Student name:_____

Teachers name:_____

2026 TRIAL HIGHER SCHOOL CERTIFICATE EXAMINATION
Assessment Task 4

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

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

Section II - 85 marks

- Attempt Questions 16-41
- Allow about 2 hours and 5 minutes for this section

This examination paper is not to be removed from the Examination Centre

Disclaimer: Students are advised that this is a trial examination only and cannot in any way guarantee the content or the format of the 2026 HSC Mathematics Standard 2 Examination.

Section I

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

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

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1 Which of the following is true at the break-even point?

A. The profit and revenue are equal

B. The profit and costs are equal

C. The costs and revenue are equal

D. The variable costs and fixed costs are equal

2 A ball is thrown straight up, and the height in metres after t seconds is given by the formula

$$h = 9.8t - 4.9t^2 \ .$$

What is the stone's height when $t = 1$?

A. 1.75 metres

B. 4.9 metres

C. 5.25 metres

D. 6.75 metres

3 It is given that $A = \frac{h}{2}(a + b)$ and $h = 6$, $a = 8$ and $b = 12$.

What is the value of A?

A. 60

B. 71

C. 78

D. 120

4 Ms Lakshmipathy takes four weeks of annual leave. Her weekly pay is \$1 800 and her annual leave loading is $17\frac{1}{2}\%$ of four weeks' pay.

What is Ms Lakshmipathy's total pay for this period of annual leave?

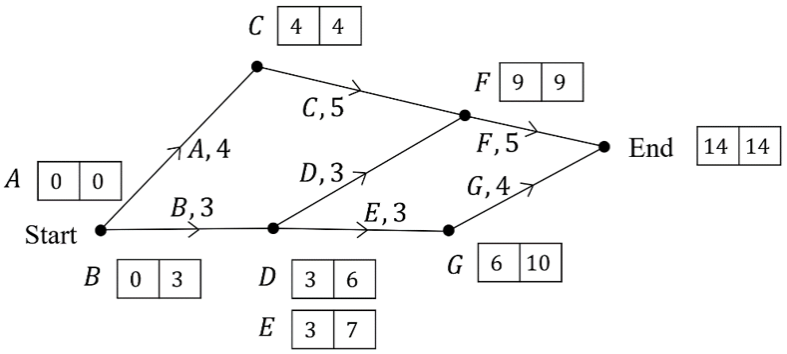
A. \$1 260

B. \$2 115

C. \$7 515

D. \$8 460

5 The network diagram shows the time needed for each step needed to complete a project.



What is the critical path to complete the project?

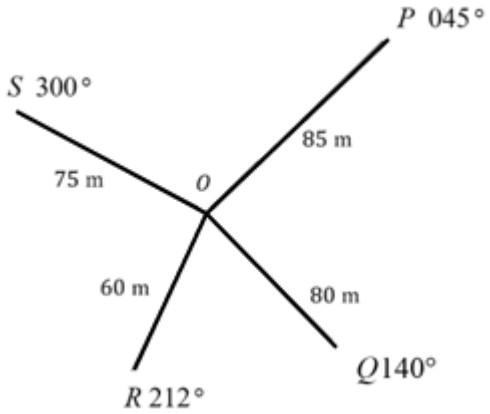
A. AC

B. BEG

C. BDF

D. ACF

6 The following radial survey of a property was done.



What is the area of ΔPOQ to the nearest square metre?

A. $2249\ \text{m}^2$

B. $2283\ \text{m}^2$

C. $3079\ \text{m}^2$

D. $3387\ \text{m}^2$

7 The gradient of the least-squares regression line is given by the formula

$$m = r \times \frac{s_y}{s_x} .$$

The least-squares regression line has a gradient of $m = 2$ for a dataset where $s_y = 12$ and $s_x = 3$.

Which of the following is the correct value for r?

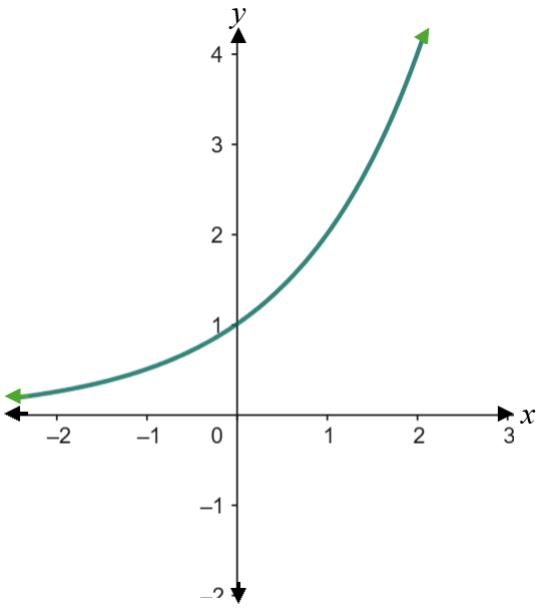
A. $r = -1$

B. $r = 0$

C. $r = \frac{1}{2}$

D. $r = 1$

8 Which equation could represent this graph?



A. $y = 2^x$

B. $y = x^2$

C. $y = 2x$

D. $y = \frac{2}{x}$

9 Sophia wants to buy her favourite fruit juice.

Which of the options listed below is the cheapest per litre?

A. Six 250 mL bottles for \$10.50

B. Ten 375 mL bottles for \$18.10

C. Twenty-four 375 mL bottles for \$37.70

D. Thirty 375 mL bottles for \$48.40

10 A mobile phone company charges a fixed monthly fee of \$25 plus \$0.10 per text message sent.
The relationship between the total monthly cost, C dollars, and the number of text messages sent, n, is represented by:

$$C = 25 + 0.10n$$

Which of the following graphs best represents this relationship?

A. A straight line passing through the origin with a positive gradient.

B. A straight line with a positive gradient and a vertical intercept of 25.

C. A straight line with a negative gradient and a vertical intercept of 25.

D. A curved graph that increases as n increases.

11 Aaryan borrows \$155 000. Interest is charged on the balance owing at a rate of 0.6% per month. A repayment of \$1200 is made at the end of each month.

What is the balance of the loan after the repayment at the end of the second month?

A. \$154 458.38

B. \$154 185.13

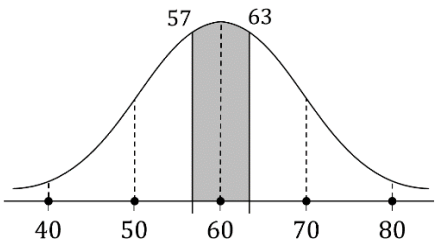
C. \$153 910.24

D. \$153 633.70

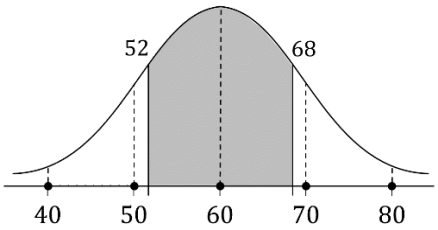
12 The scores of a class are normally distributed with a mean of 60 and a standard deviation of 10.

In which diagram below does the shaded region best indicate where the middle 60% of the scores lie?

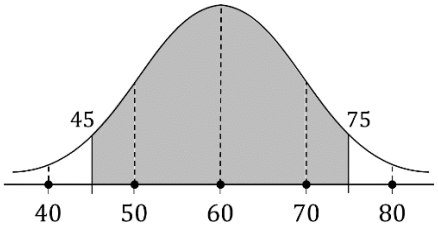
A.



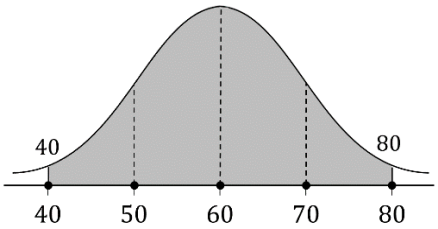
B.



C.



D.



13 A measurement of 45 centimetres was found to have a percentage error of ± 0.11 %.

Which of the following would be the absolute error?

A. $\pm$ 0.00495 cm

B. $\pm$ 0.0495 cm

C. $\pm$ 0.495 cm

D. $\pm$ 495 cm

14 Blood alcohol for a female can be estimated using the following BAC formula

$$\text{BAC}_{\text{Female}} = \frac{10N - 7.5H}{5.5M} \ ,$$

where N is the number of standard drinks consumed, H is the number of hours since they started drinking and M is the person's mass in kilograms.

Lucy weighs 58 kg and had a BAC of 0.08 after drinking for 2 hours.

How many standard drinks did she have?

A. 2.3

B. 3.2

C. 4.1

D. 5.5

15 Jordan owns a machine that is initially worth \$500 000 and which depreciates at a rate of 18% per year using the declining balance method.

How much will it depreciate in the third year?

A. \$60 516

B. \$73 800

C. \$275 684

D. \$336 200

End of Section I

Mathematics Standard 2

Section II Answer Booklet

Section II

85 marks
Attempt Questions 16-41
Show relevant mathematical reasoning and/or calculations
Allow about 2 hours and 5 minutes for this section

Instructions

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

Question 16 (2 marks)

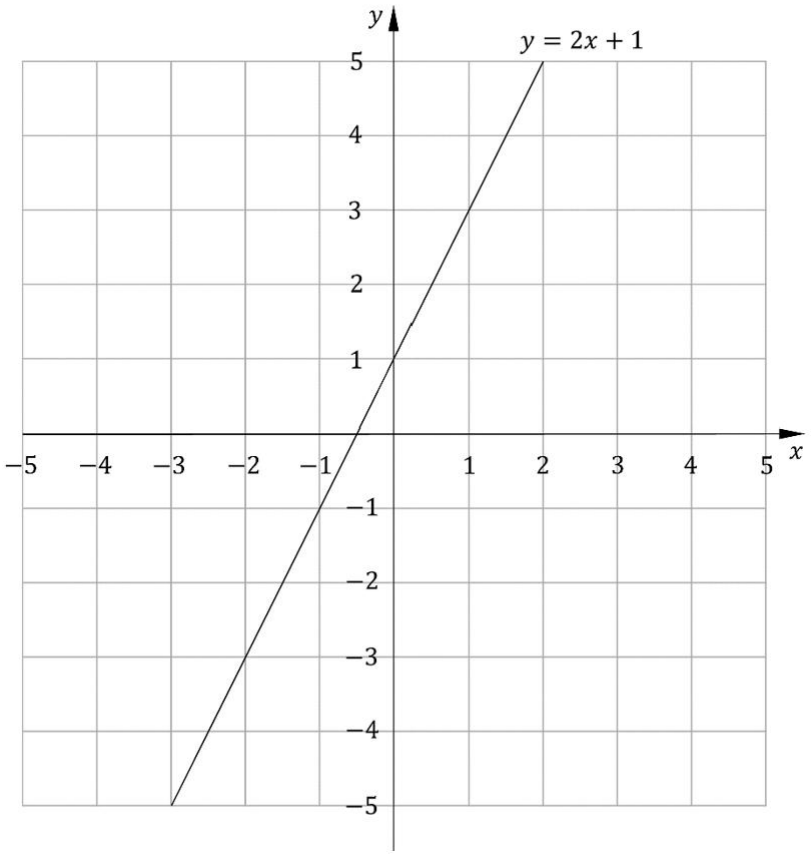
On a map of NSW, the distance between Townsville and Tweed Heads is 131 mm. **2**

The scale of the map is $1:10\,000\,000$.

What is the actual distance between Townsville and Tweed Heads in kilometres?

Question 17 (2 marks)

The line $y = 2x + 1$ is shown on the number plane below.



(a) Draw the line $x + y = -2$ on the same number plane. **1**

(b) What are the coordinates of the point of intersection? **1**

.....

Question 18 (3 marks)

Ekta is moving out of home into a new unit and needs to work out a budget. **3**

For washing clothes, she needs to buy a washing machine and clothes dryer, and allow for the first two year's electricity usage.

- The washing machine costs $947 and is estimated to use 426 kWh per year.
- The clothes dryer costs $599 and is estimated to use 202 kWh per year.
- Electricity is charged at 29.299 cents per kWh.

Find the total cost of purchasing the washing machine and clothes dryer and running them for two years.

Question 19 (3 marks)

A parent used Young's formula to calculate the required medication dosage for their child. **3**

Young's formula is

$$\text{Dosage} = \frac{\text{Age of child (years)} \times \text{Adult dose}}{\text{Age of child (years)} + 12}.$$

They found that the child's dosage was one quarter of the adult dose.

How old is the child?

Question 20 (3 marks)

Ashaal is standing at a lookout. She looks up and sees a seagull. **3**

The seagull is 153 m from Ashaal at an angle of elevation of 63°.

Ashaal then looks down and sees the seagull's nest **directly below** the seagull.
The nest is 87 m from Ashaal at an angle of depression of 27°.

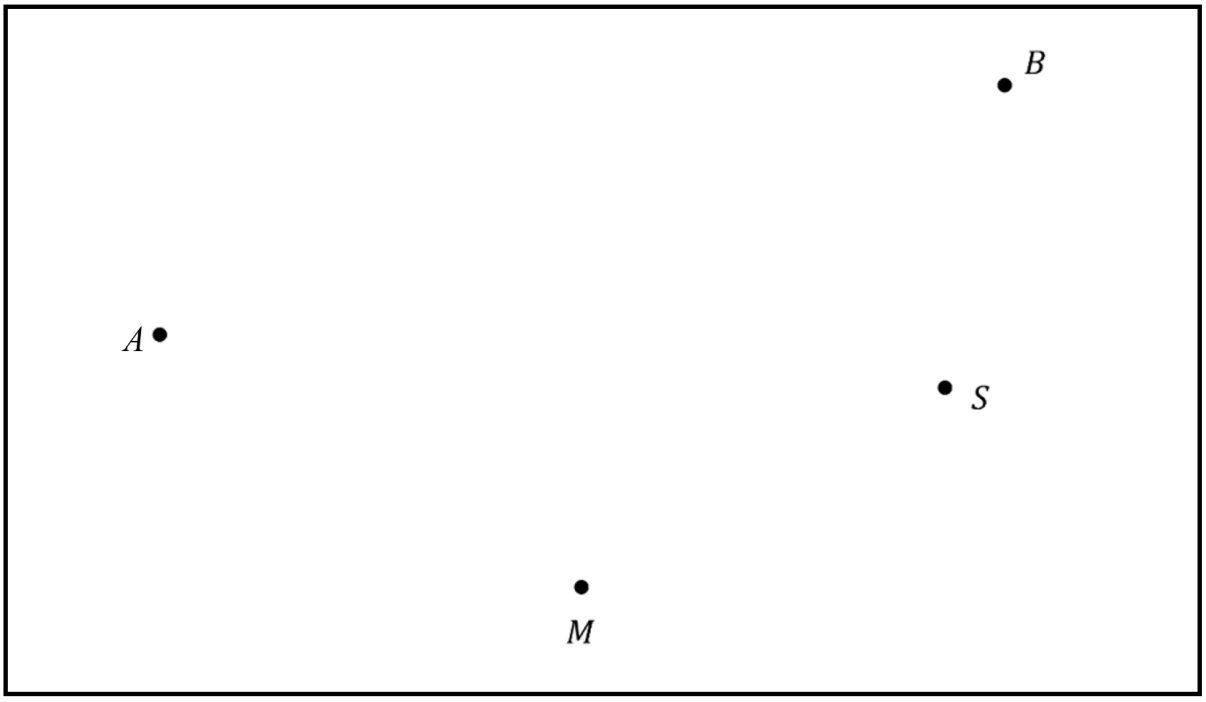
Draw a labelled diagram to represent this information.
Hence, calculate the distance between the seagull and its nest.
Give your answer to the nearest metre.

Question 21 (2 marks)

The network shown in the table below shows road distances between four Australian cities. **2**

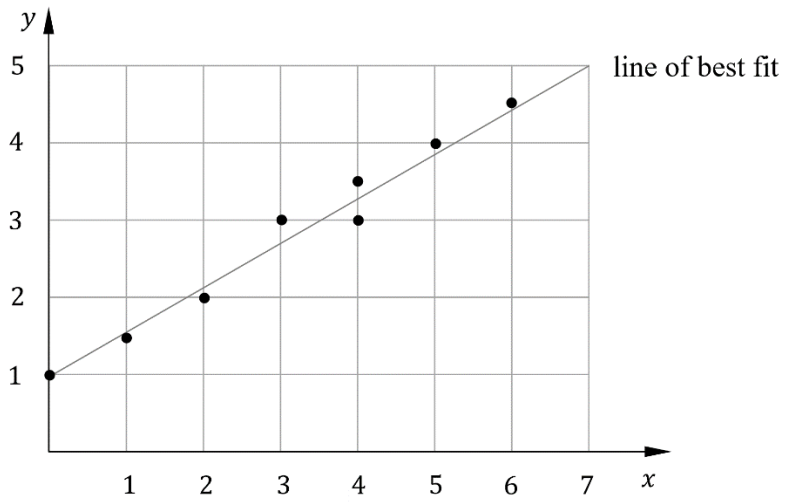
City	Adelaide (A)	Brisbane (B)	Melbourne (M)	Sydney (S)
(A)	-	2020 km	730 km	1380 km
(B)	2020 km	-	-	910 km
(M)	730 km	-	-	880 km
(S)	1380 km	910 km	880 km	-

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



Question 22 (3 marks)

Consider the bivariate data shown in the scatterplot below.



(a) Describe the bivariate dataset in terms of strength and direction. **2**

Strength:

.....

Direction:

.....

(b) The line of best fit passes through (7, 5) and (0,1). **1**
Find the equation of the line of best fit that is drawn on the scatterplot in the form $y = mx + c$.

.....

.....

.....

.....

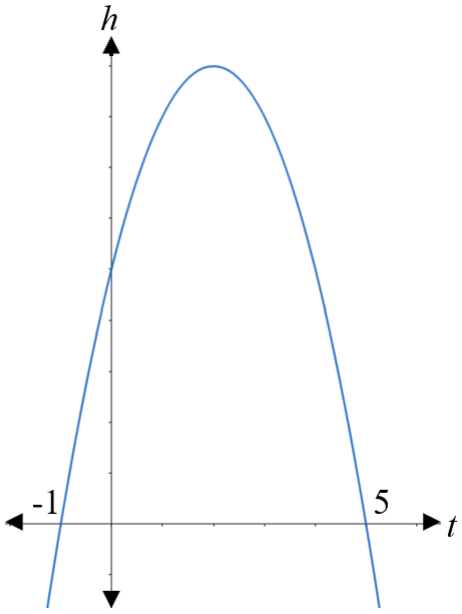
Question 23 (2 marks)

Leena decided to buy shares at a price of \$55.75 per share. She receives a dividend of \$2.49 per share. **2**

Calculate the dividend yield as a percentage correct to one decimal place.

Question 24 (3 marks)

The graph of a quadratic function represented by the equation $h = -t^2 + 4t + 5$ is shown.



(a) Find the values of t and h at the turning point of the graph. **2**

(b) The graph shows $h = 5$ when $t = 0$.

What is the other value of t for which $h = 5$? **1**

Question 25 (4 marks)

The bivariate data below shows the relationship between the number of hours students spent studying for an examination and their examination mark.

Study Hours	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Mark (%)	52	58	61	68	72	77	81	85

A line of best fit for the data is:

$$\text{Mark} = 4.7(\text{Study Hours}) + 44$$

(a) Use the line of best fit to predict the examination mark of a student who studies for 10 hours. **1**

(b) A student claims that studying for an extra hour will always increase their examination mark by about 5%.
Use the data and the line of best fit to analyse this claim. **3**

Question 26 (4 marks)

From the top of Mount Rian a bushwalker sees two other mountains.

- Mount Lily is 10 kilometres away at a bearing of 140°.
- Mount Afra is 12 kilometres away at a bearing of 120°.

(a) Draw a labelled diagram showing all relevant information. **1**

(b) Find the distance from Mount Lily to Mount Afra. Answer to the nearest hundred metres. **3**

Question 27 (2 marks)

The future value of an annuity when \$1 is invested at the start of each period is shown in the table below.

Future value of \$1						
Period	1%	2%	3%	4%	5%	6%
1	\$1.0100	\$1.0200	\$1.0300	\$1.0400	\$1.0500	\$1.0600
2	\$2.0301	\$2.0604	\$2.0909	\$2.1216	\$2.1525	\$2.1836
3	\$3.0604	\$3.1216	\$3.1836	\$3.2465	\$3.3101	\$3.3746
4	\$4.1010	\$4.2040	\$4.3091	\$4.4163	\$4.5256	\$4.6371
5	\$5.1520	\$5.3081	\$5.4684	\$5.6330	\$5.8019	\$5.9753
6	\$6.2135	\$6.4343	\$6.6625	\$6.8983	\$7.1420	\$7.3938

Nikhil invests \$8 000 at the start of each half-year for two years and earns 4% p.a. compounded twice a year.

Find the future value of the investment. **2**

Question 28 (3 marks)

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

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

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

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

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

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

Question 29 (6 marks)

Leane is saving for a holiday to Europe in twelve months' time. She needs at least $6 000 for the trip.

She has decided to put $500 at the end of each month into a special bank account that pays interest that compounds monthly. Interest is charged on the balance at the beginning of each month (i.e. Starting Balance).
She creates a spreadsheet to keep track of her savings, the first three months of which are shown below.

Month	Starting Balance	Interest	Deposit	Final Balance
1	$0.00	$0.00	$500.00	$500.00
2	$500.00	$2.50	$500.00	$1002.50
3	$1002.50	$5.01	$500.00	$1507.51

(a) What is the monthly interest rate? **1**

Question 29 (continued)

(b) The last two rows of the table are shown below. **3**

Find the four values A, B, C and D.

Month	Starting Balance	Interest	Deposit	Final Balance
11	\$5114.01	\$25.57	\$500.00	**A**
12	**B**	**C**	**D**	\$6167.78

(c) If she chose to invest one lump sum at the start of the twelve months, instead of making the monthly deposits of \$500, how much would she have had to invest to get the same final amount? **2**

Question 30 (3 marks)

Maryam needs a twelve-month loan for $9 000. She has the following loan options: **3**

- A payday lender at 0.92% per week, interest compounded weekly.
- A bank at 11.99% p.a., interest compounded monthly.

She will repay the loan with a single lump sum at the end of the twelve months.

How much more will it cost her if she takes the loan from the payday lender rather than the bank?

Question 31 (5 marks)

A popular cake mix comes in a box with a nominal weight of 220 grams.

It has been found that the actual weights of boxes being produced are normally distributed with a mean of 220 grams and a standard deviation of 10 grams.

(a) The packaging machine automatically rejects any box that weighs less than 210 grams or more than 240 grams. **3**

What percentage of cake mix boxes are rejected?

Question 31 continued next page…

Question 31 (continued)

(b) Any boxes that weigh more than 250 grams are set aside and donated to charity. **2**

The factory produces 10 000 boxes of cake mix a day. How many of these exceed 250 grams and get donated to charity?

Question 32 (4 marks)

Scientists perform two wildlife surveys six months apart to estimate the total koala population in a valley.

In the first survey they tagged 70 koalas and then released them back into the wild.

In the second survey six months later, they caught and checked 100 koalas. Of these 100 koalas, 35 had tags.

(a) What is the estimate for the number of koalas in the valley? **2**

The scientists then discovered that 6 of the koalas that had been tagged in the first survey had been moved to another location to help with a breeding program, so were not in the valley at the time of the second survey.

(b) What is the better estimate for the number of koalas in the valley at the time of the second survey? **2**

Question 33 (5 marks)

The time taken (t) for a colony of ants to break up a sandwich and carry it away to the nest is inversely proportional to the number of ants (n) performing the task.

If there are 20 ants, then it takes 42 minutes for the sandwich to be taken to the nest.

(a) Calculate how long it takes for 32 ants to carry the sandwich to the nest. **3**

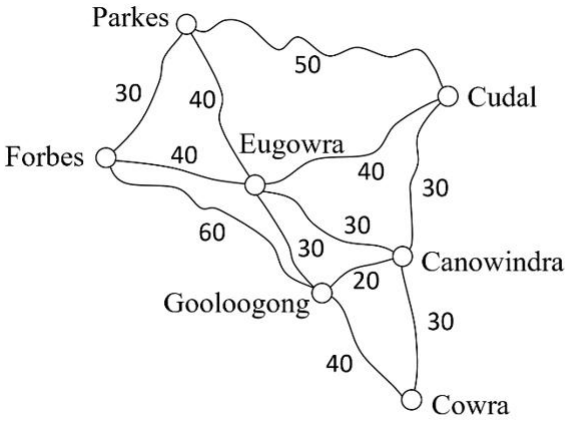
Question 33 continued next page…

(b) Another group of ants takes 1 hour and 10 minutes to carry the sandwich to the nest. **2**

How many ants are in this group?

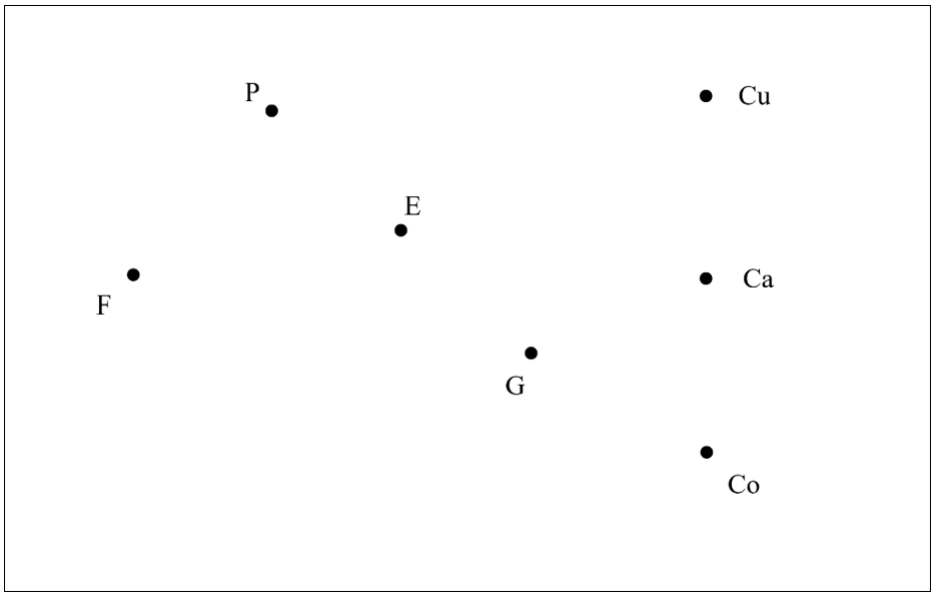
Question 34 (4 marks)

The road map shows the roads connecting 7 towns. The numbers represent the distances along the roads between the towns, in kilometres.



(a) Each town is to be connected to a new water supply. **2**

By drawing a minimum spanning tree in the space below, calculate the minimum length of pipes required to supply water to all towns if the water pipes can only be laid along the roads.



Minimum length = _____

Question 34 continued next page…

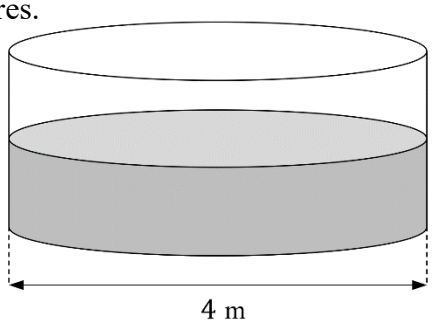
(b) A motorist usually travels the shortest possible route from Parkes to Cowra, however, road works have shut the Parkes to Eugowra Road. **2**

If they have to travel from Parkes to Cowra and back on the shortest available route, how much extra distance will they have to travel each way?

Question 35 (4 marks)

A large farm shed has a flat rectangular roof which is 12 metres wide by 24 metres long. During a thunder storm 20 mm of rain falls onto the roof in 10 minutes. **4**

Rain that falls on the roof drains immediately into a cylindrical rainwater tank with a diameter of 4 metres.



Calculate the average rate at which the water level in the tank changes during the storm. Answer in centimetres per minute to 1 decimal place.

Question 36 (4 marks)

A project requires activities A to F to be completed. The activity chart shows the immediate prerequisites and duration for each activity. **4**

Activity	Immediate Prerequisites	Duration in minutes
A	-	6
B	A	2
C	A	4
D	C	3
E	B, D	2
F	C	4
X	A	

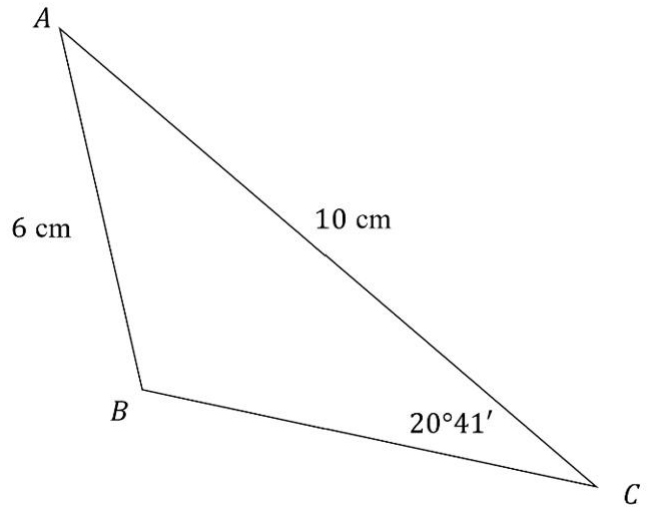
A new activity, X, is added to the project, and has A as an immediate prerequisite. No other activity has X as an immediate prerequisite.

By first drawing a network diagram showing all seven activities, find the maximum duration of X if it does not increase the minimum time to complete the project.

Maximum duration of X=_____

Question 37 (3 marks)

In ΔABC, $AC = 10$ cm, $AB = 6$ cm and $\angle ACB = 20°41'$. **3**



Given that $\angle ABC$ is obtuse, find the size of $\angle BAC$ to the nearest minute.

Question 38 (2 marks)

A bag contains 7 red balls and 9 blue balls. One ball is selected at random and thrown in the bin. A second ball is then selected from the remaining balls in the bag. **2**

Find the probability that the two balls selected are the same colour.

Question 39 (2 marks)

A factory tests a batch of batteries and finds that 77 of them are good while 3 are faulty.

(a) Express, as a percentage, the probability that a battery selected at random is good. **1**

(b) If the factory makes 5 000 batteries, how many would you expect to be faulty? **1**

Question 40 (3 marks)

A credit card has an interest-free period of 30 days from and including the date of purchase. Interest is charged on purchases made, compounding daily at a rate of 12.99% per annum, from and including the day following the interest free period. **3**

Theatre tickets were purchased for a total of $478 using the credit card.

Full payment was made on the 62nd day from the date of purchase. There are no other purchases on this credit card.

What was the total interest charged when the account was paid in full?

Question 41 (4 marks)

A financial adviser writes the following post: **4**

"If two investments have the same annual interest rate, they will earn exactly the same amount of interest over the same time period. The compounding frequency makes no difference."

To support the claim, the financial adviser shows the following calculations.

Investment	Principal	Interest Rate	Compounding	Time	Final Balance
Investment A	\$10 000	6% p.a.	Annually	5 years	\$13 382.26
Investment B	\$10 000	6% p.a	Monthly	5 years	\$13 382.26

Analyse the financial adviser's claim.

In your response:

- calculate the correct final balance for **Investment B**
- identify any errors in the financial adviser's reasoning
- determine whether the claim is valid
- justify your conclusion using appropriate calculations and financial reasoning.

End of Section II

End of Examination

Student name: Marking Guidelines

Teachers Name:_____

2026 **TRIAL HIGHER SCHOOL CERTIFICATE EXAMINATION**
Assessment Task 4

Mathematics Standard 2

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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 Which of the following is true at the break-even point?

A. The profit and revenue are equal

B. The profit and costs are equal

C. The costs and revenue are equal

D. The variable costs and fixed costs are equal

Solution
The costs and revenue are equal

Marking Guideline
1 mark for correct answer

Answer C

2 A ball is thrown straight up, and the height in metres after t seconds is given by the formula

$$h = 9.8t - 4.9t^2 \ .$$

What is the stone's height when $t = 1$?

A. 1.75 metres

B. 4.9 metres

C. 5.25 metres

D. 6.75 metres

Solution

$$t = 1, \quad h = 9.8(1) - 4.9(1)^2$$
$$= 9.8 - 4.9$$
$$= 4.9$$

Marking Guideline
1 mark for correct answer

Answer B

3 It is given that $A = \frac{h}{2}(a + b)$ and $h = 6$, $a = 8$ and $b = 12$.

What is the value of A?

A. 60

B. 71

C. 78

D. 120

Solution

$A = \frac{6}{2}(8+12)$

$A = 60$

Marking Guideline
1 mark for correct answer

Answer A

4 Ms Lakshmipathy takes four weeks of annual leave. Her weekly pay is \$1 800 and her annual leave loading is $17\frac{1}{2}\%$ of four weeks' pay.

What is Ms Lakshmipathy's total pay for this period of annual leave?

A. \$1 260

B. \$2 115

C. \$7 515

D. \$8 460

Solution

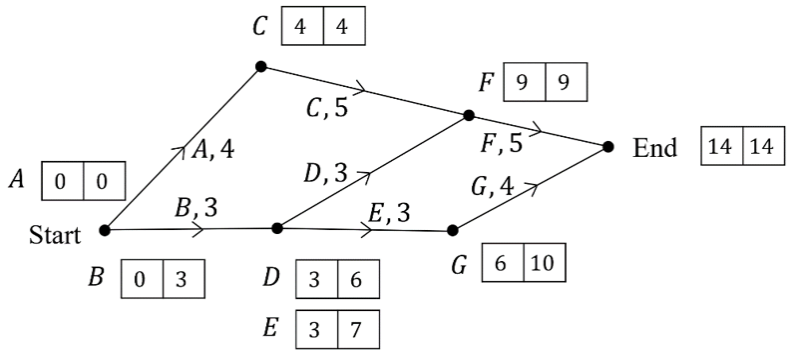
$Pay = (1800 \times 4) \times 1.175$

$= \$8460$

Marking Guideline
1 mark for correct answer

Answer D

5 The network diagram shows the time needed for each step needed to complete a project.



What is the critical path to complete the project?

A. AC

B. BEG

C. BDF

D. ACF

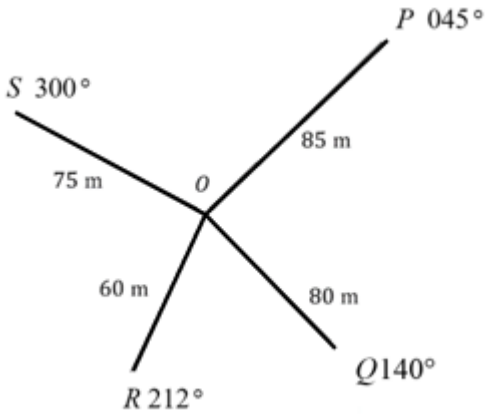
Solution

The easiest way to identify the critical path is to look for the path where all EST and LST's are equal in the table, which is ACF in this case.

Answer D

Marking Guideline
1 mark for correct answer

6 The following radial survey of a property was done.



What is the area of ΔPOQ to the nearest square metre?

A. $2249\ \text{m}^2$

B. $2283\ \text{m}^2$

C. $3079\ \text{m}^2$

D. $3387\ \text{m}^2$

Solution

$$Area_{\Delta POQ} = \frac{1}{2}(85)(80)\sin(140° - 45°)$$
$$= 3387\ \text{m}^2$$

Marking Guideline
1 mark for correct answer

Answer D

7 The gradient of the least-squares regression line is given by the formula

$$m = r \times \frac{s_y}{s_x} .$$

The least-squares regression line has a gradient of $m = 2$ for a dataset where $s_y = 12$ and $s_x = 3$.

Which of the following is the correct value for r?

A. $r = -1$

B. $r = 0$

C. $r = \frac{1}{2}$

D. $r = 1$

Solution

$m = 2,\ s_y = 12,\ s_x = 3$

$$2 = r \times \frac{12}{3}$$

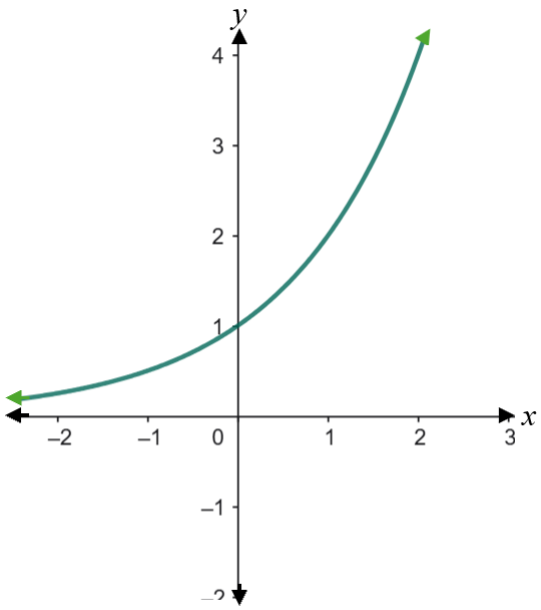
$$2 = 4r$$

$$\therefore r = \frac{1}{2}$$

Answer C

Marking Guideline
1 mark for correct answer

8 Which equation could represent this graph?



A. $y = 2^x$

B. $y = x^2$

C. $y = 2x$

D. $y = \frac{2}{x}$

Solution

This is a graph of an exponential function of the form $y = a^x$.

$\therefore y = 2^x$ is the equation of this graph.

Answer A

Marking Guideline
1 mark for correct answer

9 Sophia wants to buy her favourite fruit juice.

Which of the options listed below is the cheapest per litre?

A. Six 250 mL bottles for $10.50

B. Ten 375 mL bottles for $18.10

C. Twenty-four 375 mL bottles for $37.70

D. Thirty 375 mL bottles for $48.40

Solution

A $\dfrac{10.5}{6\times 0.25} = \$7 \text{ per litre}$

B $\dfrac{18.1}{10\times 0.375} = \$8.04 \text{ per litre}$

C $\dfrac{37.7}{24\times 0.375} = \$4.18 \text{ per litre}$

D $\dfrac{48.4}{30\times 0.375} = \$4.30 \text{ per litre}$

C < D < A <B
Therefore, cheapest per litre is option C

Marking Guideline
1 mark for correct answer

Answer C

10 A mobile phone company charges a fixed monthly fee of \$25 plus \$0.10 per text message sent.
The relationship between the total monthly cost, C dollars, and the number of text messages sent, n, is represented by:

$$C = 25 + 0.10n$$

Which of the following graphs best represents this relationship?

A. A straight line passing through the origin with a positive gradient.

B. A straight line with a positive gradient and a vertical intercept of 25.

C. A straight line with a negative gradient and a vertical intercept of 25.

D. A curved graph that increases as n increases.

Solution

Gradient $m = 0.10 > 0$ positive gradient
Vertical intercept =25
A straight line with a positive gradient and a vertical intercept of 25

Marking Guideline
1 mark for correct answer

Answer B

11 Aaryan borrows \$155 000. Interest is charged on the balance owing at a rate of 0.6% per month. A repayment of \$1200 is made at the end of each month.

What is the balance of the loan after the repayment at the end of the second month?

A. \$154 458.38

B. \$154 185.13

C. \$153 910.24

D. \$153 633.70

Solution

$V_0 = \$155000$
$V_1 = V_0 \times 1.006 - 1200 = \$154730$
$V_2 = V_1 \times 1.006 - 1200 = \$154458.38$
Balance of loan at end of second year is \$154458.38

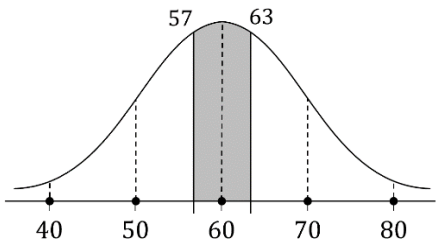
Marking Guideline
1 mark for correct answer

Answer A

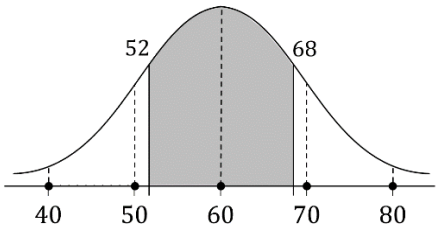
12 The scores of a class are normally distributed with a mean of 60 and a standard deviation of 10.

In which diagram below does the shaded region best indicate where the middle 60% of the scores lie?

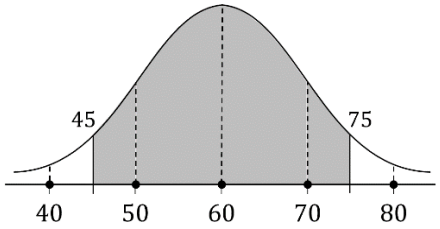
A.



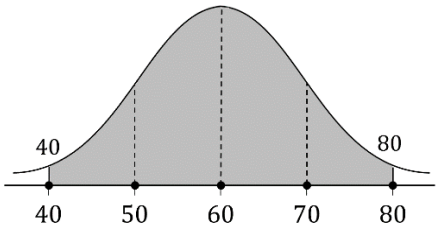
B.



C.



D.



Solution

The empirical rule states that the middle 68% of scores lie within one standard deviation of the mean, so in this case between 50 and 70.

Since 60% is a bit less than 68% then we want a bit less than one standard deviation either side of the mean, thus 52 to 68 is the best option.

Answer B

Marking Guideline
1 mark for correct answer

13 A measurement of 45 centimetres was found to have a percentage error of ± 0.11 %.

Which of the following would be the absolute error?

A. $\pm$ 0.005 cm

B. $\pm$ 0.05 cm

C. $\pm$ 0.5 cm

D. $\pm$ 5 cm

Solution

$$\text{Percentage error} = \frac{\text{absolute error}}{\text{measurement}}$$

$$\pm 0.11\% = \frac{\text{absolute error}}{45\,\text{cm}}$$

$$\text{absolute error} = \pm 0.11\% \times 45$$

$$= \pm 0.0495$$

$$\approx \pm 0.05 \text{ cm}$$

Marking Guideline
1 mark for correct answer

Answer B

14 Blood alcohol for a female can be estimated using the following BAC formula

$$\text{BAC}_{\text{Female}} = \frac{10N - 7.5H}{5.5M},$$

where N is the number of standard drinks consumed, H is the number of hours since they started drinking and M is the person's mass in kilograms.

Lucy weighs 58 kg and had a BAC of 0.08 after drinking for 2 hours.

How many standard drinks did she have?

A. 2.3

B. 3.2

C. 4.1

D. 5.5

Solution

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

$$0.08 = \frac{10N - 7.5(2)}{5.5(58)}$$

$$0.08 = \frac{10N - 15}{319}$$

$$10N - 15 = 25.52$$

$$10N = 40.52$$

$$N = 4.052$$

$$N \approx 4.1$$

Marking Guideline
1 mark for correct answer

Answer C

15 Jordan owns a machine that is initially worth \$500 000 and which depreciates at a rate of 18% per year using the declining balance method.

How much will it depreciate in the third year?

A. \$60 516

B. \$73 800

C. \$275 684

D. \$336 200

Solution

$$\text{Salvage value after 2 years} = 500\,000(1-0.18)^2$$
$$= \$336\,200$$
$$\text{Salvage value after 3 years} = 500\,000(1-0.18)^3$$
$$= \$275\,684$$
$$\text{Depreciation in 3rd years} = \$336\,200 - \$275\,684$$
$$= \$60\,516$$

Answer A

Marking Guideline
1 mark for correct answer

End of Section I

Mathematics Standard 2

Section II Answer Booklet

Section II

85 marks
Attempt Questions 16-41
Show relevant mathematical reasoning and/or calculations
Allow about 2 hours and 5 minutes for this section

Instructions

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

Question 16 (2 marks)

On a map of NSW, the distance between Townsville and Tweed Heads is 131 mm. **2**

The scale of the map is 1: 10 000 000.

What is the actual distance between Townsville and Tweed Heads in kilometres?

Solution

Map is scale 1:10 000 000

$$\text{Actual distance} = 131 \times 10\,000\,000$$
$$= 131000\,\text{m}$$
$$= 1310\,\text{km}$$

2 Marks for for complete correct solution

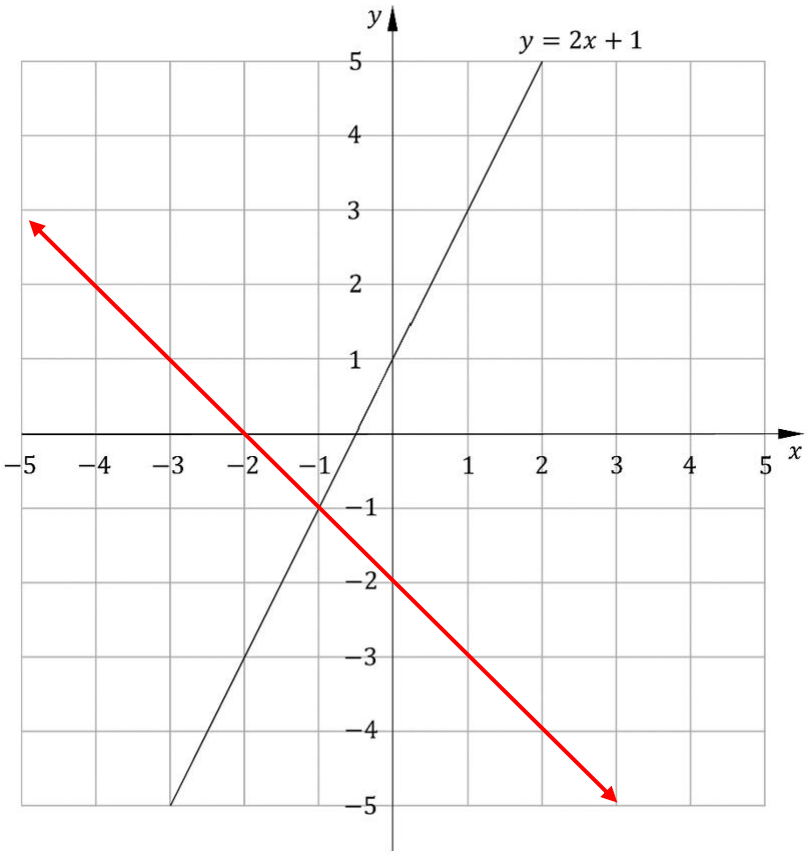
1 Mark for finding:

Actual distance $= 131 \times 10\,000\,000$ mm

but did not convert answer to km.

Question 17 (2 marks)

The line $y = 2x + 1$ is shown on the axes below.



(a) Draw the line $x + y = -2$ on the axes. **1**

Solution

See diagram for correct graph

Marking guidelines

1 Mark for correct graph

(b) What are the coordinates of the point of intersection? **1**

Solution

$(-1, -1)$

Marking guidelines

1 Mark for correct answer

Question 18 (3 marks)

Ekta is moving out of home into a new unit and needs to work out a budget. **3**

For washing clothes, she needs to buy a washing machine and clothes dryer, and allow for the first two year's electricity usage.

- The washing machine costs \$947 and is estimated to use 426 kWh per year.
- The clothes dryer costs \$599 and is estimated to use 202 kWh per year.
- Electricity is charged at 29.299 cents per kWh.

Find the total cost of purchasing the washing machine and clothes dryer and running them for two years.

Solution

$$\begin{aligned}\text{Purchase cost} &= 947+599\\ &= \$1546\\ \text{Electricity cost per year} &= 0.29299(426+202)\\ &= \$183.99772\\ &= \$184\\ \text{Total cost for 2 years} &= 1546+2(184)\\ &= \$1914\end{aligned}$$

Marking guidelines

3 Marks for complete correct solution

2 Marks for finding the total cost for 1 year instead of two years

Or

2 Marks given for CFPE (i.e. not changing 29.9299 cents per kWh to \$ per kWh) but the rest of the solution is correct.

Or

2 Marks for correct solution containing a calculation error

1 Mark for any correct working out that could lead to a correct solution

Question 19 (3 marks)

A parent used Young's formula to calculate the required medication dosage for their child. **3**

Young's formula is

$$\text{Dosage} = \frac{\text{Age of child (years)} \times \text{Adult dose}}{\text{Age of child (years)} + 12}.$$

They found that the child's dosage was one quarter of the adult dose.

How old is the child?

Solution

let a be the child's age in years

let d be the aduld dosage

$\frac{1}{4}d = \frac{ad}{a+12}$

$\frac{d}{4} = \frac{ad}{a+12}$

divide both sides by d

$\frac{1}{4} = \frac{a}{a+12}$

multiply both sides by 4 and a+12

$a+12 = 4a$

subtract a from both sides

$12 = 3a$

divide both sides by 3

$\therefore a = 4$

OR

Solution

Let the child's age in years be a

Let the adult dose be 8 and the child's dose be 2, since the child's dose was one quarter of the adult dose and

$\frac{1}{4}$ of $8 = 2$.

$$\therefore 2 = \frac{a \times 8}{a+12}$$

$2(a+12) = 8a$

$2a + 24 = 8a$

$24 = 6a$

$\therefore a = 4$

$\therefore$ the child's age is 4 years old.

OR

Solution

Using "guess and check" method correctly to find solution.

Marking guidelines

3 Marks for complete correct solution

2 Marks partial correct solutions contain one error

1 Mark for bald answer or any working out that could lead to a correct solution

Question 20 (3 marks)

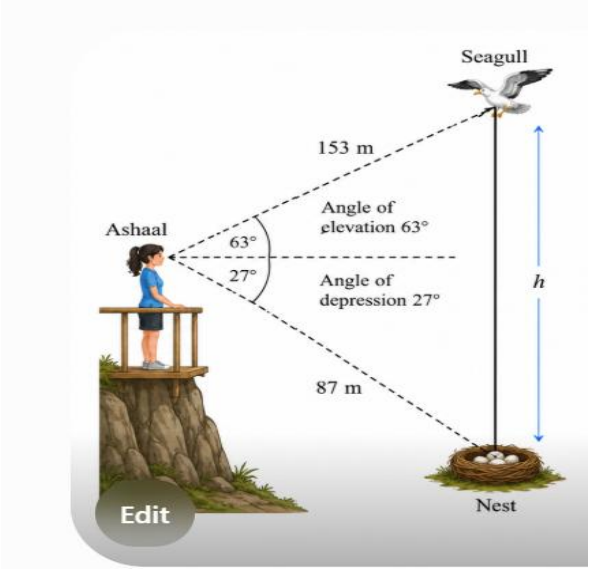
Ashaal is at a lookout. She looks up and sees a sea gull. **3**

The distance from Ashaal to the sea gull is 153 metres and it is at an angle of elevation of 63°.

Ashaal looks down from the sea gull and sees its nest. The distance from Ashaal to the nest is 87 metres and it is at an angle of depression of 27°.

Draw a diagram to represent this information, then calculate the distance of the sea gull is from its nest. Answer correct to the nearest metre.

Solution



$63° + 27° = 90°$

$\therefore$ The triangle is a right angled triangle.

Using Pythagoras Theorem

$d = \sqrt{153^2 + 87^2}$

$= 176.0056817...$

$= 176$ m (to nearest metre

Note:

Some students used the cosine rule or sine rule or cosine ratioto calculate d, these are all acceptable methods.

Students who used the sine rule or the cosine ratio methods found $d = 192$ which is correct for those methods since the problem, as written, contains inconsistent data given to satisfy these soluion methods.

Marking guidelines

3 Marks for complete correct solution with correct diagram

2 Marks for partially correct solution containing one error

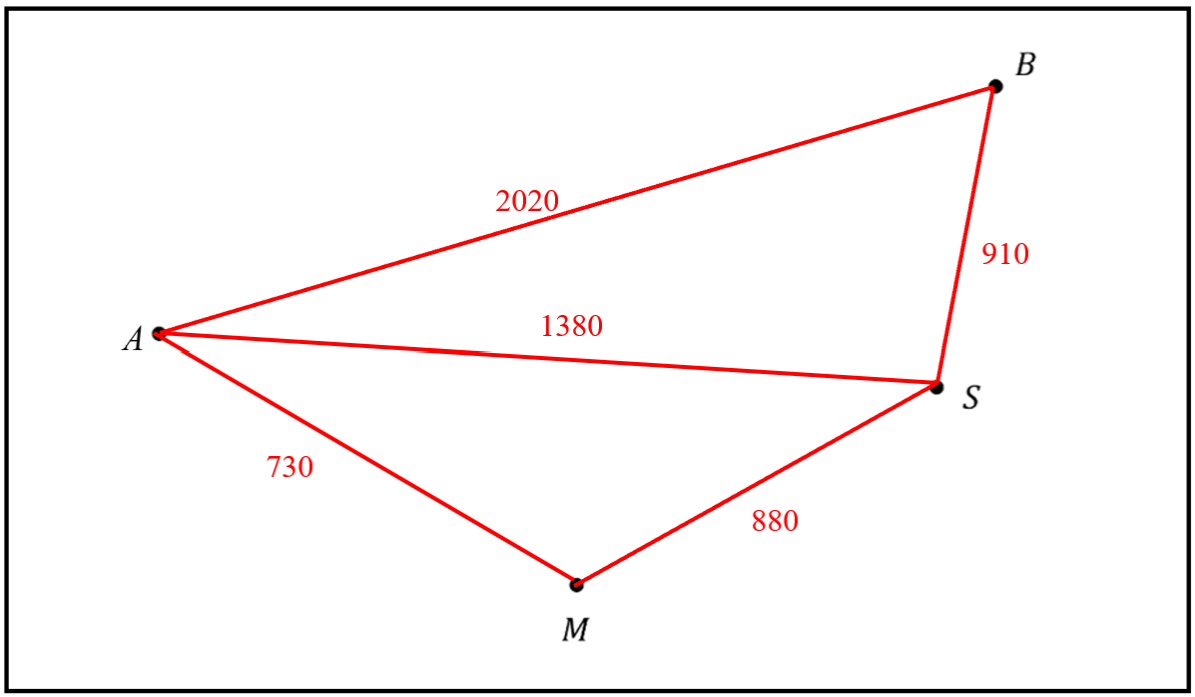
1 Mark for correct diagram but incorrect method, or for any working that could lead to a correct solution

Question 21 (2 marks)

The network shown in the table below shows road distances between four Australian cities. **2**

City	Adelaide (A)	Brisbane (B)	Melbourne (M)	Sydney (S)
(A)	-	2020 km	730 km	1380 km
(B)	2020 km	-	-	910 km
(M)	730 km	-	-	880 km
(S)	1380 km	910 km	880 km	-

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



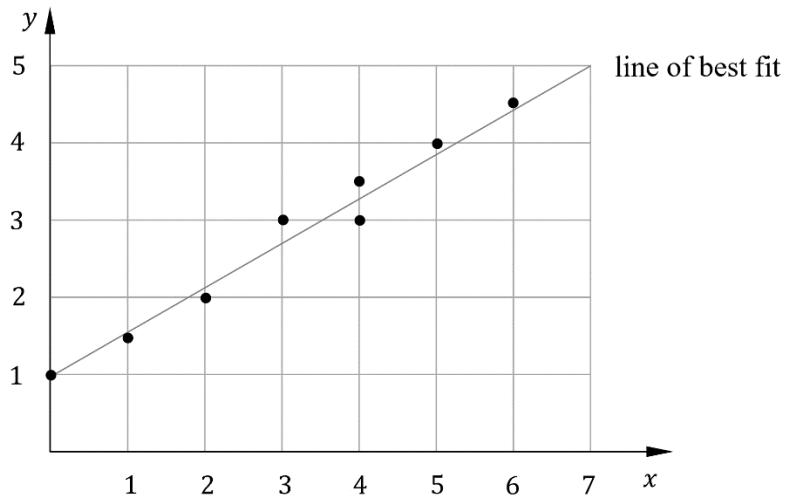
Marking guidelines

2 Marks for complete correct diagram showing information from the table.

1 Mark for correct diagram with at least three correct weights on it.

Question 22 (3 marks)

Consider the bivariate data shown in the scatterplot below.



(a) Describe the bivariate dataset in terms of strength and direction. **2**

Strength
Solution
Strong

Marking guidelines

1Mark for correct answer

Direction:
Solution
Positive

Marking guidelines

1Mark for correct answer

(b) The line of best fit passes through (7, 5) and (0,1). **1**
Find the equation of the line of best fit that is drawn on the scatterplot in the form $y = mx + c$.

Solution

$$m = \frac{1-5}{0-7} = \frac{4}{7}$$

y-intercept is $c = 1$

Equation of the line of best fit is:

$$y = \frac{4}{7}x + 1$$

Marking guidelines

1Mark for $y = \frac{4}{7}x + 1$

Question 23 (2 marks)

Leena decided to buy shares at a price of \$55.75 per share. She receives a dividend of \$2.49 per share. **2**

Calculate the dividend yield as a percentage correct to one decimal place.

Solution

$$\text{Dividend Yield} = \frac{2.49}{55.75}$$
$$= 0.04466367713...$$
$$= 0.04466367713... \times 100\%$$
$$= 4.466...\%$$
$$= 4.5\% \text{ (to1decimal place)}$$

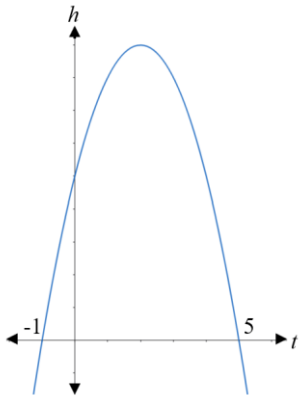
Marking guidelines

2 Marks complete correct solution

1 Mark for $\text{Dividend Yield} = \frac{2.49}{55.75}$

Question 24 (3 marks)

The graph of a quadratic function represented by the equation $h = -t^2 + 4x + 5$ is shown.



(a) Find the values of t and h at the turning point of the graph. **2**

Solution

$$t = \frac{-1+5}{2} = 2$$

when $t = 2$

$$h = -(2)^2 + 4(2) + 5$$

$$= 9$$

$\therefore t = 2,\ h = 9$ or $(2,9)$

Marking guidelines

2 Marks complete correct answer

1 Mark for finding either $t = 2$ or $h = 9$

(b) The graph shows $h = 5$ when $t = 0$.

What is the other value of t for which $h = 5$? **1**

Solution

Since the graph is symmetrical about $t = 2$ then $t = 4$

Marking guidelines

1 Mark for correct answer

Question 25 (4 marks)

The bivariate data below shows the relationship between the number of hours students spent studying for an examination and their examination mark.

Study Hours	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Mark (%)	52	58	61	68	72	77	81	85

A line of best fit for the data is:

$$\text{Mark} = 4.7(\text{Study Hours}) + 44$$

(a) Use the line of best fit to predict the examination mark of a student who studies for 10 hours. **1**

Solution

$$\begin{aligned}\text{Mark} &= \big(4.7(10)+44\big)\% \\ &= 91\%\end{aligned}$$

Marking guidelines

1 Mark for correct solution

(b) A student claims that studying for an extra hour will always increase their examination mark by about 5%.
Use the data and the line of best fit to evaluate this claim. **3**

Solution

Evaluation of this claim:

- Gradient of line of best fit is 4.7 indicating each additional hour of study is associated with a rise of approximately 4.7%.
- The actual data does not increase by 5% for every additional hour.
- The claim is not always true because the line of best fit provides an estimate and individual data values vary around the trend.

Marking guidelines

3 Marks for mentioning something equivalent to all three dot points.:

2 Marks for mentioning something equivalent to two of the dot points

1 Mark for mentioning something equivalent to one of the dot points.

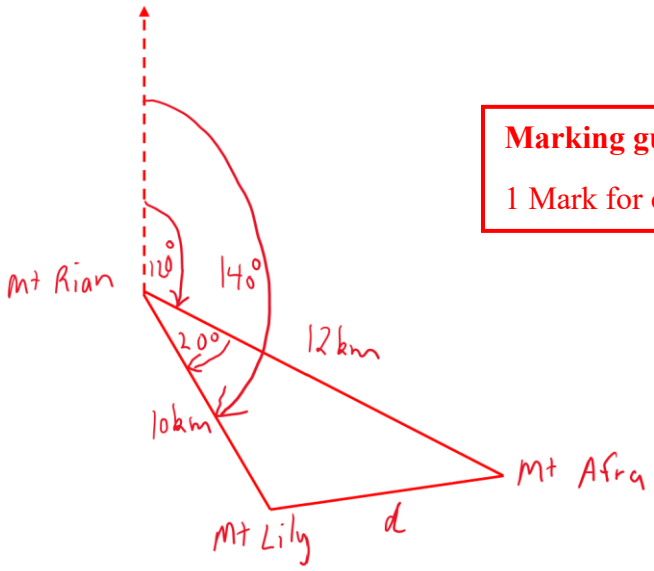
Question 26 (4 marks)

From the top of Mount Rian a bushwalker sees two other mountains.

- Mount Lily is 10 kilometres away at a bearing of 140°.
- Mount Afra is 12 kilometres away at a bearing of 120°.

(a) Draw a labelled diagram showing all relevant information. **1**

Solution



Marking guidelines

1 Mark for correct diagram

(b) Find the distance from Mount Lily to Mount Afra. Answer to the nearest hundred metres. **3**

Solution

$d^2 = 10^2 + 12^2 - 2(10)(12)\cos 20°$

$d = \sqrt{10^2 + 12^2 - 2(10)(12)\cos 20°}$

$d = 4.298...\text{km}$

$d = 4.3\,\text{km}\,(\text{to the nearest } 100\,\text{m})$

or

$d = 4300\,\text{m}\,(\text{to the nearest } 100\,\text{m})$

Note:Must round correctly.

Marking guidelines

3 Marks for complete correct solution with correct rounding

2 Marks for complete correct solution without correct rounding
i.e.

$d = \sqrt{10^2 + 12^2 - 2(10)(12)\cos 20°}$

$d = 4.298...\text{km}$

1 Mark for correctly stating the cosine rule correctly
i.e. $d^2 = 10^2 + 12^2 - 2(10)(12)\cos 20°$

Or
1 Mark for rounding their answer to the nearest hundred metres correctly

Question 27 (2 marks)

The future value of an annuity when \$1 is invested at the start of each period is shown in the table below.

Future value of \$1						
Period	1%	2%	3%	4%	5%	6%
1	\$1.0100	\$1.0200	\$1.0300	\$1.0400	\$1.0500	\$1.0600
2	\$2.0301	\$2.0604	\$2.0909	\$2.1216	\$2.1525	\$2.1836
3	\$3.0604	\$3.1216	\$3.1836	\$3.2465	\$3.3101	\$3.3746
4	\$4.1010	\$4.2040	\$4.3091	\$4.4163	\$4.5256	\$4.6371
5	\$5.1520	\$5.3081	\$5.4684	\$5.6330	\$5.8019	\$5.9753
6	\$6.2135	\$6.4343	\$6.6625	\$6.8983	\$7.1420	\$7.3938

Nikhil invests \$8 000 at the start of each half-year for two years and earns 4% p.a. compounded twice a year.

Find the future value of the investment. **2**

Solution

Period $= 4$ half years

Rate $= \dfrac{4\%}{2} = 2\%$ each half year

From table the factor $= \$4.2040$ per \$1

$\therefore$ Future value $= 8000 \times 4.2040 = \$33632$

Marking guidelines

2 Marks for complete correct solution

1Mark for converting the period and the rate into a half yearly period and a half yearly rate

Or

1Mark for finding the factor from the table correctlv

Question 28 (3 marks)

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

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

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

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

Solution

$$Z_{100} = \frac{12.8 - 14.2}{0.9} = -1.56$$

$$Z_{400} = \frac{72.2 - 84.9}{4.6} = -1.24$$

Since the time for 100 m is more standard deviations below the mean it is the better result

Marking guidelines

2 Marks for complete correct solution with justification of answer

1Mark for finding the Z scores correctly

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

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

Solution

$$Z = \frac{t - u}{\sigma}$$

$$Z\sigma = t - u$$

$$Z\sigma + u = t$$

$$\therefore t = u + Z\sigma$$

$$u = 84.9,\ Z = -2.5,\ \sigma = 4.6$$

$$\therefore t = 84.9 - 2.5(4.6)$$

$$= 73.4$$

Marking guidelines

1Mark for complete correct solution

Question 29 (6 marks)

Leane is saving for a holiday to Europe in twelve months time. She needs at least $6 000 for the trip.

She has decided to put $500 each month into a special bank account that pays interest that compounds monthly.

She creates a spreadsheet to keep track of her savings, the first three months of which are shown below.

Month	Starting Balance	Interest	Deposit	Final Balance
1	$0.00	$0.00	$500.00	$500.00
2	$500.00	$2.50	$500.00	$1002.50
3	$1002.50	$5.01	$500.00	$1507.51

(a) What is the monthly interest rate? **1**

Solution

$$\text{Monthly interest rate} = \frac{\$2.50}{\$500} \times 100\%$$
$$= 0.5\% \text{ per month}$$

Marking guidelines

1 Mark for correct answer

Question 29 (continued)

(b) The last two rows of the table are shown below. **3**

Find the four values A, B, C and D.

Month	Starting Balance	Interest	Deposit	Final Balance
11	\$5114.01	\$25.57	\$500.00	**A**
12	**B**	**C**	**D**	\$6167.78

$A = B = 5114.01 + 25.57 + 500$

$= \$5639.58$

$C = 0.005 \times 5639.58$

$= \$28.20$

$D = \$500$

Marking guidelines

3 Marks for complete correct solution

2 Marks for finding two correct values

1Mark for finding one correct value

(c) If she chose to invest one lump sum at the start of the twelve months, instead of making the monthly deposits of \$500, how much would she have had to invest to get the same final amount? **2**

Solution

$6167.78 = PV \times (1 + 0.005)^{12}$

$6167.78 = PV \times (1.005)^{12}$

$PV = 6167.78 \div (1.005)^{12}$

$= 5809.4649...$

$= \$5809.47 \ (\text{Round up})$

Note: Must round up to insure you get the same final amount

Marking guidelines

2 Marks for finding complete correct solution with correct rounding

1Mark for

$6167.78 = PV \times (1 + 0.005)^{12}$

Question 30 (3 marks)

Maryam needs a twelve-month loan for $9 000. He has the following loan options: **3**

- A payday lender at 0.92% per week, interest compounded weekly.
- A bank at 11.99% p.a., interest compounded monthly.

He will repay the loan with a single lump sum at the end of the twelve months.

How much more will it cost him if he takes the loan from the payday lender rather than the bank?

Solution

$$\begin{aligned}\text{Payday lender} &= 9000\times(1+0.0092)^{52}\\ &= 9000\times(1.0092)^{52}\\ &= 14489.68971\\ &= \$14489.69\end{aligned}$$

$$\begin{aligned}\text{Bank} &= 9000\times\left(1+\frac{0.1199}{12}\right)^{12}\\ &= 10140.42122\\ &= \$10140.42\end{aligned}$$

The Payday lender will be more expensive by

$\$14489.69-\$10140.42=\$4349.27$

Marking guidelines

3 Marks for complete correct solution

2 Marks for correctly finding the amount for the loans from both lenders but did not answer the question

1Mark for correctly finding the amount for the loan from one lender or for calculating how much more it will cost from their incorrect answers.

Question 31 (5 marks)

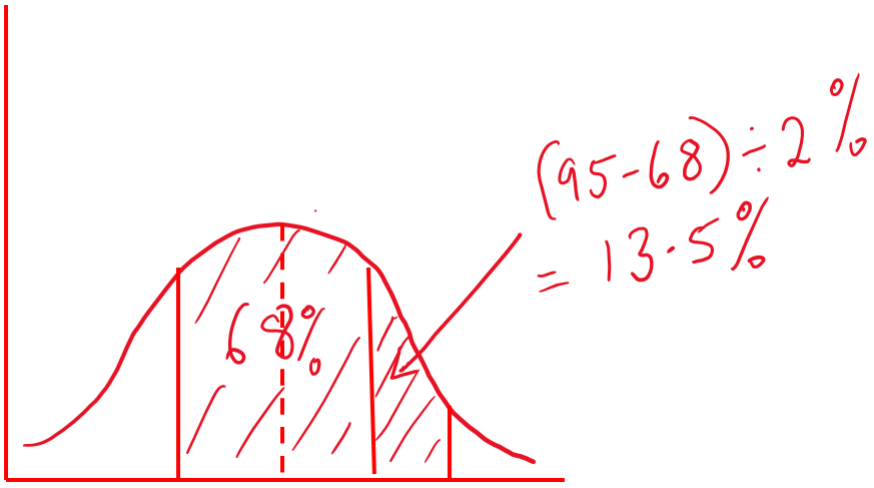
A popular cake mix comes in a box with a nominal weight of 220 grams.

It has been found that the actual weights of boxes being produced are normally distributed with a mean of 220 grams and a standard deviation of 10 grams.

(a) The packaging machine automatically rejects any box that weighs less than 210 grams or more than 240 grams. **3**

What percentage of cake mix boxes are rejected?

Solution



Shaded section $= 68\% + 13.5\%$

$= 81.5\%$

Unshaded section $= 100\% - 81.5\%$

$= 18.5\%$

$\therefore 18.5\%$ get rejected.

Marking guidelines

3 Marks for complete correct solution

2 Marks for correctly finding 13.5% and the Shaded section = 81.5%

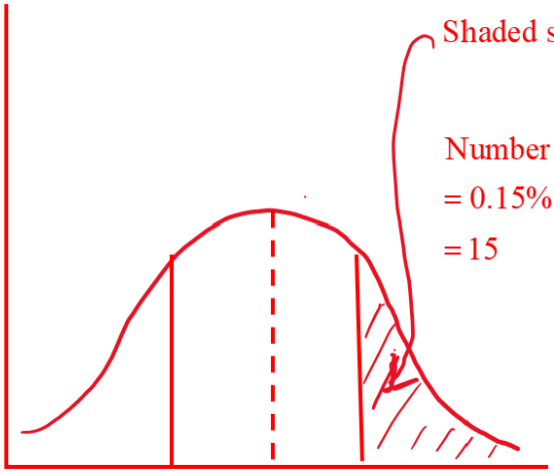
1Mark for correctly finding 13.5%

Question 31 (continued)

(b) Any boxes that weigh more than 250 grams are set aside and donated to charity. **2**

The factory produces 10 000 boxes of cake mix a day. How many of these exceed 250 grams and get donated to charity?

Solution



Shaded section $= \frac{1}{2}(100\% - 98.7\%)$

$= 0.15\%$

Number of boxes that get donated to charity

$= 0.15\% \times 10\,000$

$= 15$

Marking guidelines

2 Marks for complete correct solution

1Mark for correctly finding the Shaded section $= 0.15\%$

Question 32 (4 marks)

Scientists perform two wildlife surveys six months apart to estimate the total koala population in a valley.

In the first survey they tagged 70 koalas and then released them back into the wild.

In the second survey six months later, they caught and checked 100 koalas. Of these 100 koalas, 35 had tags.

(a) What is the estimate for the number of koalas in the valley? **2**

Solution

First survey 70 Koalas tagged

Second survey 35 Koalas had tags out of 100 Koalas caught.

$$\therefore \frac{T}{70} = \frac{100}{35}$$

$$T = \frac{70 \times 100}{35}$$

$$= 200$$

Marking guidelines

2 Marks for complete correct solution

1Mark for $\frac{T}{70} = \frac{100}{35}$

The scientists then discovered that 6 of the koalas that had been tagged in the first survey had been moved to another location to help with a breeding program, so were not in the valley at the time of the second survey.

(b) What is the better estimate for the number of koalas in the valley at the time of the second survey? **2**

Solution

Number of Koalas after 6 removed to new location

$$= 70 - 6$$

$$= 64$$

$$T_{new} = \frac{64 \times 100}{35}$$

$$= 182.5...$$

$$= 183 \text{ (round up)}$$

Marking guidelines

2 Marks for complete correct solution

1 Mark for finding number of koalas after six removed to new location is 64

A better estimate is 183 koalas in the valley.

Question 33 (5 marks)

The time taken for a colony of ants to break up a sandwich and carry it away to the nest is inversely proportional to the number of ants performing the task.

If there are 20 ants, then it takes 42 minutes for the sandwich to be taken to the nest.

(a) Calculate how long it takes for 32 ants to carry the sandwich to the nest. **3**

Solution

let t be the time taken

let n be the number of ants

$t \propto \frac{1}{n} \rightarrow t = \frac{k}{n}$

When $t = 42$ and $n = 20$

$42 = \frac{k}{20}$

$k = 42 \times 20$

$= 840$

$\therefore t = \frac{840}{n}$

When $n = 32$

$t = \frac{840}{32}$

$= 26.25$ minutes

or 26 minutes 15 seconds

Marking guidelines

3 Marks for complete correct solution

2 Marks for correctly finding $t = \frac{840}{n}$

1Mark for correctly finding $k = 840$

Question 33 continued…

Question 33 (continued)

(b) Another group of ants takes 1 hour and 10 minutes to carry the sandwich to the nest. **2**

How many ants are in this group?

Solution

$1\,\text{hour}\,10\,\text{minutes} = 70\,\text{minutes}$

$$t = \frac{840}{n}$$

$$70 = \frac{840}{n}$$

$$70n = 840$$

$$n = 12$$

There are 12 ants in the group.

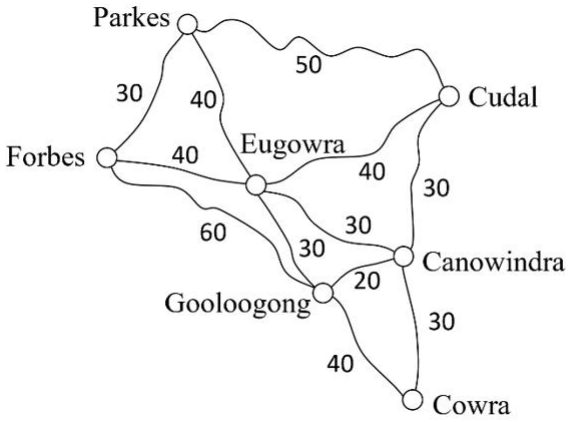
Marking guidelines

2 Marks for complete correct solution

1Mark for correctly finding
$1\,\text{hour}\,10\,\text{minutes} = 70\,\text{minutes}$

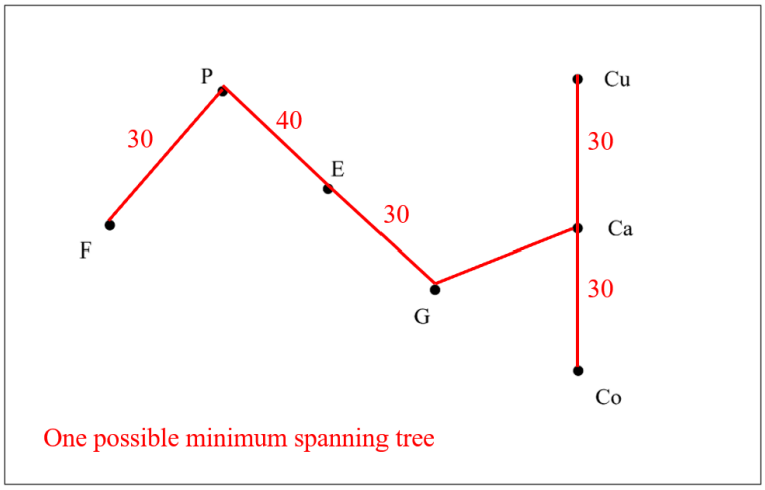
Question 34 (4 marks)

The road map shows the roads connecting 7 towns. The numbers represent the distances along the roads between the towns, in kilometres.



(a) Each town is to be connected to a new water supply. **2**

By drawing a minimum spanning tree in the space below, calculate the minimum length of pipes required to supply water to all towns if the water pipes can only be laid along the roads.



One possible minimum spanning tree

Minimum length = 30+30+30+30+20+40=180 km

Marking guidelines

2 Marks for complete correct solution

1Mark for correctly drawing the minimum spanning tree

Question 34 (continued)

(b) A motorist usually travels the shortest possible route from Parkes to Cowra, however, road works have shut the Parkes to Eugowra Road. **2**

If they have to travel from Parkes to Cowra and back on the shortest available route, how much extra distance will they have to travel each way?

Solution

Normal shortest route:

Parkes $\rightarrow$ Eugowra $\rightarrow$ Canowinda $\rightarrow$ Cowra

distance $= 40 + 30 + 30 = 100$ km

Roadworks shortest route:

Parkes $\rightarrow$ *Cudal* $\rightarrow$ Canowinda $\rightarrow$ Cowra

distance $= 50 + 30 + 30 = 110$ km

$\therefore$ Extra distance travelled each way

$= 110 - 100$

$= 10$ km

Marking guidelines

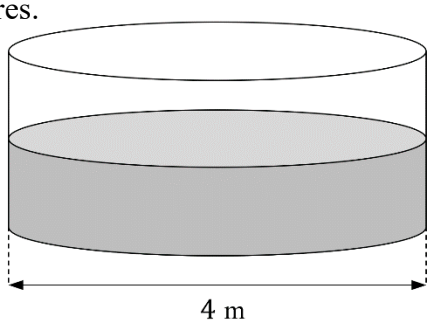
2 Marks for complete correct solution

1Mark for correctly finding the distance of **either** the normal shortest route **or** the roadworks shortest route

Question 35 (4 marks)

A large farm shed has a flat rectangular roof which is 12 metres wide by 24 metres long. During a thunder storm 20 mm of rain falls onto the roof in 10 minutes. **4**

Rain that falls on the roof drains immediately into a cylindrical rainwater tank with a diameter of 4 metres.



Calculate the average rate at which the water level in the tank changes during the storm. Answer in centimetres per minute to 1 decimal place.

Solution

Convert 20 millimetres to metres:

$20 \div 1000 = 0.02\,\text{m}$

$$\begin{aligned} V_{\text{Water}} &= 12 \times 24 \times 0.02 \\ &= 5.76\,\text{m}^3 \\ V_{\text{Tank}} &= \pi \times 2^2 \times h \\ &= 4\pi h \\ V_{\text{Tank}} &= V_{\text{Water}} \\ 4\pi h &= 5.76 \\ h &= \frac{5.76}{4\pi} \\ &= 0.4583662361...\,\text{m} \\ &= 45.83662361...\,\text{cm} \\ \text{Rate} &= \frac{45.83662361...\,\text{cm}}{10\,\text{minutes}} \\ &= 4.583...\,\text{cm/min} \\ &\approx 4.6\,\text{cm/min} \end{aligned}$$

Marking guidelines

4 Marks for complete correct solution including answer in centimetres per minute

3 Marks for establishing the equation $4\pi h = 5.76$

2 Marks for correctly finding the volume of the water

1 Mark for correctly convert 20 millimetres to metres

Question 36 (4 marks)

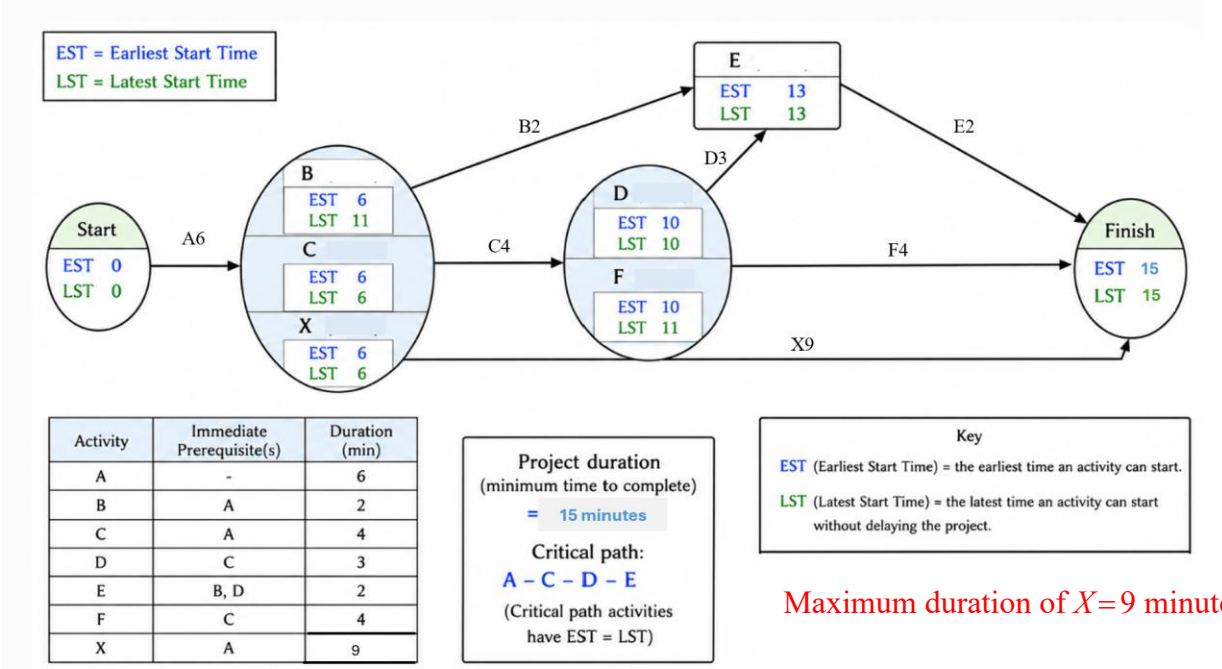
A project requires activities A to F to be completed. The activity chart shows the immediate prerequisites and duration for each activity. 4

Activity	Immediate Prerequisites	Duration in minutes
A	-	6
B	A	2
C	A	4
D	C	3
E	B, D	2
F	C	4
X	A	

A new activity, X, is added to the project, and has A as an immediate prerequisite. No other activity has X as an immediate prerequisite.

By first drawing a network diagram showing all seven activities, find the maximum duration of X if it does not increase the minimum time to complete the project.

Solution



Activity	Immediate Prerequisite(s)	Duration (min)
A	-	6
B	A	2
C	A	4
D	C	3
E	B, D	2
F	C	4
X	A	9

Project duration
(minimum time to complete)
= 15 minutes
Critical path:
A – C – D – E
(Critical path activities have EST = LST)

Key
EST (Earliest Start Time) = the earliest time an activity can start.
LST (Latest Start Time) = the latest time an activity can start without delaying the project.

Maximum duration of $X = 9$ minutes

Marking guidelines

4 Marks for complete correct diagram with all seven activities, EST and LST correctly shown on diagram, minimum completion time of 15 minutes identified and correct maximum duration of X found

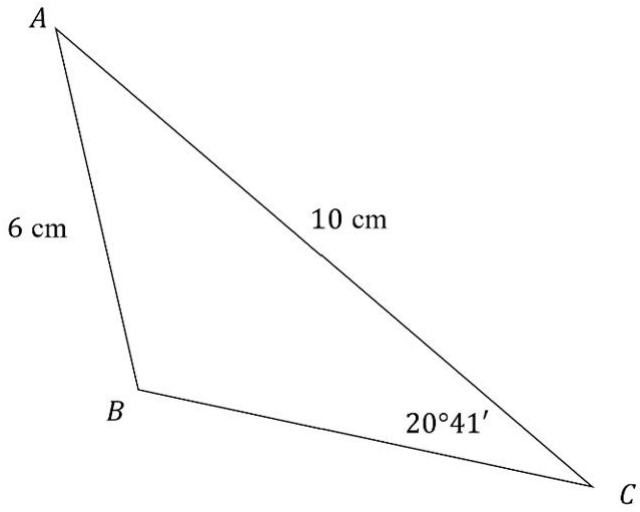
3 Marks for partially correct diagram with all seven activities shown but not all EST and LST shown on diagram correctly, minimum completion time of 15 minutes identified and correct maximum duration of X found

2 Marks for a partial correct diagram with all seven activities but not all EST and LST shown on diagram, with minimum completion time identified

1 Mark for partially correct diagram **or** minimum completion time identified **or** correct maximum duration of X found

Question 37 (3 marks)

In ΔABC, $AC = 10$ cm, $AB = 6$ cm and $\angle ACB = 20°41'$. **3**



Given that $\angle ABC$ is obtuse, find the size of $\angle BAC$ to the nearest minute.

Solution

$$\frac{\sin \angle ABC}{10} = \frac{\sin 20°44'}{6}$$

$$\sin \angle ABC = \frac{10 \sin 20°44'}{6}$$

$$\angle ABC = \sin^{-1}\left(\frac{10 \sin 20°44'}{6}\right)$$

$$\angle ABC = 36°4' \quad (\text{acute angle})$$

$\angle ABC$ is an obtuse angle

$$\therefore \angle ABC = 180° - 36°4'$$

$$= 143°56'$$

$$\therefore \angle BAC = 180° - (143°56' + 20°41')$$

$$= 15°23'$$

Marking guidelines

3 Marks for complete correct solution

2 Marks for correctly finding $\angle ABC = 143°56'$

1 Mark for correctly uising sine rule

i.e. $\frac{\sin \angle ABC}{10} = \frac{\sin 20°44'}{6}$

Question 38 (2 marks)

A bag contains 7 red balls and 9 blue balls. One ball is selected at random and thrown in the bin. A second ball is then selected from the remaining balls in the bag. **2**

Find the probability that the two balls selected are the same colour.

Solution

$$P(\text{RR}) = \frac{7}{16} \times \frac{6}{15} = \frac{42}{240} = \frac{7}{40}$$

$$P(\text{BB}) = \frac{9}{16} \times \frac{8}{15} = \frac{72}{240} = \frac{3}{10}$$

$$P(\text{same colour}) = \frac{7}{40} + \frac{3}{10}$$

$$= \frac{7}{40} + \frac{12}{40}$$

$$= \frac{19}{40}$$

Marking guidelines

2 Marks for complete correct solution

1 Mark for correctly finding **either**

$P(\text{RR}) = \frac{7}{16} \times \frac{6}{15}$ **or** $P(\text{BB}) = \frac{9}{16} \times \frac{8}{15}$

Question 39 (2 marks)

A factory tests a batch of batteries and finds that 77 of them are good while 3 are faulty.

(a) Express, as a percentage, the probability that a battery selected at random is good. **1**

.....

Solution

$$\text{Total} = 77 + 3 = 80$$

$$\%\ \text{good} = \frac{77}{80} \times 100\%$$

$$= 96.25\%\ (\text{to 2 decimal places})$$

Marking Guideline
1 mark for correct answer

(b) If the factory makes 5 000 batteries, how many would you expect to be faulty? **1**

.....

Solution

$$\text{Faulty batteries} = \frac{3}{80} \times 5000$$

$$= 187.5$$

Expected faulty batteries is 188

(Note:must round up)

Marking Guideline
1 mark for correct answer

Question 40 (3 marks)

A credit card has an interest-free period of 30 days from and including the date of purchase. Interest is charged on purchases made, compounding daily at a rate os 12.99% per annum, from and including the day following the interest free period. **3**

Theatre tickets were purchased for a total of $478 using the credit card.

Full payment was made on the 62nd day from the date of purchase. There are no other purchases on this credit card.

What was the total interest charged when the account was paid in full?

Solution

- The credit card has an interest free period of 30 days from and including date of puechase. Therefore interest begins on day 31.
- T account is paid in full on day 62.
- Interest is charged from day 31 to day 62 inclusively i.e. $62-31+1=32$ days.

Daily interest rate is $r=\dfrac{0.1299}{365}$

Number of time periods $=32$

$$A=478\left(1+\frac{0.1299}{365}\right)^{32}$$
$$=483.473816...$$
$$\approx \$483.47$$

$$\text{Interest} = A-P$$
$$=\$483.47-\$478$$
$$=\$5.47$$

Marking guidelines

3 Marks for complete correct solution

2 Marks for correctly finding $A\approx\$483.47$

1 Mark for correctly finding time period $=32$ days

Question 41 (4 marks)

A financial adviser makes the following statement: **4**

"If two savings accounts have the same annual interest rate, it does not matter how often the interest is compounded because the final balance will be the same."

Sarah invests $10,000 for 5 years at 6% p.a. in Account A, which compounds interest annually. Tom invests $10,000 for 5 years at 6% p.a. in Account B, which compounds interest monthly.

Determine the final balance in each account and evaluate the adviser's statement. Use appropriate calculations and mathematical reasoning to justify your conclusion.

Solution

Account A:

$A_A = 10\,000(1+0.06)^5 = \$13\ 382.26$

Account B:

$A_B = 10\,000\left(1+\frac{0.06}{12}\right)^{60} = \$13\ 488.50$

Difference $= \$13\ 488.50 - \$13\ 382.26 = \$106.24$

The adviser's statement is incorrect.

Although both accounts have the same annual interest rate, the account with monthly compounding producers a higher final balance because interest is added more frequently.

Therefore the frequency of compounding affects the amount earned overtime.

Marking guidelines

4 Marks for complete correct solution including all appropriate calculations and mathematical reasoning to justify the conclusion that the adviser made an incorrect statement.

3 Marks for correct solution including some but not all appropriate calculations and mathematical reasoning to justify that the adviser made an incorrect statement.

2 Marks for correctly finding the amount for investment B and making an attempt at mathematical reasoning to justify that the adviser made an incorrect statement.

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1 Mark for any correct calculation that could support that the adviser made an incorrect statement.

End of Section II

End of Examination