

HSC Trial Examination 2020

Mathematics Standard 2

General Instructions

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

Total marks: 100

Section I – 15 marks (pages 2–8)

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

Section II – 85 marks (pages 9–33)

- Attempt Questions 16–43
- Allow about 2 hours and 5 minutes for this section

Students are advised that this is a trial examination only and cannot in any way guarantee the content or the format of the 2020 HSC Mathematics Standard 2 Examination.

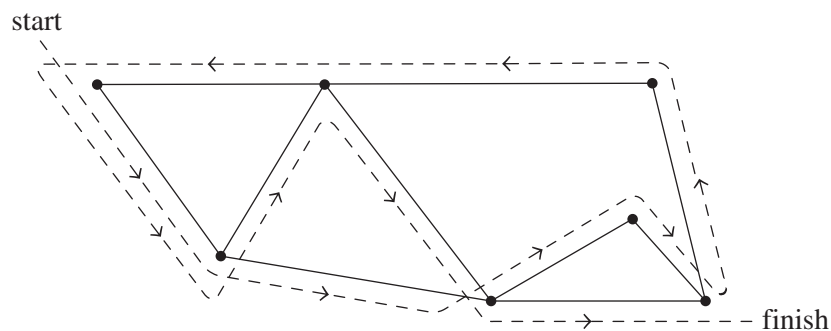
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Section I

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

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

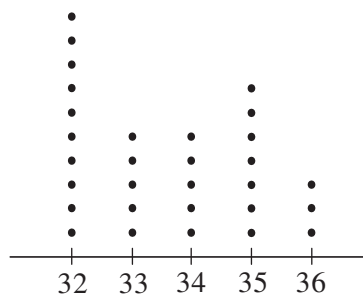
1. A network diagram is shown.



What is the travel route?

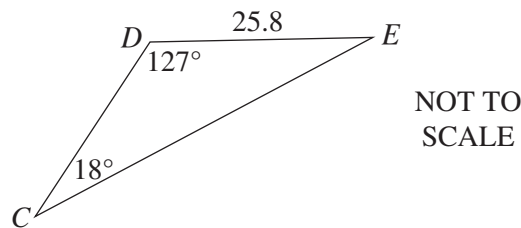
- (A) a cycle
(B) a path
(C) a trail
(D) a walk
2. A car uses an average of 7 L of fuel per 100 km travelled.
- How much fuel would the car use if it travels 382 km?
- (A) 26.74 L
(B) 34.72 L
(C) 38.20 L
(D) 54.57 L
3. In a normally distributed set of scores, the mean is 72 and the standard deviation is 6.
- Approximately what percentage of the scores will lie between 66 and 78?
- (A) 16%
(B) 34%
(C) 68%
(D) 95%

4. A set of data is displayed in the dot plot.



What is the median score?

- (A) 32
(B) 33.5
(C) 34
(D) 36
5. The triangle shown has one angle of 127° and another angle of 18° .



What is the length of CE , correct to the nearest whole number?

- (A) 10
(B) 31
(C) 39
(D) 67
6. Evelyn worked for eight hours a day on Thursday and Friday at a rate of \$19.20 per hour. On Saturday, she worked for six hours at time-and-a-half.

How much did Evelyn earn in total for working Thursday, Friday and Saturday?

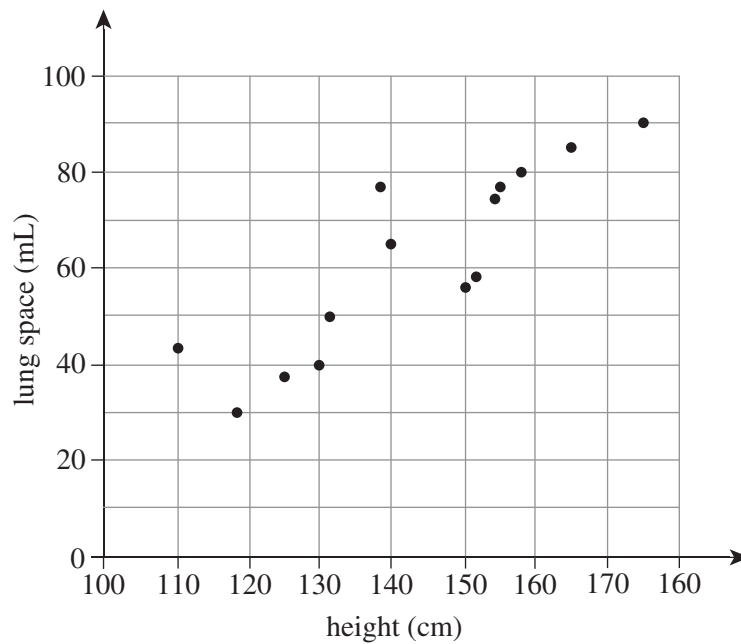
- (A) \$268.80
(B) \$307.20
(C) \$480.00
(D) \$691.20

7. Liam invests \$1600 for three years at 8% per annum compounding quarterly.

How much compound interest will Liam receive at the end of the three years?

- (A) \$415.54
- (B) \$429.19
- (C) \$2015.54
- (D) \$2029.19

8. The data in the scatterplot compares the heights of a group of children with the amount of space in their lungs.

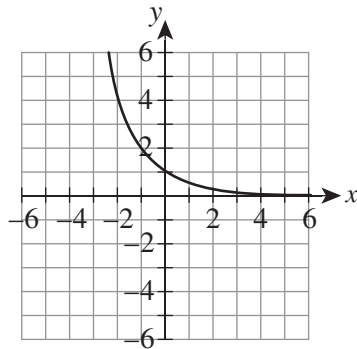


What relationship is suggested by the data?

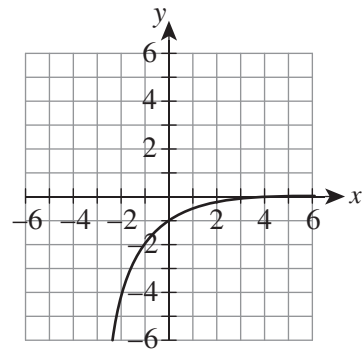
- (A) perfect positive correlation
- (B) strong positive correlation
- (C) weak negative correlation
- (D) no correlation

9. Which of the following graphs best represents the equation $y = 2^{-x}$?

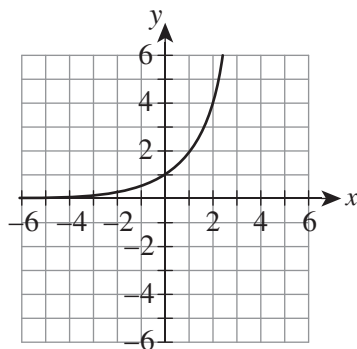
(A)



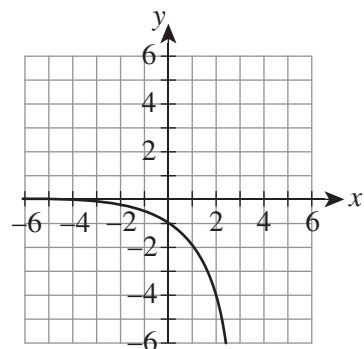
(B)



(C)



(D)



10. Molly is concerned about the parrot population in her town. She gathers 170 parrots and tags them. A couple of months later she gathers 32 parrots and finds 10 of them tagged.

What is Molly's estimate of the parrot population using the capture-recapture method?

- (A) 524
(B) 544
(C) 572
(D) 588

11. The frequency table shows the number of hours that 20 students spend studying each week.

<i>Hours spent studying each week</i>	<i>Frequency</i>
0–4	5
5–9	10
10–14	3
15–19	2

What is the mean number of hours that the students spend studying each week?

- (A) 6.5
(B) 7.0
(C) 7.5
(D) 9.5
12. The table shows future value interest factors.

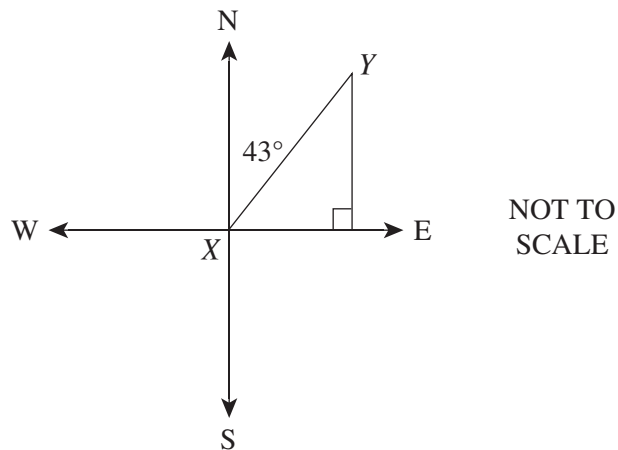
	<i>Interest rate per period</i>					
<i>Period</i>	<i>1%</i>	<i>2%</i>	<i>3%</i>	<i>4%</i>	<i>5%</i>	<i>6%</i>
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	2.0100	2.0200	2.0300	2.0400	2.0500	2.0600
3	3.0301	3.0604	3.0909	3.1216	3.1525	3.1836
4	4.0604	4.1216	4.1836	4.2465	4.3101	4.3746

An annuity of \$80 000 is invested into an account every six months for two years at an interest rate of 2% per annum.

Using the data from the table, what is the future value of this annuity?

- (A) \$160 800
(B) \$161 600
(C) \$324 832
(D) \$329 728

13. The compass bearing of Y from X is $N43^\circ E$.



What is the compass bearing of X from Y ?

- (A) $N47^\circ E$
 - (B) $N43^\circ E$
 - (C) $S47^\circ W$
 - (D) $S43^\circ W$
14. Consider the following simultaneous equations.

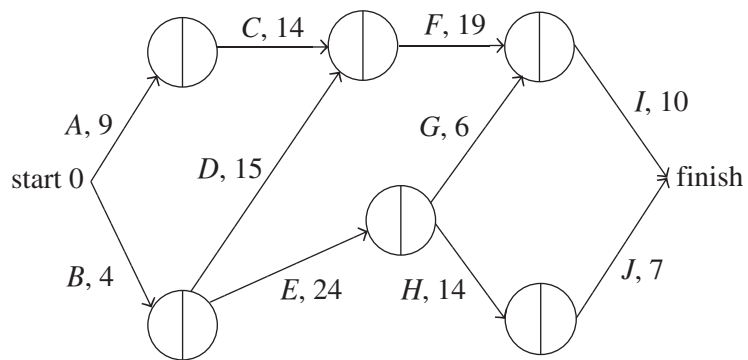
$$3x - 5y = 28$$

$$x + 4y = 15$$

What is the solution to the simultaneous equations?

- (A) $(11, 1)$
- (B) $(1, 11)$
- (C) $(6, -2)$
- (D) $(-2, 6)$

15. A network diagram is shown.



What is the minimum completion time?

- (A) 44
- (B) 49
- (C) 50
- (D) 52

Section II

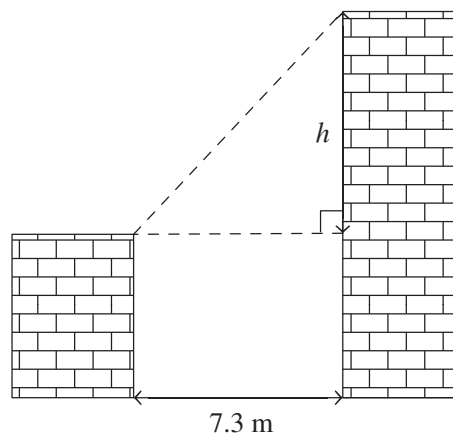
85 marks**Attempt all questions****Allow about 2 hours and 5 minutes for this section**

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.

Question 16 (2 marks)

The following two buildings are standing on level ground. The horizontal distance between the buildings is 7.3 metres and the angle of elevation between the buildings is 49° .

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What is the difference in height between the buildings, correct to one decimal place?

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Question 17 (2 marks)

A water tank collects water from the rectangular roof of a house that has a length of 26 metres and a width of 15 metres. **2**

What is the volume of water collected by the water tank after 15 mm of rain? Give your answer correct to the nearest litre.

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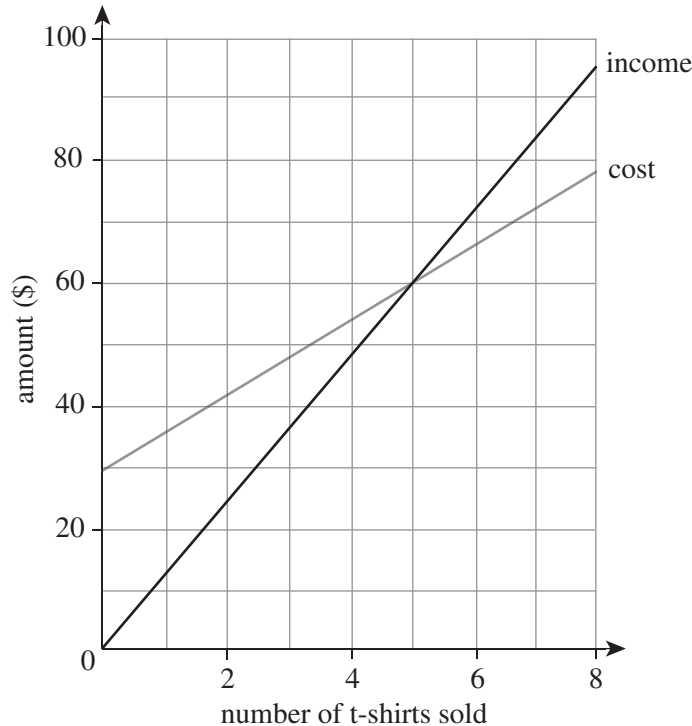
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Question 18 (4 marks)

A clothing company makes and sells t-shirts.

The linear graphs show the cost to make t-shirts and the income received from sales of the t-shirts.



- (a) Let the income received be I and the number of t-shirts sold be n .

1

Write a formula for the income received.

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- (b) Let the cost of making a t-shirt be C and the number of t-shirts sold be n .

1

Write a formula for the cost.

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Question 18 continues on page 12

Question 18 (continued)

- (c) What profit does the company earn if it sells seven t-shirts? **1**

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- (d) How many t-shirts does the company need to sell to break even? **1**

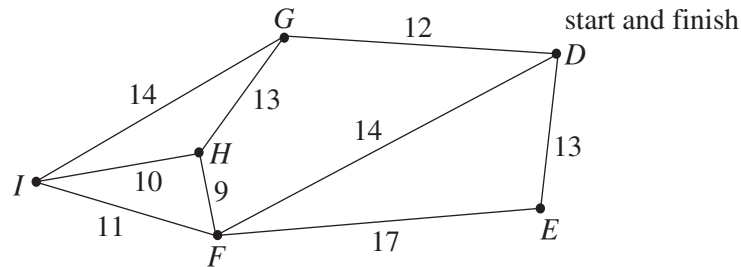
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End of Question 18

Question 19 (3 marks)

The network diagram shows a walking course for a charity walk. Participants must pass the checkpoints D , E , F , G , H and I . The average time (in minutes) to walk between the checkpoints is shown on the edges of the diagram.

3

Participants must start and finish at checkpoint D . They can pass through the other checkpoints in any order they wish.

Determine which route has the shortest average completion time. Justify your answer with calculations

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Question 20 (2 marks)

A car is sold for \$19 990. It will depreciate at 18% per annum. **2**

Using the declining-balance method, what is the salvage value of the car after four years, correct to the nearest dollar?

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Question 21 (4 marks)

Dominic has a drum filled with 10 litres of water. The drum has a small hole in the base, and water is leaking out of the drum at a rate of 0.25 litres per minute.

(a) Write a linear equation to describe this situation. **1**

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(b) What volume of water remains in the drum after 90 seconds? **1**

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(c) How long would it take for all the water to leak out of the drum? **2**

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Question 22 (2 marks)

The formula shown is used to calculate an estimate for the blood alcohol content (*BAC*) for females. N is the number of standard drinks consumed, H is the number of hours of drinking and M is the person's weight in kilograms.

2

$$BAC_{\text{Female}} = \frac{10N - 7.5H}{5.5M}$$

The table shows the number of standard drinks in glasses of wine.

<i>Number of standard drinks</i>			
<i>White wine</i>		<i>Red wine</i>	
<i>Small glass</i>	<i>Large glass</i>	<i>Small glass</i>	<i>Large glass</i>
0.8	1.3	1.0	1.5

Alexis weighs 66 kg and drinks two small glasses of white wine and three large glasses of red wine between 7.00 pm and midnight.

What is Alexis' *BAC* estimate at midnight, correct to two significant places?

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Question 23 (3 marks)

The time taken to lay a timber floor (t) varies inversely with the number of workers employed to lay the floor (n). It takes three workers seven days to lay the timber floor in a school hall.

- (a) How many days would four workers take to lay the same timber floor? **2**

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- (b) How many workers would be required to lay the same timber floor in one day? **1**

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Question 24 (4 marks)

The mass of a car is 1800 kg, rounded to the nearest 100 kg.

- (a) What is the precision or limit of reading? **1**

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- (b) What is the absolute error? **1**

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- (c) What are the upper and lower bounds for the measurement? **1**

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- (d) Find the percentage error, correct to one decimal place. **1**

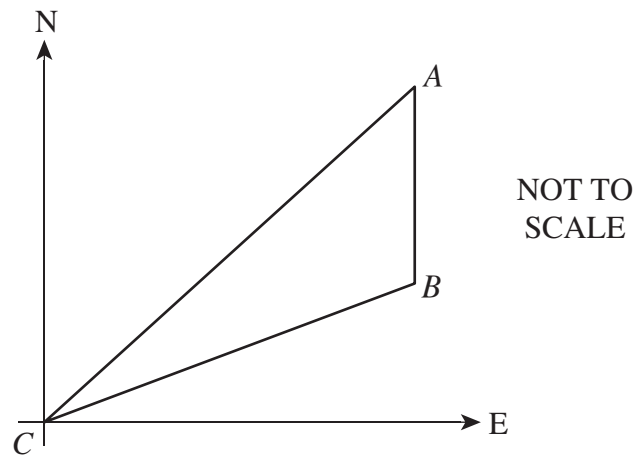
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Question 25 (5 marks)

Lewis travels 27 km from C to A on a bearing of 049°T . He then changes direction and travels due south for 12 km to B .



- (a) What is the value of $\angle CAB$? 1

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- (b) Find the distance from B to C , correct to one decimal place. 2

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- (c) What is the true bearing of B from C ? 2

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Question 26 (1 mark)

The number of people in a town is given by $N = 1000 (2.1^t)$ where N is the number of people and t is the time in years. **1**

What is the population of the town after five years?

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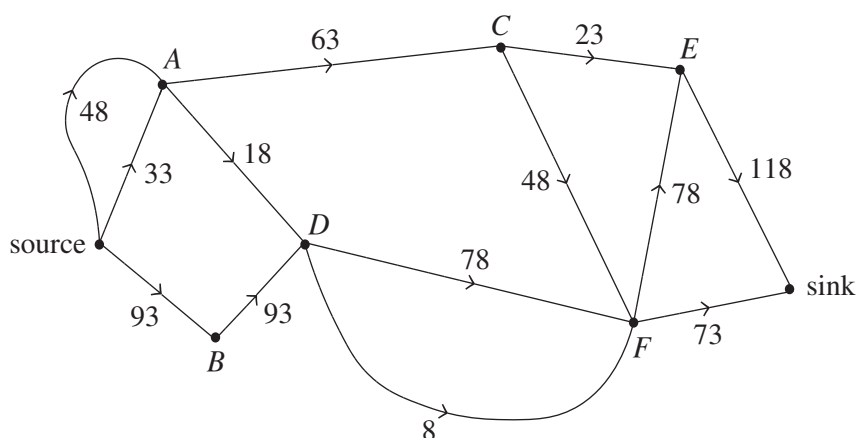
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Question 27 (4 marks)

The network diagram shows the flow of water in litres through a series of pipes from the source to the sink.



- (a) What is the outflow of vertex E ?

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- (b) Draw the minimum cut on the network diagram above.

2

- (c) What is the maximum flow for the network?

1

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Question 28 (2 marks)

An estimate of a person's maximum heart rate (MHR) is given by the formula $MHR = 220 - \text{age}$, where MHR is measured in beats per minute and age is measured in years. It is estimated that when a healthy person begins to exercise, they should have a heart rate that is 58% of their maximum heart rate.

2

Maya is healthy and is 18 years and three months old.

What is an estimate of Maya's heart rate, in beats per minute, when she begins exercising?
Give your answer correct to the nearest whole number.

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Question 29 (3 marks)

Winona runs her own business and gets a new credit card to make business purchases. **3**
The credit card:

- has no annual fees
- charges 15.7% per annum simple interest on all purchases
- charges interest daily (including the day of purchase and the day of payment).

On 27 August, Winona uses her credit card to purchase a tablet for an employee. The tablet costs \$1240. Winona makes the first repayment on 7 September.

What is the total amount Winona paid for the tablet, including interest? Give your answer correct to the nearest cent.

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Question 30 (2 marks)

The probability that a new variety of seed will produce flowers in the first year of growth after being planted is 0.4. Two hundred new variety seeds were planted. **2**

How many of the seeds would NOT be expected to produce flowers in the first year of growth?

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Question 31 (3 marks)

The table shows the present value of a \$1 annuity.

<i>Present value of \$1</i>						
<i>Period</i>	<i>1%</i>	<i>2%</i>	<i>4%</i>	<i>6%</i>	<i>8%</i>	<i>10%</i>
1	0.9901	0.9804	0.9615	0.9434	0.9259	0.9091
2	1.9704	1.9416	1.8861	1.8334	1.7833	1.7355
3	2.9410	2.8839	2.7751	2.6730	2.5771	2.4869
4	3.9020	3.8077	3.6299	3.4651	3.3121	3.1699
5	4.8534	4.7135	4.4518	4.2124	3.9927	3.7908
6	5.7955	5.6014	5.2421	4.9173	4.6229	4.3553

- (a) Calculate the present value of a \$15 000 per year annuity at 10% per annum for five years, with interest compounding annually. **1**

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- (b) Calculate the present value of a \$10 000 annuity invested every three months at 4% per annum, compounded quarterly for one year. **1**

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- (c) What is the value of the annuity that would provide a present value of \$52 217 after three years at 8% per annum compound interest? Give your answer correct to the nearest dollar. **1**

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Question 32 (2 marks)

A 4 kL water tank is emptied at a rate of 5 litres per minute.

2

How long will it take to empty the water tank? Give your answer in hours and minutes.

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Question 33 (5 marks)

A two-digit number is formed using the digits 3, 4 and 5. The first digit chosen is the tens digit and the second digit chosen is the units digit. Digits are NOT repeated.

- (a) Construct a tree diagram AND list the sample space. **2**

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- (b) What is the probability that the number is 55? **1**

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- (c) What is the probability that the number is 35? **1**

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- (d) If the digits ARE repeated, what is the probability that the number is 35? **1**

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Question 34 (1 mark)

The equation of the least-squares regression line is given by $y = mx + c$ where $m = r \frac{s_y}{s_x}$ **1**
and $c = \bar{y} - m\bar{x}$.

What is the y-intercept of the least-squares regression line given $m = 0.4$, $\bar{x} = 60$ and $\bar{y} = 85$?

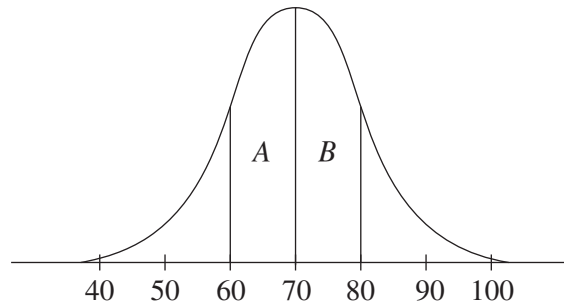
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Question 35 (5 marks)

The graph shows the normal distribution of the masses, in kilograms, of 500 students.



- (a) What is the standard deviation of the distribution? 1

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- (b) What percentage of students are in region A? 1

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- (c) What is the mass of a student with a z -score of -2 ? 1

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- (d) How many students selected at random will have a mass less than 100 kg? 2

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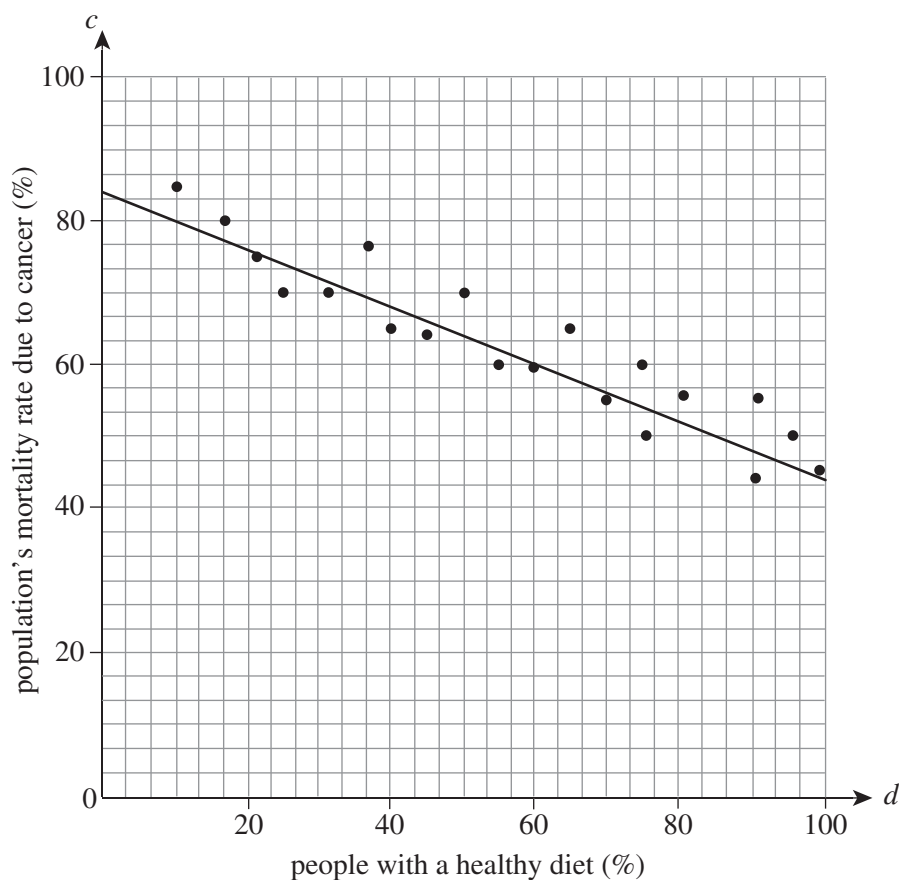
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Question 36 (3 marks)

The relationship between a population's mortality rate due to cancer (c) and the percentage of people with a healthy diet (d) is shown in the scatterplot..



- (a) Calculate the gradient of the line. 1

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- (b) What is the equation of the line of best fit? 1

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- (c) Estimate the value of the correlation coefficient. 1

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Question 37 (2 marks)

Samuel scored 71% in his first school assessment task for which the mean was 83% and the standard deviation was 6. In his second assessment task, he scored 66%; for which the mean was 76% and the standard deviation was 10.

2

Did Samuel's performance improve from his first assessment task to his second? Justify your answer with reference to Samuel's z -scores.

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Question 38 (3 marks)

The table shows a \$490 000 loan borrowed at a reducible interest of 5.6% per annum.

<i>Loan period in years</i>	15	20	25	30
<i>Monthly repayments</i>	\$3831	\$3318	\$3034	\$2864

- (a) Find the total amount to be repaid if the loan were taken over 20 years. **1**

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- (b) What extra amount would need to be repaid if the loan were taken over 25 years rather than 20 years? **2**

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Question 39 (2 marks)

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

<i>Future value of an annuity of \$1</i>				
<i>Period</i>	<i>1%</i>	<i>4%</i>	<i>8%</i>	<i>12%</i>
1	1.0000	1.0000	1.0000	1.0000
3	3.0301	3.1216	3.2464	3.3744
5	5.1010	5.4163	5.8666	6.3528

- (a) Find the future value of \$17 200 invested at the end of each year for three years at 12% per annum compounding annually. Give your answer correct to the nearest dollar. **1**

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- (b) Find the future value of \$900 invested at the end of each month for five months at 12% per annum compounding monthly. Give your answer correct to the nearest dollar. **1**

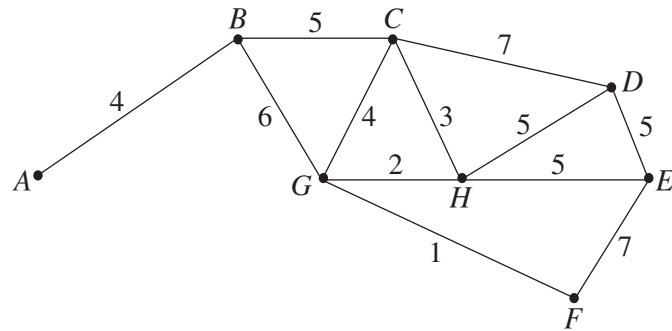
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Question 40 (6 marks)

The network diagram shows the distance between sites in a park in kilometres.



- (a) What is the distance to travel $ABCDE$? 1

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- (b) List the vertices with an even degree. 1

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- (c) What is the shortest distance to travel from C to F ? 1

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- (d) Draw a minimum spanning tree for this network AND determine its length. 3

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Question 41 (4 marks)

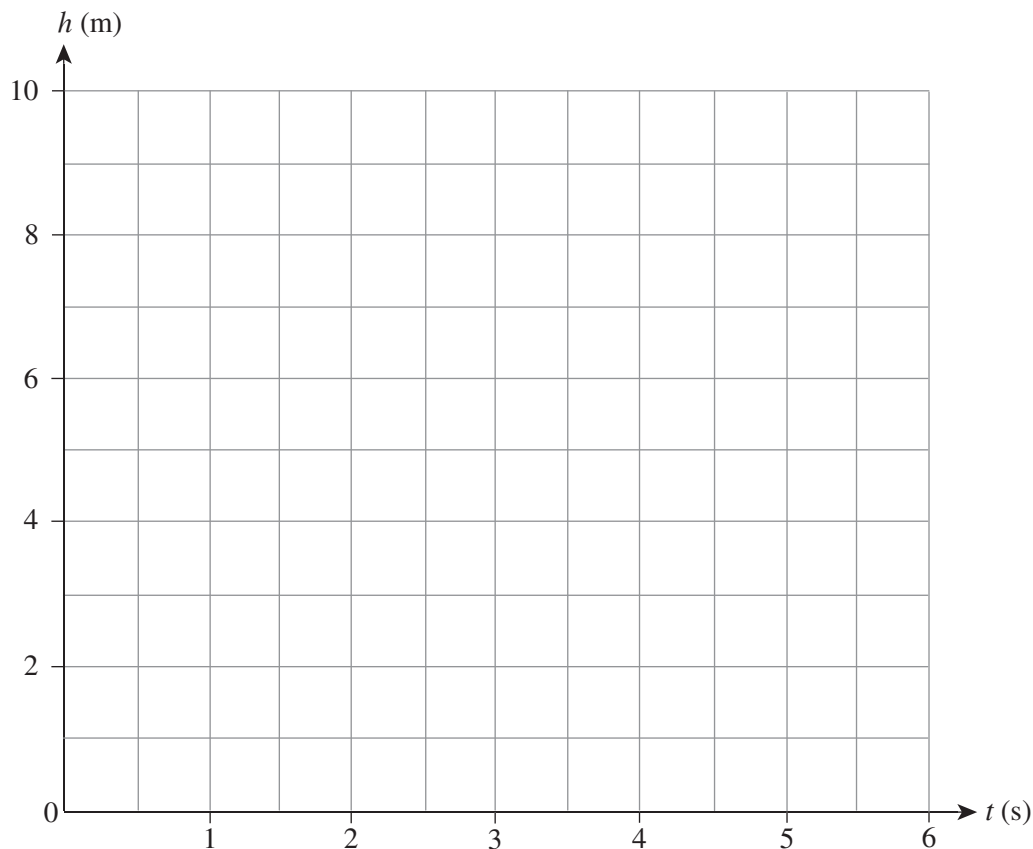
Christian throws a stone. The stone takes 6 seconds to reach the ground. The height, in metres, that it reaches is given by the formula $h = 6t - t^2$.

- (a) Complete the table of values.

1

t	0	1	2	3	4	5	6
h							

- (b) Draw the graph of $h = 6t - t^2$ on the axes provided.

1

- (c) What is the maximum height reached by the stone?

1

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- (d) When does the stone reach its maximum height?

1

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Question 42 (2 marks)

Heidi's new refrigerator consumes 160 W per hour.

- (a) How much electricity does the refrigerator consume in one week? Give your answer correct to the nearest kilowatt hour (kWh). **1**

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- (b) What is the cost of using the refrigerator for one week if electricity costs \$0.41 per kWh? Give your answer correct to the nearest cent. **1**

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Question 43 (4 marks)

A class of students is assigned a project that requires them to complete activities *A* to *G*. The activity chart shows the immediate prerequisite(s) and duration (in hours) for each activity.

<i>Activity</i>	<i>Immediate prerequisite(s)</i>	<i>Duration (hours)</i>
<i>A</i>	–	13
<i>B</i>	–	9
<i>C</i>	<i>A</i>	10
<i>D</i>	<i>A, B</i>	14
<i>E</i>	<i>D</i>	11
<i>F</i>	<i>C, E</i>	2
<i>G</i>	<i>D</i>	5

- (a) Construct a network diagram using the activity chart.

2

- (b) What is the minimum time required for the students to complete the project?

1

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- (c) Determine the float time of activity *G*.

1

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End of paper

Reference Sheet

Measurement

Limits of accuracy

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

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

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

Length

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

Area

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

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

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

Surface area

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

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

Volume

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

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

Trigonometry

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

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

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

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

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

Financial Mathematics

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

Straight-line method of depreciation

$$S = V_0 - Dn$$

Declining-balance method of depreciation

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

Statistical Analysis

An outlier is a score

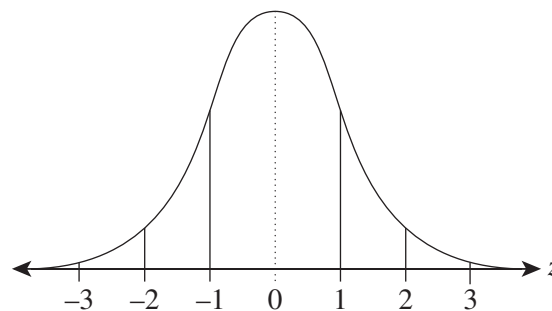
$$\text{less than } Q_1 - 1.5 \times IQR$$

or

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

$$z = \frac{x - \bar{x}}{s}$$

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