Student's Name: _____

Student Number: | | | | | | | | | |

Teacher's Name: _____

ABBOTSLEIGH

2020
HIGHER SCHOOL CERTIFICATE
Trial Examination

Mathematics Standard 2

General Instructions

- Reading time – 10 minutes.
- Working time – 2 hours and 30 minutes
- Write using black pen.
- **NESA approved** calculators may be used.
- **NESA approved** reference sheet is provided.
- All necessary working should be shown in every question to gain full marks.
- Make sure your Student Number is on the front cover of each section.
- Answer the Multiple-Choice questions on the answer sheet provided.
- In Questions 16 - 20, show relevant mathematical reasoning and/ or calculations.

Total marks – 100

- Attempt Sections I and II.

Section I — Pages 3 - 12

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

Section II — Pages 13 - 42

85 marks
- Attempt Questions 16 - 20
- All questions are of equal value
- Allow about 2 hours and 5 minutes for this section.

Outcomes to be assessed:

Standard 2 Mathematics:

Preliminary Outcomes:

MS11-1 uses algebraic and graphical techniques to compare alternative solutions to contextual problems

MS11-2 represents information in symbolic, graphical and tabular form

MS11-3 solves problems involving quantity measurement, including accuracy and the choice of relevant units

MS11-4 performs calculations in relation to two-dimensional and three-dimensional figures

MS11-5 models relevant financial situations using appropriate tools

MS11-6 makes predictions about everyday situations based on simple mathematical models

MS11-7 develops and carries out simple statistical processes to answer questions posed

MS11-8 solves probability problems involving multistage events

MS11-9 uses appropriate technology to investigate, organise and interpret information in a range of contexts

HSC Outcomes:

MS2-12-1 uses detailed algebraic and graphical techniques to critically evaluate and construct arguments in a range of familiar and unfamiliar contexts

MS2-12-2 analyses representations of data in order to make inferences, predictions and draw conclusions

MS2-12-3 interprets the results of measurements and calculations and makes judgements about their reasonableness, including the degree of accuracy and the conversion of units where appropriate

MS2-12-4 analyses two-dimensional and three-dimensional models to solve practical problems

MS2-12-5 makes informed decisions about financial situations, including annuities and loan repayments

MS2-12-6 solves problems by representing the relationships between changing quantities in algebraic and graphical forms

MS2-12-7 solves problems requiring statistical processes, including the use of the normal distribution and the correlation of bivariate data

MS2-12-8 solves problems using networks to model decision-making in practical problems

MS2-12-9 chooses and uses appropriate technology effectively in a range of contexts, and applies critical thinking to recognise appropriate times and methods for such use

SECTION I

15 marks
Attempt Questions 1 – 15
Use the multiple-choice answer sheet
Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.
Sample 2 + 4 = (A) 2 (B) 6 (C) 8 (D) 9

(A) ○ (B) ● (C) ○ (D) ○

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

(A) ● (B) ⊗ (C) ○ (D) ○

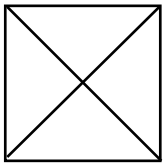
If you change your mind and have crossed out what you consider to be the correct answer, then indicate this by writing the word *correct* and drawing an arrow as follows.

correct ←

(A) ⊗ (B) ⊗ (C) ○ (D) ○

---

1. The following symbol is used on the floor plan of a 4 bedroom house.



In which room of the house floor plan is this symbol likely to be seen?

A. Kitchen

B. Dining room

C. Bathroom

D. Bedroom

2. Katie has a resting heart rate of 50 beats/minute. When exercising it increases to 80 beats/minute. How many more times would her heartbeat in five minutes when exercising, compared to when resting?

A. 150

B. 160

C. 180

D. 200

3. The table shows income tax payable.

Taxable income	Tax on this income
0 - $18,200	Nil
$18,201 - $37,000	19c for each $1 over $18,200
$37,001 - $87,000	$3,572 plus 32.5c for each $1 over $37,000
$87,001 - $180,000	$19,822 plus 37c for each $1 over $87,000
$180,001 and over	$54,232 plus 45c for each $1 over $180,000

John's taxable income is $102 000. What is the tax payable on John's income?

A. $5550

B. $19 822

C. $25 372

D. $37 740

4. Tom works in a restaurant and below is his wage sheet for last week.

Employee	**Hourly Rate**	**Normal hours worked**	**Double hours worked**
Tom	**$22**	***x***	**5**

If his total wage for last week was $770, what is the value of x ?

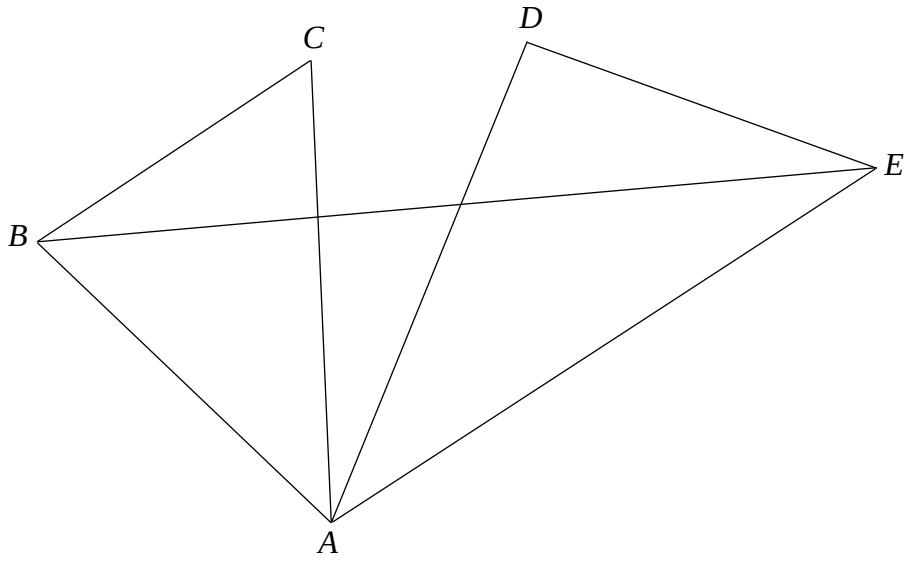
A. 20

B. 25

C. 30

D. 35

5. In the following graph, which vertex has the largest degree?



A. *A*

B. *B*

C. *C*

D. *D*

6. Tania lives in New York, USA (UTC –5) and Margaret lives in Sydney, NSW (UTC +10).

Margaret makes a call to Tania at 12:30 pm on Wednesday 26th February.

February is a month when NSW has daylight saving time and the USA does not.

What is the time in New York when Tania receives the call?

A. 2:30 am Thursday 27th February

B. 4:30 am Thursday 27th February

C. 10:30 pm Tuesday 25th February

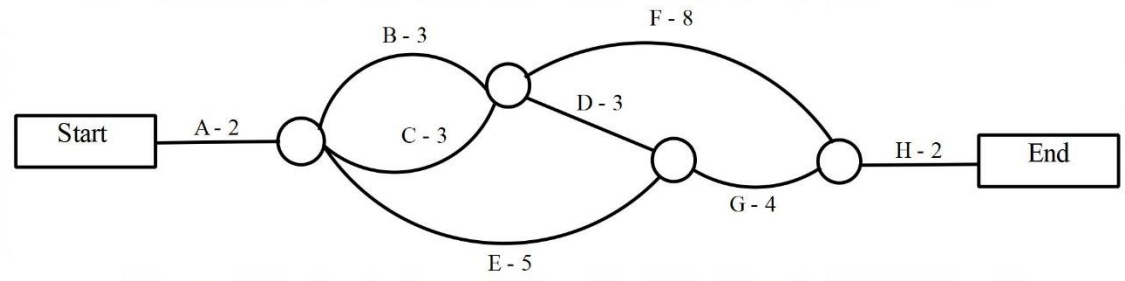
D. 8:30 pm Tuesday 25th February

7. The activity chart below shows the immediate prerequisite(s) and duration for each activity in a project.

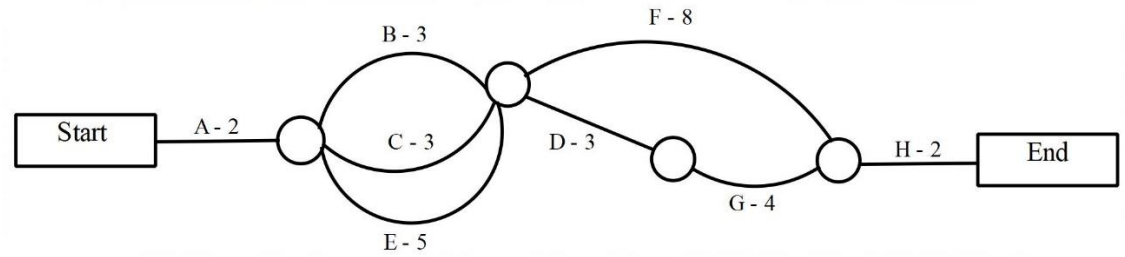
Activity	Immediate Prerequisites	Time (days)
A	-	2
B	A	3
C	A	3
D	B, C	3
E	A	5
F	B, C	8
G	D, E	4
H	F, G	2

Which network could be drawn from the activity chart?

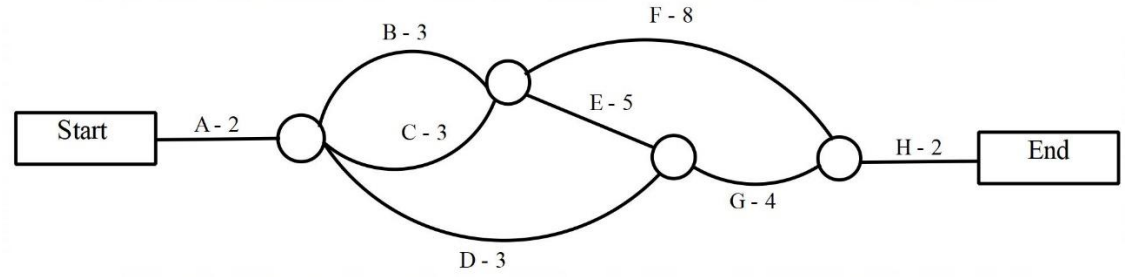
A.



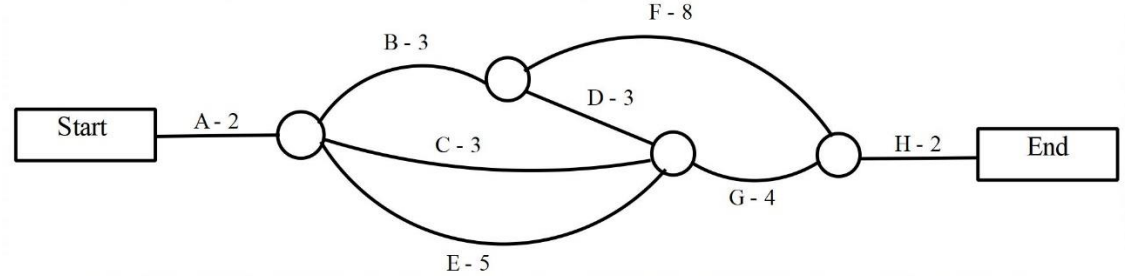
B.



C.



D.



8. The formula below gives the blood alcohol concentration for a male.

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

where 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. Harry weighs 80 kg and consumes 6 standard drinks in 3 hours. What is his *BAC*, correct to 1 significant figure?

A. 0.04

B. 0.05

C. 0.06

D. 0.07

9. Sally 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 Sally's estimate of the parrot population?

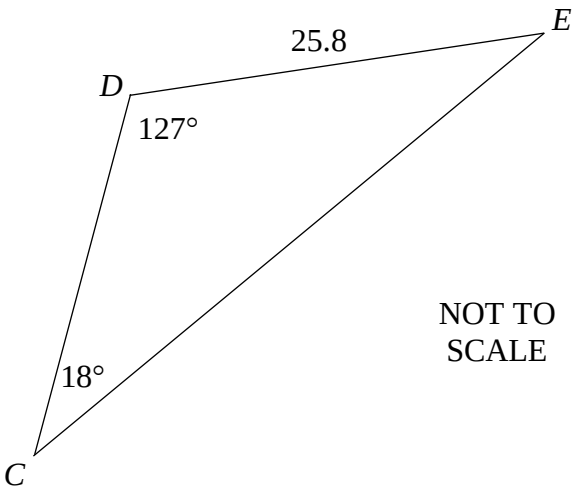
A. 588

B. 572

C. 544

D. 524

`10. The triangle shown has one angle of $127°$ and another of $18°$.



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

A. 10

B. 31

C. 39

D. 67

11. The scale on an aerial photograph is given as 1 mm = 200 m.

If the length of land is 1350 m, then the length on the map between these points would be?

A. 1.48 mm

B. 6.75 mm

C. 6.75 cm

D. 14.8 cm

12. On a recent assessment task, the results were normally distributed.

Rob achieved a score of 68% with a *z*-score of 0.5 and Steve achieved a score of 82% with a *z*-score of 2.25 on the task. What was the mean (%) score?

A. 64

B. 62

C. 60

D. 58

13. Kathy plans on switching to a new internet provider that helps her save $50 on expenses every month. Her contract is set for 5 years and the interest rate is 6% per annum. Using Microsoft Excel how would she calculate the present value?

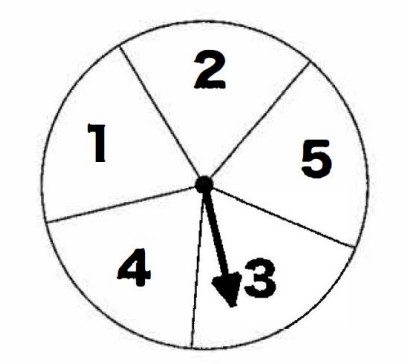
A. = PV(0.06, 5, -50)

B. = PV(0.005, 5, -50)

C. = PV(0.005, 60, - 50)

D. = PV(0.06, 60, -50)

14. The spinner shown contains equal sized sections labelled with the numbers from 1 to 5.



Outcome	Frequency
1	19
2	21
3	25
4	15
5	20

The table represents the outcomes of an experiment involving 100 spins.

When considering the probability of the outcome being an even number, which of the following statements is correct?

A. The theoretical probability is the same as the relative frequency.

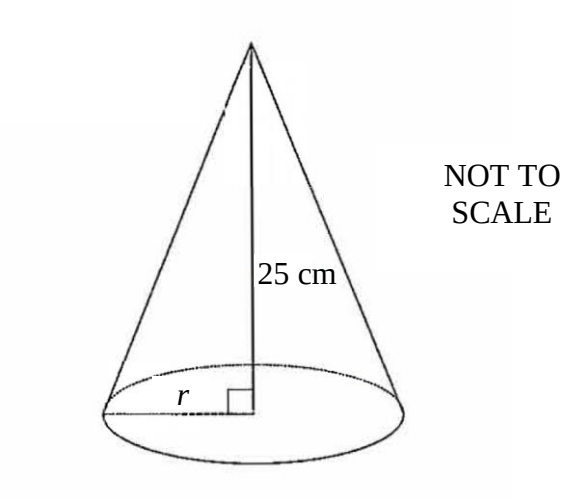
B. The theoretical probability is greater than the relative frequency.

C. The theoretical probability is less than the relative frequency.

D. The theoretical probability cannot be determined from the information given.

15. The capacity of a cone with a height of 25 cm is 2 litres.

Find the radius (r) of the circular base, in centimetres correct to 2 decimal places.



NOT TO SCALE

A. 2.76 cm

B. 5.05 cm

C. 8.74 cm

D. 76.39 cm

End of Section I

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2020 TRIAL HIGHER SCHOOL CERTIFICATE EXAMINATION

Mathematics Standard 2

Student Number

Section II

85 marks
Attempt Questions 16 - 20
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.

Extra writing space is provided on pages 18, 24, 30, 35, 41. If you use this space, clearly indicate which question you are answering.

Please Turn Over

Question 16 (17 marks)

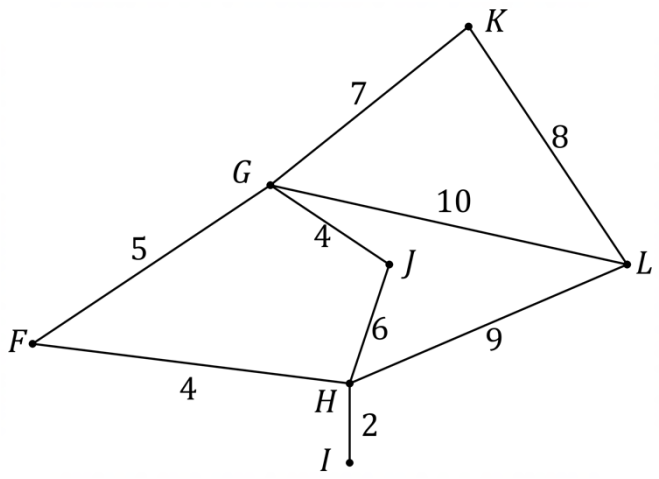
(a) The ratio of trees to shrubs in a park is 2 : 7. If there are 14 trees, how many shrubs are there? **2**

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(b) The network diagram shows seven campsites, *F*, *G*, *H*, *I*, *J*, *K* and *L*, which are joined by tracks. The numbers next to the paths show lengths (in km) of that section of track.



(i) On the above diagram highlight the minimum spanning tree of the network. **1**

(ii) A telephone cable is to be laid along as few of the existing tracks as possible. **1**
What is the minimum length of cable necessary to complete this task?

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Question 16 continued on page 15

Question 16 (continued)

(c) A solar panel system exports 21.4 kWh per day of energy to the grid. An energy retailer pays $0.079 per kWh for energy. What is the expected saving from the solar panel system for the year? Answer correct to the nearest cent. **2**

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(d) The number of students absent from year 12 for the past nine days was as follows:

17, 23, 20, 21, 16, 15, 32, 18, 21

(i) What is the mean? Give your answer correct to one decimal place. **1**

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(ii) Find the interquartile range. **1**

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(iii) Is 32 an outlier for this set of data? Justify your answer with calculations. **2**

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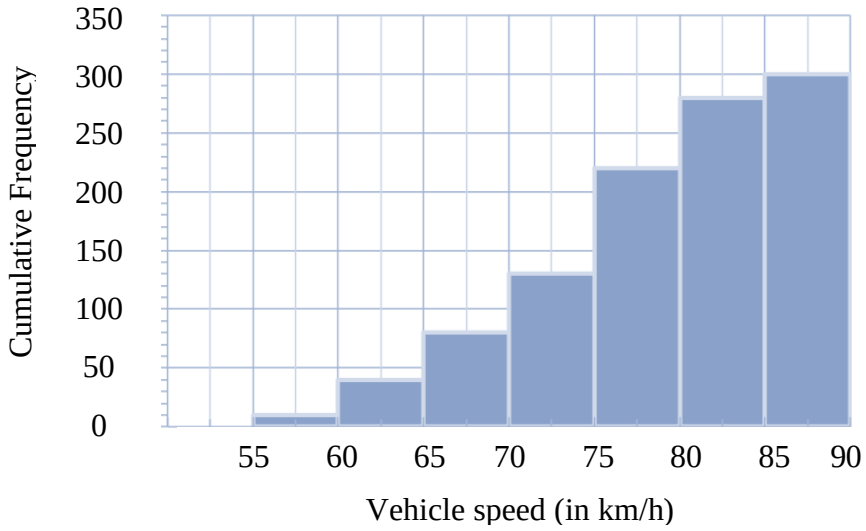
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Question 16 continued on page 16

Question 16 (continued)

(e) The speeds of a vehicle are shown in the cumulative frequency histogram below.



(i) What is the frequency of 75 km/h? **1**

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(ii) Construct a cumulative frequency polygon (or ogive) on this graph. **1**

(iii) Use the graph to estimate the median. **1**

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Question 16 continued on page 17

Question 16 (continued)

(f) Tran's industrial unit produces aluminium rods. In the past week the industrial unit has produced aluminium rods with a mean weight of 12.5 kilograms and a standard deviation of 0.5 kilograms.

(i) Quality control requires any aluminium rod with a z-score less than –1 to be rejected. What is the minimum weight that will be accepted? **1**

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(ii) Aluminium rods with a z-score greater than 2 are also rejected. What is the maximum weight that will be accepted? **1**

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(g) Kiara takes out a loan for \$58 000 at an interest rate of 6% per annum compounding monthly. The loan will be repaid by making monthly repayments of \$810 per month. Using the recurrence relation $V_{n+1} = V_n \times (1 + r) - D$, determine the balance of the loan after 2 months. **2**

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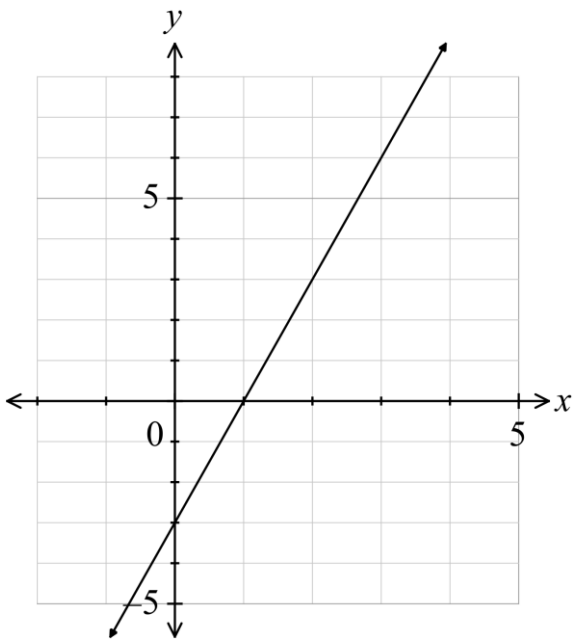
End of Question 16

Section II Extra writing space

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

Question 17 (17 marks) **Student Number:**

(a) The graph below shows the line $y = 3x - 3$.



(i) On the same set of axes, draw the line $y = 7 - 2x$. **1**

(ii) What is the solution to the simultaneous equations below? **1**

$$y = 3x - 3$$
$$y = 7 - 2x$$

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(b) Calculate the percentage error in a measurement of 2.75 metres. **2**

Give your answer correct to 2 decimal places.

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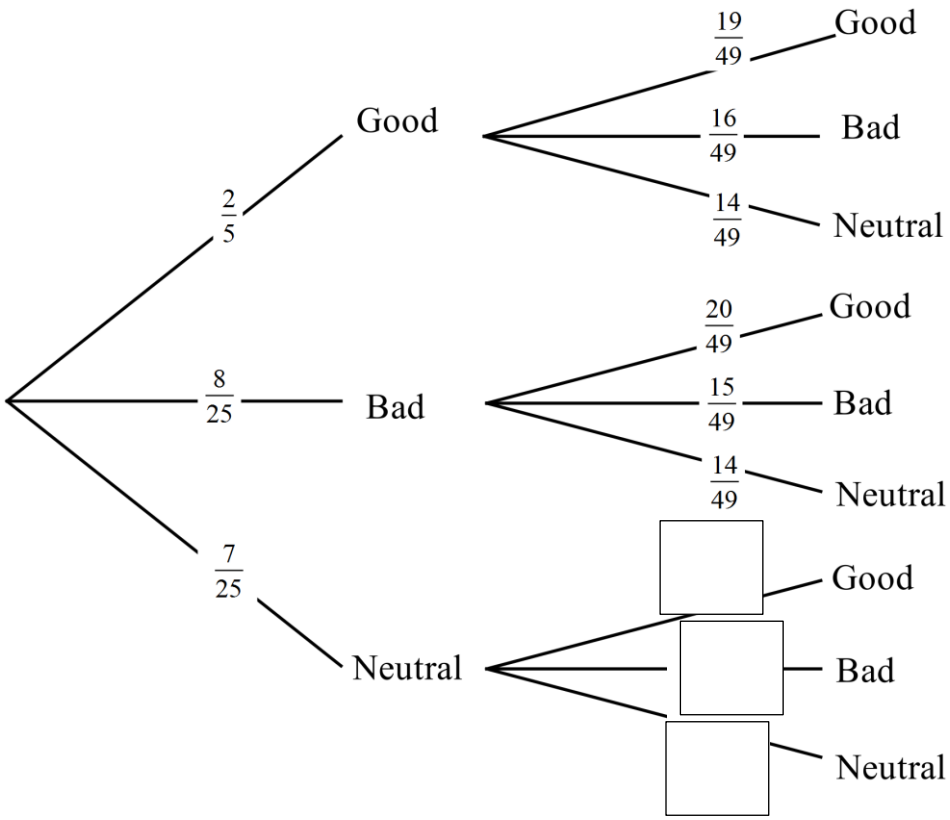
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Question 17 continues on page 20

Question 17 (continued)

(c) In a board game there are 50 cards in a pile which are picked up two at a time by the players. Of these cards, 20 have a good outcome for the player, 16 have a bad outcome and the remainder have neutral outcomes.



(i) Complete the three missing probabilities on the tree diagram above for the first player's draw from the deck. **2**

(ii) What is the probability that the first two cards drawn are both neutral outcomes? **1**

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(iii) What is the probability that the first two cards drawn are NOT both neutral outcomes? **1**

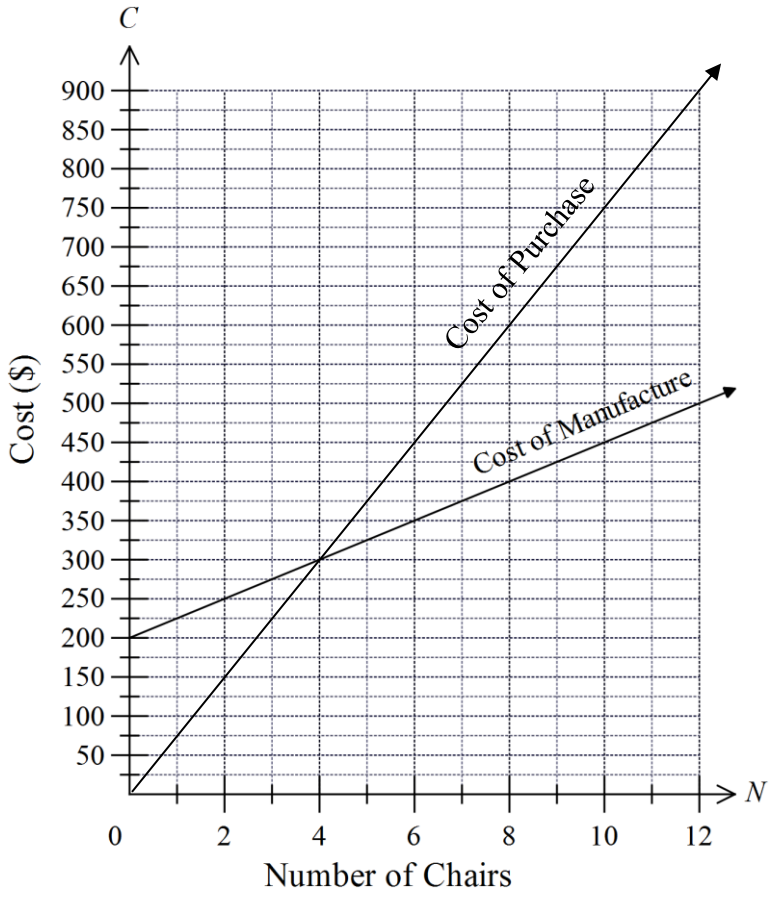
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Question 17 continues on page 21

Question 17 (continued)

(d) The Home Furniture Company makes an occasional chair that they sell to stores.
The lines on the set of axes below shows the cost of manufacturing and purchasing up to 12 chairs on a given day. The graphs are drawn as continuous lines, for convenience.



(i) What is the equation of the line representing the cost of manufacture? **2**

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(ii) How many chairs need to be sold to break even? **1**

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(iii) What is the profit made when 10 chairs are sold? **1**

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Question 17 continues on page 22

Question 17 (continued)

(e) The table below gives the future value of an annuity of $1 per period for various periods and interest rates.

Table of Future Value Interest Factors								
n \ *r*	0.0025	0.0030	0.0035	0.0040	0.0045	0.0050	0.0055	0.0060
53	56.5961	57.3530	58.1230	58.9063	59.7033	60.5141	61.3391	62.1785
54	57.7376	58.5250	59.3264	60.1419	60.9719	61.8167	62.6765	63.5516
55	58.8819	59.7006	60.5340	61.3825	62.2463	63.1258	64.0212	64.9329
56	60.0291	60.8797	61.7459	62.6280	63.5264	64.4414	65.3733	66.3225
57	61.1792	62.0624	62.9620	63.8786	64.8123	65.7636	66.7329	67.7204
58	62.3322	63.2485	64.1824	65.1341	66.1040	67.0924	68.0999	69.1267
59	63.4880	64.4383	65.4070	66.3946	67.4014	68.4279	69.4744	70.5415
60	64.6467	65.6316	66.6359	67.6602	68.7047	69.7700	70.8565	71.9647
61	65.8083	66.8285	67.8692	68.9308	70.0139	71.1189	72.2463	73.3965
62	66.9729	68.0290	69.1067	70.2065	71.3290	72.4745	73.6436	74.8369
63	68.1403	69.2331	70.3486	71.4874	72.6499	73.8368	75.0487	76.2859
64	69.3106	70.4408	71.5948	72.7733	73.9769	75.2060	76.4614	77.7436
65	70.4839	71.6521	72.8454	74.0644	75.3098	76.5821	77.8820	79.2101
66	71.6601	72.8670	74.1004	75.3607	76.6487	77.9650	79.3103	80.6854

(i) Alice invests $600 per month in an annuity which pays 4.2% p.a. compounding monthly. What will be the value of the annuity after 62 months? **1**

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(ii) An annuity has a value of $49 738 after being invested for five and a half years at a rate of 4.8% p.a. compounded monthly. How much was invested in the annuity each month? **2**

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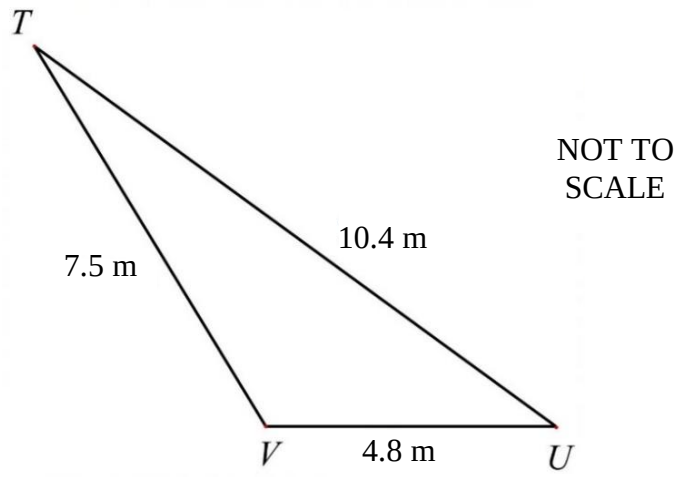
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Question 17 continues on page 23

Question 17 (continued)

(f) In the diagram below, $TV = 7.5$ m, $VU = 4.8$ m and $TU = 10.4$ m. **2**



Use the cosine rule to calculate the size of $\angle TVU$ correct to the nearest degree.

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End of Question 17

Section II Extra writing space

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

Question 18 (17 marks) **Student Number:** | | | | | | | | | |

(a) Amanda and Kylie are twins and are given $2 000 each by their grandparents for their 18th birthdays. On the day after their birthday, they both invest their money.

(i) Amanda uses her $2 000 to buy a piece of antique jewellery which is predicted to appreciate at 6% p.a. What is the expected value of the jewellery after 6 years? **1**

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(ii) Kylie invests her $2 000 in shares which cost $8.00 each and are predicted to pay a dividend of 60 cents per share, once each year. The dividends are paid into a transaction account which pays no interest. **2**
Whose investment will be worth more after 6 years, and by how much?

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Question 18 continues on page 26

Question 18 continued

(b) Short of time in the morning, a student gets a coffee and muffin on their way to school.
On average, a coffee and a muffin give 506 kJ and 447 kJ of energy respectively.

(i) If it takes the student 5 minutes of running to burn off 146 kJ of energy, how many minutes will the student need to run to consume the energy from the coffee and muffin? Round your answer to the nearest whole minute. **2**

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(ii) The conversion rate between calories and kilojoules is 1 calorie = 4.184 kilojoules. Determine the number of calories in the coffee, giving your answer correct to four significant figures. **2**

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Question 18 continues on page 27

Question 18 continued

(c) Miriam bought a car for $32 000 on 31st January 2016.

It depreciates at a rate of 20% p.a. using the declining-balance method.

(i) What was the value of the vehicle on 31st January 2019? **1**

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(ii) How much will the value of the vehicle drop between 31st January 2019 and 31st January 2020? **2**

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(d) The ages of the residents who live in Hudson Creek are normally distributed. **2**
The mean age is 56 years and the standard deviation is 14. If there are 1400 residents in Hudson Creek, how many are younger than 70?

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Question 18 continues on page 28

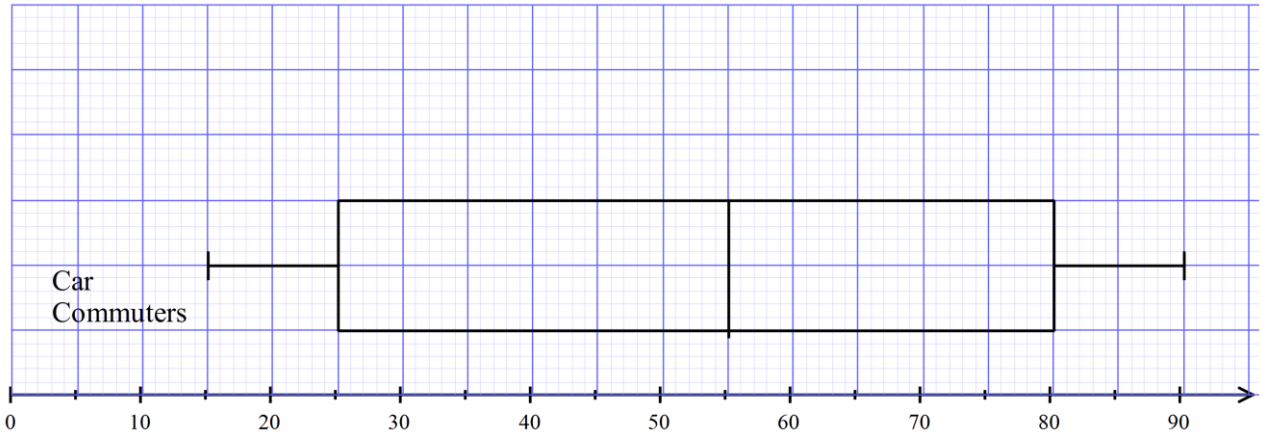
Question 18 continued

(e) Adam completes a survey of trip times (in minutes) for commuters using two different methods of transport.

A five-number summary of his results for train commuters are shown below.

Train Commuters five-number summary: 19, 26, 35, 50, 75

A box and whisker plot for his results for car commuters is shown below.



(i) On the grid above, draw a box and whisker plot for the Train Commuters. **1**

(ii) By comparing two statistical measures or features that can be found from the two plots, compare the data for the two types of transport. **2**

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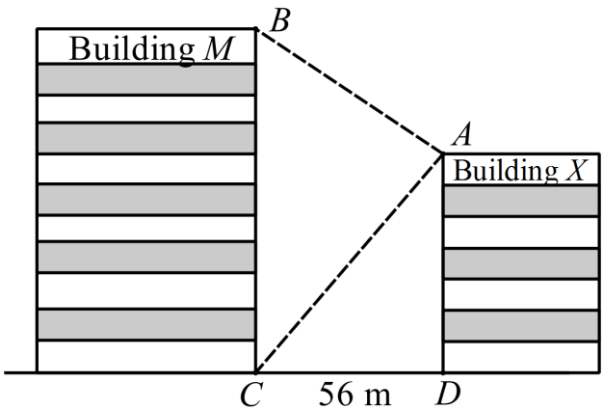
Question 18 continues on page 29

Question 18 continued

(f) Two buildings, called *M* and *X*, are situated 56 metres apart on level ground. **2**

From point *C*, the angle of elevation of point *A* is 57°.

From point *B*, the angle of depression of point *A* is 34°.



NOT TO SCALE

Calculate the height of Building *M* (correct to 1 decimal place).

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End of Question 18

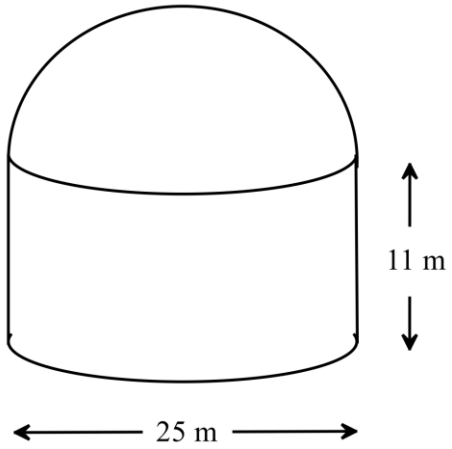
Section II Extra writing space

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

Question 19 (17 marks) **Student Number:**

(a) A bulk gas container consists of a cylindrical section topped with a hemisphere. **2**

It is made entirely of sheet metal, including the circular base of the cylinder.



NOT TO SCALE

Calculate the area of sheet metal needed to manufacture the container.

Give your answer correct to the nearest square metre.

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Question 19 continues on page 32

Question 19 continued

(b) The cost of preparing meals in a school canteen is linearly related to the number of meals prepared. To help the caterers predict the costs, data was collected on the cost of preparing meals for different levels of demand. The data is shown below.

Number (n) (meals)	30	35	40	45	50	55	60	65	70	75	80
Cost (C) (dollars)	138	154	159	182	198	198	214	208	238	234	244

(i) Calculate the value of the Pearson's correlation coefficient. **1**
Give your answer correct to four decimal places.

……

(ii) Using your answer from (i) **describe** the relationship between the number of meals and the cost in dollars. **1**

……

……

(iii) Using your calculator find the equation of the least-squares line of best fit. **2**
Answer correct to one decimal place.

……

……

(iv) What is the predicted cost of producing 48 meals? **1**

……

……

(v) Matthew would like to predict the cost of 120 meals. Would he be interpolating or extrapolating? Justify your answer. **2**

……

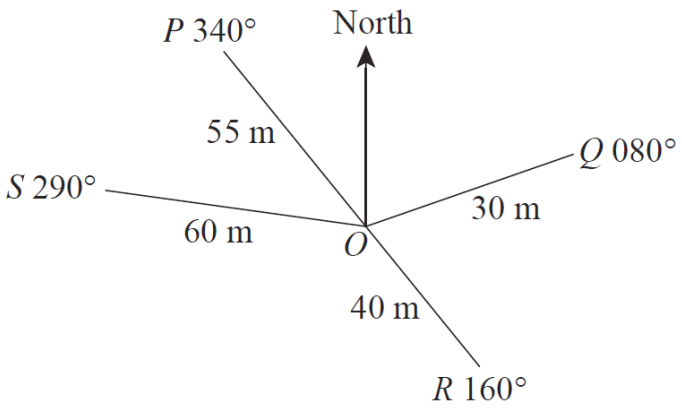
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Question 19 continues on page 33

Question 19 continued

(c) A radial survey of a field is shown.



NOT TO SCALE

(i) Find the size of $\angle POQ$. **1**

……

……

(ii) What is the length of PQ, correct to the nearest metre? **2**

……

……

……

……

(iii) The triangular area ROQ is going to be planted with barley. **2**
What is the size of this area, correct to three decimal places?

……

……

……

……

Question 19 continues on page 34

Question 19 continued

(d) Shannon owns a credit card that has no annual fees and charges 18.82 % per annum compound interest on all purchases. The interest is charged daily from the day of purchase and includes the day of payment.

(i) Show that the daily interest rate is 0.052%. **1**

…….

…….

(ii) On the 23rd of March, Shannon bought a painting for $580 using her credit card. She paid her credit card account on the 15th of April. **2**

Calculate the total amount Shannon paid for the painting, including interest, correct to the nearest cent.

…….

…….

…….

…….

…….

…….

End of Question 19

Section II Extra writing space

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

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Question 20 (17 marks) **Student Number:**

(a) 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

Terri borrows $36 000 for a car. She arranges to repay the loan with monthly repayments over 4 years. She is charged 7.8% per annum interest.

(i) Find Terri's monthly repayment. Answer correct to the nearest cent. **2**

……

……

……

……

(ii) Calculate the amount of interest Terri will pay over the term of the loan. **2**
Answer correct to the nearest dollar.

……

……

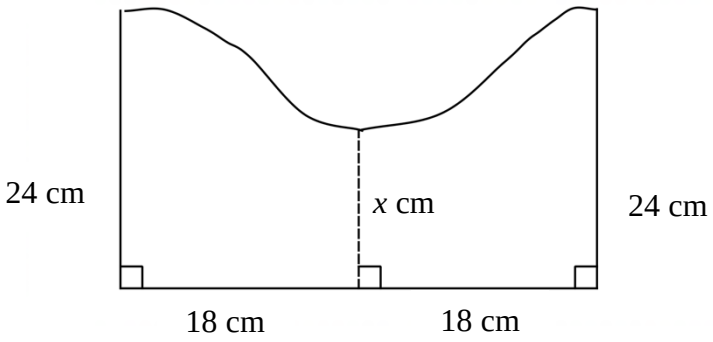
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Question 20 continues on page 38

Question 20 continued

(b) The cross-section of a piece of artwork is shown below. **2**



NOT TO SCALE

The trapezoidal rule with 2 intervals was used to approximate the area of the artwork as 612 cm^2.
What is the value of x?

……...

……...

……...

……...

……...

(c) The equation of least-squares line of best fit is given by $y = mx + c$ **1**

Where $m = r\frac{s_y}{s_x}$ and $c = \bar{y} - m\bar{x}$

What is the y-intercept of the least-squares line of best fit given $m = 0.8$, $\bar{x} = 60$ and $\bar{y} = 75$?

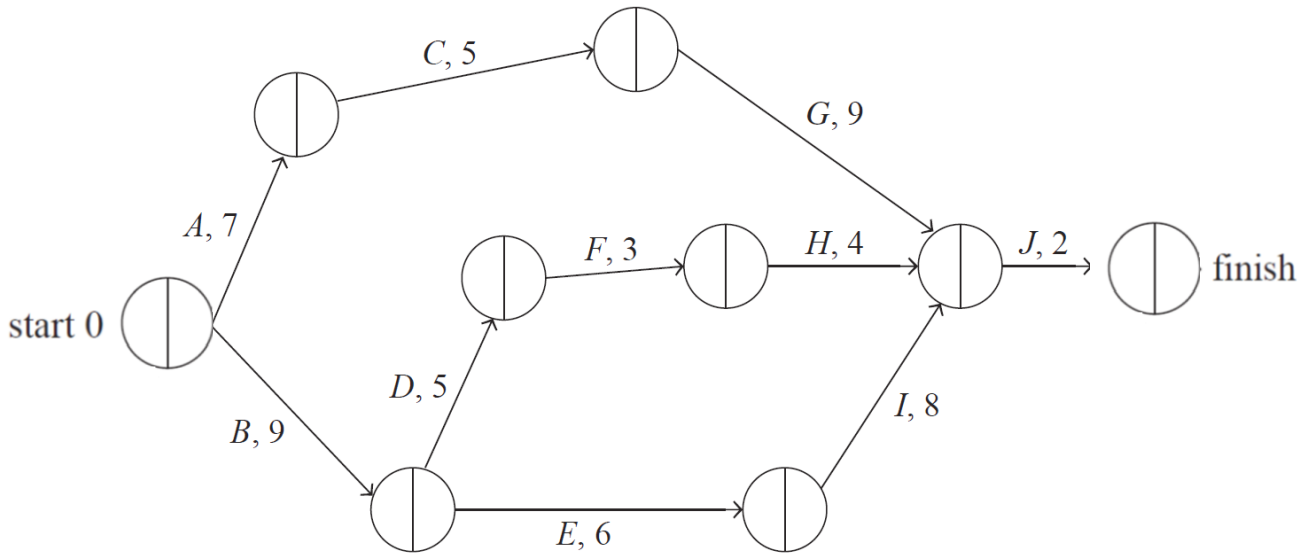
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Question 20 continues on page 39

(d) The network diagram for a project is shown below. The duration for each activity is in days.



(i) Write the earliest starting times (ESTs) and latest starting times (LSTs) on the above network diagram. **3**

(ii) What is the float time at *C* ? **1**

……

……

(iii) What is the critical path of the project? **1**

……

……

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

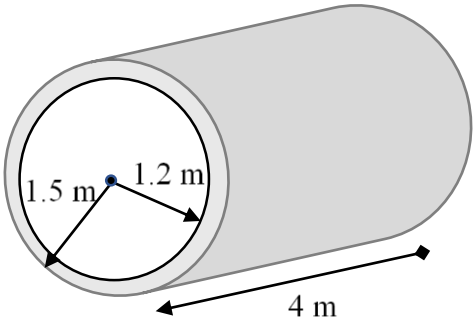
……

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Question 20 continues on page 40

Question 20 continued

(e) A four-metre length of cylindrical pipe is shown. The outer radius is 1.5 metres and the inner radius is 1.2 metres.



NOT TO SCALE

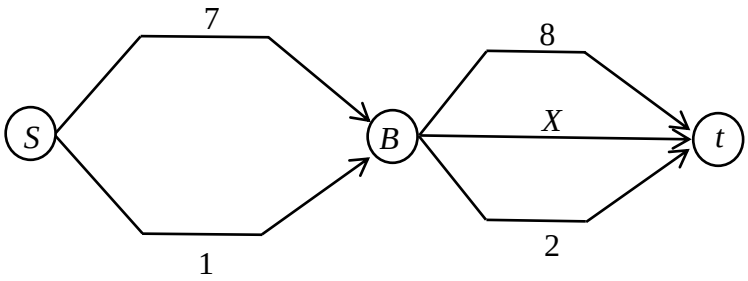
(i) What volume of water will flow through this pipe, to the nearest cubic metre? **2**

……

……

……

This four-metre length of pipe is shown in the network diagram below (*X*), connecting (B) to the sink (t). Weights on the edges are the volume of water each pipe can carry, in cubic metres.



(ii) What is the flow capacity of the current network? **1**

……

……

(iii) In order to maximise the flow in this network, one more pipe is to be added between the source (*S*) and *B*. What must this pipe's capacity be, in cubic metres? **1**

……

……

End of Task

Section II Extra writing space

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

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Student's Name: Solutions

Student Number: | | | | | | | | | |

Teacher's Name: _____

ABBOTSLEIGH

2020
HIGHER SCHOOL CERTIFICATE
Trial Examination

Standard 2 Mathematics

General Instructions

- Reading time – 10 minutes.
- Working time – 2 hours and 30 minutes
- Write using black pen.
- **NESA approved** calculators may be used.
- **NESA approved** reference sheet is provided.
- All necessary working should be shown in every question to gain full marks.
- Make sure your Student Number is on the front cover of each section.
- Answer the Multiple-Choice questions on the answer sheet provided.
- In Questions 16 - 20, show relevant mathematical reasoning and/ or calculations.

Total marks – 100

- Attempt Sections I and II.

Section I Pages 3 - 12

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

Section II Pages 13 - 42

85 marks
- Attempt Questions 16 - 20
- All questions are of equal value
- Allow about 2 hours and 5 minutes for this section.

Outcomes to be assessed:

Standard 2 Mathematics:

Preliminary Outcomes:

MS11-1 uses algebraic and graphical techniques to compare alternative solutions to contextual problems

MS11-2 represents information in symbolic, graphical and tabular form

MS11-3 solves problems involving quantity measurement, including accuracy and the choice of relevant units

MS11-4 performs calculations in relation to two-dimensional and three-dimensional figures

MS11-5 models relevant financial situations using appropriate tools

MS11-6 makes predictions about everyday situations based on simple mathematical models

MS11-7 develops and carries out simple statistical processes to answer questions posed

MS11-8 solves probability problems involving multistage events

MS11-9 uses appropriate technology to investigate, organise and interpret information in a range of contexts

HSC Outcomes:

MS2-12-1 uses detailed algebraic and graphical techniques to critically evaluate and construct arguments in a range of familiar and unfamiliar contexts

MS2-12-2 analyses representations of data in order to make inferences, predictions and draw conclusions

MS2-12-3 interprets the results of measurements and calculations and makes judgements about their reasonableness, including the degree of accuracy and the conversion of units where appropriate

MS2-12-4 analyses two-dimensional and three-dimensional models to solve practical problems

MS2-12-5 makes informed decisions about financial situations, including annuities and loan repayments

MS2-12-6 solves problems by representing the relationships between changing quantities in algebraic and graphical forms

MS2-12-7 solves problems requiring statistical processes, including the use of the normal distribution and the correlation of bivariate data

MS2-12-8 solves problems using networks to model decision-making in practical problems

MS2-12-9 chooses and uses appropriate technology effectively in a range of contexts, and applies critical thinking to recognise appropriate times and methods for such use

SECTION I

15 marks
Attempt Questions 1 – 15
Use the multiple-choice answer sheet
Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

Sample 2 + 4 = (A) 2 (B) 6 (C) 8 (D) 9

(A) ○ (B) ● (C) ○ (D) ○

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

(A) ● (B) ⊗ (C) ○ (D) ○

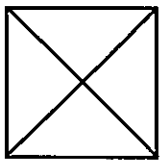
If you change your mind and have crossed out what you consider to be the correct answer, then indicate this by writing the word *correct* and drawing an arrow as follows.

correct ←

(A) ⊗ (B) ⊗ (C) ○ (D) ○

---

1. The following symbol is used on the floor plan of a 4 bedroom house.



In which room of the house floor plan is this symbol likely to be seen?

A. Kitchen

B. Dining room

(C.) Bathroom

D. Bedroom

2. Katie has a resting heart rate of 50 beats/minute. When exercising it increases to 80 beats/minute. How many more times would her heartbeat in five minutes when exercising, compared to when resting?

(A.) 150

30 beats/min quicker
30 beats × 5 = 150

B. 160

C. 180

D. 200

SECTION I

15 marks
Attempt Questions 1 – 15
Use the multiple-choice answer sheet
Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.
Sample 2 + 4 = (A) 2 (B) 6 (C) 8 (D) 9

(A) ○ (B) ● (C) ○ (D) ○

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

(A) ● (B) ⊗ (C) ○ (D) ○

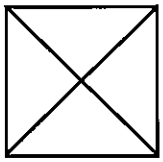
If you change your mind and have crossed out what you consider to be the correct answer, then indicate this by writing the word *correct* and drawing an arrow as follows.

correct

(A) ⊗ (B) ● (C) ○ (D) ○

---

1. The following symbol is used on the floor plan of a 4 bedroom house.



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(A.) 150

30 beats/min quicker
30 beats x 5 min = 150

B. 160

C. 180

D. 200

3. The table shows income tax payable.

Taxable income	Tax on this income
0 - $18,200	Nil
$18,201 - $37,000	19c for each $1 over $18,200
$37,001 - $87,000	$3,572 plus 32.5c for each $1 over $37,000
$87,001 - $180,000	$19,822 plus 37c for each $1 over $87,000
$180,001 and over	$54,232 plus 45c for each $1 over $180,000

John's taxable income is $102 000. What is the tax payable on John's income?

A. $5550

B. $19 822

(C.) $25 372

D. $37 740

$19822 + 0.37 \times (102000 - 87000)$
$= \$25\ 372$

4. Tom works in a restaurant and below is his wage sheet for last week.

Employee	Hourly Rate	Normal hours worked	Double hours worked
Tom	**$22**	x	**5**

If his total wage for last week was $770, what is the value of x ?

A. 20

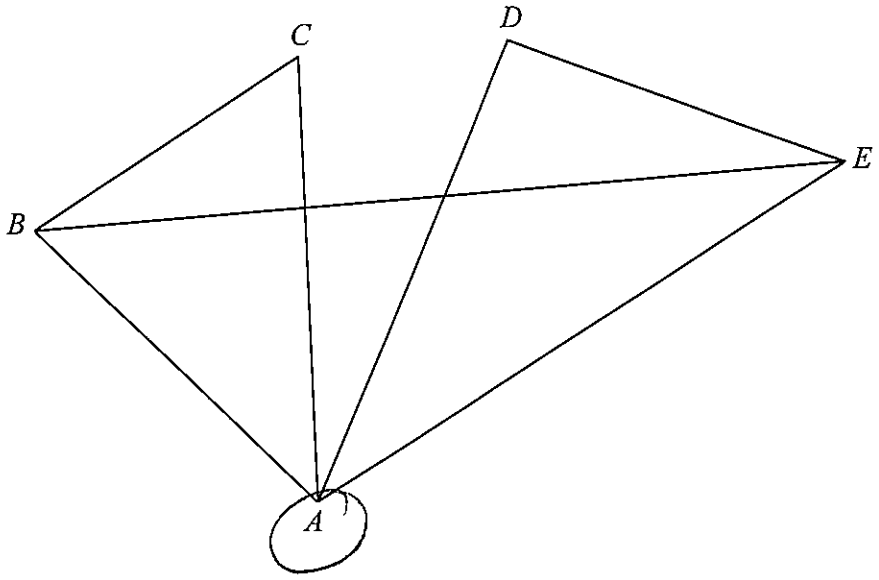
(B.) 25

C. 30

D. 35

$22 \times (x + 5 \times 2) = 770$
$22 \times (x + 10) = 770$
$x + 10 = 35$
$x = 25$

5. In the following graph, which vertex has the largest degree?



A. *A*

B. *B*

C. *C*

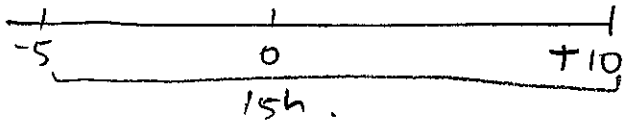
D. *D*

6. Tania lives in New York, USA (UTC –5) and Margaret lives in Sydney, NSW (UTC +10).

Margaret makes a call to Tania at 12:30 pm on Wednesday 26th February.

February is a month when NSW has daylight saving time and the USA does not.

What is the time in New York when Tania receives the call?



A. 2:30 am Thursday 27th February

B. 4:30 am Thursday 27th February

C. 10:30 pm Tuesday 25th February

D. 8:30 pm Tuesday 25th February

12.30p.m Wed
Daylight savings
ie 11.30am EST
- 15h

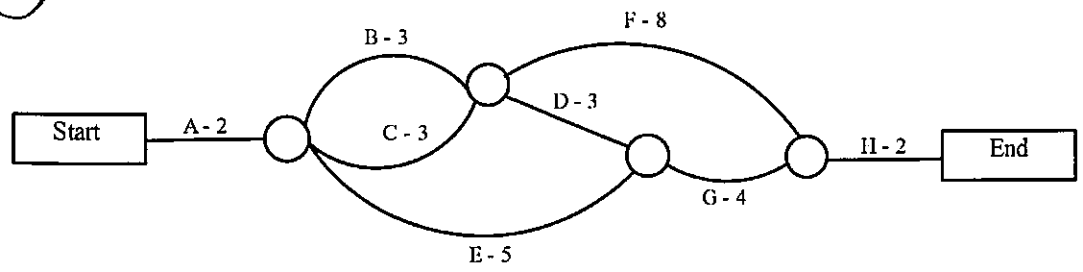
11.30 am Wed
-11h 30
12am
3h 30
8.30p.m Tues

7. The activity chart below shows the immediate prerequisite(s) and duration for each activity in a project.

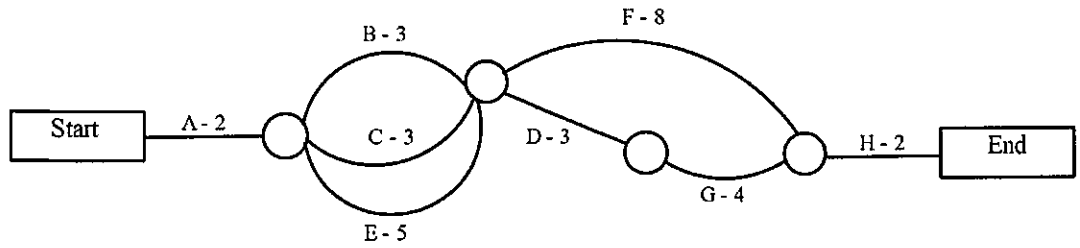
Activity	Immediate Prerequisites	Time (days)
A	-	2
B	A	3
C	A	3
D	B, C	3
E	A	5
F	B, C	8
G	D, E	4
H	F, G	2

Which network could be drawn from the activity chart?

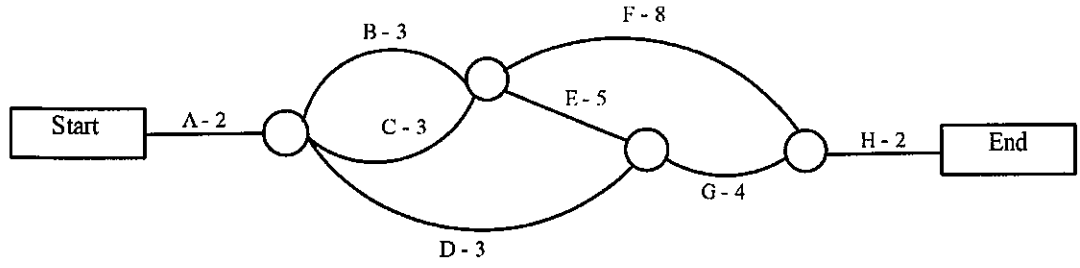
A.



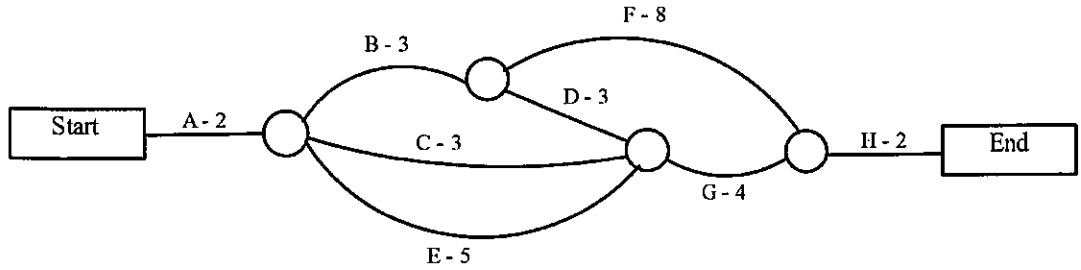
B.



C.



D.



8. The formula below gives the blood alcohol concentration for a male.

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

where 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. Harry weighs 80 kg and consumes 6 standard drinks in 3 hours. What is his BAC, correct to 1 significant figure?

$$BAC = \frac{10 \times 6 - 7.5 \times 3}{6.8 \times 80}$$

$$= 0.0689.$$

$$= 0.07 \text{ to 1 sf.}$$

A. 0.04

B. 0.05

C. 0.06

(D.) 0.07

9. Sally 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 Sally's estimate of the parrot population?

let population be P

$$\frac{\text{Tagged}}{\text{Total}} = \frac{170}{P} = \frac{10}{32}$$

$$170 \times 32 = 10 \times P$$

$$P = \frac{170 \times 32}{10}$$

$$= 544$$

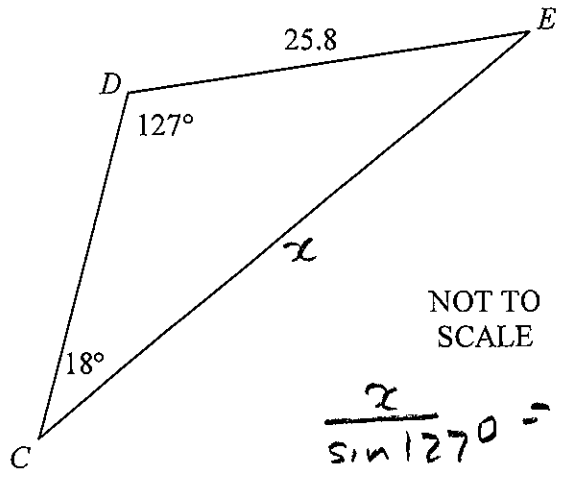
A. 588

B. 572

(C.) 544

D. 524

10. The triangle shown has one angle of 127° and another of 18°.



NOT TO SCALE

$$\frac{x}{\sin 127^0} = \frac{25.8}{\sin 18^0}$$

$$x = \frac{25.8 \sin 127^0}{\sin 18^0}$$

$$= 66.68$$

$$= 67 \text{ to nr whole.}$$

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

A. 10

B. 31

C. 39

(D.) 67

11. The scale on an aerial photograph is given as 1 mm = 200 m.

If the length of land is 1350 m, then the length on the map between these points would be?

Scale : Actual

1 : 200000

$$\text{Scale length} = \frac{1}{200000} \times 1350\text{m}$$

$$= 0.00675\text{ m}$$

$$= 6.75\text{ mm}.$$

A. 1.48 mm

(B.) 6.75 mm

C. 6.75 cm

D. 14.8 cm

12. On a recent assessment task, the results were normally distributed.

Rob achieved a score of 68% with a z-score of 0.5 and Steve achieved a score of 82% with a z-score of 2.25 on the task. What was the mean (%) score?

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

Rob.

$0.5 = \frac{68 - \bar{x}}{s}$

$68 - \bar{x} = 0.5s$ (1)

Steve.

$2.25 = \frac{82 - \bar{x}}{s}$

$82 - \bar{x} = 2.25s$ (2).

(2) − (1)

$14 = 1.75s$

$s = 8$

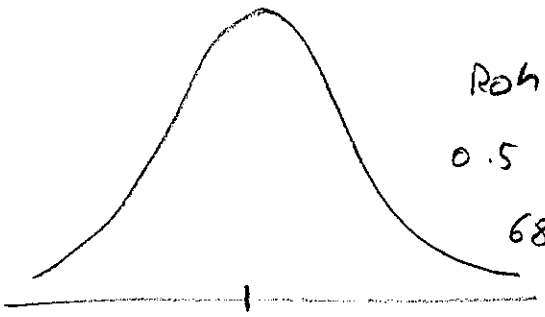
Sub in (1)

A. 64

B. 62

C. 60

D. 58



$68 - \bar{x} = 0.5 \times 8$

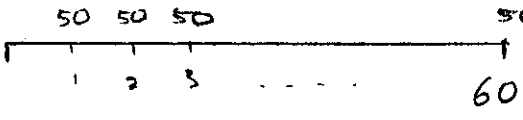
$68 - 4 = \bar{x}$

$\bar{x} = 64$.

13. Kathy plans on switching to a new internet provider that helps her save $50 on expenses every month. Her contract is set for 5 years and the interest rate is 6% per annum. Using excel how would she calculate the present value?

$r = 0.06 \div 12$

$= 0.005$.



PV

$n = 5 \times 12 = 60$.

= PV (

✗ A. = PV(0.06, 5, -50)

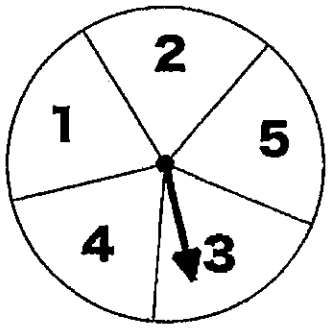
B. = PV(0.005, 5, -50)

C. = PV(0.005, 60, - 50)

$2586.28

✗ D. = PV(0.06, 60, -50)

14. The spinner shown contains equal sized sections labelled with the numbers from 1 to 5.



theoretical $\frac{2}{5} = 0.4$

Outcome	Frequency
1	19
2	21
3	25
4	15
5	20

100

The table represents the outcomes of an experiment involving 100 spins.

When considering the probability of the outcome being an even number, which of the following statements is correct?

$P(\text{even}) = \frac{21+15}{100} = \frac{36}{100} = 0.36$.
2, 4.

✗ A. The theoretical probability is the same as the relative frequency.

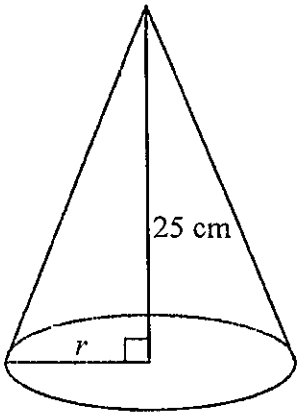
✓ B. The theoretical probability is greater than the relative frequency.

C. The theoretical probability is less than the relative frequency.

D. The theoretical probability cannot be determined from the information given.

15. The capacity of a cone with a height of 25 cm is 2 litres.

Find the radius (r) of the circular base, in centimetres correct to 2 decimal places.



NOT TO SCALE

$2L = 2000mL$
$= 2000cm^3$

$V = \frac{1}{3}\pi r^2 h = 2000$

$\frac{1}{3} \pi \times r^2 \times 25 = 2000$

$r^2 = \frac{2000}{25\pi \times \frac{1}{3}}$

$= 76.394$

$r = \sqrt{76.394}$

A. 2·76 cm

B. 5·05 cm

C. 8·74 cm

D. 76.39 cm

End of Section I

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2020 TRIAL HIGHER SCHOOL CERTIFICATE EXAMINATION

Mathematics Standard 2

Student Number

Section II

85 marks
Attempt Questions 16 - 20
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.

Extra writing space is provided on pages 18, 24, 30, 35, 41

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

Please Turn Over

Question 16 (17 marks)

(a) The ratio of trees to shrubs in a park is 2 : 7. If there are 14 trees, how many shrubs are there? **2**

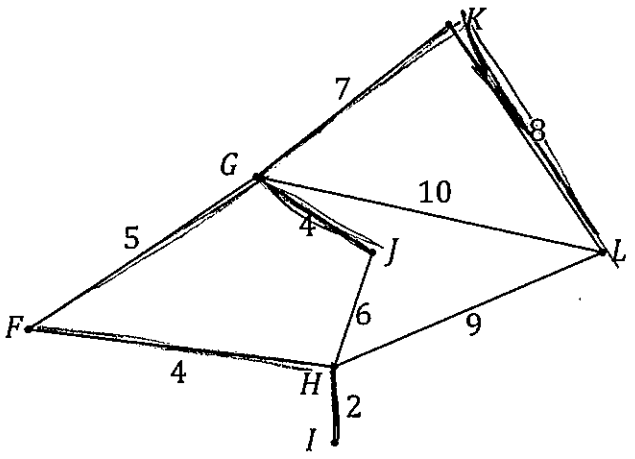
Trees : shrubs

$\times 7 \left(2 : 7\right) \times 7$

$14 : 49$

∴ 49 shrubs

(b) The network diagram shows seven campsites, F, G, H, I, J, K and L, which are joined by tracks. The numbers by the paths show lengths (in km) of that section of track.



(i) On the above diagram highlight the minimum spanning tree of the network. **1**

(ii) A telephone cable is to be laid along as few of the existing tracks as possible. **1**
What is the minimum length of cable necessary to complete this task?

Minimum length = 2 + 4 + 5 + 4 + 7 + 8

= 30 km.

Question 16 continued on page 15

Question 16 (continued)

(c) A solar panel system exports 21.4 kWh per day of energy to the grid. An energy retailer pays \$0.079 per kWh for energy. What is the expected saving from the solar panel system for the year? Answer to the nearest cent. **2**

Energy generated = 21.4kWh × 365
= 7811 kWh over the year

Expected saving = 7811 kWh × \$0.079/kWh
= \$617.07 (to nearest cent)

(d) The number of students absent from year 12 for the past nine days was as follows:

17, 23, 20, 21, 16, 15, 32, 18, 21

(i) What is the mean? Give your answer correct to one decimal place. **1**

$\text{Mean} = \frac{\text{Sum}}{\text{Number}} = \frac{17+23+20+21+16+15+32+18+21}{9}$

$= \frac{183}{9} = 20.3 = 20.3$ (to 1dp)

(ii) Find the interquartile range? **1**

$IQR = Q_3 - Q_1$

$= 22 - 16.5$

$= 5.5$

(iii) Is 32 an outlier for this set of data? Justify your answer with calculations. **2**

This score is above mean so outlier if more than $Q_3 + 1.5 \times IQR$

$Q_3 + 1.5 \times IQR$

$= 22 + 1.5 \times 5.5$

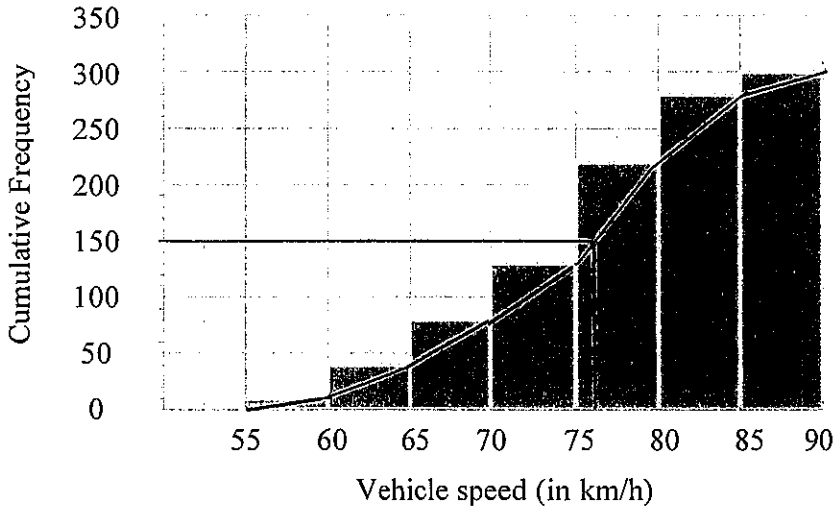
$= 30.25$

$32 > 30.25$ so yes it is an outlier.

Question 16 continued on page 16

Question 16 (continued)

(e) The speeds of a vehicle are shown in the cumulative frequency histogram below.



(i) What is the frequency of 75 km/h? **1**

up to 75 cum is 130
up to 70 cum is 80

∴ Frequency of 75 km/h = 130 − 80
= 50

(ii) Construct a cumulative frequency polygon (or ogive) on this graph. **1**

(iii) Use the graph to estimate the median. **1**

Total is 300
Median halfway at 150.
Median is 76 km/h.

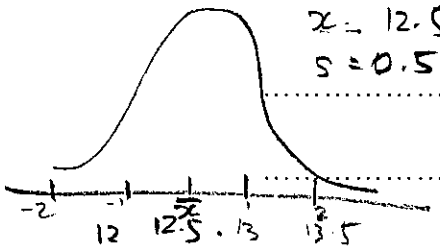
Question 16 continued on page 17

Question 16 (continued)

(f) Tran's industrial unit produces aluminium rods. In the past week the industrial unit has produced aluminium rods with a mean weight of 12.5 kilograms and a standard deviation of 0.5 kilograms.

(i) Quality control requires any aluminium rod with a z-score less than -1 to be rejected. **1**

What is the minimum weight that will be accepted?



Minimum weight accepted is 12.0 kg.

(ii) Aluminium rods with a z-score greater than 2 are also rejected. **1**

What is the maximum weight that will be accepted?

Max weight accepted is 2 std devns above mean
so 13.5 kg

(g) Kiara takes out a loan for \$58 000 at an interest rate of 6% per annum compounding monthly. **2**

The loan will be repaid by making monthly repayments of \$810 per month.

Using the recurrence relation $V_{n+1} = V_n \times (1+r) - D$, determine the balance of the loan after 2 months.

$r = \frac{0.06}{12} = 0.005$

$V_0 = \$58000$

$V_1 = V_0 \times (1+0.005) - 810$

$= 58000(1.005) - 810$

$= 57480.$

$V_2 = 57480(1.005) - 810$

$= \$56\,957.90$ is bal of loan after 2 mths.

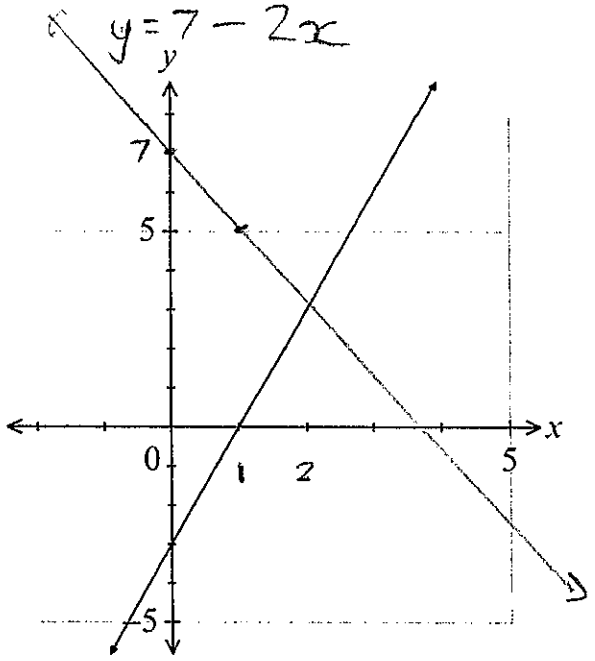
End of Question 16

Section II Extra writing space

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

Question 17 (17 marks) **Student Number:**

(a) The graph below shows the line $y = 3x - 3$.



(i) On the same set of axes, draw the line $y = 7 - 2x$. **1**

(ii) What is the solution to the simultaneous equations below? **1**

$$y = 3x - 3$$
$$y = 7 - 2x$$

$x = 2, y = 3$

(b) Calculate the percentage error in a measurement of 2.75 metres. **2**

Give your answer correct to 2 decimal places.

Precision = 0.01

$\therefore AE = 0.005$

$\%\text{ error} = \frac{\text{error}}{\text{meas}} \times 100$

$= \frac{0.005}{2.75} \times 100$

$= 0.1818$

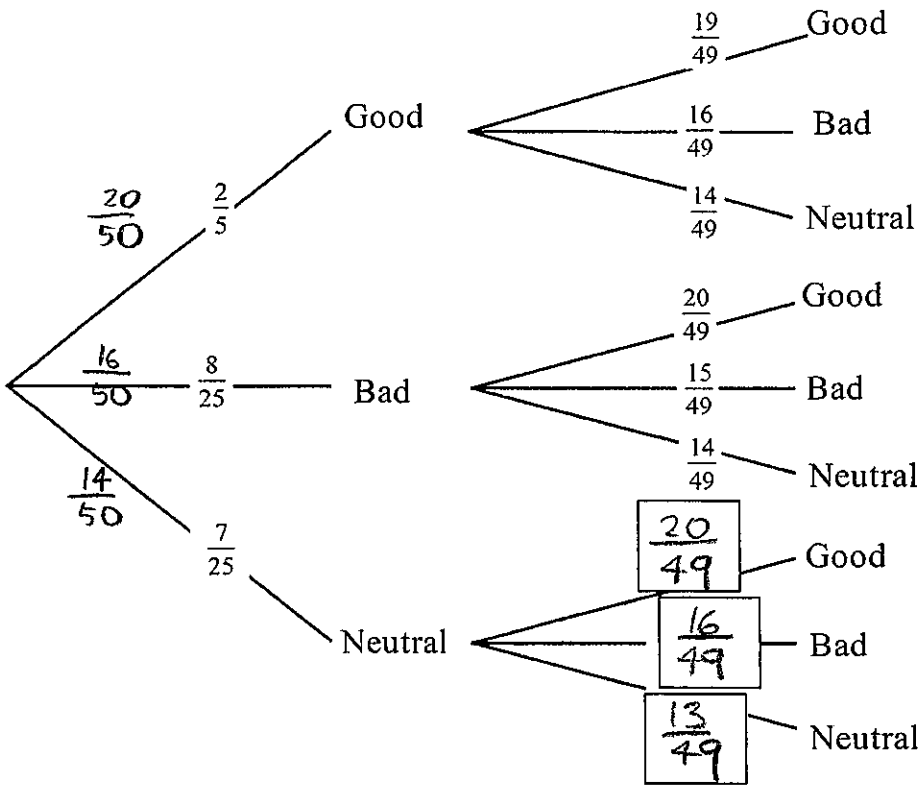
$= 0.18$

$\therefore$ % error is 0.18 %.

Question 17 continues on page 20

Question 17 (continued)

(c) In a board game there are 50 cards in a pile which are picked up two at a time by the players. Of these cards, 20 have a good outcome for the player, 16 have a bad outcome and the remainder have neutral outcomes.



(i) Complete the three missing probabilities on the tree diagram above for the first player's draw from the deck. **2**

1 off 1 error
0 more than 1 error

(ii) What is the probability that the first two cards drawn are both neutral outcomes? **1**

$P(N,N) = \frac{7}{25} \times \frac{13}{49}$

$= \frac{13}{175} = 7.43\%$ (to 2dp)

(iii) What is the probability that the first two cards drawn are NOT both neutral outcomes? **1**

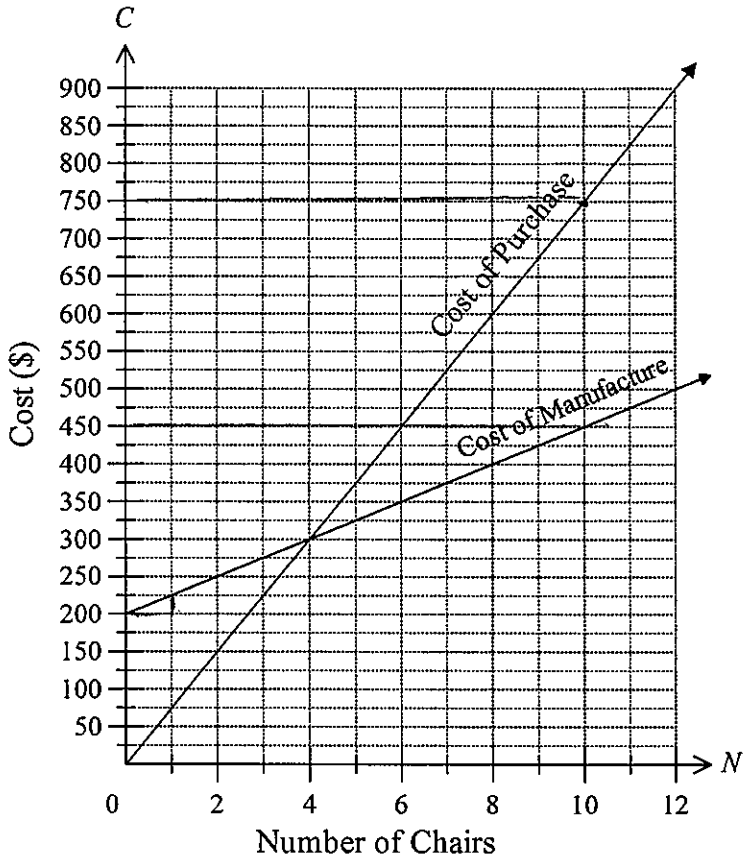
$P(\text{not } NN) = 1 - \frac{13}{175}$

$= \frac{162}{175} = 92.57\%$

Question 17 continues on page 21

Question 17 (continued)

(d) The Home Furniture Company makes an occasional chair that they sell to stores.
The lines on the set of axes below shows the cost of manufacturing and purchasing up to 12 chairs on a given day. The graphs are drawn as continuous lines, for convenience.



(i) What is the equation of the line representing the cost of manufacture? **2**

$y = mx + b$.

$C = 25N + 200$

(ii) How many chairs need to be sold to break even? **1**

4

(iii) What is the profit made when 10 chairs are sold? **1**

Profit = $750 - $450

= $300

Question 17 continues on page 22

Question 17 (continued)

(e) The table below gives the future value of an annuity of \$1 per period for various periods and interest rates.

Table of Future Value Interest Factors								
n \ r	0.0025	0.0030	0.0035	0.0040	0.0045	0.0050	0.0055	0.0060
53	56.5961	57.3530	58.1230	58.9063	59.7033	60.5141	61.3391	62.1785
54	57.7376	58.5250	59.3264	60.1419	60.9719	61.8167	62.6765	63.5516
55	58.8819	59.7006	60.5340	61.3825	62.2463	63.1258	64.0212	64.9329
56	60.0291	60.8797	61.7459	62.6280	63.5264	64.4414	65.3733	66.3225
57	61.1792	62.0624	62.9620	63.8786	64.8123	65.7636	66.7329	67.7204
58	62.3322	63.2485	64.1824	65.1341	66.1040	67.0924	68.0999	69.1267
59	63.4880	64.4383	65.4070	66.3946	67.4014	68.4279	69.4744	70.5415
60	64.6467	65.6316	66.6359	67.6602	68.7047	69.7700	70.8565	71.9647
61	65.8083	66.8285	67.8692	68.9308	70.0139	71.1189	72.2463	73.3965
62	66.9729	68.0290	69.1067	70.2065	71.3290	72.4745	73.6436	74.8369
63	68.1403	69.2331	70.3486	71.4874	72.6499	73.8368	75.0487	76.2859
64	69.3106	70.4408	71.5948	72.7733	73.9769	75.2060	76.4614	77.7436
65	70.4839	71.6521	72.8454	74.0644	75.3098	76.5821	77.8820	79.2101
66	71.6601	72.8670	74.1004	75.3607	76.6487	77.9650	79.3103	80.6854

(i) Alice invests \$600 per month in an annuity which pays 4.2% p.a. compounding monthly. What will be the value of the annuity after 62 months? **1**

$r = 4.2\% \div 12 = 0.0035$

$n = 62$

Value $= 600 \times 69.1067$

$= \$41464.02$

(ii) An annuity has a value of \$49 738 after being invested for five and a half years at a rate of 4.8% p.a. compounded monthly. How much was invested in the annuity each month? **2**

$r = 4.8\% \div 12 = 0.004$

$n = 5.5 \times 12 = 66$

Let investment be \$M

$FV = M \times 75.3607$

$49738 = M \times 75.3607$

$M = \frac{49738}{75.3607}$

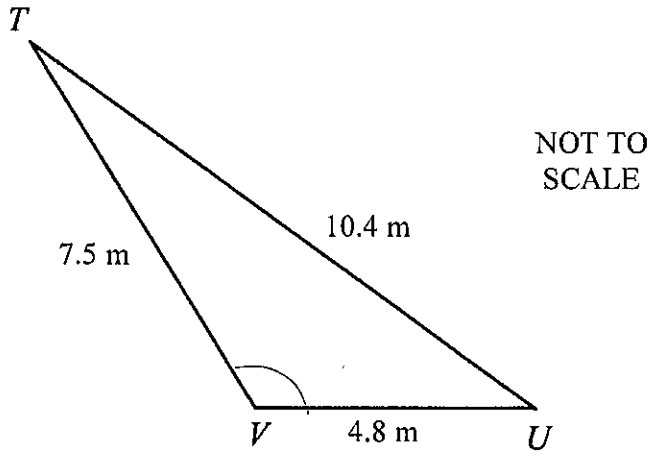
$= 659.999$

$= \$660$ to nearest cent.

Question 17 continues on page 23

Question 17 (continued)

(f) In the diagram below, $TV = 7.5$ m, $VU = 4.8$ m and $TU = 10.4$ m. **2**



Use the cosine rule to calculate the size of $\angle TVU$ correct to the nearest degree.

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

$\cos \angle TVU = \dfrac{7.5^2 + 4.8^2 - 10.4^2}{2 \times 7.5 \times 4.8}$

$= -0.4$

cos is negative as $\angle TVU$ is obtuse.

$\angle TVU = 113.639$

$= 114^\circ$ to nearest degree.

End of Question 17

Section II Extra writing space

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

Question 18 (17 marks) **Student Number:**

(a) Amanda and Kylie are twins and are given $2 000 each by their grandparents for their 18th birthdays. On the day after their birthday, they both invest their money.

(i) Amanda uses her $2 000 to buy a piece of antique jewellery which is predicted to appreciate at 6% p.a. What is the expected value of the jewellery after 6 years? **1**

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

$= 2000(1.06)^6$

$= \$2837.04$

(ii) Kylie invests her $2 000 in shares which cost $8.00 each and are predicted to pay a dividend of 60 cents per share, once each year. The dividends are paid into a transaction account which pays no interest. **2**

Whose investment will be worth more after 6 years, and by how much?

$\text{No. of shares} = \frac{2000}{8} = 250$

Kylie Yearly divd $= 250 \times 0.6 = \$150$

Investment $= 2000 + 150 \times 6$

$= \$2900$

$\therefore$ Kylie's investment is worth more by

$\$2900 - \$2837.04 = \$62.96$

Question 18 continues on page 26

Question 18 continued

(b) Short of time in the morning, a student gets a coffee and muffin on their way to school. On average, a coffee and a muffin give 506 kJ and 447 kJ of energy respectively.

(i) If it takes the student 5 minutes of running to burn off 146 kJ of energy, how many minutes will the student need to run to consume the energy from the coffee and muffin? Round your answer to the nearest whole minute. **2**

Coffee + Muffin = $506 + 447 = 953$ kJ

Minutes needed = $\frac{953}{146} \times 5$

$= 6.527 \times 5$

$= 32.64$ min

$= 33$ min

(ii) The conversion rate between calories and kilojoules is 1 calorie = 4.184 kilojoules. Determine the number of calories in the coffee, giving your answer correct to four significant figures. **2**

4.184 kJ $= 1$ cal

Coffee 506 kJ $= \frac{1}{4.184}$ cal.

$= \frac{506}{4.184}$ cal

$= 120.9369$

$= 120.9$ cal.

Question 18 continues on page 27

Question 18 continued

(c) Miriam bought a car for $32 000 on 31st January 2016

It depreciates at a rate of 20% p.a. using the declining-balance method.

(i) What was the value of the vehicle on 31st January 2019? **1**

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

$= 32000(1-0.2)^3$

$= \$16\,384$

(ii) How much will the value of the vehicle drop between 31st January 2019 and 31st January 2020? **2**

$S_{2020} = 32000(1-0.2)^4$

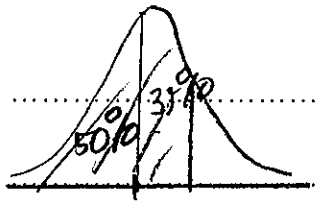
$= \$13107.20$

$\therefore$ Drop in value $= \$16\,384 - 13107.20$

$= \$3276.80.$

(d) The ages of the residents who live in Hudson Creek are normally distributed. **2**

The mean age is 56 years and the standard deviation is 14. If there are 1400 residents in Hudson Creek, how many are younger than 70?



$s = 14$

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

$= \frac{70 - 56}{14}$

$= 1$

No. Younger than 70 $= 84\% \times 1400$

$= 1176.$

Question 18 continues on page 28

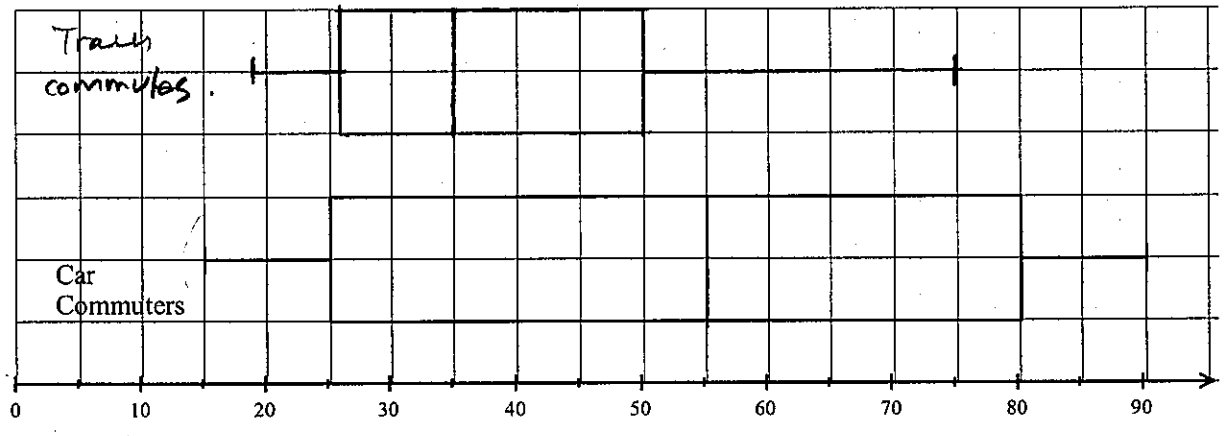
Question 18 continued

(e) Adam completes a survey of trip times (in minutes) for commuters using two different methods of transport.

A five-number summary of his results for train commuters are shown below.

Train Commuters five-number summary: 19, 26, 35, 50, 75

A box and whisker plot for his results for car commuters is shown below.



(i) On the grid above, draw a box and whisker plot for the Train Commuters. **1**

(ii) By comparing <u>two statistical measures</u> or features that can be found from the two plots, compare the data for the two types of transport. **2**

Median Median train journey is shorter only 35min compared with median car journey of 55min.

IQR Train IQR is smaller 50-26 = 24min compared with car IQR 80-25 = 55min which shows that the trip time on the train is both shorter and more predictable and consistent + wide variation in car travel time.

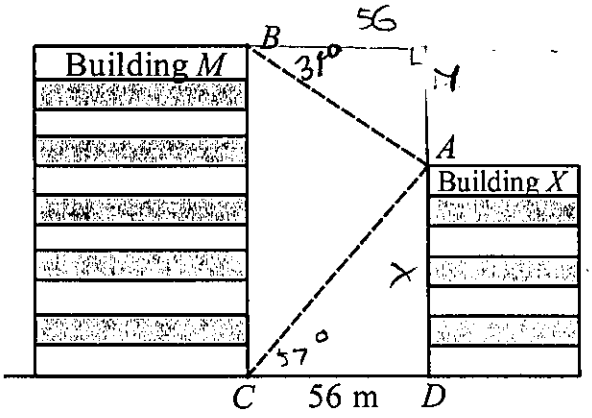
Question 18 continues on page 29

Question 18 continued

(f) Two buildings, called M and X, are situated 56 m apart on level ground. **2**

From point C, the angle of elevation of point A is 57°.

From point B, the angle of depression of point A is 34°.



NOT TO SCALE

Calculate the height of Building M (correct to 1 decimal place).

$\tan 57^\circ = \frac{X}{56}$

$X = 56 \tan 57^\circ$

$= 86.2\text{m}$.

$\tan 34^\circ = \frac{Y}{56}$

$Y = 56 \tan 34^\circ$

$= 37.77\text{m}$.

Building M height $= X + Y$

$= 86.2 + 37.77$

$= 123.972$

$= 124.0\text{m}$ (to 1dp)

End of Question 18

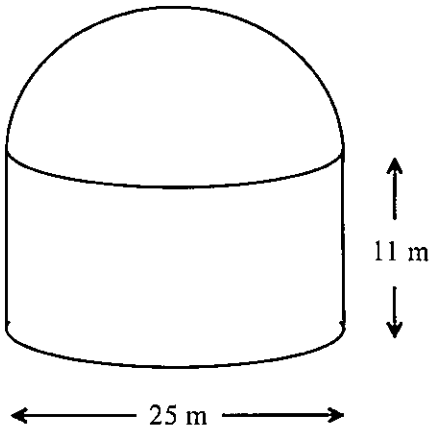
Section II Extra writing space

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

Question 19 (17 marks) **Student Number:**

(a) A bulk gas container consists of a cylindrical section topped with a hemisphere. **2**

It is made entirely of sheet metal, including the circular base of the cylinder.



NOT TO SCALE

Calculate the area of sheet metal needed to manufacture the container.

Give your answer correct to the nearest square metre. $r = 12.5m$

Surface area = Base + Curved surface area + Hemisphere

$= \pi r^2 + 2\pi rh + \frac{1}{2} \times 4\pi r^2$

$= \pi \times 12.5^2 + 2\pi \times 12.5 \times 11 + \frac{1}{2} \times 4\pi \times 12.5^2$

$= 490.87 + 863.94 + 981.75$

$= 2336.56$

$= 2337 m^2$

Question 19 continues on page 32

Question 19 continued

(b) The cost of preparing meals in a school canteen is linearly related to the number of meals prepared. To help the caterers predict the costs, data was collected on the cost of preparing meals for different levels of demand. The data is shown below.

Number (n) (meals)	30	35	40	45	50	55	60	65	70	75	80
Cost (C) (dollars)	138	154	159	182	198	198	214	208	238	234	244

(i) Calculate the value of the Pearson's correlation coefficient. **1**

Give your answer correct to four decimal places.

0.9784

(ii) Using your answer from (i) **describe** the relationship between the number of meals and the cost in dollars. **1**

There is a strong positive correlation between number of meals and cost as 0.9784 is close to 1.

(iii) Using your calculator find the equation of the least-squares line of best fit. **2**

Answer correct to one decimal place. $y = A + Bx$

Cost = 81.5 + 2.1 × number of meals

$C = 81.5 + 2.1n$

(iv) What is the predicted cost of producing 48 meals? **1**

Predicted cost = 81.5 + 2.1 × 48

= $182.30

(v) Matthew would like to predict the cost of 120 meals. Would he be interpolating or extrapolating? Justify your answer. **2**

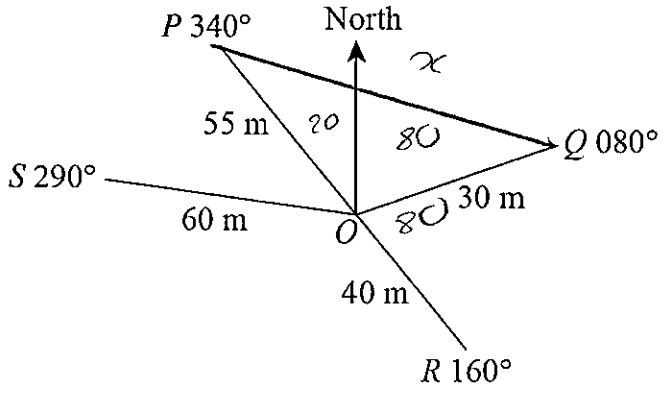
1 answer
1 explanation

He is extrapolating as 120 meals is outside the given range, so he is making a prediction outside the given range.

Question 19 continues on page 33

Question 19 continued

(c) A radial survey of a field is shown.



NOT TO SCALE

(i) Find the size of $\angle POQ$. **1**

$20^\circ + 80^\circ = 100^\circ$

(ii) What is the length of PQ, correct to the nearest metre? **2**

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

$PQ^2 = 55^2 + 30^2 - 2 \times 55 \times 30 \cos 100^\circ$

$= 4498$

$PQ = \sqrt{4498} = 67\text{m}$.

(iii) The triangular area ROQ is going to be planted with barley. **2**

What is the size of this area, correct to three decimal places?

$\text{Area} = \frac{1}{2} ab \sin C$

$= \frac{1}{2} \times 30 \times 40 \times \sin 80^\circ$

$= 590.885\ \text{m}^2$

Question 19 continues on page 34

Question 19 continued

(d) Shannon owns a credit card that has no annual fees and charges 18.82 % per annum compound interest on all purchases. The interest is charged daily from the day of purchase and includes the day of payment.

(i) Show that the daily interest rate is 0.052%. **1**

$r = 18.82\% \div 365$

$= 0.05156\%$

$= 0.052\%$

(ii) On the 23rd of March, Shannon bought a painting for $580 using her credit card. She paid her credit card account on the 15th of April. **2**

Calculate the total amount Shannon paid for the painting, including interest, correct to the nearest cent.

23/3 — 31/3 | 1/4 — 15/4

9 days | 15 days

24 days (1)

Total amt paid $= PV(1+r)^n$

$= 580(1+0.052\%)^{24}$ (1)

$= \$587.28$ (note also $587.22 if keep 18.82% exact value in calc)

End of Question 19

Section II Extra writing space

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

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Question 20 (17 marks) **Student Number:**

(a) 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

Terri borrows $36 000 for a car. She arranges to repay the loan with monthly repayments over 4 years. She is charged 7.8% per annum interest.

M M M M M

36000.

(i) Find Terri's monthly repayment. Answer to the nearest cent. **2**

$r = 7.8\% \div 12 = 0.0065$

$n = 4 \times 12 = 48.$

$PV = M \times 41.11986$

$36000 = M \times 41.11986$

$M = \frac{36000}{41.11986} = \$875.49$

(ii) Calculate the amount of interest Terri will pay over the term of the loan. **2**

Answer to the nearest dollar.

Total paid $= 875.49 \times 48$

$= \$42023.52$

Interest = Total paid − Amt borrowed

$= 42023.52 - 36000$

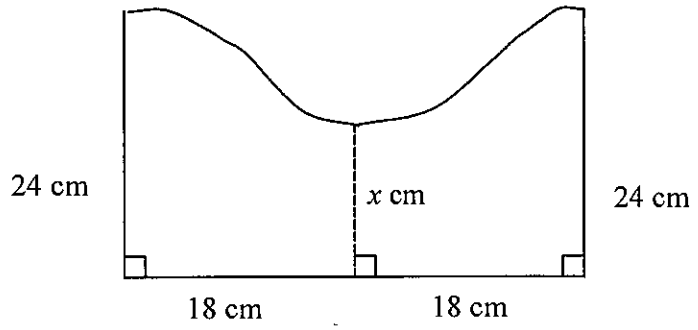
$= \$6023.52$

$= \$6024$

Question 20 continues on page 38

Question 20 continued

(b) The cross-section of a piece of artwork is shown below **2**



NOT TO SCALE

The trapezoidal rule with 2 intervals was used to approximate the area of the artwork as 612 cm^2.

What is the value of x?

$A = \frac{h}{2}(a_f + a_l)$

Area $= \frac{18}{2}(24 + x) + \frac{18}{2}(x + 24) = 612$ (1)

$612 = 9(24 + x) + 9(x + 29)$

$612 = 216 + 9x + 9x + 216$

$180 = 18x \quad \therefore x = 10$ (1)

(c) The equation of least-squares line of best fit is given by $y = mx + c$ **1**

Where $m = r\frac{s_y}{s_x}$ and $c = \bar{y} - m\bar{x}$

What is the y-intercept of the least-squares line of best fit given $m = 0.8$, $\bar{x} = 60$ and $\bar{y} = 75$?

y intercept is $c = \bar{y} - m\bar{x}$

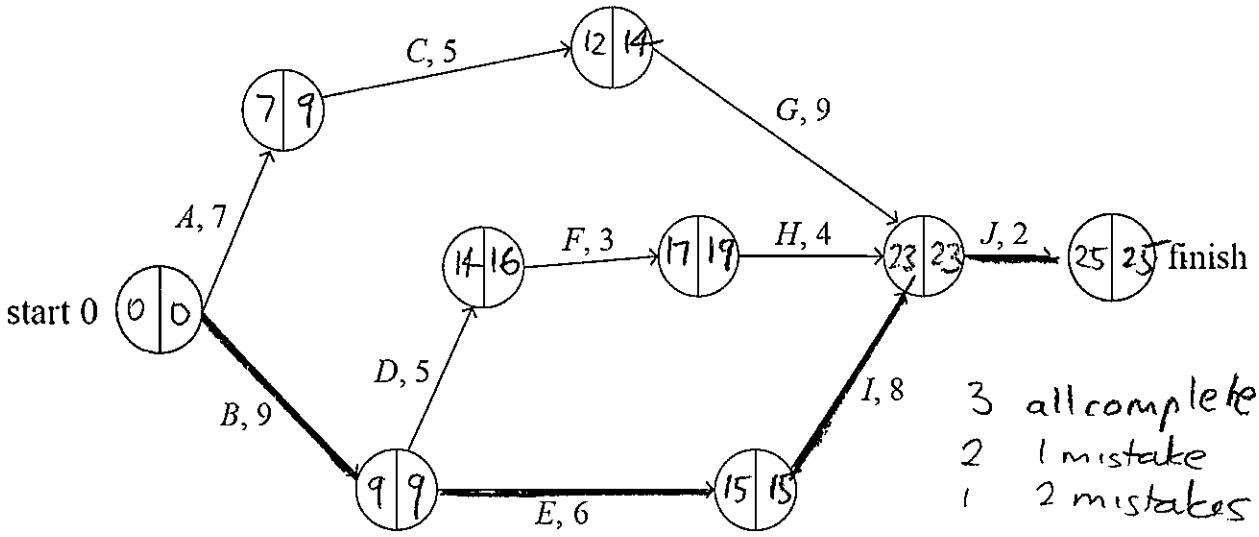
$= 75 - 0.8 \times 60$

$= 27$

Question 20 continues on page 39

Question 20 continued

(d) The network diagram for a project is shown below. The duration for each activity is in days.



3 all complete
2 1 mistake
1 2 mistakes
0 multiple mistakes.

(i) Write the earliest starting times (ESTs) and latest starting times (LSTs) on the above network diagram. **3**

(ii) What is the float time at C? **1**

14 - 12 = 2 days

(iii) What is the critical path of the project? **1**

B → E → I → J

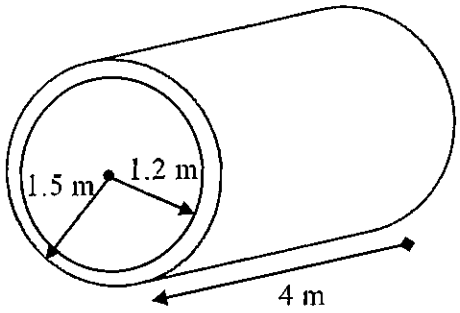
(iv) What is the minimum completion time for the project? **1**

25 days

Question 20 continues on page 40

Question 20 continued

(e) A four-metre length of cylindrical pipe is shown. The outer radius is 1.5 metres and the inner radius is 1.2 metres.



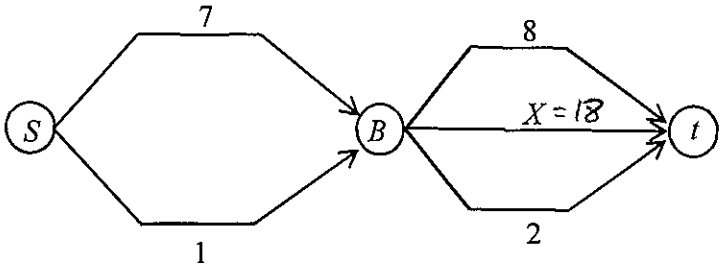
NOT TO SCALE

(i) What volume of water will flow through this pipe, to the nearest cubic metre? **2**

Volume $= \pi \times 1.2^2 \times 4$ ✓

$= 18\ m^3$ ✓

This four-metre length of pipe is shown in the network diagram below (X), connecting (B) to the sink (t). Weights on the edges are the volume of water each pipe can carry, in cubic metres.



(ii) What is the flow capacity of the current network? **1**

$8\ m^3$

(iii) In order to maximise the flow in this network, one more pipe is to be added between the source (S) and B. What must this pipe's capacity be, in cubic metres? **1**

Capacity $= (8+18+2) - (7+1)$

$= 20\ m^3$

End of Task