

Using the information above, write down two equations for x and y, then solve these simultaneous equations graphically on the given number plane on the next page.

Do **not** solve these equations algebraically.

From your graph determine how many square metres of each grade of timber was purchased.

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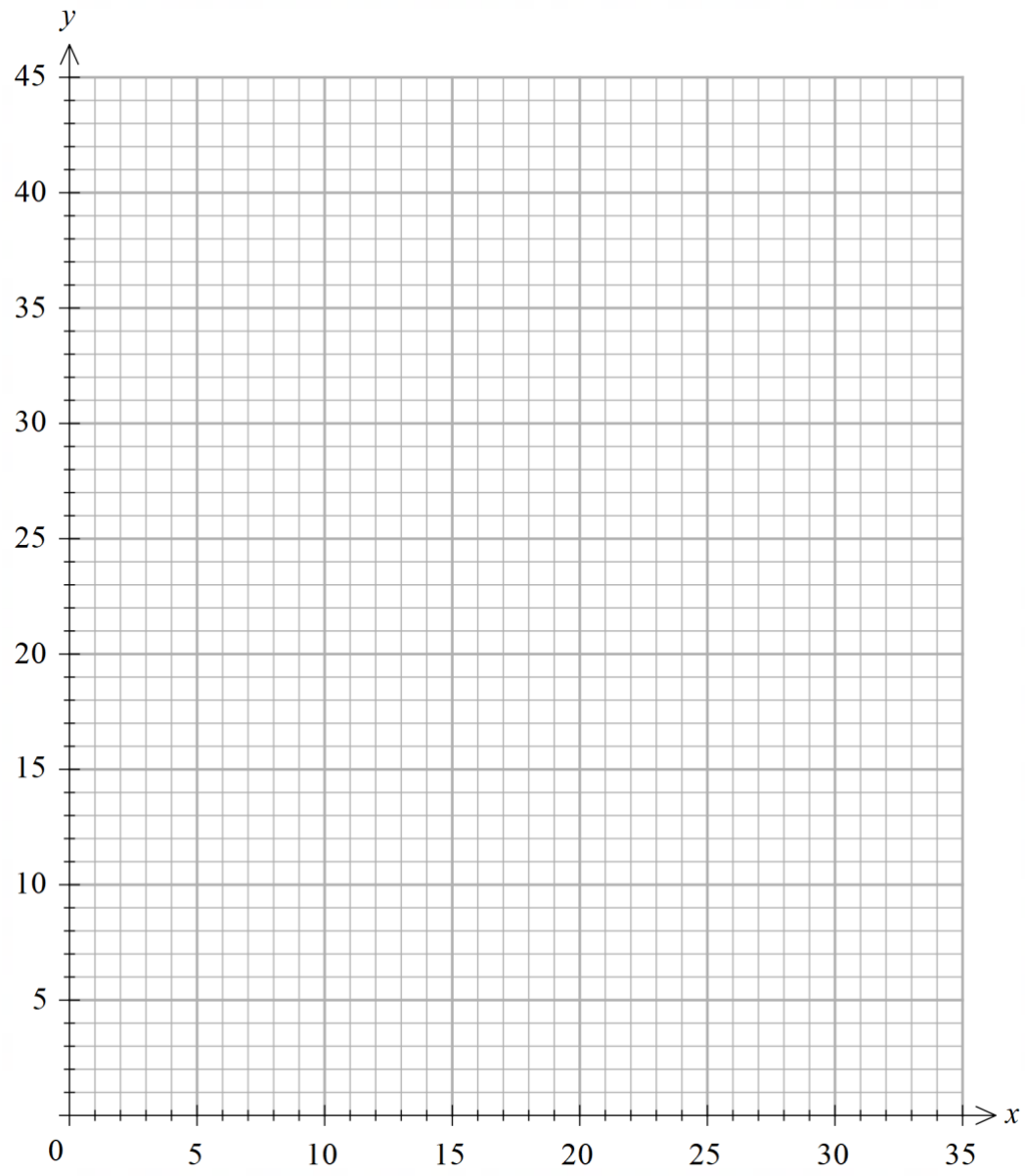
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Question 41 continued on page 29

Marks

Question 41 continued.



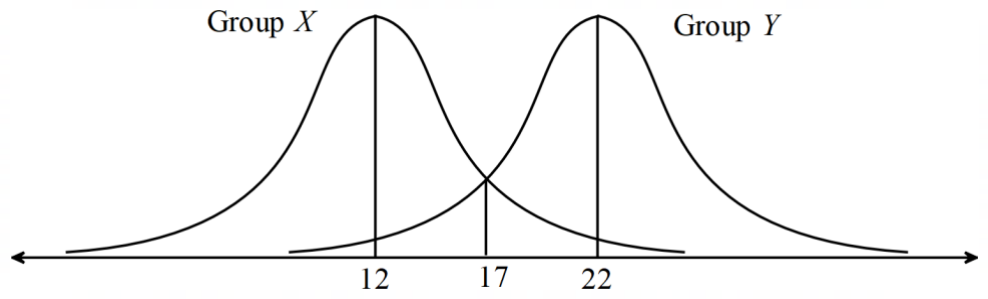
Number of square metres of grade *A* = ...

Number of square metres of grade *B* = ...

Marks

Question 42 (3 marks) **3**

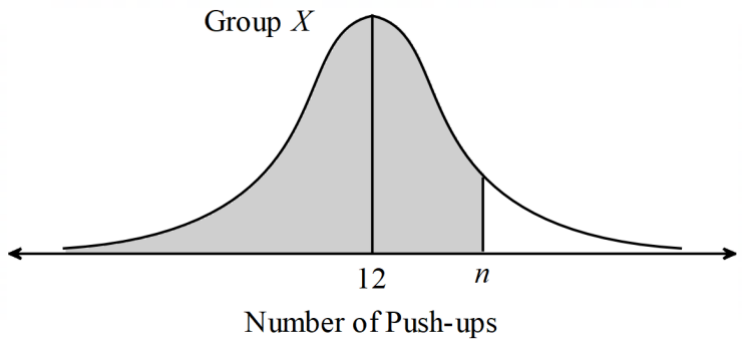
Two groups, Group *X* and Group *Y*, compare the number of push-ups their members can perform. Group *X* is normally distributed with a mean of 12 push-ups. Group *Y* is normally distributed with a mean of 22 push-ups. Both groups have the same standard deviation.



It is known that 25% of Group *X* can perform more than 17 push-ups, and 25% of Group *Y* can perform less than 17 push-ups.
The table below gives the probability that a member in Group *X* performs a certain number of push-ups below *n* push-ups.

n	17	19	21	23	25	27	29
Probability	0.7500	0.8275	0.8876	0.9311	0.9603	0.9785	0.9891

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



Find the probability that members of Group *Y* can perform between 17 and 29 push-ups.

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END OF PAPER

Section II extra writing space.

If you use this space, clearly indicate which question you are answering.

Section II extra writing space.

If you use this space, clearly indicate which question you are answering.

NSW Education Standards Authority

HIGHER SCHOOL CERTIFICATE

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

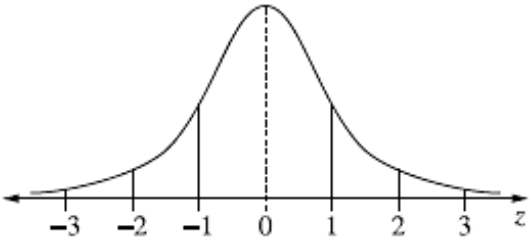
less than $Q_1 - 1.5 \times IQR$

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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