



ABBOTSLEIGH

Student Name: _____

Student Number:

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Teacher Name: _____

2016
HIGHER SCHOOL CERTIFICATE
Trial Examination

General 2 Mathematics

General Instructions

- Reading time – 5 minutes.
- Working time – 2.5 hours.
- Write using black pen.
- Board-approved calculators may be used.
- A formulae and data 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 26–30, show relevant mathematical reasoning and/ or calculations

Total marks – 100

- Attempt Sections I and II.

Section 1 Pages 3 - 13

25 marks

- Attempt Questions
- Allow about 35 minutes for this section.

Section 2 Pages 15-44

75 marks

- Attempt Questions 26 - 30
- All questions are equal value
- Allow about 1 hour and 55 minutes for this section.

Outcomes to be assessed:

General 2 Mathematics:

Preliminary Outcomes:

- MGP-1 uses mathematics and statistics to compare alternative solutions to contextual problems.
- MGP-2 represents information in symbolic, graphical and tabular form.
- MGP-3 represents the relationships between changing quantities in algebraic and graphical form
- MGP-4 performs calculations in relation to two-dimensional and three-dimensional figures
- MGP-5 demonstrates awareness of issues in practical measurement, including accuracy, and the choice of relevant units
- MGP-6 models financial situations relevant to the student's current life using appropriate tools
- MGP-7 determines an appropriate form of organisation and representation of collected data
- MGP-8 performs simple calculations in relation to the likelihood of familiar events
- MGP-9 uses appropriate technology to organise information from a limited range of practical and everyday contexts
- MGP-10 justifies a response to a given problem using appropriate mathematical terminology

HSC Outcomes:

- MG2H-1 uses mathematics and statistics to evaluate and construct arguments in a range of familiar and unfamiliar contexts
- MG2H-2 analyses representations of data in order to make inferences, predictions and conclusions
- MG2H-3 makes predictions about situations based on mathematical models
- MG2H-4 analyses two-dimensional and three-dimensional models to solve practical problems, including those involving spheres and non-right-angled triangles
- MG2H-5 interprets the results of measurements and calculations and makes judgements about reasonableness, including the degree of accuracy of measurements and calculations and the conversion to appropriate units
- MG2H-6 makes informed decisions about financial situations, including loan repayments
- MG2H-7 answers questions requiring statistical processes, including the use of the normal distribution, and the correlation of bivariate data
- MG2H-8 solves problems involving counting techniques, multistage events and expectation
- MG2H-9 chooses and uses appropriate technology to locate and organise information from a range of contexts
- MG2H-10 uses mathematical argument and reasoning to evaluate conclusions drawn from other sources, communicating a position clearly to others, and justifies a response

SECTION I

25 marks

Attempt Questions 1 – 25

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.

(A) ☒ (B) ☒ (C) ☐ (D) ☐

correct
↖

-
- 1 Josie works at the local coffee shop and is paid at an hourly rate of \$11.20. How much would she earn in a week if she worked 12 hours at normal time, 3.5 hours at time and a half and 5 hours at double time?

(A) \$305.20 (B) \$162.40 (C) \$277.20 (D) \$193.20

- 2 A high school has 125 students in each year group Year 7 to Year 12. A survey is to be conducted to determine the average number of hours per week of study by students at the school. Which of the following would provide the most representative sample for the survey?

(A) Random sample (B) Systematic sample
(C) Stratified sample (D) Census

- 3 Alex borrows \$9 800 to buy a new car. She pays off the loan in monthly instalments over 6 years at a rate of 5.4% p.a. How much will she pay, in total, over the 6 years?
- (A) $\$9800 \times (1.54)^6$
- (B) $\$9800 - (1.0045) \times 6$
- (C) $\$9800 \times (1.54) \times 72$
- (D) $\$9800 \times (1.0045)^{72}$
- 4 There are 1 056 006 tiles on the Sydney Opera House. When this number is written in scientific notation to two decimal places, it is equivalent to which of the following?
- (A) 1.056×10^6 (B) 1.06×10^6 (C) 1.05×10^6 (D) 1.06
- 5 The maximum size of a text message before modern messaging systems was 140 bytes. How many text messages could be sent by India if she has one megabyte of data to use?
- (A) 7489 (B) 1 048 576 (C) 59 919 (D) 749
- 6 Clare tabulated the times taken for 200 cars to cover a 400 m stretch on a local highway. Her results are shown in the table below.

Time in seconds	Class Centre	Frequency
8-12	10	1
13-17	15	30
18-22	20	80
23-27	25	60
28-32	30	20
33-37	35	9

The standard deviation of the scores was closest to which of the following?

- (A) 15.13 (B) 5.12 (C) 21 (D) 11.03

- 7 A premium gold car number plate consists of three letters followed by three digits. If Eve wants to buy one with the first two letters, being A followed by B, how many different number plates are possible?

(A) $2 \times 26 \times 10 \times 10 \times 10$

(B) $2 \times 26 \times 10 \times 9 \times 8$

(C) $1 \times 26 \times 9 \times 9 \times 9$

(D) $1 \times 26 \times 10 \times 10 \times 10$

- 8 Scientists are using capture-recapture to determine the population of giant otters in an isolated area of Brazil. They tagged 25 giant otters and released them back into the wild. A month later they caught 15 giant otters, two of which were tagged. Which of the following is the closest estimate of the population of giant otters?

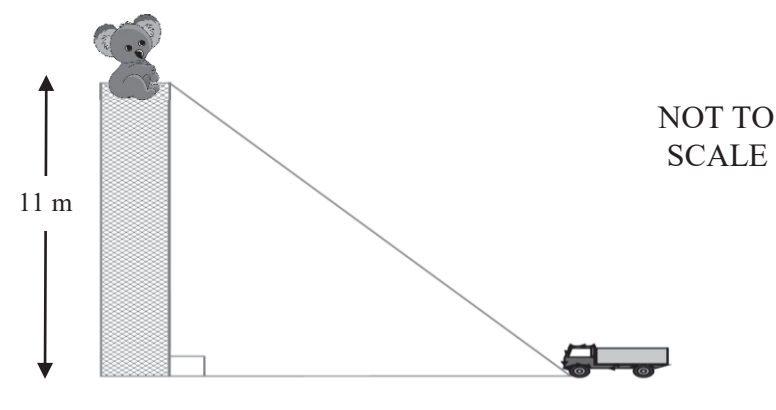
(A) 1

(B) 3

(C) 188

(D) 375

- 9 A koala is stranded on top of an 11 metre telegraph pole. From the top of the telegraph pole, the angle of depression of the rescue vehicle is 24° .



How far from the base of the telegraph pole is the rescue vehicle, to the nearest metre?

(A) 25 m

(B) 4 m

(C) 9 m

(D) 27 m

- 10 A study was conducted in the USA between 1982 and 1991 based on casualties to seatbelt wearing drivers in car to car collisions. The probabilities of fatality and severe injury according to impact speed are shown in the table below.

Impact speed (km/h)	Probability of fatality
40	0.02
50	0.05
60	0.11
70	0.21
80	0.31
90	0.41
100	0.50

Source: <http://users.tpg.com.au/users/mpaine/speed.html#stopping>

If there were 625 collisions involving cars driving at 90 km/h, approximately how many of them could be expected to result in a fatality?

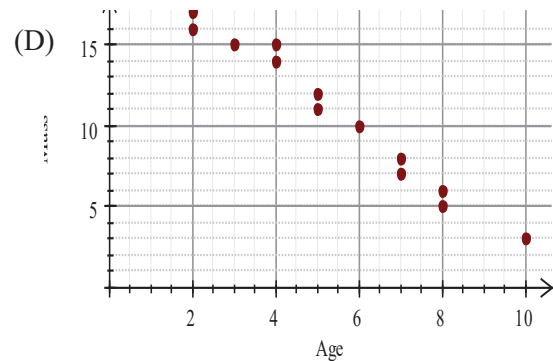
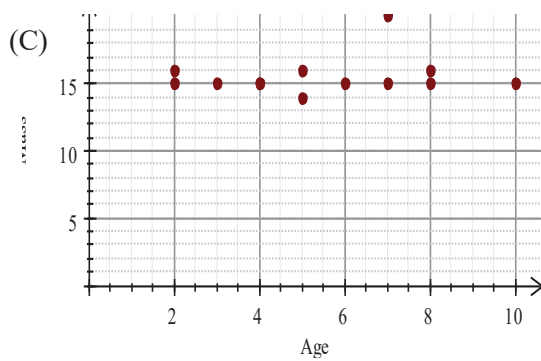
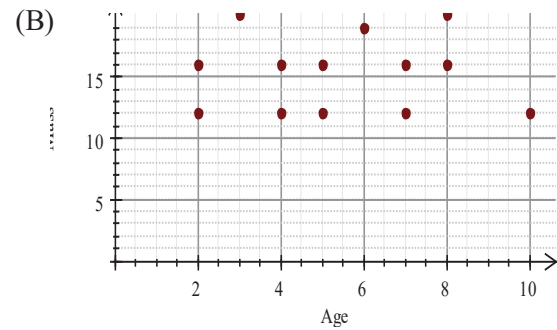
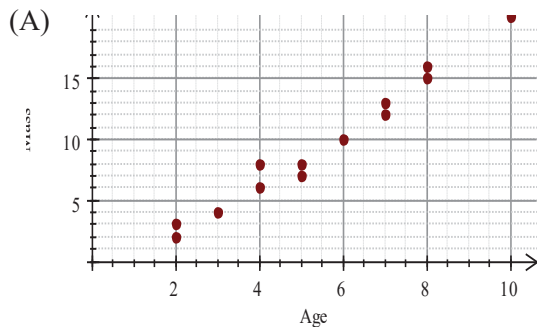
- (A) 37 (B) 79 (C) 256 (D) 59
- 11 Rani is driving to Young when she notices a wombat on the road. Her reaction time is 2.6 s and her braking distance is 20 metres.
- If she is travelling at 80 km/h, what is her total stopping distance, to the nearest metre?
- (A) 12 m (B) 45 m (C) 58 m (D) 78 m
- 12 Sophie recorded her runs for the last eight cricket games she played, shown below.

100 45 67 81 107 93 80 75

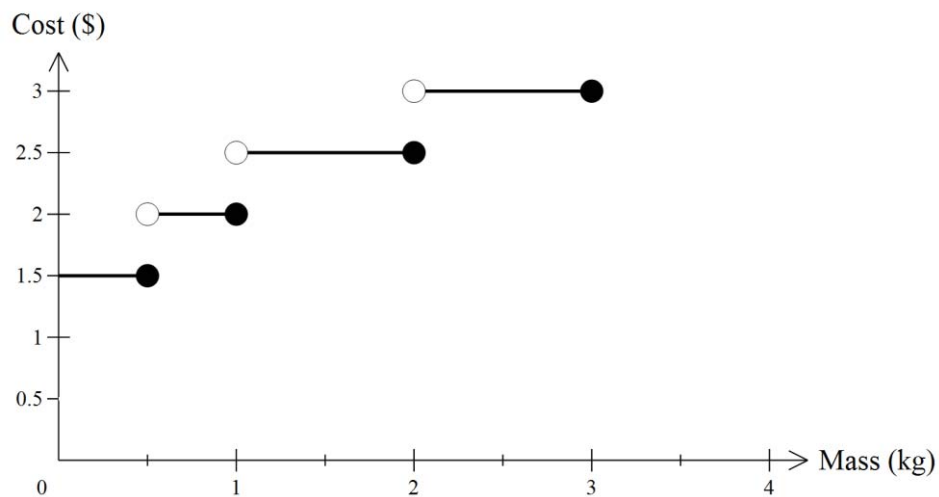
How many runs will she need to make in the next game if she is to increase her average to 85?

- (A) 10 (B) 27 (C) 85 (D) 117

- 13 Which of the following scatter plots would have a correlation coefficient closest to $r = -0.9$?



- 14 The graph below shows the cost of sending parcels of different masses.



Josie is starting an online business and wants to send a client four packages each weighing 400g.

How much would Josie save by sending them together as one parcel, rather than separately?

- (A) \$1.00 (B) \$3.00 (C) \$3.50 (D) \$4.50

- 15 Using the tax table below, determine the tax payable on a taxable income of \$29 000.

<i>Taxable Income</i>	<i>Tax on this income</i>
\$0 - \$6000	NIL
\$6001 - \$22 000	16 cents for each \$1 over \$ 6 000
\$22 001 - \$45 000	\$2560 plus 25 cents for each \$1 over \$22 000
\$45 001 - \$60 000	\$8310 plus 40 cents for each \$1 over \$45 000
\$60 001 and over	\$14 310 plus 48 cents for each \$1 over \$60 000

- (A) \$2560.25 (B) \$4310.00 (C) \$5749.75 (D) \$8310
- 16 The Hand Stirred Condiment Shop in Berrima sells 9 different condiments. Teaan wants to make up a gift pack consisting of 4 different condiments. In how many ways could Teaan choose the four condiments?

(A) $9 \times 8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1$

(B) $4 \times 3 \times 2 \times 1$

(C) $\frac{9 \times 8 \times 7 \times 6}{4 \times 3 \times 2}$

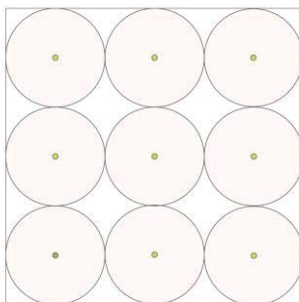
(D) $\frac{4 \times 3 \times 2}{9 \times 8 \times 7 \times 6}$

- 17 The following rates notice was issued by Wombat Council.

Wombat Council 	RATES AND CHARGES NOTICE 1 st July 2016 to 30 th June 2017		
	A Beigh 76 The Wynd Wombat		
Customer Ref No		1111111	
Due Date		31/08/2016	
Issue Date		17/07/2016	
Assessment No		11111-00000-1	
PROPERTY RATING CATEGORY Residential	VALUER GENERAL'S LAND VALUE \$377 000	VALUATION BASE DATE 01/07/2016	
RATES & CHARGES	RATEABLE VALUE OR QTY	CENTS IN \$ OR CHARGE	AMOUNT
Residential rate	\$377 000	0.272950	
Waste Mgt Chg 80 litres	1	\$195.00	\$195.00
TOTAL PAYABLE			
Payments made after 29/06/2016 will not be shown on this notice.			

What is the total payable?

- (A) \$1029.02 (B) \$1224.02
- (C) \$102 902.15 (D) \$103 097.15
- 18 A caterer had boxes made to exactly hold 9 round biscuits as shown below. She wants to cover the remaining space with sprinkles. If the box is a square with side length 15 cm, which of the following is closest to the area to be covered with sprinkles?

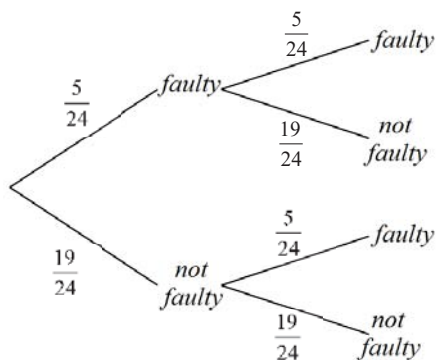


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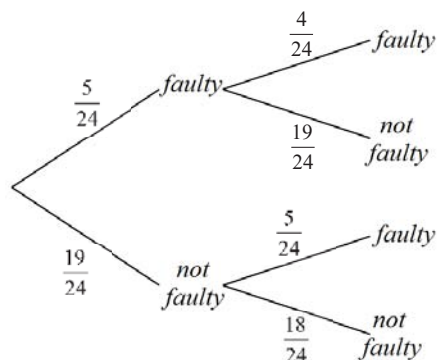
- (A) 209.29 cm² (B) 146.46 cm² (C) 48.29 cm² (D) 140.18 cm²

- 19 In a box of 24 seatbelts it is known that five are faulty. Two seatbelts are chosen at random. Which of the following probability trees could be used to determine the probability of choosing one faulty seatbelt and one non-faulty seatbelt?

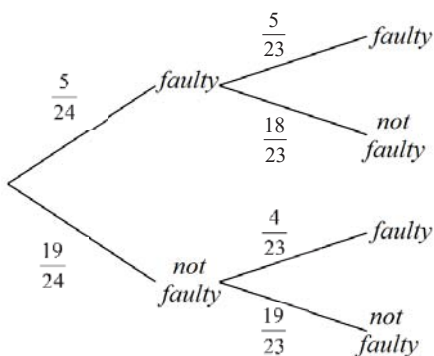
(A)



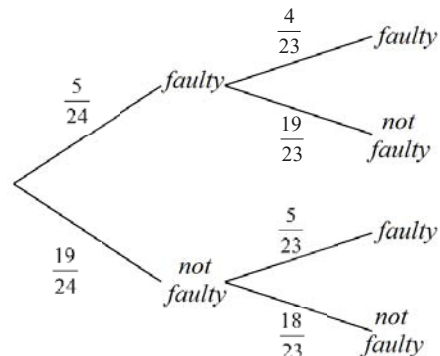
(B)



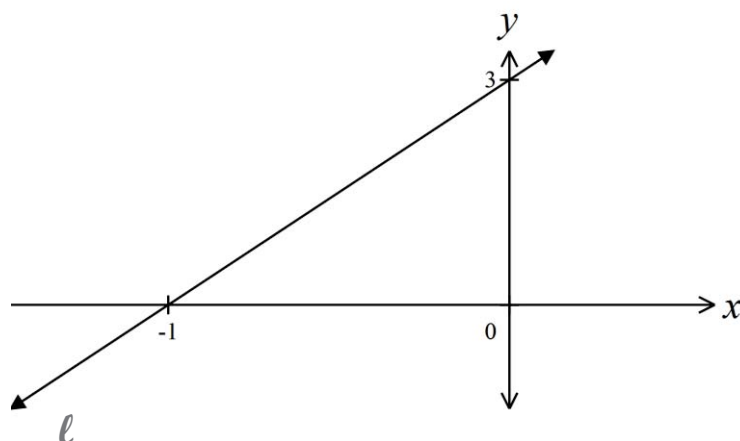
(C)



(D)



- 20 What is the equation of the line ℓ ?



(A) $y = -3x + 3$

(B) $y = 3x + 3$

(C) $y = \frac{-x}{3} - 1$

(D) $y = \frac{x}{3} - 1$

- 21 The expected life of an Evercharge battery is normally distributed with a mean of 10 hours. What is the standard deviation if 95% of Evercharge batteries are expected to last between 8.8 and 11.2 hours?

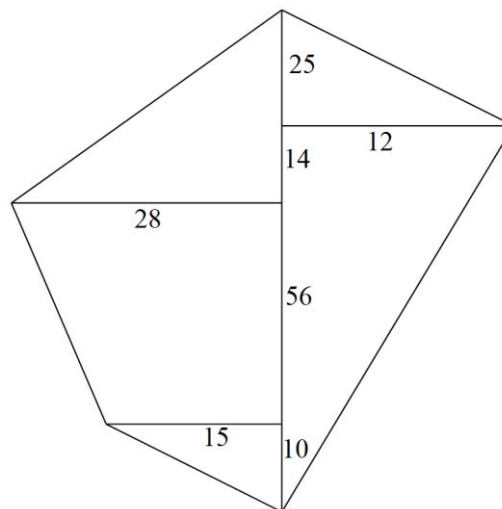
(A) 0.6 hours

(B) 3.8 hours

(C) 7.6 hours

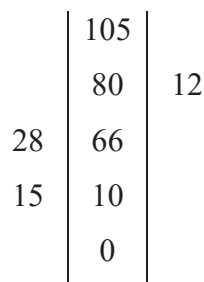
(D) 9.5 hours

- 22 The diagram below shows the sketch of a field, measurements in metres. Choose the correct corresponding field diagram.

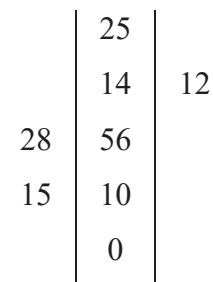


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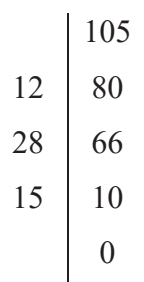
(A)



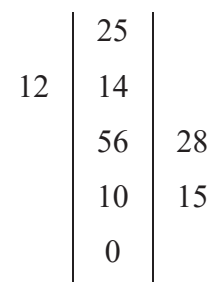
(B)



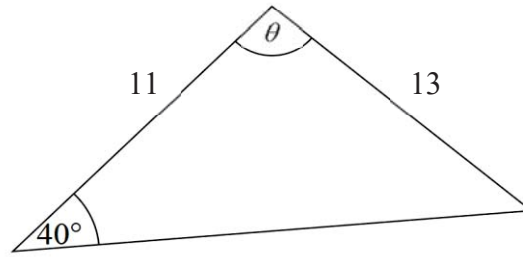
(C)



(D)



- 23 Using the sine rule, find the size of angle θ to the nearest degree.



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- (A) 33° (B) 49° (C) 91° (D) 107°

- 24 Consider the equation $\frac{5x}{4} + 3 = 2 - \frac{7x}{5}$.

Which of the following would be a correct step in solving the equation?

- (A) $\frac{5x}{4} + 5 = -\frac{7x}{5}$
- (B) $\frac{5x}{4} = -1 - \frac{7x}{5}$
- (C) $5x + 3 = 8 - \frac{28x}{5}$
- (D) $\frac{5x}{20} + 15 = 10 - 7x$

- 25 The following back to back stem and leaf plot shows the prices (\$) of Poodle and Chihuahua puppies at a popular breeder.

Poodle		Chihuahua
3 1 0	4	0 0 2 3 3
7 5 5	5	1 1 2 3 5 5
8 7 6 5 4	6	0 2 2 7
8 8 5 5	7	
3	8	6

What percentage of Chihuahua puppies cost less than the median price of the poodle puppies?

- (A) 64.5% (B) 93.75%
- (C) 87.5% (D) 51.5%

End of Section I

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Total Marks – 75**Attempt Questions 26-30****All questions are of equal value**

Answer the questions in the spaces provided. Your responses should include relevant mathematical reasoning and/or calculations.

Extra writing space is provided on pages 19, 24, 29, 35, 43. If you use any of these spaces, clearly indicate which question you are answering.

Question 26 (15 marks)

Jen has bought herself a pet rabbit.

- (a) A healthy diet for a rabbit should have 18 parts fibre to 14 parts protein to 3 parts fat. The local pet shop sells rabbit food containing 1.2 kg protein. **2**

What is the total weight of fibre, protein and fat in the packet?

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- (b) Jen pays \$85 per month for food and supplies for her rabbit. **2**

Assuming a constant annual inflation rate of 2.6%, calculate how much Jen would pay per month for the food and supplies in 3 years' time.

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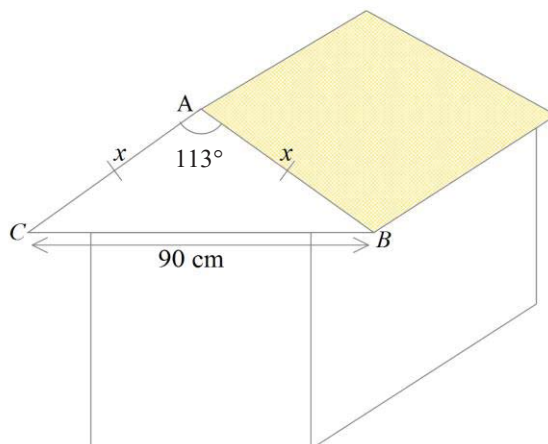
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Question 26 continued on page 16

Question 26 (continued)

- (c) Jen is designing a new hutch for her pet rabbit. The front view of the sleeping quarters is made up of a triangle and rectangle, as shown in the diagram below.



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Angle BAC is to measure 113° and the base of the triangle, BC , is to be 90 cm. Let $AB = AC = x$.

- (i) If $AB = AC = x$, show that $x = \sqrt{\frac{8\,100}{2(1 - \cos 113^\circ)}}$.

2

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- (ii) Hence, find the length of AB , to the nearest centimetre.

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Question 26 continues on page 17

Question 26 (continued)

- (iii) If Jen uses a ruler with centimetre markings to measure the length of BC , what is the absolute error of her measurement? **1**

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- (iv) Jen wants to paint triangle ABC in the diagram on the previous page with textured exterior paint. Calculate the area of triangle ABC to the nearest square centimetre. **2**

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- (v) Textured exterior paint comes in 2 L tins with a coverage rate of $600\text{ cm}^2 / \text{L}$. How many tins of paint will Jen have to buy? **1**

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Question 26 continues on page 18

Question 26 (continued)

- (d) Jen's rabbit had some minor surgery and needs to be given medication at the rate of 30 g/ L 2
in the rabbit's water.

The medication is supplied in solution. The label states the concentration as 150 g/ 250 mL.

How many millilitres of the solution should Jen add to 500 mL of water?

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- (e) Jen discovered her rabbit likes listening to music. She can download at a rate of 2
600 kilobits per second (kbps), where 1 kilobit = 1000 bits. Jen wants to download
a 38 megabyte (MB) file.

How long will it take Jen to download the file? Give your answer in minutes and
seconds, correct to the nearest second.

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End of Question 26

[illegible]

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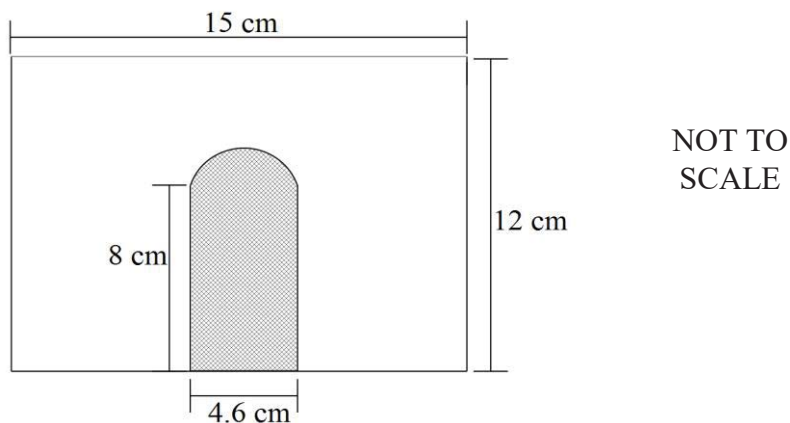
Question 27 (15 marks)

Student Number:

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Shenali and Hayley went to Hawaii for a holiday.

- (a) While they were out shopping, Shenali and Hayley discovered Dylan's Candy Bar. There were boxes in the shape of a medieval castle. The section under the ramparts was a rectangle with a doorway cut all the way through from the front, as shown below.



- (i) The doorway is a semi-circle on top of a rectangle.

Calculate the area of the front of the box, without the door section, as shown above.

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- (ii) If the candy container is 5cm deep, calculate its volume, in mL, to the nearest mL, assuming the doorway is cut all the way through the box.

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Question 27 continued on page 22

Question 27 (continued)

- (ii) There are 25 blue, 16 yellow and 13 red lollies in the box. If Shenali randomly selects one, what is the probability it will **not** be a yellow lolly?

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- (iv) The lolly box above is made to a 1: 900 scale of a real castle.

Using the diagram above, calculate the width of the real castle, to the nearest metre.

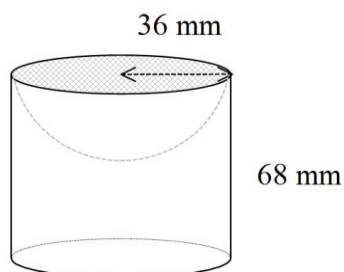
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- (b) There was a chocolate coated object on the counter. It consisted of a hemisphere inside the top of a cylinder, as shown below.

The cylinder had a radius 36 mm and height 68 mm.



NOT TO
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The object was entirely dipped in chocolate. Calculate the total surface area coated in chocolate, to the nearest cm^2 .

3

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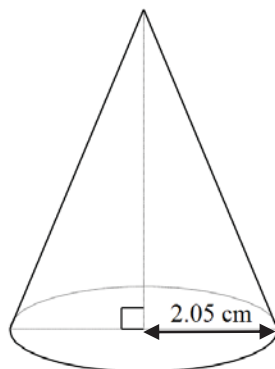
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Question 27 continued on page 23

Question 27 (continued)

- (c) Hayley discovered a packet of sherbet in the shape of a cone, like a princess hat. It had a radius of 2.05 cm and a volume of 62 cm^3 . Calculate, to the nearest cm, the height of the cone.

2



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- (d) Shenali and Hayley met Janet, a female Hawaiian university student, who took them to a bar to listen to music. Shenali and Hayley drank pineapple juice while Janet had 5 standard drinks in 3.5 hours. The legal driving limit in Hawaii is a BAC content of 0.08. If Janet's mass is 60 kg, would you recommend Shenali and Hayley accept Janet's offer to drive them home? Give reasons.

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End of Question 27

Section II Extra writing space

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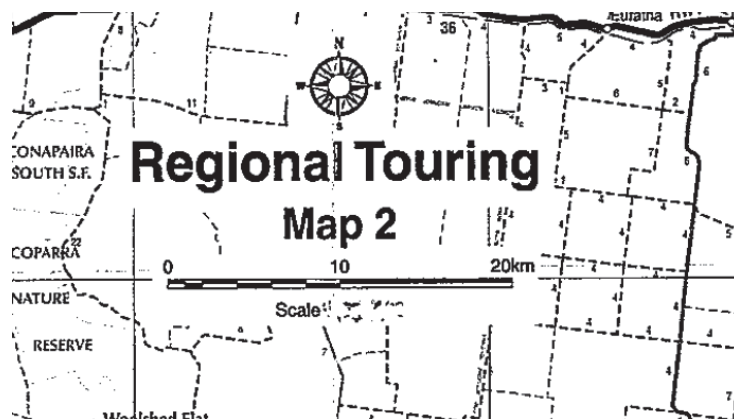
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Question 28 (15 marks)

Student Number:

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- (a) Emma is moving to a new job in Young. She looked up the map shown below.



Calculate the scale on the map.

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- (b) Emma needs a car for her new job. She bought a car for \$32 000 which depreciates by \$2400 each year.

- (i) Use the straight-line method of depreciation to find the value of the car after 4 years.

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- (ii) How many years and months after the car was purchased, will Sarah's car have a \$0 salvage value?

2

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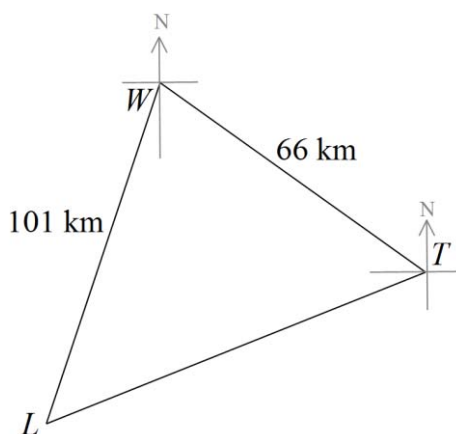
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Question 28 continued on page 26

Question 28 (continued)

- (c) Alex is visiting Emma and they drive to the Temora Aviation Museum to go on a joy flight, shown in the diagram below. The plane flies 66 km from Temora (T) on a bearing of 330° to West Wyalong (W). It then flies 101 km on a bearing of 223° from West Wyalong to Leeton (L). They have lunch at Leeton before returning to Temora.



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- (i) Mark the bearings on the diagram above.
- (ii) Show that angle TWL is 73° 1
-
-
-
- (iii) Hence, calculate the distance from Leeton to Temora, to the nearest kilometre. 2
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-
-
- (iv) Calculate the true bearing of Temora from Leeton. 2
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Question 28 continued on page 27

Question 28 (continued)

- (d) Emma is saving for a holiday. She deposits \$3600 into an account at the end of every year for four years. The account pays 5% per annum interest, compounding annually.

The table shows future values of an annuity of \$1.

Future values of an annuity of \$1

<i>End of Year</i>	<i>Interest Rate</i>				
	1%	2%	3%	4%	5%
1	1.0000	1.0000	1.0000	1.0000	1.0000
2	2.0100	2.0200	2.0200	2.0400	2.0500
3	3.0301	3.0604	3.0909	3.1216	3.1525
4	4.0604	4.1216	4.1836	4.2465	4.3101
5	5.1010	5.2040	5.3091	5.4163	5.5256
6	6.1520	6.3081	6.4684	6.6330	6.8019
7	7.2135	7.4343	7.6625	7.8983	8.1420
8	8.2857	8.5830	8.8923	9.2142	9.5491

- (i) Use the table to find the value of Emma's investment at the end of four years.

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- (ii) How much interest does Emma earn on her investment over the four years?

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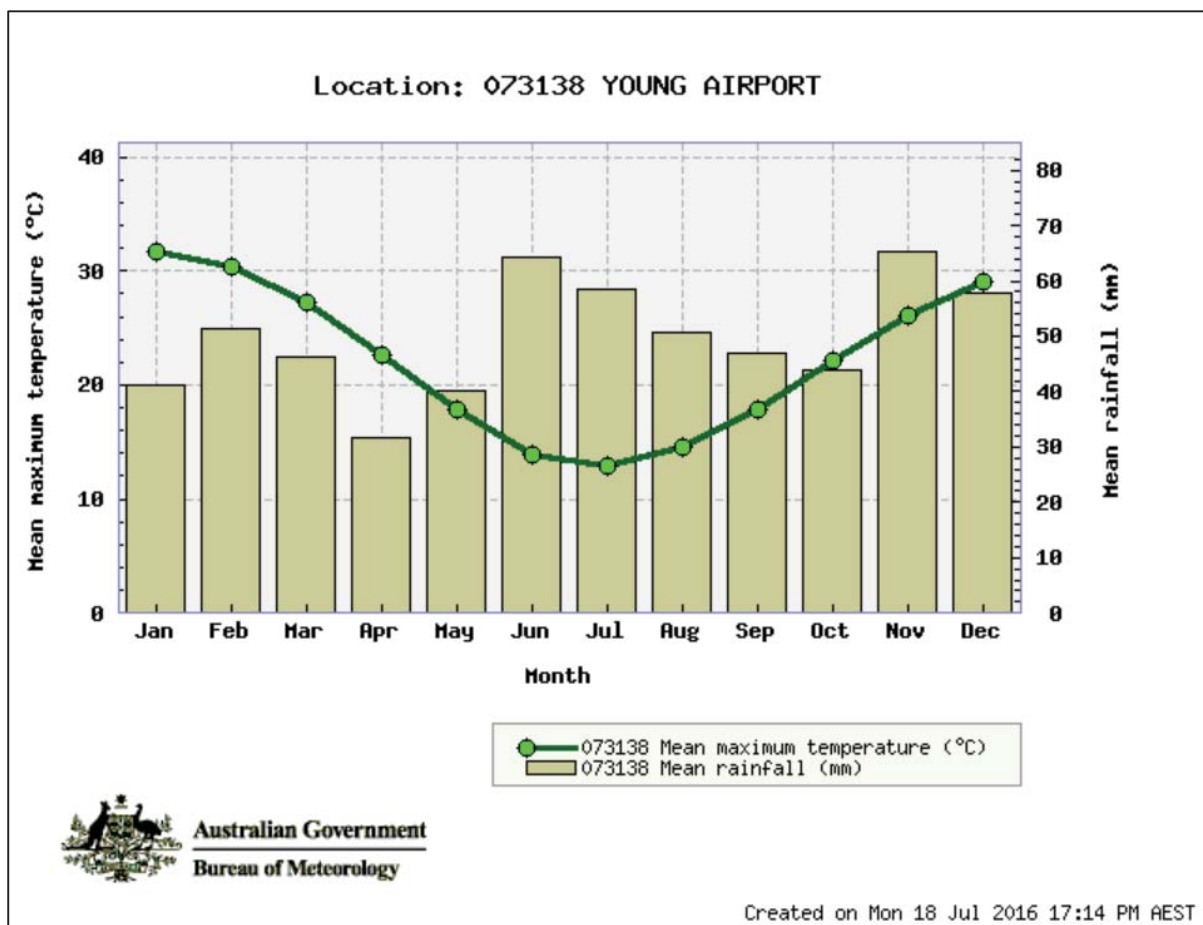
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Question 28 continued on page 28

Question 28 (continued)

- (e) The following graph shows the average annual temperature and rainfall in Young, NSW.



Source: <http://www.bom.gov.au/jsp/ncc/cdio/cvg/av>

Emma wants to plant a special tree in her garden. The label on the pot indicates the tree needs at least 30 mm rain, on average, per month and the temperature cannot go below 18°C. Using the graph above, should Emma buy the tree? Explain.

1

End of Question 28

Section II Extra writing space

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

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Question 29 (15 marks)

Student Number:

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In April, Abbotsleigh's robotics team flew to St. Louis, in the USA, to compete in the FIRST Robotics World Championships. The coordinates of Sydney are (34°S,151°E) and St. Louis (39°N,90°W).

- (a) The flight left Sydney's Kingsford Smith airport at 10 a.m. on Saturday. If the total travel time was 19 hours and 45 minutes, what was the local time in St. Louis when the team arrived?

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- (b) Calculate the shortest distance from St. Louis to the equator, to the nearest kilometre.

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Question 29 continued on page 32

Question 29 continued)

- (c) On the second night, the team went to dinner at the Olive Garden Italian restaurant. The total cost of the meal was \$372.83, including 8.3% GST (Goods and Services Tax).

- (i) Show the cost of the meal before GST was \$344.26, to the nearest cent.

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- (ii) If the team also paid a tip of 18% of the cost of the meal before GST, calculate the total amount they paid for their meal.

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Question 29 continued on page 33

Question 29 (continued)

(d) The table below shows the international call costs of different plans with Telstar.

International calls	International calls standard rates Telstar Home Phone plan	International Saver	International Ultimate
Call connection fee (for new Telstar bundles available from 30 June 2015)	52c per call	52c per call	52c per call except where the call is Unlimited
Call connection fee (all other plans)	55c per call	55c per call	55c per call except where the call is Unlimited
Monthly charge	Nil	\$5 per month (included in Telstar Voice Ultimate and Telstar Home Phone Pinnacle)	\$15 per month
	Call rates per minute or part thereof	Call rates per minute or part thereof	Call rates per minute or part thereof
United States	\$0.21	\$0.02	Unlimited

- (i) In January 2016, Tia's mother switched from the International Saver Plan to the Telstar Home Phone Plan. Tia's mother called Tia while she was in the United States in April 2016. If they talked for 22.7 minutes, calculate the total cost of the call.

2

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- (ii) If this was the only call Tia's mother made in the month, should she have kept the International Saver Plan she started in 2014? Explain, using calculations to justify your answer.

2

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Question 29 continued on page 34

Question 29 (continued)

- (e) Abbotsleigh's robotics team competed in the Australian regionals of the FIRST Robotics Competition to qualify for the world championships. The quarterfinal results for the red and blue alliances are shown in the table below.

Red Alliance	Blue Alliance
107	64
36	100
97	92
90	100
115	106
86	106
105	72
120	64

- (i) Calculate the mean for the red alliance.

1

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- (ii) Calculate the standard deviation for the red alliance.

1

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- (iii) If the mean for the blue alliance is 88.75 and the standard deviation is 16.18, which alliance is more likely to win the competition? Explain, using the means and standard deviations, to justify your answer.

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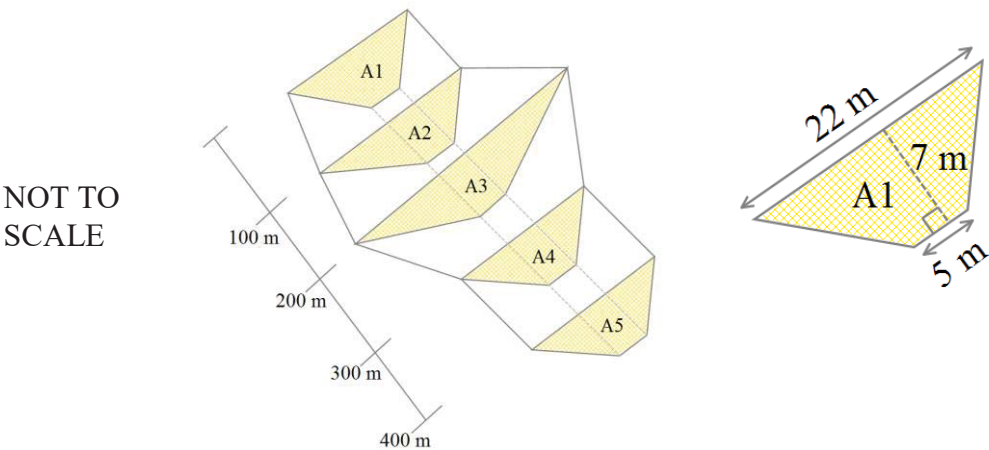
End of Question 29

[illegible][illegible]

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(a) A team of students is going to Cambodia to assist aid workers creating a landfill site. They need to calculate the volume of the planned site to determine whether it will be enough for the waste disposal. One section of the site is to be divided into cells. The sides of the cells are trapeziums, evenly spaced 100 metres apart, as shown below.



Areas A2, A3, A4 and A5 have been calculated as shown in the following table.

Section	A1	A2	A3	A4	A5
Area		168.75 m ²	542.5 m ²	383.25 m ²	383.25 m ²

(i) Calculate the area of A1 shown in the diagram above. 2

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(ii) Use two applications of Simpson’s Rule to calculate the total volume of the landfill, to the nearest cubic metre. 2

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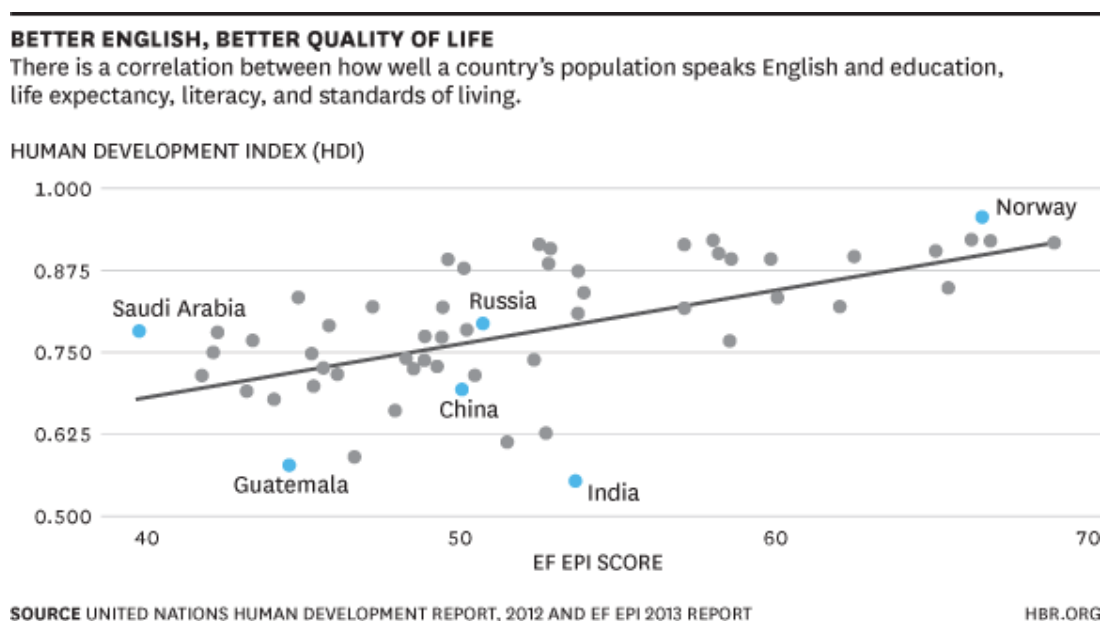
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Question 30 (continued)

- (b) The graph below shows the correlation between the English Proficiency Index (EF EPI) and the Human Development Index (HDI).



Source: <http://maloloschan.com/ae/4.html>

Whilst the above graph shows a correlation between the level of English spoken in a country (EF EPI score) and the HDI (education, life-expectancy, literacy and standards of living of the people), is it correct to say the level of English spoken in a country determines education, life-expectancy, literacy and standards of living of the people in that country? Explain.

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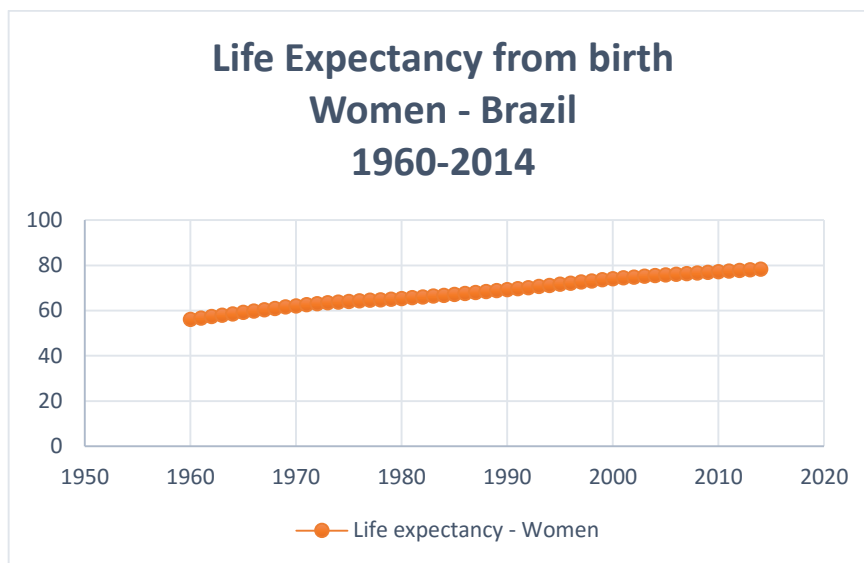
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Question 30 continues on page 39

Question 30 (continued)

- (c) Verity and Sophia went to the Olympics in Brazil. They found the life expectancy of women in Brazil has been improving, as shown in the table below.



Source: <http://countryeconomy.com/demography/life-expectancy/brazil>

	Mean	Standard Deviation
Year (x)	1987	15.87
Life expectancy (y)	68.21	6.42

If the correlation coefficient, $r = 0.9959$, use the values in the table above to find the:

- (i) gradient

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- (ii) y-intercept

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- (iii) equation of the least-squares line of best fit for women

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Question 30 continued on page 40

Question 30 (continued)

- (iv) Use your equation from (iii) to estimate the life expectancy, from birth, of a woman Brazilian who was born in 1998.

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- (d) A medical researcher used 40 Brazilian women with hypertension (higher than normal heart rate) in an experiment to test a new drug designed to reduce hypertension, using two groups of equal size. There is a control group (untreated) and an experimental group (treated with the new drug).

Measurements of heart rates were taken over a 6-week period and recorded. The mean and standard deviation for these sets of measurements were calculated as shown in the table below.

Group	Mean	Standard deviation
Control	67.6	15.8
Treated	60.6	10.2

If a normal heart rate is 60, what conclusions can be drawn about the effectiveness of the drug? Explain, using z-scores.

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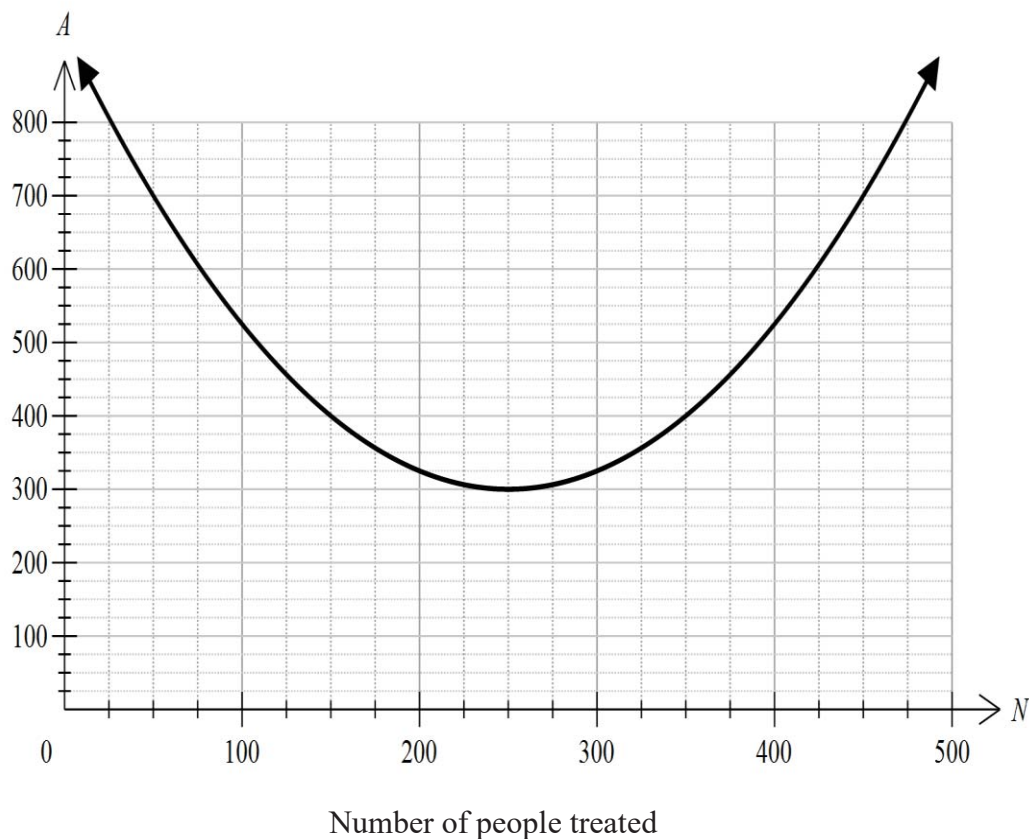
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Question 30 continued on page 41

Question 30 (continued)

- (e) A cure has been developed for a serious illness but the treatment is very expensive. The following graph shows the average amount (\$A), per person, it will cost the hospital to treat N people. The equation for this graph is

$$A = 0.01(N - 250)^2 + 300.$$



The following table shows the average amount of revenue (\$A), per person, received by the hospital when N people undergo the treatment.

Number of People (N)	25	70	150	215	425
Amount (\$A)	600	555	475	410	200

- (i) Use the table of values to calculate the gradient of the line.

2

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Question 30 continues on page 42

Question 30 (continued)

(ii) Plot the points on the graph on the previous page and join them to make a straight line. **1**

(iii) Estimate how many people would need to be treated for the hospital to make the most profit. **1**

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End of Question 30

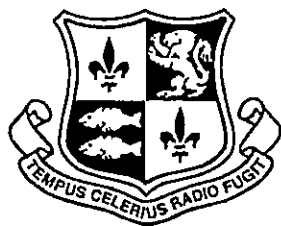
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Section II Extra writing space

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

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Solutions



ABBOTSLEIGH

Student's Name: _____

Student Number: _____

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Teacher's Name: _____

2016
HIGHER SCHOOL CERTIFICATE
Trial Examination

General 2 Mathematics

General Instructions

- Reading time – 5 minutes.
- Working time – 2.5 hours.
- Write using black pen.
- Board-approved calculators may be used.
- A formulae and data 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 26–30, show relevant mathematical reasoning and/ or calculations

Total marks – 100

- Attempt Sections 1 and 2.

Section 1 Pages 3 - 13

25 marks

- Attempt Questions
- Allow about 35 minutes for this section.

Section 2 Pages 15-44

75 marks

- Attempt Questions 26 - 30
- All questions are equal value
- Allow about 1 hour and 55 minutes for this section.

Outcomes to be assessed:

General 2 Mathematics:

Preliminary Outcomes:

- MGP-1 uses mathematics and statistics to compare alternative solutions to contextual problems.
- MGP-2 represents information in symbolic, graphical and tabular form.
- MGP-3 represents the relationships between changing quantities in algebraic and graphical form
- MGP-4 performs calculations in relation to two-dimensional and three-dimensional figures
- MGP-5 demonstrates awareness of issues in practical measurement, including accuracy, and the choice of relevant units
- MGP-6 models financial situations relevant to the student's current life using appropriate tools
- MGP-7 determines an appropriate form of organisation and representation of collected data
- MGP-8 performs simple calculations in relation to the likelihood of familiar events
- MGP-9 uses appropriate technology to organise information from a limited range of practical and everyday contexts
- MGP-10 justifies a response to a given problem using appropriate mathematical terminology

HSC Outcomes:

- MG2H-1 uses mathematics and statistics to evaluate and construct arguments in a range of familiar and unfamiliar contexts
- MG2H-2 analyses representations of data in order to make inferences, predictions and conclusions
- MG2H-3 makes predictions about situations based on mathematical models
- MG2H-4 analyses two-dimensional and three-dimensional models to solve practical problems, including those involving spheres and non-right-angled triangles
- MG2H-5 interprets the results of measurements and calculations and makes judgements about reasonableness, including the degree of accuracy of measurements and calculations and the conversion to appropriate units
- MG2H-6 makes informed decisions about financial situations, including loan repayments
- MG2H-7 answers questions requiring statistical processes, including the use of the normal distribution, and the correlation of bivariate data
- MG2H-8 solves problems involving counting techniques, multistage events and expectation
- MG2H-9 chooses and uses appropriate technology to locate and organise information from a range of contexts
- MG2H-10 uses mathematical argument and reasoning to evaluate conclusions drawn from other sources, communicating a position clearly to others, and justifies a response

- 3 Alex borrows \$9 800 to buy a new car. She pays off the loan in monthly instalments over 6 years at a rate of 5.4% p.a. How much will she pay, in total, over the 6 years?

(A) $\$9800 \times (1.54)^6$

(B) $\$9800 - (1.0045) \times 6$

(C) $\$9800 \times (1.54) \times 72$

(D) $\$9800 \times (1.0045)^{72}$

$r = 5.4\% \text{ p.a.}$

$= \frac{5.4}{12} \% \text{ per month}$

$= \left(\frac{5.4}{12}\right) \div 100$

$= 0.0045$

$n = 6 \text{ yrs} \times 12$

$= 72 \text{ months}$

$A = P(1+r)^n$

$= \$9800(1+0.0045)^{72}$

$= \$9800 \times (1.0045)^{72}$

- 4 There are 1 056 006 tiles on the Sydney Opera House. When this number is written in scientific notation to two decimal places, it is equivalent to which of the following?

$1.056006 \times 10^6 = 1.06 \times 10^6$

(A) 1.056×10^6

(B) 1.06×10^6

(C) 1.05×10^6

(D) 1.06

- 5 The maximum size of a text message before modern messaging systems was 140 bytes.

How many text messages could be sent by India if she has one megabyte of data to use?

$\frac{1024 \times 1024}{140} = 7489.828571$

(A) 7489

(B) 1 048 576

(C) 59 919

(D) 749

- 6 Clare tabulated the times taken for 200 cars to cover a 400 m stretch on a local highway. Her results are shown in the table below.

Time in seconds	Class Centre	Frequency
8-12	10	1
13-17	15	30
18-22	20	80
23-27	25	60
28-32	30	20
33-37	35	9

The standard deviation of the scores was closest to which of the following?

$\sigma = 5.121950312$

(A) 15.13

(B) 5.12

(C) 21

(D) 11.03

- 7 A premium gold car number plate consists of three letters followed by three digits. If Eve wants to buy one with the first two letters, being A followed by B, how many different number plates are possible (repeated letters and digits are allowed)?

1	1	26	10	10	10
A	B				

- (A) $2 \times 26 \times 10 \times 10 \times 10$ (B) $2 \times 26 \times 10 \times 9 \times 8$
 (C) $1 \times 26 \times 9 \times 9 \times 9$ (D) $1 \times 26 \times 10 \times 10 \times 10$

- 8 Scientists are using capture-recapture to determine the population of giant otters in an isolated area of Brazil. They tagged 25 giant otters and released them back into the wild. A month later they caught 15 giant otters, two of which were tagged. Which of the following is the closest estimate of the population of giant otters?

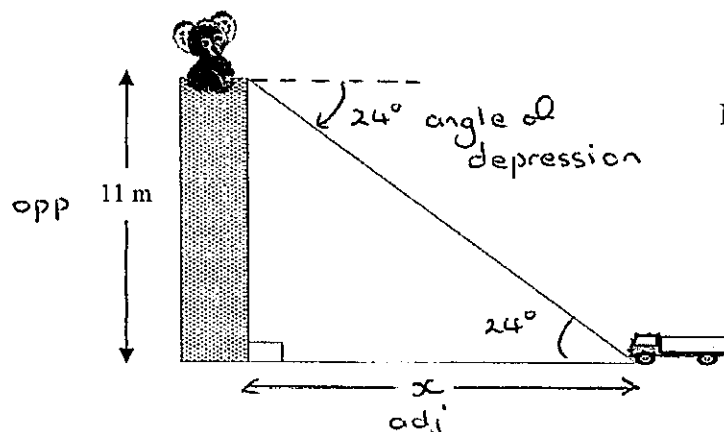
$$\frac{25}{x} = \frac{2}{15} \quad \therefore 25 \times 15 = 2 \times x$$

$$375 = 2x$$

$$x = 187.5$$

- (A) 1 (B) 3 (C) 188 (D) 375

- 9 A koala is stranded on top of an 11 metre telegraph pole. From the top of the telegraph pole, the angle of depression of the rescue vehicle is 24° .



NOT TO SCALE

$$\tan \theta = \frac{\text{opp}}{\text{adj}}$$

$$\tan 24^\circ = \frac{11}{x}$$

$$x \times \tan 24^\circ = 11$$

$$x = \frac{11}{\tan 24^\circ}$$

$$= 24.70640451$$

How far from the base of the telegraph pole is the rescue vehicle, to the nearest metre?

- (A) 25 m (B) 4 m (C) 9 m (D) 27 m

- 10 A study was conducted in the USA between 1982 and 1991 based on casualties to seatbelt wearing drivers in car to car collisions. The probabilities of fatality and severe injury according to impact speed are shown in the table below.

Impact speed (km/h)	Probability of fatality
40	0.02
50	0.05
60	0.11
70	0.21
80	0.31
90	0.41
100	0.50

Source: <http://users.tpg.com.au/users/mpaine/speed.html#stopping>

If there were 625 collisions involving cars driving at 90 km/h, approximately how many of them could be expected to result in a fatality?

$$625 \times 0.41 = 256.25$$

- (A) 37 (B) 79 (C) 256 (D) 59

- 11 Rani is driving to Young when she notices a wombat on the road. Her reaction time is 2.6 s and her braking distance is 20 metres.

If she is travelling at 80 km/h, what is her total stopping distance, to the nearest metre?

- (A) 12 m (B) 45 m (C) 58 m (D) 78 m

$$\begin{aligned} 80 \frac{\text{km}}{\text{h}} &= 80 \times \frac{1000}{3600} = 22.2 \frac{\text{m}}{\text{s}} \\ \left. \begin{array}{l} \text{reaction distance} = \text{speed} \times \text{time} \\ = 22.2 \times 2.6 \\ = 57.7 \text{ m} \end{array} \right\} & \text{stopping dist} = 20 + 57.7 \text{ m} \\ &= 77.7 \text{ m} \end{aligned}$$

- 12 Sophie recorded her runs for the last eight cricket games she played, shown below.

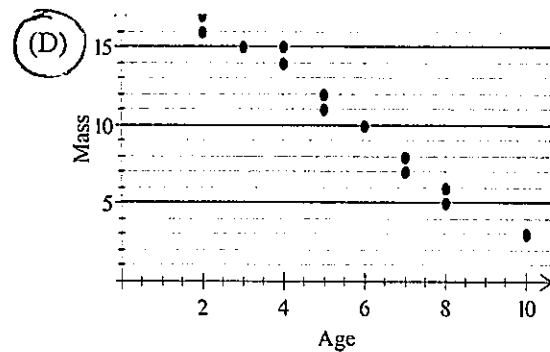
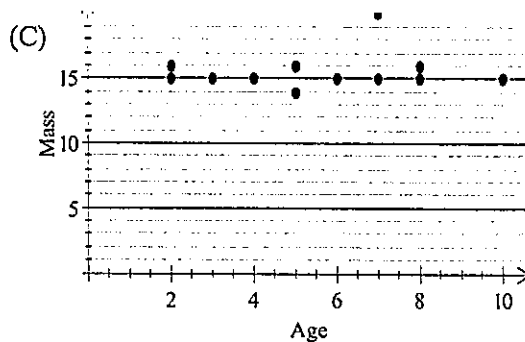
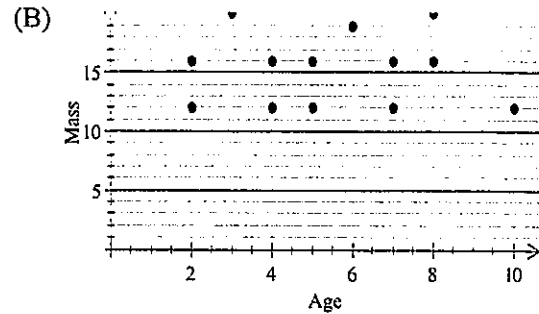
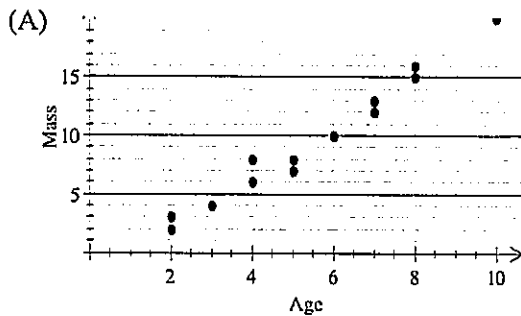
$$100 \quad 45 \quad 67 \quad 81 \quad 107 \quad 93 \quad 80 \quad 75 \quad A_v = \frac{648}{8} = 81$$

How many runs will she need to make in the next game if she is to increase her average to 85?

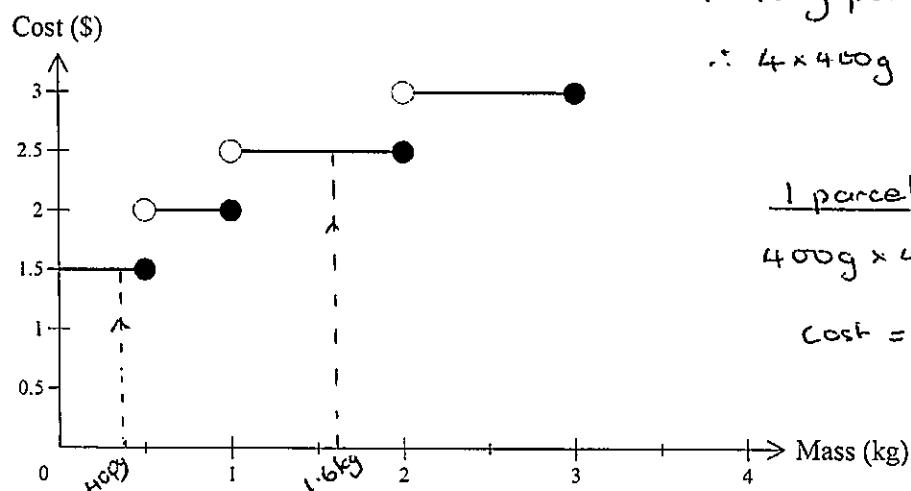
$$\begin{aligned} \text{Total runs} &= 85 \times 9 \\ &= 765 \end{aligned} \quad \begin{aligned} 9^{\text{th}} \text{ innings} &= 765 - 648 \\ &= 117 \end{aligned}$$

- (A) 10 (B) 27 (C) 85 (D) 117

- 13 Which of the following scatter plots would have a correlation coefficient closest to $r = -0.9$?
- Negative slope
 - Close to being a line



- 14 The graph below shows the cost of sending parcels of different masses.



4 parcels
 $1 \times 400\text{g parcel} = \1.50
 $\therefore 4 \times 400\text{g parcels} = 1.50 \times 4$
 $= \$6$

1 parcel
 $400\text{g} \times 4 = 1600\text{g}$
 $= 1.6\text{kg}$
 $\text{Cost} = \$2.50$

$\text{Saving} = \$6 - \$2.50 = \$3.50$

Josie is starting an online business and wants to send a client four packages each weighing 400g.

How much would Josie save by sending them together as one parcel, rather than separately?

- (A) \$1.00 (B) \$3.00 (C) \$3.50 (D) \$4.50

- 15 Using the tax table below, determine the tax payable on a taxable income of \$29 000.

<i>Taxable Income</i>	<i>Tax on this income</i>
\$0 - \$6000	NIL
\$6001 - \$22 000	16 cents for each \$1 over \$ 6 000
\$22 001 - \$45 000	\$2560 plus 25 cents for each \$1 over \$22 000
\$45 001 - \$60 000	\$8310 plus 40 cents for each \$1 over \$45 000
\$60 001 and over	\$14 310 plus 48 cents for each \$1 over \$60 000

$$\$29\,000 - \$22\,000 = \$7\,000$$

- (A) \$2560.25 (B) \$4310.00 (C) \$5749.75 (D) \$8310

$$\begin{aligned}
 \text{Tax} &= \$2560 + 0.25 \times 7000 \\
 &= \$2560 + \$1750 \\
 &= \$4310
 \end{aligned}$$

- 16 The Hand Stirred Condiment Shop in Berrima sells 9 different condiments. Teaan wants to make up a gift pack consisting of 4 different condiments. In how many ways could Teaan choose the four condiments?

$${}^9C_4 = \frac{9 \times 8 \times 7 \times 6}{4 \times 3 \times 2 \times 1} = 126$$

(A) $9 \times 8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1 = 362880$

(B) $4 \times 3 \times 2 \times 1 = 24$

(C) $\frac{9 \times 8 \times 7 \times 6}{4 \times 3 \times 2} = 126$

(D) $\frac{4 \times 3 \times 2}{9 \times 8 \times 7 \times 6} = \frac{1}{126}$

- 17 The following rates notice was issued by Wombat Council.

Wombat Council 	RATES AND CHARGES NOTICE 1 st July 2016 to 30 th June 2017															
A Beigh 76 The Wynd Wombat	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;">Customer Ref No</td> <td>1111111</td> </tr> <tr> <td>Due Date</td> <td>31/08/2016</td> </tr> <tr> <td>Issue Date</td> <td>17/07/2016</td> </tr> <tr> <td>Assessment No</td> <td>11111-00000-1</td> </tr> </table>	Customer Ref No	1111111	Due Date	31/08/2016	Issue Date	17/07/2016	Assessment No	11111-00000-1							
	Customer Ref No	1111111														
	Due Date	31/08/2016														
	Issue Date	17/07/2016														
Assessment No	11111-00000-1															
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%;">PROPERTY RATING CATEGORY</td> <td style="width: 33%;">VALUER GENERAL'S LAND VALUE</td> <td style="width: 33%;">VALUATION BASE DATE</td> </tr> <tr> <td>Residential</td> <td>\$377 000</td> <td>01/07/2016</td> </tr> </table>	PROPERTY RATING CATEGORY	VALUER GENERAL'S LAND VALUE	VALUATION BASE DATE	Residential	\$377 000	01/07/2016										
PROPERTY RATING CATEGORY	VALUER GENERAL'S LAND VALUE	VALUATION BASE DATE														
Residential	\$377 000	01/07/2016														
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 35%;">RATES & CHARGES</th> <th style="width: 25%;">RATEABLE VALUE OR QTY</th> <th style="width: 25%;">CENTS IN \$ OR CHARGE</th> <th style="width: 15%;">AMOUNT</th> </tr> <tr> <td>Residential rate</td> <td>\$377 000</td> <td>0.272950</td> <td> </td> </tr> <tr> <td>Waste Mgt Chg 80 litres</td> <td>1</td> <td>\$195.00</td> <td>\$195.00</td> </tr> <tr> <td colspan="3" style="text-align: right;">TOTAL PAYABLE</td> <td> </td> </tr> </table>	RATES & CHARGES	RATEABLE VALUE OR QTY	CENTS IN \$ OR CHARGE	AMOUNT	Residential rate	\$377 000	0.272950		Waste Mgt Chg 80 litres	1	\$195.00	\$195.00	TOTAL PAYABLE			
RATES & CHARGES	RATEABLE VALUE OR QTY	CENTS IN \$ OR CHARGE	AMOUNT													
Residential rate	\$377 000	0.272950														
Waste Mgt Chg 80 litres	1	\$195.00	\$195.00													
TOTAL PAYABLE																
Payments made after 29/06/2016 will not be shown on this notice.																

What is the total payable?

$$\begin{aligned}
 \$377,000 \times 0.272950 &= \$102,902.15 \\
 \text{Total} &= \$102,902.15 + \$195 \\
 &= \$103,097.15
 \end{aligned}$$

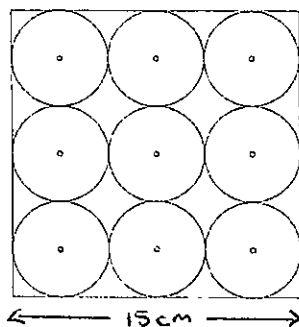
(A) \$1029.02

(B) \$1224.02

(C) \$102 902.15

(D) \$103 097.15

- 18 A caterer had boxes made to exactly hold 9 round biscuits as shown below. She wants to cover the remaining space with sprinkles. If the box is a square with side length 15 cm, which of the following is closest to the area to be covered with sprinkles?



$$\begin{aligned}
 \text{Each diameter} &= \frac{15 \text{ cm}}{3} = 5 \text{ cm} \\
 \therefore \text{radius} &= 2.5 \text{ cm}
 \end{aligned}$$

$$\begin{aligned}
 A_{\text{circles}} &= 9 \times \pi r^2 \\
 &= 9 \times \pi \times 2.5^2 \\
 &= 176.7145868 \text{ cm}^2
 \end{aligned}$$

$$\begin{aligned}
 A_{\text{square}} &= L \times W \\
 &= 15 \times 15 \\
 &= 225 \text{ cm}^2
 \end{aligned}$$

(A) 209.29 cm²

(B) 146.46 cm²

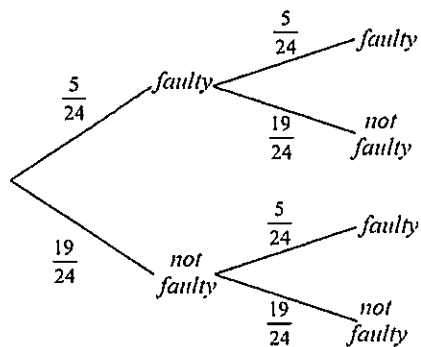
(C) 48.29 cm²

(D) 140.18 cm²

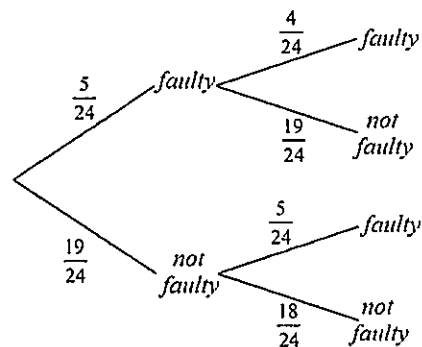
$$\begin{aligned}
 A_{\text{sprinkles}} &= 225 - 176.7145868 \\
 &= 48.28541324 \text{ cm}^2 \\
 &= 48.29 \text{ cm}^2 \text{ (2 dec. pl.)}
 \end{aligned}$$

- 19 In a box of 24 seatbelts it is known that five are faulty. Two seatbelts are chosen at random. Which of the following probability trees could be used to determine the probability of choosing one faulty seatbelt and one non-faulty seatbelt?

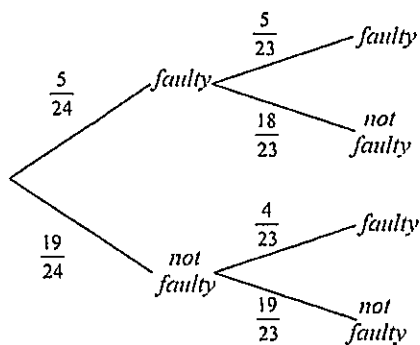
(A)



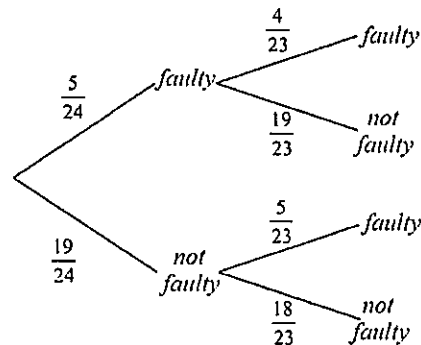
(B)



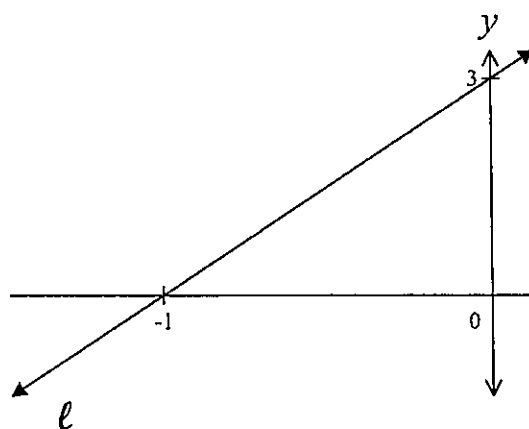
(C)



(D)



- 20 What is the equation of the line ℓ ?



$$y = mx + b$$

$$m = \frac{\text{rise}}{\text{run}}$$

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

$$= 3$$

$$b = \text{y-intercept}$$

$$= 3$$

$$\therefore y = 3x + 3$$

(A) $y = -3x + 3$

(B) $y = 3x + 3$

(C) $y = \frac{-x}{3} - 1$

(D) $y = \frac{x}{3} - 1$

- 21 The expected life of an Evercharge battery is normally distributed with a mean of 10 hours. What is the standard deviation if 95% of Evercharge batteries are expected to last between 8.8 and 11.2 hours? $\bar{x} \pm 2\sigma = 95\%$

2 standard deviations = 1.2

$$\therefore 1\sigma = \frac{1.2}{2}$$

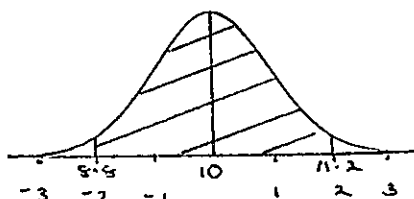
= 0.6 hours

(A) 0.6 hours

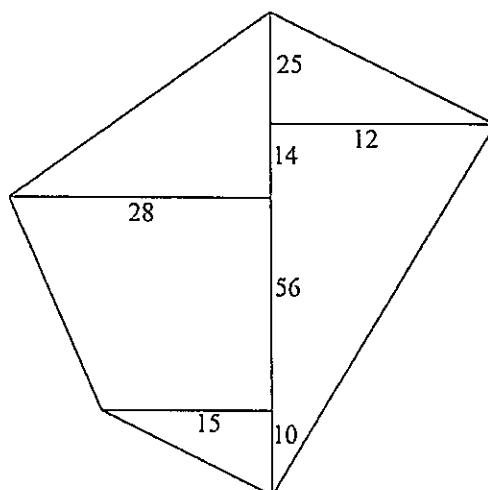
(B) 3.8 hours

(C) 7.6 hours

(D) 9.5 hours



- 22 The diagram below shows the sketch of a field, measurements in metres. Choose the correct corresponding field diagram.



NOT TO SCALE

(A)

	105		$105 - 80 = 25$
	80	12	$80 - 66 = 14$
28	66		$66 - 10 = 56$
15	10		
	0		

(B)

	25	
	14	12
28	56	
15	10	
	0	

(C)

	105	
12	80	
28	66	
15	10	
	0	

(D)

	25	
12	14	
	56	28
	10	15
	0	

23 Using the sine rule, find the size of angle θ to the nearest degree.

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

$$\frac{13}{\sin 40^\circ} = \frac{11}{\sin C}$$

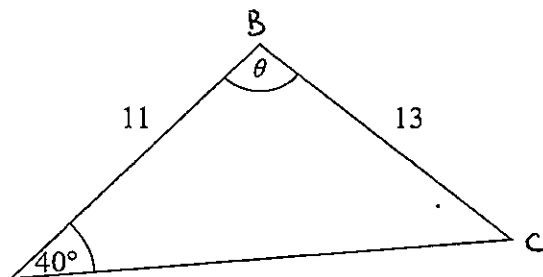
$$13 \times \sin C = 11 \times \sin 40^\circ$$

$$\sin C = \frac{11 \times \sin 40^\circ}{13}$$

$$C = \sin^{-1}(0.5438972\dots)$$

$$= 32.94933487^\circ$$

$$\approx 33^\circ$$



NOT TO
SCALE

(A) 33°

(B) 49°

(C) 91°

(D) 107°

$$\therefore B = 180^\circ - 40^\circ - 33^\circ$$

$$= 107^\circ$$

24 Consider the equation $\frac{5x}{4} + 3 = 2 - \frac{7x}{5}$.

Which of the following would be a correct step in solving the equation?

(A) $\frac{5x}{4} + 5 = -\frac{7x}{5}$
error

(B) $\frac{5x}{4} = -1 - \frac{7x}{5}$

(C) $5x + 3 = 8 - \frac{28x}{5}$
error

(D) $\frac{5x}{20} + 15 = 10 - 7x$
errors

- 25 The following back to back stem and leaf plot shows the prices (\$) of Poodle and Chihuahua puppies at a popular breeder.

Poodle		Chihuahua
3 1 0	4	0 0 2 3 3
7 5 5	5	1 1 2 3 5 5
8 7 6 5 4	6	0 2 2 7
8 8 5 5	7	
3	8	6

16 Poodle puppies

$$\text{median} = \frac{65 + 66}{2} = 65.5$$

No. of Chihuahua puppies

< 65.5 is 14 out of 16

$$\therefore \frac{14}{16} \times 100\% = 87.5\%$$

What percentage of Chihuahua puppies cost less than the median price of the poodle puppies?

- (A) 64.5% (B) 93.75%
 (C) 87.5% (D) 51.5%

End of Section I

SECTION II

Student Number:

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Total Marks – 75

Attempt Questions 26-30

All questions are of equal value

Answer the questions in the spaces provided. Your responses should include relevant mathematical reasoning and/or calculations.

Extra writing space is provided on pages 19, 24, 29, 34, 41. If you use any of these spaces, clearly indicate which question you are answering.

Question 26 (15 marks)

Jen has bought herself a pet rabbit.

- (a) A healthy diet for a rabbit should have 18 parts fibre to 14 parts protein to 3 parts fat. The local pet shop sells rabbit food containing 1.2 kg protein. 2

What is the total weight of fibre, protein and fat in the packet?

Fibre : protein : fat

18 : 14 : 3

1.2 kg of protein

18 + 14 + 3 = 35 parts

$\therefore \frac{14}{35} \times \text{total weight} = 1.2$

total = $\frac{1.2 \times 35}{14}$

= 3 kg

$\therefore$ The total weight of a packet is 3 kg.

- (b) Jen pays \$85 per month for food and supplies for her rabbit. 2

Assuming a constant annual inflation rate of 2.6%, calculate how much Jen would pay for the food and supplies in 3 years' time.

PV = \$85

FV = PV(1+r)ⁿ

$r = \frac{2.6}{100} = 0.026$

= 85(1+0.026)³

n = 3

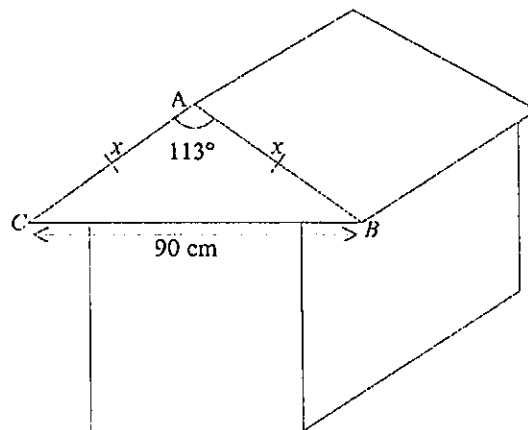
= \$91.80387396

= \$91.80 (nearest cent)

Question 26 continued on page 16

Question 26 (continued)

- (c) Jen is designing a new hutch for her pet rabbit. The front view of the sleeping quarters is made up of a triangle and rectangle, as shown in the diagram below.



NOT TO
SCALE

Angle BAC is to measure 113° and the base of the triangle, BC , is to be 90 cm. Let $AB = AC = x$.

- (i) If $AB = AC = x$, show that $x = \sqrt{\frac{8100}{2(1 - \cos 113^\circ)}}$.

2

$$BC^2 = AC^2 + AB^2 - 2(AC)(AB)\cos A$$

$$90^2 = x^2 + x^2 - 2(x)(x)\cos 113^\circ$$

$$= 2x^2 - 2x^2 \cos 113^\circ$$

$$= 2x^2(1 - \cos 113^\circ)$$

$$\therefore 2x^2 = \frac{90^2}{1 - \cos 113^\circ}$$

$$x^2 = \frac{8100}{2(1 - \cos 113^\circ)}$$

$$x = \sqrt{\frac{8100}{2(1 - \cos 113^\circ)}}$$

- (ii) Hence, find the length of AB , to the nearest centimetre.

1

$$x = \sqrt{\frac{8100}{2(1 - \cos 113^\circ)}}$$

$$= \sqrt{2912.137305}$$

$$= 53.96422245$$

$$= \underline{54 \text{ cm (nearest cm)}}$$

Question 26 continues on page 17

Question 26 (continued)

- (iii) If Jen uses a ruler with centimetre markings to measure the length of BC , what is the absolute error of her measurement? 1

$$1 \text{ marking} = 1 \text{ cm}$$

$$\therefore \text{absolute error} = \underline{\underline{\pm 0.5 \text{ cm}}}$$

- (iv) Jen wants to paint triangle ABC in the diagram on the previous page with textured exterior paint. Calculate the area of triangle ABC to the nearest square centimetre. 2

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

$$A_{\text{area}} = \frac{1}{2} bc \sin A \text{ for given diagram}$$

$$= \frac{1}{2} (53.96422245)(53.96422245) \times \sin 113^\circ$$

$$= 1340.318261 \text{ cm}^2$$

$$= \underline{\underline{1340 \text{ cm}^2}} \text{ (nearest cm}^2\text{)}$$

- (v) Textured exterior paint comes in 2 L tins with a coverage rate of $600 \text{ cm}^2 / \text{L}$. How many tins of paint will Jen have to buy? 1

$$A \text{ 2L tin will cover } 2 \times 600 = 1200 \text{ cm}^2$$

$$\therefore \underline{\underline{2 \text{ tins}} \text{ would be required to cover } 1340 \text{ cm}^2}$$

$$\left(\frac{1340}{1200} = 1.116 \text{ tins} \right)$$

Question 26 continues on page 18

Question 26 (continued)

- (d) Jen's rabbit had some minor surgery and needs to be given medication at the rate of 30 g/L in the rabbit's water. 2

The medication is supplied in solution. The label states the concentration as 150 g/250 mL.

How many millilitres of the solution should Jen add to 500 mL of water?

$$\begin{aligned} 30\text{g/L} &= 15\text{g}/500\text{mL} \quad \leftarrow \quad 150\text{g}/250\text{mL} = 15\text{g}/25\text{mL} \\ \therefore 15\text{g}/500\text{mL} &\text{ requires } \underline{25\text{mL}} \text{ of the solution} \end{aligned}$$

- (e) Jen discovered her rabbit likes listening to music. She can download at a rate of 600 kilobits per second (kbps), where 1 kilobit = 1000 bits. Jen wants to download a 38 megabyte (MB) file. 2

How long will it take Jen to download the file? Give your answer in minutes and seconds, correct to the nearest second.

$$\begin{aligned} 600\text{kbps} &= 600 \times 1000 \text{ bits per sec} \\ &= 600\,000 \text{ bps.} \end{aligned}$$

$$38\text{MB} = 38 \times 1024 \times 1024 \times 8 \text{ bits}$$

$$\text{Time} = \frac{\text{data}}{\text{speed}}$$

$$= \frac{38 \times 1024 \times 1024 \times 8}{600\,000}$$

$$= 531.2785067 \text{ seconds}$$

$$= 8.854641778 \text{ minutes}$$

$$= 8 \text{ minutes } 51.27850667 \text{ sec}$$

$$= \underline{8 \text{ minutes } 51 \text{ secs}} \text{ (nearest second)}$$

End of Question 26

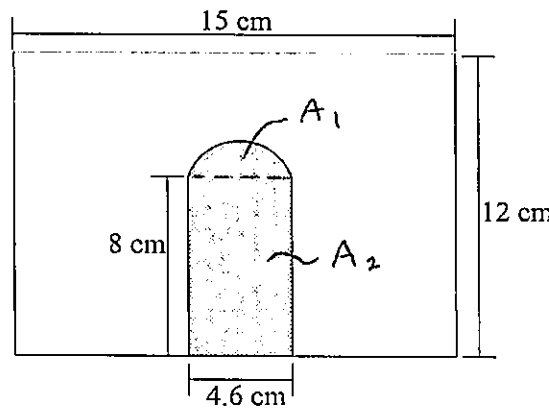
Question 27 (15 marks)

Student Number:

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Shenali and Hayley went to Hawaii for a holiday.

- (a) While they were out shopping, Shenali and Hayley discovered Dylan's Candy Bar. There were boxes in the shape of a medieval castle. The section under the ramparts was a rectangle with a doorway cut all the way through from the front, as shown below.



NOT TO SCALE

- (i) The doorway is a semi-circle on top of a rectangle.

3

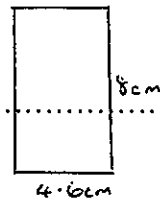
Calculate the area of the front of the box, without the door section, as shown above.



$$A_1 = \frac{1}{2} \pi r^2$$

$$= \frac{1}{2} \times \pi \times (2.3)^2$$

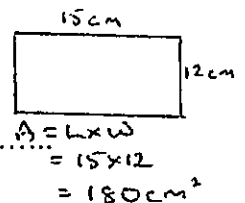
$$= 8.309512569 \text{ cm}^2$$



$$A_2 = L \times W$$

$$= 8 \times 4.6$$

$$= 36.8 \text{ cm}^2$$



$$A = L \times W$$

$$= 15 \times 12$$

$$= 180 \text{ cm}^2$$

$$\text{Total Area} = A_1 + A_2 = 8.309512569 + 36.8$$

$$= 45.10951257 \text{ cm}^2$$

$$A_{\text{net}} = 180 - 45.109$$

$$= 134.8904871$$

$$\approx 134.9 \text{ cm}^2 \text{ (1 d.p.)}$$

- (ii) If the candy container is 5 cm deep, calculate its volume, in mL, to the nearest mL, assuming the doorway is cut all the way through the box.

2

$$V = A \times h$$

$$= 134.8904871 \times 5$$

$$= 674.4524372 \text{ cm}^3$$

$$\approx 674.5 \text{ cm}^3 \text{ (1 d.p.)}$$

- (iii) There are 25 blue, 16 yellow and 13 red lollies in the box. If Shenali randomly selects one, what is the probability it will **not** be a yellow lolly?

1

$$25 + 16 + 13 = 54 \text{ lollies}$$

$$P(\text{not yellow}) = \frac{25 + 13}{54}$$

$$= \frac{38}{54}$$

$$= \frac{19}{27}$$

Question 27 continued on page 22

Question 27 (continued)

- (iv) The lolly box above is made to a 1: 900 scale of a real castle.

2

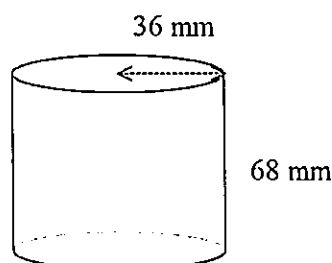
Calculate the width of the real castle, to the nearest metre.

$$\begin{aligned} 900 \times 15 \text{ cm} &= 13500 \text{ cm} \quad (\div 100) \\ &= \underline{135 \text{ m}} \quad (\text{nearest metre}) \end{aligned}$$

- (b) There was a chocolate coated object on the counter. It consisted of a hemisphere inside the top of a cylinder, as shown below.

3

The cylinder had a radius 36 mm and height 68 mm.



NOT TO
SCALE

The object was entirely dipped in chocolate. Calculate the total surface area coated in chocolate, to the nearest cm^2 . $r = 3.6 \text{ cm}$, $h = 6.8 \text{ cm}$

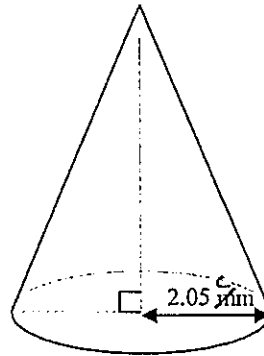
$$\begin{aligned} \text{TSA} &= \frac{1}{2} \text{ sphere} + \text{CSA of cylinder} + \text{Circle (base)} \\ &= \frac{1}{2}(4\pi r^2) + 2\pi r h + \pi r^2 \\ &= \frac{1}{2}(4 \times \pi \times 3.6^2) + (2 \times \pi \times 3.6 \times 6.8) + (\pi \times 3.6^2) \\ &= 275.9574987 \text{ cm}^2 \\ &= \underline{276 \text{ cm}^2} \quad (\text{nearest cm}^2) \end{aligned}$$

Question 27 continued on page 23

Question 27 (continued)

- (c) Hayley discovered a packet of sherbet in the shape of a cone, like a princess hat. It had a radius of 2.05 cm and a volume of 62 cm^3 . Calculate, to the nearest cm, the height of the cone.

2



NOT TO
SCALE

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

$$62 = \frac{1}{3} \times \pi \times (2.05)^2 \times h$$

$$= 4.400847709 \times h$$

$$h = \frac{62}{4.400847709}$$

$$= 14.08819484 \text{ cm}$$

$$= \underline{14 \text{ cm}} \text{ (nearest cm)}$$

- (d) Shenali and Hayley met Janet, a female Hawaiian university student, who took them to a bar to listen to music. Shenali and Hayley drank pineapple juice while Janet had 5 standard drinks in 3.5 hours. The legal driving limit in Hawaii is a BAC content of 0.08. If Janet's mass is 60 kg, would you recommend Shenali and Hayley accept Janet's offer to drive them home? Give reasons.

2

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

$$= \frac{10(5) - 7.5(3.5)}{5.5(60)}$$

$$= 0.07196$$

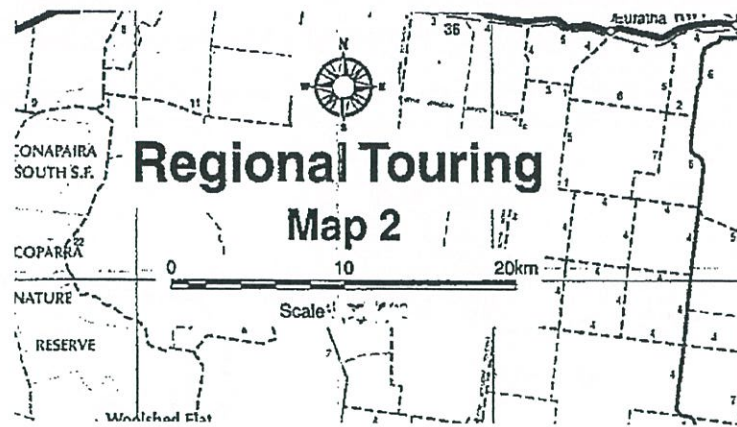
(i) Just under the legal limit of 0.08 but may be risky so would recommend not accepting a lift.

(ii) Under the limit, so would accept the lift.

End of Question 27

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- (a) Emma is moving to a new job in Young. She looked up the map shown below.



Calculate the scale on the map.

$$4.6 \text{ cm} = 20 \text{ km}$$

$$46 \text{ cm} = 20000000$$

$$23 = 10000000$$

$$1 : 434782.6087$$

$$4.5 \text{ cm} = 20 \text{ km}$$

$$45 \text{ cm} = 20000000$$

$$1 : 444444.4$$

1

$$[\text{km} \times 1000 \times 100 = \text{cm}]$$

- (b) Emma needs a car for her new job. She bought a car for \$32 000 which depreciates by \$2400 each year.

- (i) Use the straight-line method of depreciation to find the value of the car after 4 years.

2

$$S = V_0 - Dn$$

$$= \$32000 - (\$2400 \times 4)$$

$$= \underline{\underline{\$22,400}}$$

- (ii) How many years and months after the car was purchased, will Sarah's car have a \$0 salvage value?

2

$$S = V_0 - Dn$$

$$0 = \$32000 - (\$2400 \times n)$$

$$2400 \times n = 32000$$

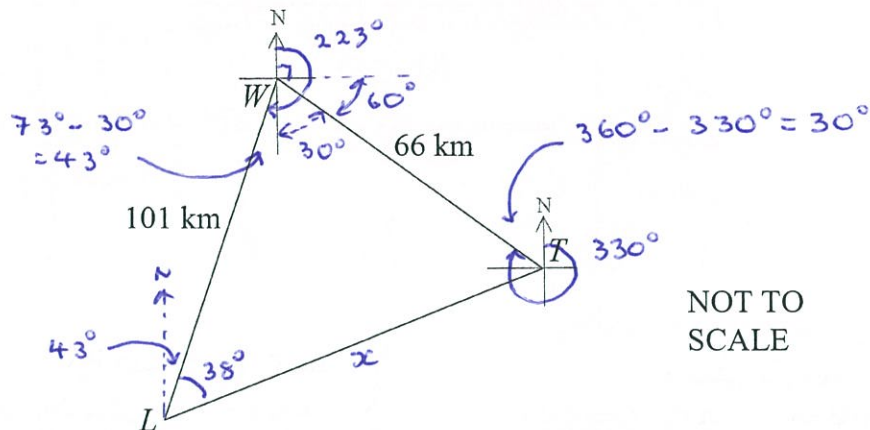
$$n = \frac{32000}{2400}$$

$$= \underline{\underline{13.3 \text{ years or 13 years 4 months}}}$$

$$[0.3 \times 12 = 4 \text{ months}]$$

Question 28 (continued)

- (c) Alex is visiting Emma and they drive to the Temora Aviation Museum to go on a joy flight, shown in the diagram below. The plane flies 66 km from Temora (T) on a bearing of 330° to West Wyalong (W). It then flies 101 km on a bearing of 223° from West Wyalong to Leeton (L). They have lunch at Leeton before returning to Temora.



- (i) Mark the bearings on the diagram above.

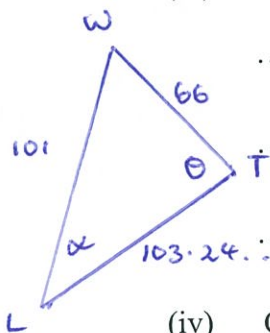
- (ii) Show that angle TWL is 73°

1

$$\begin{aligned}\angle TWL &= 223^\circ - 90^\circ - 60^\circ \\ &= 73^\circ\end{aligned}$$

- (iii) Hence, calculate the distance from Leeton to Temora, to the nearest kilometre.

2



$$\begin{aligned}x^2 &= 101^2 + 66^2 - 2(101)(66)\cos 73^\circ \\ &= 10659.10043 \\ x &= \sqrt{10659.10043} \\ &= 103.2429195 \text{ km} \\ &= \underline{103 \text{ km (nearest km)}}\end{aligned}$$

- (iv) Calculate the true bearing of Temora from Leeton.

2

$$\begin{aligned}\frac{\sin \theta}{101} &= \frac{\sin 73^\circ}{103.242...} & \text{OR} & \cos \alpha = \frac{101^2 + (103.242...)^2 - 66^2}{2(101)(103.242...)} \\ \sin \theta &= \frac{\sin 73^\circ}{103.242...} \times 101 & & = 0.7913711456 \\ &= 0.9355293399 & & \alpha = \cos^{-1}(0.7913711456) \\ &= 0.9355293399 & & = 38^\circ \text{ (nearest degree)} \\ \theta &= \sin^{-1}(0.9355293399) & & \text{Bearing} = 43^\circ + 38^\circ \\ &= 69^\circ \text{ (nearest degree)} & & = \underline{081^\circ \text{ T}} \\ \alpha &= 180^\circ - 73^\circ - 69^\circ \\ &= 38^\circ \\ \text{Bearing} &= 43^\circ + 38^\circ \\ &= \underline{081^\circ \text{ T}}\end{aligned}$$

Question 28 continued on page 27

Question 28 (continued)

- (d) Emma is saving for a holiday. She deposits \$3600 into an account at the end of every year for four years. The account pays 5% per annum interest, compounding annually.

The table shows future values of an annuity of \$1.

Future values of an annuity of \$1

End of Year	Interest Rate				
	1%	2%	3%	4%	5%
1	1.0000	1.0000	1.0000	1.0000	1.0000
2	2.0100	2.0200	2.0200	2.0400	2.0500
3	3.0301	3.0604	3.0909	3.1216	3.1525
4	4.0604	4.1216	4.1836	4.2465	4.3101
5	5.1010	5.2040	5.3091	5.4163	5.5256
6	6.1520	6.3081	6.4684	6.6330	6.8019
7	7.2135	7.4343	7.6625	7.8983	8.1420
8	8.2857	8.5830	8.8923	9.2142	9.5491

- (i) Use the table to find the value of Emma's investment at the end of four years.

2

$$\text{\$1} \rightarrow \text{\$4.3101}$$

$$\therefore \$3600 \rightarrow 3600 \times \$4.3101$$

$$= \underline{\underline{\text{\$15,516.36}}}$$

- (ii) How much interest does Emma earn on her investment over the four years?

2

$$\text{Total of deposits} = 4 \times \$3600 = \$14400$$

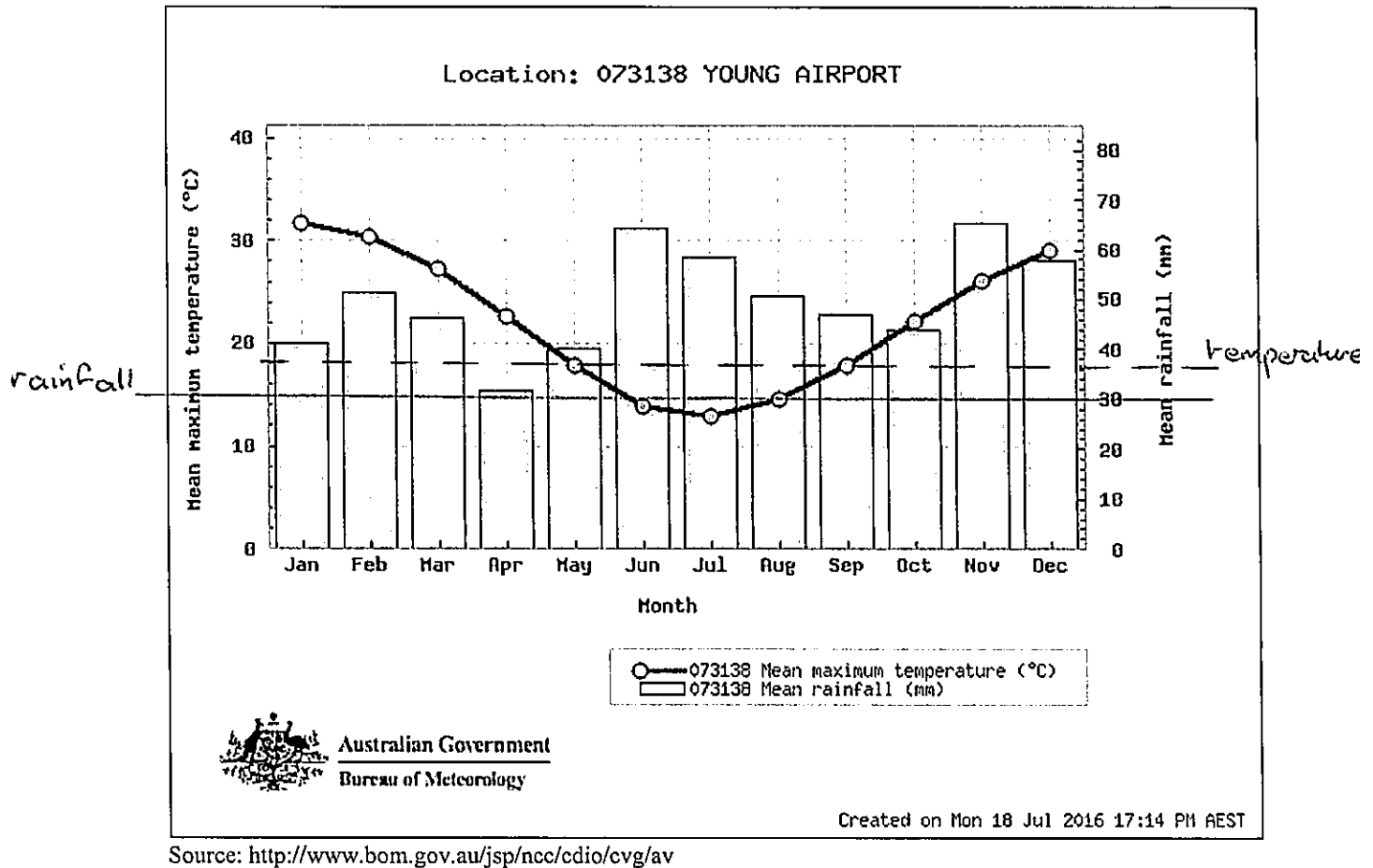
$$\text{Interest} = \$15516.36 - \$14400$$

$$= \underline{\underline{\text{\$1116.36}}}$$

Question 28 continued on page 28

Question 28 (continued)

- (e) The following graph shows the average annual temperature and rainfall in Young, NSW.



Emma wants to plant a special tree in her garden. The label on the pot indicates the tree needs at least 30 mm rain, on average, per month and the temperature cannot go below 18°C. Using the graph above, should Emma buy the tree? Explain.

1

No. The rainfall (columns) is always above 30mm but there are 3 months where the temperature is below 18°C (Jun, Jul, Aug).

End of Question 28

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In April, Abbotsleigh's robotics team flew to St. Louis, in the USA, to compete in the FIRST Robotics World Championships. The coordinates of Sydney are ($34^{\circ}\text{S}, 151^{\circ}\text{E}$) and St. Louis ($39^{\circ}\text{N}, 90^{\circ}\text{W}$).

- (a) The flight left Sydney's Kingsford Smith airport at 10 a.m. on Saturday. If the total travel time was 19 hours and 45 minutes, what was the local time in St. Louis when the team arrived?

2



$$\text{Time Difference} = \frac{151^{\circ} + 90^{\circ}}{15} = 16\frac{1}{3} \text{ hours} = 16 \text{ hrs } 4 \text{ mins}$$

10am Sat in Syd

- 16hrs 4min

5:56 Fri in St. L

Add Flight: + 19hr 45min

= 1:41pm Sat

10am Sat in Syd

Add Flight: + 19hr 45min

6:45am Sun

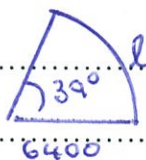
Subtract time difference

= 1:41pm Sat

- (b) Calculate the shortest distance from St. Louis to the equator, to the nearest kilometre.

2

St. Louis 39°N



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

$$= \frac{39}{360} \times 2 \times \pi \times 6400$$

$$= 4356.341813 \text{ km}$$

$$= \underline{4356 \text{ km (nearest km)}}$$

Question 29 continued on page 32

Question 29 continued)

- (c) On the second night, the team went to dinner at the Olive Garden Italian restaurant. The total cost of the meal was \$372.83, including 8.3% GST (Goods and Services Tax).

- (i) Show the cost of the meal before GST was \$344.26, to the nearest cent.

2

$$100\% + 8.3\% = 108.3\%$$

$$108.3\% = \$372.83$$

$$1\% = \frac{372.83}{108.3}$$

$$100\% = \frac{372.83}{108.3} \times 100$$

$$= \$344.2566944$$

$$= \underline{\underline{\$344.26}} \text{ (nearest cent)}$$

- (ii) If the team also paid a tip of 18% of the cost of the meal before GST, calculate the total amount they paid for their meal.

2

$$\text{Tip} = \frac{18}{100} \times \$344.26$$

$$= \$61.9668$$

$$= \$61.97 \text{ (nearest cent)}$$

$$\text{Total paid for meal} = \$372.83 + \$61.97$$

$$= \underline{\underline{\$434.80}}$$

Question 29 continued on page 33

Question 29 (continued)

(d) The table below shows the international call costs of different plans with Telstar.

International calls	International calls standard rates Telstar Home Phone plan	International Saver	International Ultimate
Call connection fee (for new Telstar bundles available from 30 June 2015)	52c per call	52c per call	52c per call except where the call is Unlimited
Call connection fee (all other plans)	55c per call	55c per call	55c per call except where the call is Unlimited
Monthly charge	Nil	\$5 per month (included in Telstar Voice Ultimate and Telstar Home Phone Pinnacle)	\$15 per month
	Call rates per minute or part thereof	Call rates per minute or part thereof	Call rates per minute or part thereof
United States	\$0.21	\$0.02	Unlimited

- (i) In January 2016, Tia's mother switched from the International Saver Plan to the Telstar Home Phone Plan. Tia's mother called Tia while she was in the United States in April 2016. If they talked for 22.7 minutes, calculate the total cost of the call.

2

$$\begin{aligned} \text{Cost} &= \$0.52 + 23 \times \$0.21 \\ &= \underline{\underline{\$5.35}} \end{aligned}$$

- (ii) If this was the only call Tia's mother made in the month, should she have kept the International Saver Plan she started in 2014? Explain, using calculations to justify your answer.

2

International Saver	Home Phone Plan
$\$0.55 + 23 \times \$0.02 + \$5$	$\$5.35$
$= \$6.01$	

No, should not keep the International Saver as the Home Phone Plan is cheaper.

Question 29 continued on page 34

Question 29 (continued)

- (e) Abbotsleigh's robotics team competed in the Australian regionals of the FIRST Robotics Competition to qualify for the world championships. The quarterfinal results for the red and blue alliances are shown in the table below.

Red Alliance	Blue Alliance
107	64
36	100
97	92
90	100
115	106
86	106
105	72
120	64

- (i) Calculate the mean for the red alliance.

1

$$\bar{x}_{\text{red}} = 94.5$$

- (ii) Calculate the standard deviation for the red alliance.

1

$$\sigma_{\text{red}} = 24.64244306$$

- (iii) If the mean for the blue alliance is 88.75 and the standard deviation is 16.18, which alliance is more likely to win the competition? Explain, using the means and standard deviations, to justify your answer.

1

$$\bar{x}_{\text{blue}} = 88.75$$

$$\sigma_{\text{blue}} = 16.18$$

Red has a higher mean so they should win, but their scores are more spread (higher σ), so they could still lose.

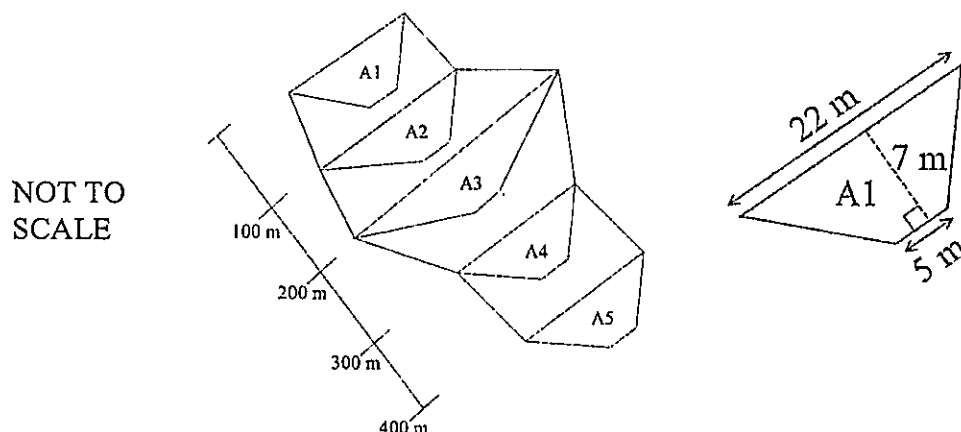
End of Question 29

Question 30 (15 marks)

Student Number:

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- (a) A team of students is going to Cambodia to assist aid workers creating a landfill site. They need to calculate the volume of the planned site to determine whether it will be enough for the waste disposal. One section of the site is to be divided into cells. The sides of the cells are trapeziums, evenly spaced 100 metres apart, as shown below.



Areas A2, A3, A4 and A5 have been calculated as shown in the following table.

Section	A1	A2	A3	A4	A5
Area	94.5 m^2	168.75 m^2	542.5 m^2	383.25 m^2	383.25 m^2

- (i) Calculate the area of A1 shown in the diagram above.

2

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

$$= \frac{(5+22)}{2} \times 7$$

$$= \underline{94.5 \text{ m}^2}$$

- (ii) Use two applications of Simpson's Rule to calculate the total volume of the landfill, to the nearest cubic metre.

2

$$V_1 \approx \frac{1}{3} [A_L + 4A_m + A_R]$$

$$= \frac{100}{3} [94.5 + 4(168.75) + 542.5]$$

$$= 43733.3 \text{ m}^3$$

$$V_2 \approx \frac{h}{3} [A_L + 4A_m + A_R]$$

$$= \frac{100}{3} [542.5 + 4(383.25) + 383.25]$$

$$= 81958.3 \text{ m}^3$$

Total Volume = $V_1 + V_2 = 125691.6 \text{ m}^3$

$$= \underline{125692 \text{ m}^3} \text{ (to nearest m}^3\text{)}$$

Question 30 continues on page 38

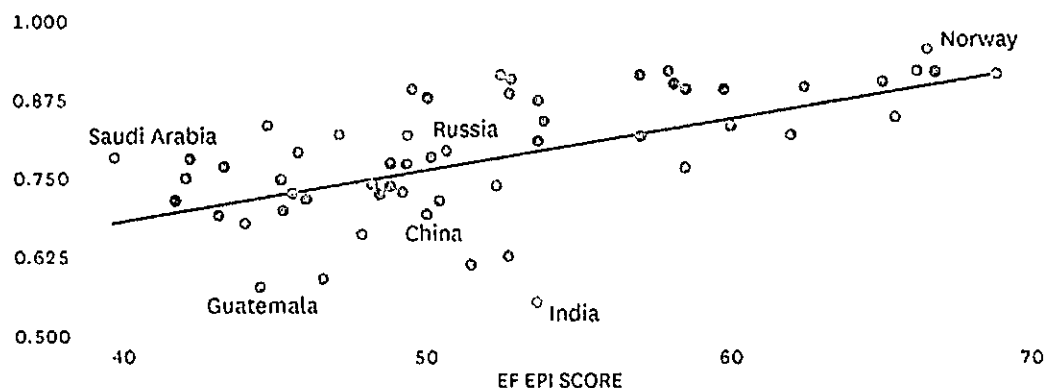
Question 30 (continued)

- (b) The graph below shows the correlation between the English Proficiency Index (EF EPI) and the Human Development Index (HDI).

BETTER ENGLISH, BETTER QUALITY OF LIFE

There is a correlation between how well a country's population speaks English and education, life expectancy, literacy, and standards of living.

HUMAN DEVELOPMENT INDEX (HDI)



SOURCE UNITED NATIONS HUMAN DEVELOPMENT REPORT, 2012 AND EF EPI 2013 REPORT

HBR.ORG

Source: <http://maloloschan.com/ae/4.html>

Whilst the above graph shows a correlation between the level of English spoken in a country (EF EPI score) and the HDI (education, life-expectancy, literacy and standards of living of the people), is it correct to say the level of English spoken in a country determines education, life-expectancy, literacy and standards of living of the people in that country? Explain.

1

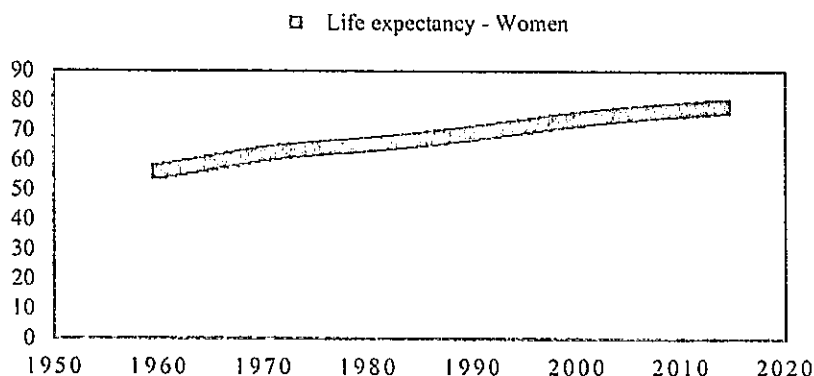
No. While there is a correlation between these two variables, it does not mean that one variable causes the other to occur. ie a greater level of English does not guarantee an increase in HDI. HDI depends on many factors such as diet, access to education, income etc.

Question 30 continues on page 39

Question 30 (continued)

- (c) Verity and Sophia went to the Olympics in Brazil. They found the life expectancy of women in Brazil has been improving, as shown in the table below.

**LIFE EXPECTANCY FROM BIRTH
WOMEN - BRAZIL
1960-2014**



Source: <http://countryeconomy.com/demography/life-expectancy/brazil>

	Mean	Standard Deviation
Year (x)	1987	15.87
Life expectancy (y)	68.21	6.42

If the correlation coefficient, $r = 0.9959$, use the values in the table above to find the:

- (i) gradient

$$m = \frac{r \times \sigma_y}{\sigma_x} = 0.9959 \times \frac{6.42}{15.87}$$

$$= 0.4028782609$$

$$\approx 0.40 \text{ (2 dec. places)}$$

1

- (ii) y-intercept

$$b = \bar{y} - m\bar{x}$$

$$= 68.21 - 0.40 \times 1987$$

$$= -726.59$$

$$\left. \begin{array}{l} b = \bar{y} - m\bar{x} \\ = 68.21 - 0.40 \times 1987 \\ = -726.59 \end{array} \right\} \begin{array}{l} b = \bar{y} - m\bar{x} \text{ (using full } m \text{ value)} \\ = 68.21 - (0.4028782609) \times 1987 \\ = -732.3091043 \end{array}$$

$$= 68.21 - (0.4028782609) \times 1987$$

$$= -732.3091043$$

1

- (iii) equation of the least-squares line of best fit for women

$$y = mx + b$$

$$= 0.40x - 726.59$$

$$\left. \begin{array}{l} y = mx + b \\ = 0.40x - 726.59 \end{array} \right\} \begin{array}{l} y = mx + b \\ = 0.40x - 732.31 \end{array}$$

$$= 0.40x - 732.31$$

1

Question 30 continued on page 40

Question 30 (continued)

- (iv) Use your equation from (iii) to estimate the life expectancy, from birth, of a woman Brazilian who was born in 1998.

1

$$\begin{array}{lcl}
 y = 0.40x - 726.59 & \left\{ & y = 0.40x - 732.31 \\
 = 0.40(1998) - 726.59 & & = 0.40(1998) - 732.31 \\
 = \underline{72.61 \text{ years}} & & = \underline{66.89 \text{ years}}
 \end{array}$$

- (d) A medical researcher used 40 Brazilian women with hypertension (higher than normal heart rate) in an experiment to test a new drug designed to reduce hypertension, using two groups of equal size. There is a control group (untreated) and an experimental group (treated with the new drug).

Measurements of heart rates were taken over a 6-week period and recorded. The mean and standard deviation for these sets of measurements were calculated as shown in the table below.

Group	Mean	Standard deviation
Control	67.6	15.8
Treated	60.6	10.2

If a normal heart rate is 60, what conclusions can be drawn about the effectiveness of the drug? Explain, using z-scores.

2

$$\begin{array}{lcl}
 \text{Control: } z = \frac{x - \bar{x}}{s} & & \text{Treated: } z = \frac{x - \bar{x}}{s} \\
 = \frac{67.6 - 60}{15.8} & & = \frac{60.6 - 60}{10.2}
 \end{array}$$

$$\begin{array}{lcl}
 = 0.4810126582 & & = 0.05882352941 \\
 = 0.48 & & = 0.06
 \end{array}$$

The lower z-score occurs for the treated group.

ie $0.06 < 0.48$.

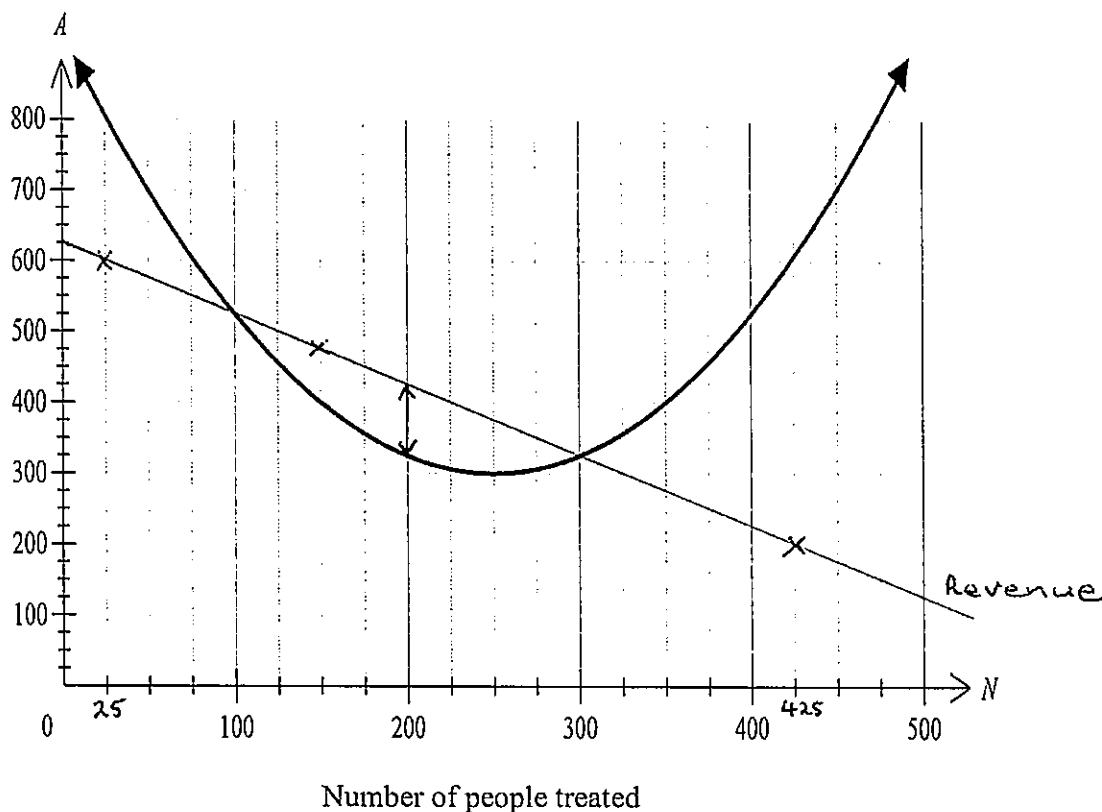
$\therefore$ The treated group is more effective as results closer to mean.

Question 30 continued on page 41

Question 30 (continued)

- (e) A cure has been developed for a serious illness but the treatment is very expensive. The following graph shows the average amount (\$ A), per person, it will cost the hospital to treat N people. The equation for this graph is

$$A = 0.01(N - 250)^2 + 300.$$



The following table shows the average amount of revenue (\$ A), per person, received by the hospital when N people undergo the treatment.

Number of People (N)	25	70	150	215	425
Amount (\$ A)	600	555	475	410	200

- (i) Use the table of values to calculate the gradient of the line.

2

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$= \frac{200 - 600}{425 - 25}$$

$$= \frac{-400}{400}$$

$$\underline{\underline{m = -1}}$$

Question 30 continues on page 42

Question 30 (continued)

(ii) Plot the points on the graph on the previous page and join them to make a straight line. **1**

(iii) Estimate how many people would need to be treated for the hospital to make the most profit. **1**

Need to locate where the greatest vertical
gap occurs between the 2 graphs
This is at about 200 people.

End of Question 30

End of paper