SYDNEY GRAMMAR SCHOOL

CANDIDATE NUMBER

2024 Trial HSC Examination

Form VI Mathematics Standard 2

Tuesday 13th August, 2024

8:40am

General Instructions

- Reading time — 10 minutes
- Working time — 2 hours 30 minutes
- Attempt all questions.
- Write using black pen.
- Calculators approved by NESA may be used.
- A loose reference sheet is provided separate to this paper.

Thirty Seven Questions — 100 Marks

Section I (15 marks) Questions 1 – 15

- This section is multiple-choice. Each question is worth 1 mark.
- Record your answers on the provided answer sheet.

Section II (85 marks) Questions 16 – 37

- Relevant mathematical reasoning and calculations are required.
- Answer the questions in this paper in the spaces provided.

Collection

- Write your candidate number on this page and on the multiple choice sheet.

Checklist

- Reference sheet
- Multiple-choice answer sheet
- Candidature: 20 pupils

Writer: PKS

Section I

Questions in this section are multiple-choice.
Record the single best answer for each question on the provided answer sheet.

---

1. Caprice's car uses 26 L of fuel to travel 481 km. How far can it travel on 50 L of fuel, to the nearest kilometre? **1**

   (A) 925 km

   (B) 952 km

   (C) 962 km

   (D) 1081 km

2. Which equation represents the relationship between x and y in this table? **1**

x	-2	0	2	4	6	8
y	12	8	4	0	-4	-8

   (A) $y = -2x + 12$

   (B) $y = -2x + 8$

   (C) $y = -4x + 8$

   (D) $y = 2x + 8$

3. Which of the following is an example of a census? **1**

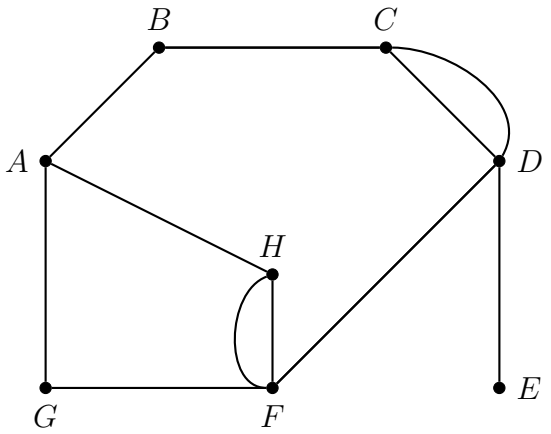
   (A) A TV poll for the preferred Prime Minister.

   (B) All students in Form V voting for the 2025 Prefect positions.

   (C) Testing every 100th USB memory stick on a production line for faults.

   (D) Surveying 100 Sydney Grammar School College Street boys preferences to determine what drinks are sold at the canteen.

4. Which one of the following edges should be added to the graph to make an Eulerian trail possible? **1**



(A) AC

(B) AD

(C) EF

(D) HD

5. Pamela bought a watch for \$8000. This included 10% GST. She left Australia to return to the UK and claimed a GST refund. **1**

How much was the refund?

(A) \$727.27

(B) \$800

(C) \$7200

(D) \$7272.73

6. Consider a dataset with mean 10 and standard deviation 2. Two scores, 10.5 and 9.5 are added to the dataset. Which choice shows how the mean and standard deviation are affected by the added scores? **1**

(A) Both mean and standard deviation will change.

(B) Only standard deviation will decrease.

(C) Only standard deviation will increase.

(D) Neither mean nor standard deviation will change.

7. Alan, Ben and Cody must complete three activities (A – C) in total. The activity table below shows the person selected to complete each activity, in minutes, and the immediate predecessor for each activity. **1**

Person	**Activity**	**Immediate Predecessor(s)**	**Duration (minutes)**
Alan	A	–	14
Ben	B	A	6
Cody	C	B	17

All three activities must be completed in a total of 42 minutes. The instant that Alan starts his activity, Cody gets a phone call. What is the maximum time, in minutes, before Cody must start his allocated activity?

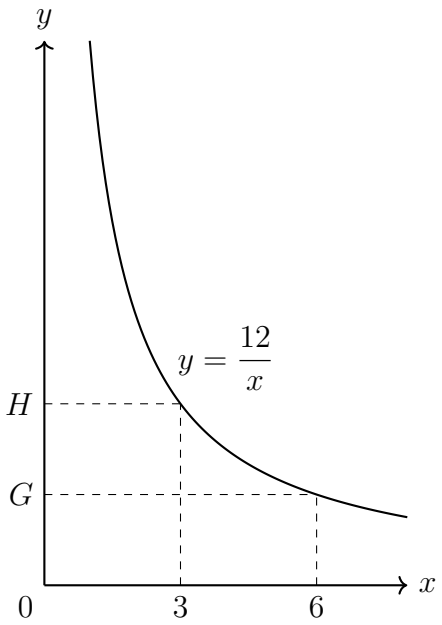
(A) 5

(B) 14

(C) 20

(D) 25

8. The diagram below shows the graph of $y = \dfrac{12}{x}$. **1**



What is the length of GH in units?

(A) 1

(B) 2

(C) 4

(D) 8

9. An amount of \$16 000 is invested for three years. Interest is earned at a rate of 6% per annum, compounding monthly. **1**

   Which expression gives the value of the investment after three years, in dollars?

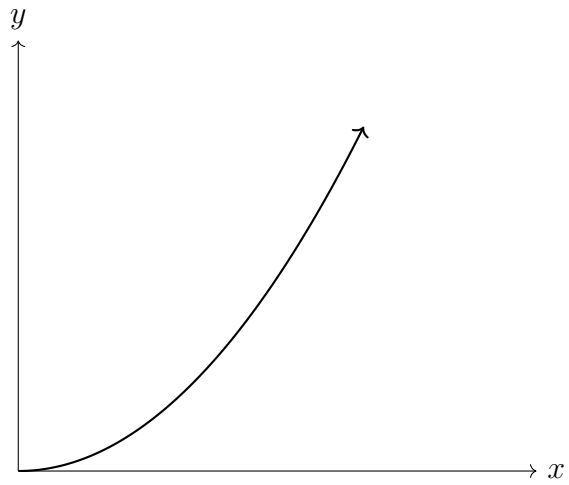
   (A) $16\,000 \times 1.005^3$

   (B) $16\,000 \times 1.005^{36}$

   (C) $16\,000 \times 1.06^3$

   (D) $16\,000 \times 1.06^{36}$

10. Which equation best represents the graph drawn below? **1**



   (A) $y = 4x$

   (B) $y = 4^x$

   (C) $y = 4x^2$

   (D) $y = \dfrac{4}{x}$

11. Researchers are investigating population density, house size and the distance from the centre of a city. Data is plotted with distance on the horizontal axis. **1**

    - For the graph of population density vs distance, the Pearson's correlation coefficient is $r = -0.563$.
    - For house size vs distance, the Pearson's correlation coefficient is $r = 0.357$.

    Given this information, which one of the following statements is true?

    (A) Population density tends to be higher when it is farther away from the city centre.

    (B) House size tends to be larger when it is closer to the city centre.

    (C) House size is positively correlated with population density.

    (D) Population density is more strongly associated with distance from the centre of the city than house size.

12. A crane lifted a crate 152 metres into the sky in 28 seconds. **1**

    What is its average speed, correct to the nearest kilometre per hour?

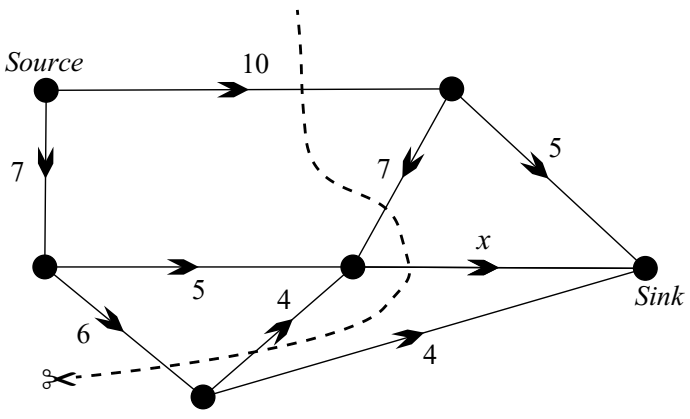
    (A) 5 km/h

    (B) 7 km/h

    (C) 18 km/h

    (D) 20 km/h

13. A network with source and sink is shown. The capacities of the edges are labelled. The cut shown on the diagram has a capacity of 24. **1**



What is the value of x?

(A) 1

(B) 3

(C) 4

(D) 8

14. Which equation represents a decreasing exponential function? **1**

(A) $y = 8^{-x}$

(B) $y = 0.5(8^x)$

(C) $y = 2(8^x)$

(D) $y = (0.5)^{-x}$

15. A park ranger wishes to estimate the number of swans in a lake. A sample of N swans was caught, tagged and released. The next day a second sample of S swans is caught, and it is noted that M of them had been previously tagged. **1**

Which is the correct expression to estimate the number of swans in the lake?

(A) $\dfrac{MN}{S}$

(B) $\dfrac{NS}{M}$

(C) $\dfrac{MS}{N}$

(D) $\dfrac{N}{MS}$

End of Section I

The paper continues in the next section

Section II

This section consists of long-answer questions.
Marks may be awarded for reasoning and calculations.
Marks may be lost for poor setting out or poor logic.
Record your answers in the space provided in this paper.

QUESTION SIXTEEN (2 marks)

Three friends, Will, Oliver and Rob, travel together by car to Blueys Beach. They share the driving and the ratio of the distances they each drive is $4:6:7$. **2**

Find the combined distance that Will and Oliver drive, if the road trip is a distance of 306 km.

.....

.....

.....

.....

.....

.....

QUESTION SEVENTEEN (2 marks)

If $a = 3$, $b = -4$ and $c = 1$, find the value of $\dfrac{-b + \sqrt{b^2 - 4ac}}{2a}$. **2**

.....

.....

.....

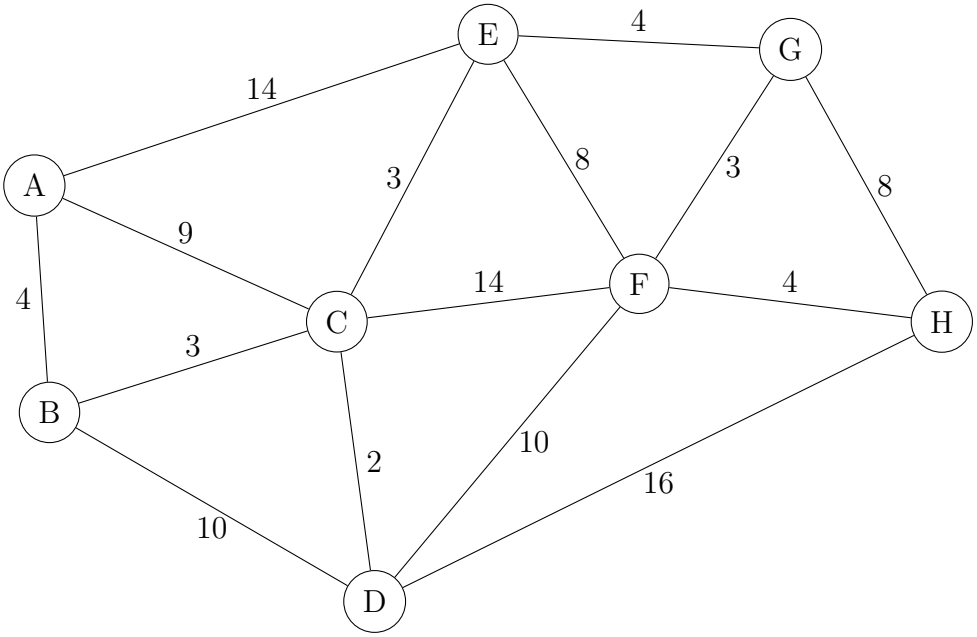
.....

.....

.....

QUESTION EIGHTEEN (5 marks)

The network diagram below shows the roads connecting 8 towns. The edges show the distance along the roads between the towns, in kilometres.



(a) State the vertices that identify the shortest path from A to H. **2**

.....

.....

.....

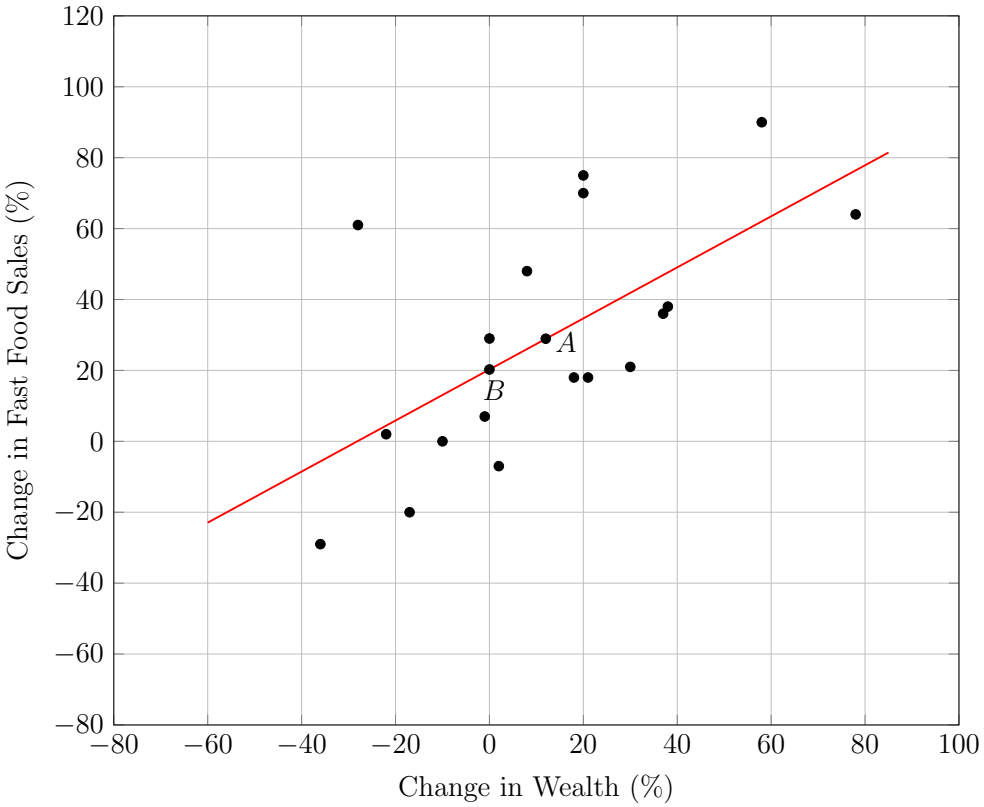
(b) Draw a minimum spanning tree for this network and determine its length. **3**

Length of minimum spanning tree = _____.

QUESTION NINETEEN (3 marks)

The graph below is adapted from a diagram in the New York Times series "Planet Fat". It shows how as the countries prosper, the fast-food sales also increase.

The two quantitative variables in this scatterplot are the percentage change of gross domestic product per capita (horizontal axis, x) and the percentage change in fast food sales from 2010 to 2015 (vertical axis, y).



Using the data provided, the least-squares regression line was found as shown above. It passes through $A\,(12,\ 28.94)$ and $B\,(0,\ 20.3)$. The correlation coefficient was 0.63.

(a) Describe the relationship between percentage change of gross domestic product per capita and percentage change in fast food sales from 2010 to 2015. **1**

.....

.....

(b) Find the equation of the regression line. **2**

.....

.....

.....

.....

QUESTION TWENTY (2 marks)

Ricardo has a credit card which has no interest-free period. Interest is charged at 19% p.a. compounding daily, on the amount owing. During the month, Ricardo bought a new bicycle for $2300 using the credit card. The full amount owing was repaid 19 days later. **2**

Calculate the amount of interest charged on the credit card for the purchase of the bicycle, assuming that interest is charged for the 19 days.

.....

.....

.....

.....

.....

.....

QUESTION TWENTY ONE (3 marks)

Mandy buys a 60-inch OLED television which consumes approximately 118.5 watts of electricity when switched on and uses 0.5 watts of electricity in standby mode. Mandy uses the television for an average of 6 hours a day and it is on standby the rest of the time. **3**

If electricity is charged at 40 c/kWh, how much does it cost Mandy to run the television per year?

.....

.....

.....

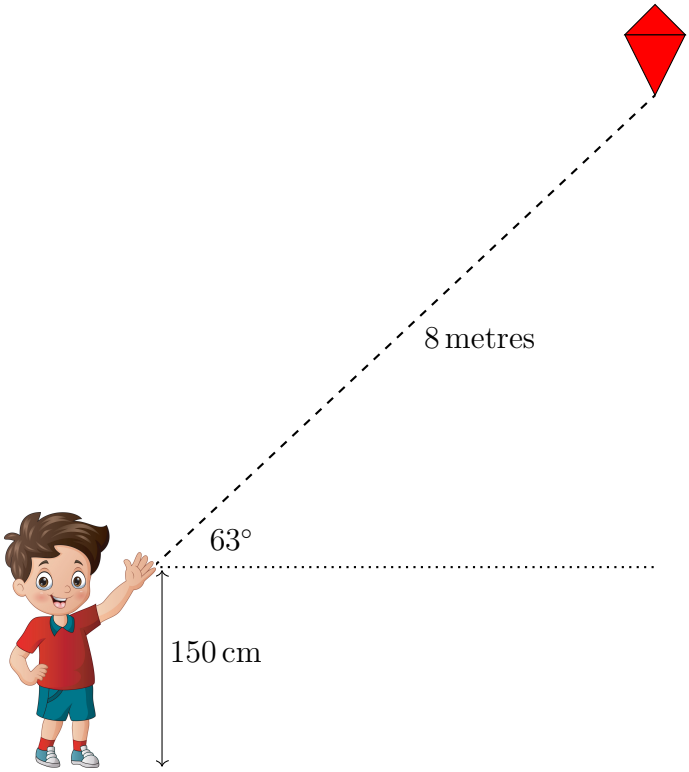
.....

.....

.....

QUESTION TWENTY TWO (3 marks)

Bertie is flying a kite. The handle is held 150 cm above the ground and the kite is on a string 8 metres long. The string makes an angle of 63° with the horizontal.



How high is the bottom of the kite above the ground? Give your answer in metres correct to 3 significant figures. **3**

.....

.....

.....

.....

.....

.....

.....

QUESTION TWENTY THREE (5 marks)

A table of future value interest factors for an annuity of \$1 is shown.

Rate / *Period*	*0.25%*	*1%*	*2%*	*4%*
2	2.0025	2.0100	2.0200	2.0400
4	4.0150	4.0604	4.1216	4.2465
6	6.0376	6.1520	6.3081	6.6330
8	8.0704	8.2857	8.5830	9.2142
10	10.1133	10.4622	10.9497	9.2142

Kim plans to deposit \$4000 into a savings account at the end of each quarter for 2 years to save for a trip overseas. The interest rate is 4% per annum compounding quarterly.

(a) Find the amount of money in Kim's savings account after the 2 years. **2**

.....

.....

.....

.....

(b) Calculate the total interest earned. **1**

.....

.....

(c) Instead, Kim decides to invest a single amount into a fixed term deposit account for 2 years. The interest rate is 4% per annum compounding annually. **2**

How much does she need to invest to have the same amount at the end of 2 years as the savings account?

.....

.....

.....

.....

QUESTION TWENTY FOUR (4 marks)

A house has a square-shaped roof, with each side being x metres. During a period of rainfall, the amount of rainwater (W litres) collected is directly proportional to the square of x. The roof collects 79 380 litres when the value of x is 14 m.

(a) Find the equation relating W and x. **2**

.....

.....

.....

.....

(b) Find the side length of a square roof that would collect 131 220 litres. **2**

.....

.....

.....

.....

QUESTION TWENTY FIVE (4 marks)

Germaine purchased 600 shares valued at \$37.90 each. Brokerage fees were 2.3% of the total purchase price. A few months later, Germaine is paid a dividend of \$492.

(a) Calculate the total cost of purchasing the shares. **2**

.....

.....

.....

.....

(b) Calculate the dividend yield. **2**

.....

.....

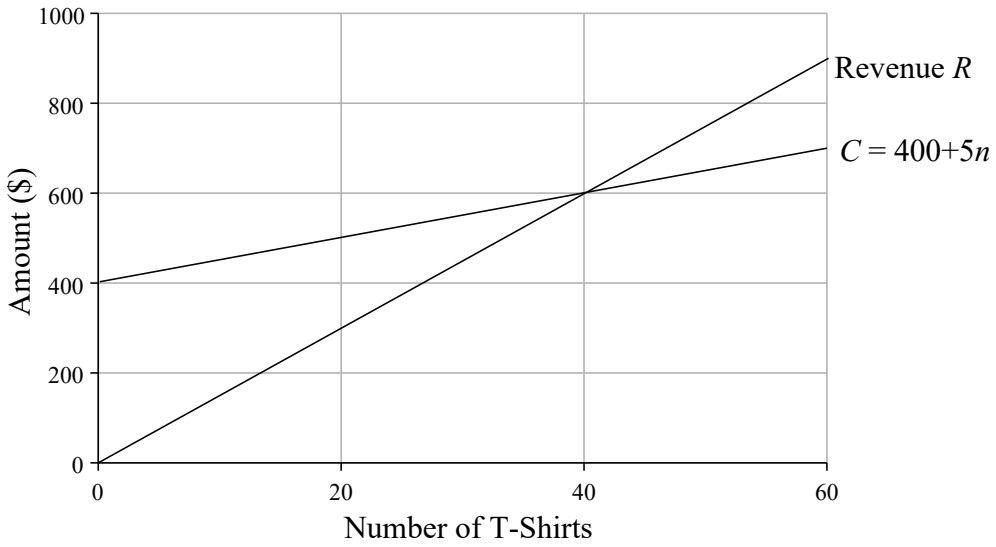
.....

.....

QUESTION TWENTY SIX (4 marks)

A manufacturer makes and sells T-shirts. The cost of producing a batch of T-shirts ($\$C$) is represented by the equation $C = 400 + 5n$ where n is the number of T-shirts made.

The graph shows planned revenue and cost when a T-shirt price is \$15.



(a) How many T-shirts need to be sold to break even? **1**

.....

.....

(b) Find the loss if only 25 T-shirts are sold. **1**

.....

.....

(c) The manufacturer plans to sell 60 T-shirts and wants to make a profit of \$500. What should be the price of a T-shirt, assuming all 60 will be sold? **2**

.....

.....

.....

.....

QUESTION TWENTY SEVEN (5 marks)

The table shows monthly repayments for each \$1000 borrowed.

Monthly repayment table

Principal and Interest per \$1000 borrowed						
Interest rate	*Term of loan*(years)					
(per annum)	5	10	15	20	25	30
6.5%	19.57	11.35	8.71	7.46	6.75	6.32
7.0%	19.80	11.61	8.99	7.75	7.07	6.65
7.5%	20.04	11.87	9.27	8.06	7.39	6.99
8.0%	20.28	12.13	9.56	8.36	7.72	7.34

(a) Alan borrows \$1 080 000 to buy a house at 7% per annum over 25 years. How much does he repay in total for this loan? **2**

.....

.....

.....

.....

.....

(b) How much interest will Alan pay over the loan period? **1**

.....

.....

(c) Calculate the equivalent flat rate of interest that Alan pays over the life of the loan. Give your answer as a percentage, correct to 1 decimal place. **2**

.....

.....

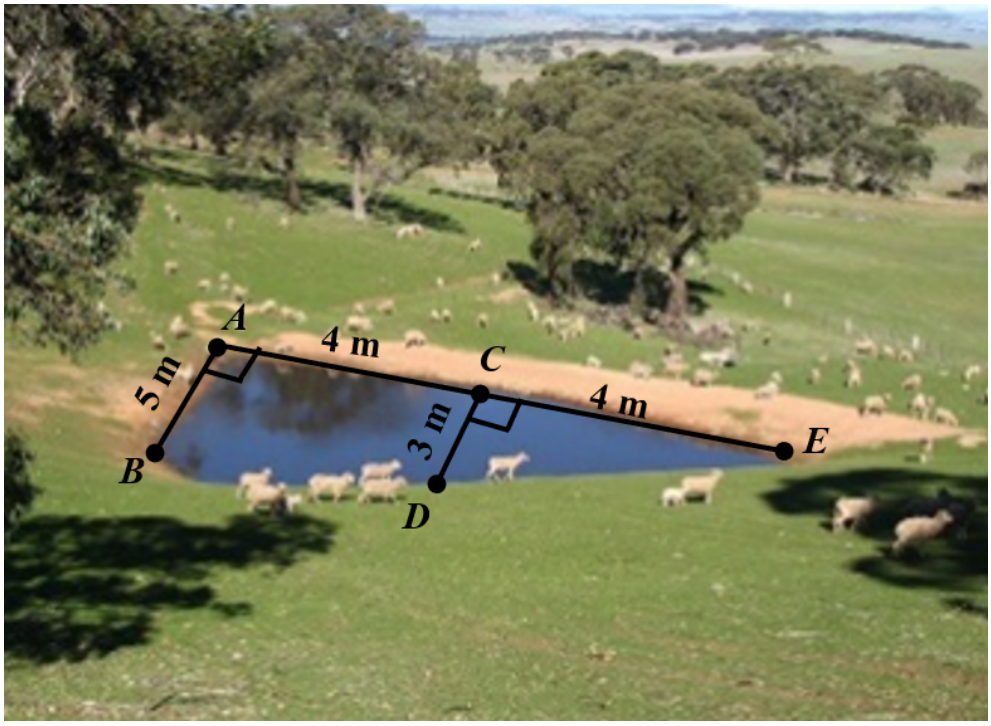
.....

.....

.....

QUESTION TWENTY EIGHT (4 marks)

The photograph shows an irregular-shaped lake. The length of the lake is 8 m. Some measurements taken of the width of the lake at AB and CD are shown as 5 m and 3 m respectively.



(a) Use the trapezoidal rule to estimate the area of the lake. **2**

.....

.....

.....

.....

.....

.....

(b) The lake has an average depth of 2.5 m. Calculate the approximate volume of the lake in litres. **2**

.....

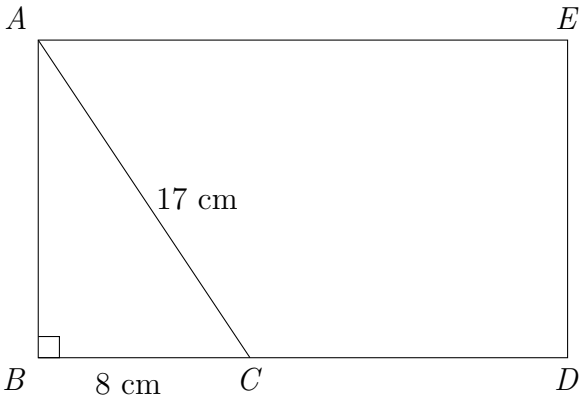
.....

.....

.....

QUESTION TWENTY NINE (4 marks)

The diagram shows rectangle $ABDE$ and right-angled triangle ABC. The length of AC is 17 cm and the length of BC is 8 cm. **4**



NOT TO SCALE

If the ratio of sides $BC : CD = 1 : 2$, find the area of rectangle $ABDE$.

.....

.....

.....

.....

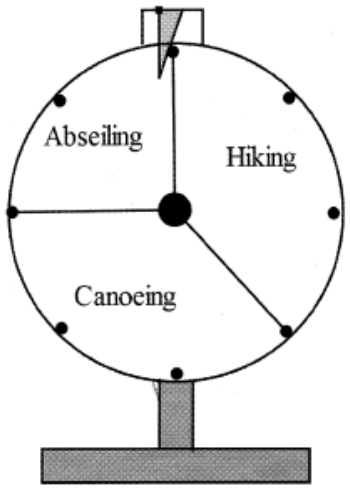
.....

.....

.....

QUESTION THIRTY (3 marks)

The diagram shows a wheel that boys spin to see which two activities will be included in their Form IV camp program. Boys must try two different activities and are not permitted to do the same activity twice.



(a) Calculate the probability of a boy abseiling and then hiking. **2**

.....

.....

.....

.....

.....

.....

.....

.....

(b) From a group of 192 boys, how many would you expect to go abseiling and then hiking? **1**

.....

.....

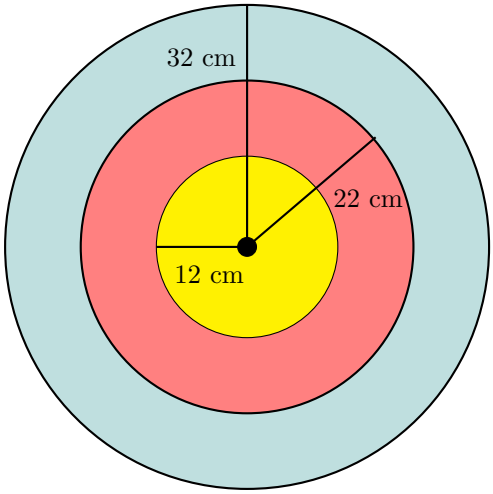
.....

.....

QUESTION THIRTY ONE (4 marks)

The diagram shows the target at an archery range. The centre of the target is at a height of 2.45 m above the ground.

Hitting inside the inner circle of radius 12 cm with a yellow bullseye scores 10 points. The next circle has a radius of 22 cm with the red, middle ring scoring 8 points. The final circle has a radius of 32 cm with the blue, outer ring scoring 6 points.



(a) The height, in metres, of an arrow x metres horizontally from the archer is given by the formula $h = 0.015x + 1.55$. The target is 70 metres from the archer. **1**

Find the height the arrow reaches when it hits the target.

.....

.....

.....

(b) Find the score obtained by the shot. **1**

.....

.....

.....

(c) A second shot from the same distance is influenced by air resistance and the equation describing the height is now given by $h_2 = -0.001x^2 + 0.0791x + 1.55$. **2**

Find the score obtained by the second shot.

.....

.....

.....

.....

.....

.....

QUESTION THIRTY TWO (2 marks)

The table shows personal income tax rates for different taxable incomes. **2**

Income tax rates for Australian residents	
Taxable income	Tax on this income
\$0–\$18 200	Nil
\$18 201–\$45 000	16c for each \$1 over \$18 200
\$45 001–\$135 000	\$4288 plus 30c for each \$1 over \$45 000
\$135 001–\$190 000	\$31 288 plus 37c for each \$1 over \$135 000
\$190 001 and over	\$51 638 plus 45c for each \$1 over \$190 000

Karen earns \$147 140 in a year. Her allowable deductions total \$3240. Use the tax table to calculate her tax payable. Ignore the Medicare Levy.

.....

.....

.....

.....

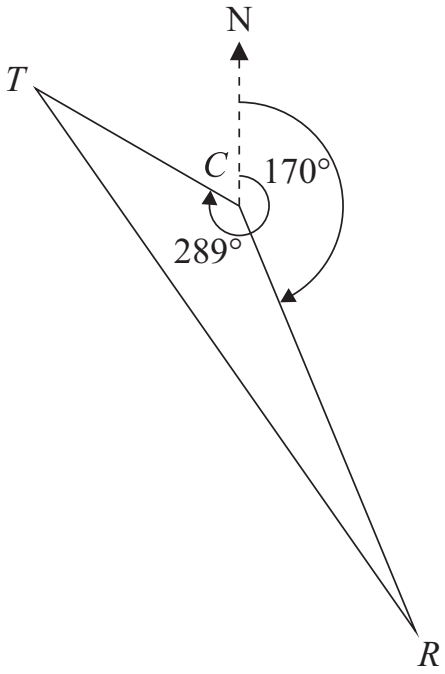
.....

.....

QUESTION THIRTY THREE (5 marks)

The Carpathium was a passenger steamship which rescued all the survivors of a ship called the Titanium. When sailing towards another ship, the Rijeki, the Carpathium received a distress signal from the Titanium. While not the closest ship, the Carpathium swiftly altered its bearing from 170°T to 289°T and reached the scene first.

At the time the signal was received, the Carpathium was 1503 nautical miles from Rijeki. The distance between the Titanium and Rijeki was 1560 nautical miles. The diagram below illustrates the positions of the Titanium (T), the Carpathium (C), and Rijeki (R) at that moment.



(a) Find angle RTC, correct to 1 decimal place. **3**

.....

.....

.....

.....

.....

.....

.....

.....

(b) Hence, by using the **cosine rule**, find the distance between the Titanium (T) and the Carpathium (C) when it changed its course. Give your answer correct to the nearest nautical mile. **2**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

QUESTION THIRTY FOUR (4 marks)

Young's Formula, given below, is used to determine the dosage of medication for children aged 1–12 years based on the adult dosage.

$$D = \frac{yA}{y + 12}$$

D is the dosage for children aged 1–12 years

A is the adult dosage

y is the age of the child in years

Sara buys a prescription for 250 mg of medicine. The adult dose is 20 mg and the recommended dose for Sara's child is 5 mg.

(a) Using the formula, calculate the age of Sara's child. **2**

.....

.....

.....

.....

.....

.....

.....

(b) How many doses for Sara's child are contained in the prescription? **1**

.....

.....

.....

.....

(c) It is recommended the medicine be take 5 times a day. How many days will the prescription last when taken at this rate? **1**

.....

.....

.....

.....

QUESTION THIRTY FIVE (7 marks)

Sparks produces 1500 boxes of Clown Pops cereal every day. The weights of boxes are normally distributed with a mean of 501 g and a standard deviation of 13 g. Only boxes with a weight between 488 g and 527 g will sell. They sell for \$7 per box.

(a) Find the probability that a box of Clown Pops, chosen at random, is sold. **2**

.....

.....

.....

.....

(b) Calculate Sparks' expected daily income from these sales. **2**

.....

.....

.....

.....

(c) Nettles, a different cereal manufacturer, produces boxes of Ready Oats cereal with weights that are normally distributed with a mean of 495 g and a standard deviation of 10 g. A randomly selected box of Clown Pops and and a randomly selected box of Ready Oats both have the same weight and the same z-score. **3**

By first forming an equation, calculate the weight of the randomly selected boxes. Give your answer correct to one decimal place.

.....

.....

.....

.....

.....

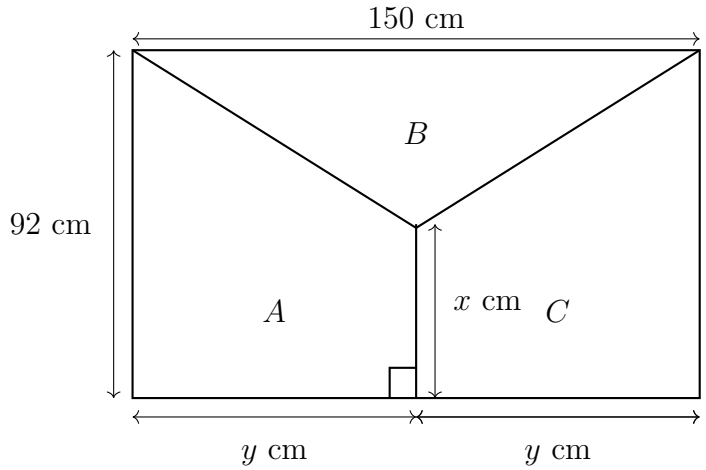
.....

.....

.....

QUESTION THIRTY SIX (4 marks)

The diagram below represents a rectangular flag with dimensions 150 cm by 92 cm. The flag is divided into three regions A, B and C. The areas of regions A, B and C are equal.



(a) Calculate the total area of the flag. **1**

.....

.....

.....

(b) Find the value of x. **3**

.....

.....

.....

.....

.....

.....

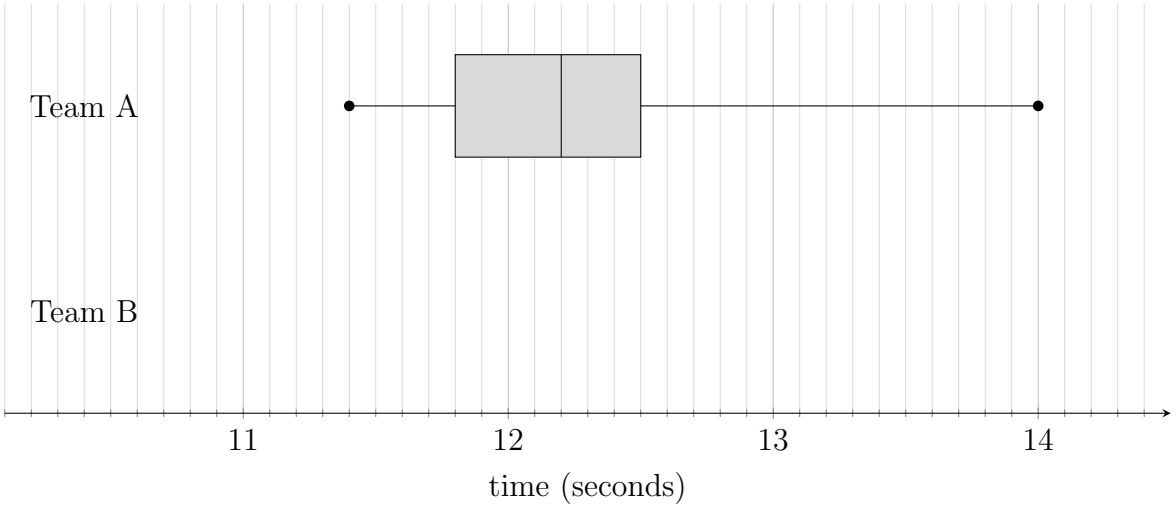
.....

.....

.....

QUESTION THIRTY SEVEN (6 marks)

Two athletic teams, each with 12 members, participated in a 100 m sprint competition. All results for Team A are unique, as are the results for Team B.
The results for Team A are displayed in the box plot below.



(a) The five-number-summary for Team B's results is 11.2, 12, 12.5, 13, 13.5. **2**
Draw a box plot to display Team B's results below that of Team A.

(b) Describe the shape of the distribution for Team A. **1**

.....

.....

(c) One member from each team is selected at random. Find the probability that at least one of them spent less than 12.5 seconds in the 100 m sprint. **3**

.....

.....

.....

.....

.....

.....

.....

.....

END OF PAPER

SYDNEY GRAMMAR SCHOOL

CANDIDATE NUMBER

2024 Trial HSC Examination

Form VI Mathematics Standard 2

Tuesday 13th August, 2024

8:40am

General Instructions

- Reading time — 10 minutes
- Working time — 2 hours 30 minutes
- Attempt all questions.
- Write using black pen.
- Calculators approved by NESA may be used.
- A loose reference sheet is provided separate to this paper.

Thirty Seven Questions — 100 Marks

Section I (15 marks) Questions 1 – 15

- This section is multiple-choice. Each question is worth 1 mark.
- Record your answers on the provided answer sheet.

Section II (85 marks) Questions 16 – 37

- Relevant mathematical reasoning and calculations are required.
- Answer the questions in this paper in the spaces provided.

Collection

- Write your candidate number on this page and on the multiple choice sheet.

Checklist

- Reference sheet
- Multiple-choice answer sheet
- Candidature: 20 pupils

Writer: PKS

Section I

Questions in this section are multiple-choice.
Record the single best answer for each question on the provided answer sheet.

---

1. Caprice's car uses 26 L of fuel to travel 481 km. How far can it travel on 50 L of fuel, to the nearest kilometre? **1**

   (A) 925 km

   (B) 952 km

   (C) 962 km

   (D) 1081 km

2. Which equation represents the relationship between x and y in this table? **1**

x	-2	0	2	4	6	8
y	12	8	4	0	-4	-8

   (A) $y = -2x + 12$

   (B) $y = -2x + 8$

   (C) $y = -4x + 8$

   (D) $y = 2x + 8$

3. Which of the following is an example of a census? **1**

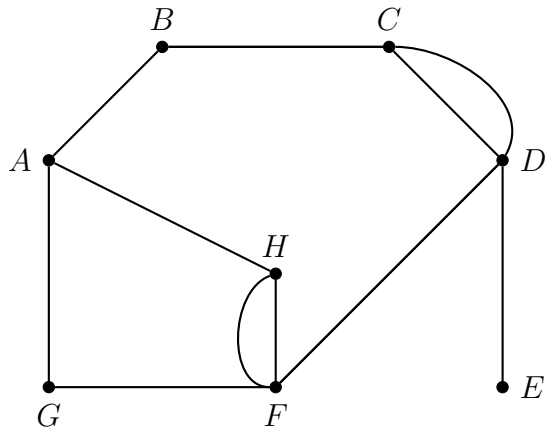
   (A) A TV poll for the preferred Prime Minister.

   (B) All students in Form V voting for the 2025 Prefect positions.

   (C) Testing every 100th USB memory stick on a production line for faults.

   (D) Surveying 100 Sydney Grammar School College Street boys preferences to determine what drinks are sold at the canteen.

4. Which one of the following edges should be added to the graph to make an Eulerian trail possible? **1**



(A) AC

(B) AD

(C) EF

(D) HD

5. Pamela bought a watch for \$8000. This included 10% GST. She left Australia to return to the UK and claimed a GST refund. **1**

How much was the refund?

(A) \$727.27

(B) \$800

(C) \$7200

(D) \$7272.73

6. Consider a dataset with mean 10 and standard deviation 2. Two scores, 10.5 and 9.5 are added to the dataset. Which choice shows how the mean and standard deviation are affected by the added scores? **1**

(A) Both mean and standard deviation will change.

(B) Only standard deviation will decrease.

(C) Only standard deviation will increase.

(D) Neither mean nor standard deviation will change.

7. Alan, Ben and Cody must complete three activities (A – C) in total. The activity table below shows the person selected to complete each activity, in minutes, and the immediate predecessor for each activity. **1**

Person	**Activity**	**Immediate Predecessor(s)**	**Duration (minutes)**
Alan	A	–	14
Ben	B	A	6
Cody	C	B	17

All three activities must be completed in a total of 42 minutes. The instant that Alan starts his activity, Cody gets a phone call. What is the maximum time, in minutes, before Cody must start his allocated activity?

(A) 5

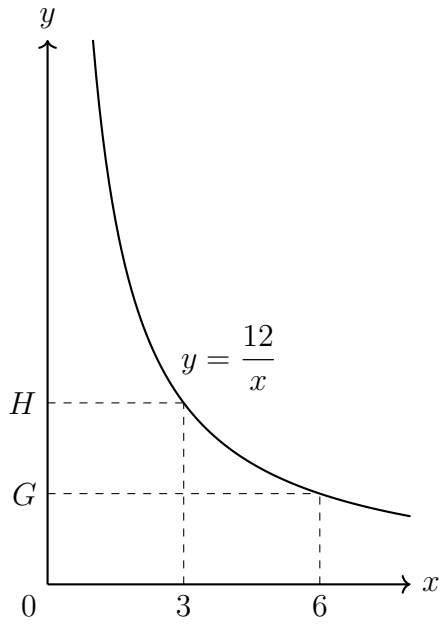
(B) 14

(C) 20

(D) 25

$42-17=25$

8. The diagram below shows the graph of $y = \frac{12}{x}$. **1**



$H-G$

$= \frac{12}{3} - \frac{12}{6}$

$= 4 - 2$

$= 2$

What is the length of GH in units?

(A) 1

(B) 2

(C) 4

(D) 8

9. An amount of \$16 000 is invested for three years. Interest is earned at a rate of 6% per annum, compounding monthly. **1**

   Which expression gives the value of the investment after three years, in dollars?

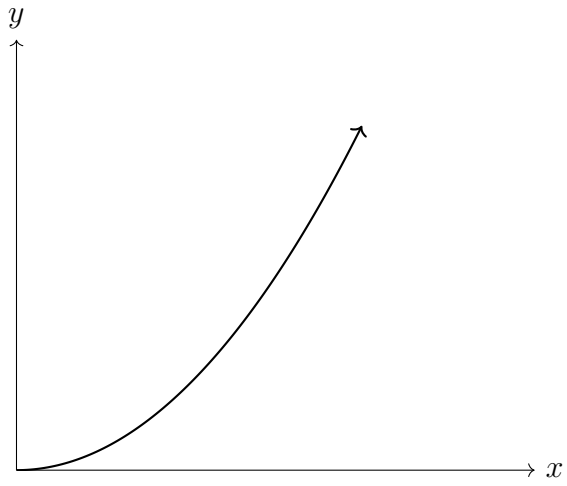
   (A) $16\,000 \times 1.005^3$

   (B) $16\,000 \times 1.005^{36}$

   (C) $16\,000 \times 1.06^3$

   (D) $16\,000 \times 1.06^{36}$

10. Which equation best represents the graph drawn below? **1**



   (A) $y = 4x$

   (B) $y = 4^x$

   (C) $y = 4x^2$

   (D) $y = \dfrac{4}{x}$

11. Researchers are investigating population density, house size and the distance from the centre of a city. Data is plotted with distance on the horizontal axis. **1**

    - For the graph of population density vs distance, the Pearson's correlation coefficient is $r = -0.563$.
    - For house size vs distance, the Pearson's correlation coefficient is $r = 0.357$.

    Given this information, which one of the following statements is true?

    (A) Population density tends to be higher when it is farther away from the city centre.

    (B) House size tends to be larger when it is closer to the city centre.

    (C) House size is positively correlated with population density.

    (D) Population density is more strongly associated with distance from the centre of the city than house size.

12. A crane lifted a crate 152 metres into the sky in 28 seconds. **1**

    What is its average speed, correct to the nearest kilometre per hour?

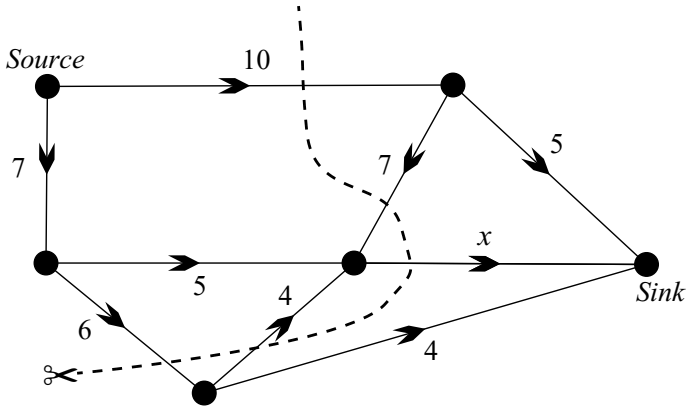
    (A) 5 km/h

    (B) 7 km/h

    (C) 18 km/h

    (D) 20 km/h

13. A network with source and sink is shown. The capacities of the edges are labelled. The cut shown on the diagram has a capacity of 24. **1**



What is the value of x?

(A) 1

(B) 3

(C) 4

(D) 8

$6+x+10=24$

$x=8$

14. Which equation represents a decreasing exponential function? **1**

(A) $y = 8^{-x}$

(B) $y = 0.5(8^x)$

(C) $y = 2(8^x)$

(D) $y = (0.5)^{-x}$

15. A park ranger wishes to estimate the number of swans in a lake. A sample of N swans was caught, tagged and released. The next day a second sample of S swans is caught, and it is noted that M of them had been previously tagged. **1**

Which is the correct expression to estimate the number of swans in the lake?

(A) $\dfrac{MN}{S}$

(B) $\dfrac{NS}{M}$

(C) $\dfrac{MS}{N}$

(D) $\dfrac{N}{MS}$

$$\frac{x}{N} = \frac{S}{M}$$

$$x = \frac{SN}{M}$$

End of Section I

The paper continues in the next section

Section II

This section consists of long-answer questions.
Marks may be awarded for reasoning and calculations.
Marks may be lost for poor setting out or poor logic.
Record your answers in the space provided in this paper.

QUESTION SIXTEEN (2 marks)

Three friends, Will, Oliver and Rob, travel together by car to Blueys Beach. They share the driving and the ratio of the distances they each drive is $4:6:7$. **2**

Find the combined distance that Will and Oliver drive, if the road trip is a distance of 306 km.

$\frac{10}{17} \times 306 = 180$ km

QUESTION SEVENTEEN (2 marks)

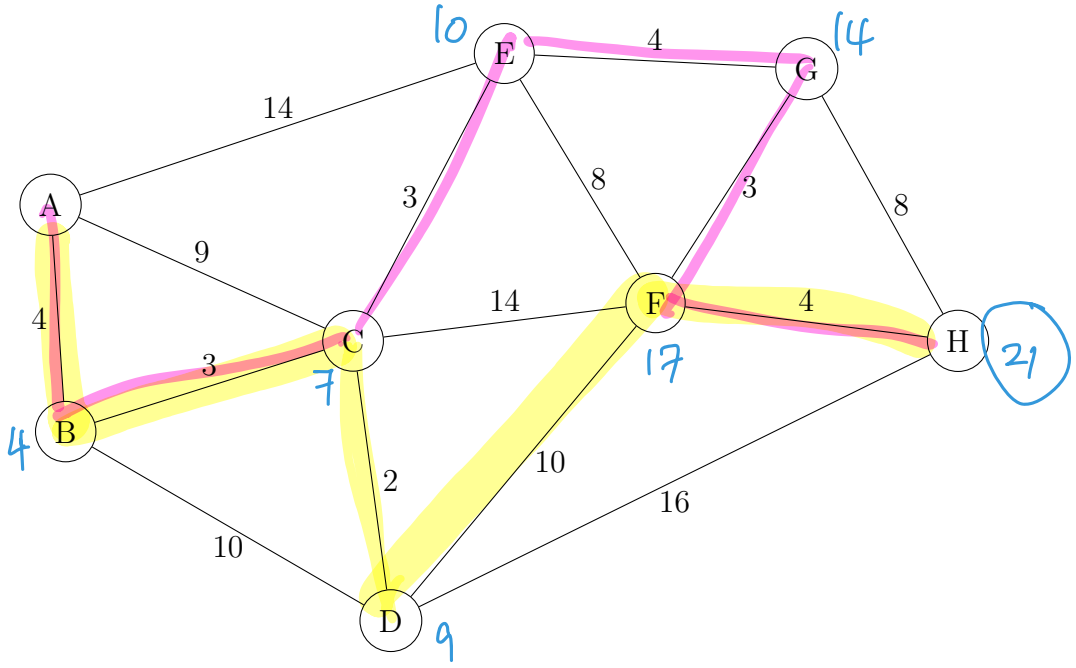
If $a = 3$, $b = -4$ and $c = 1$, find the value of $\dfrac{-b + \sqrt{b^2 - 4ac}}{2a}$. **2**

$\dfrac{-(-4) + \sqrt{(-4)^2 - 4(3)(1)}}{2 \times 3} = \dfrac{4 + \sqrt{4}}{6}$

1 mark - progress towards ie correct substitution. = 1

QUESTION EIGHTEEN (5 marks)

The network diagram below shows the roads connecting 8 towns. The vertices A to H represent the distance along the roads between the towns, in kilometres.

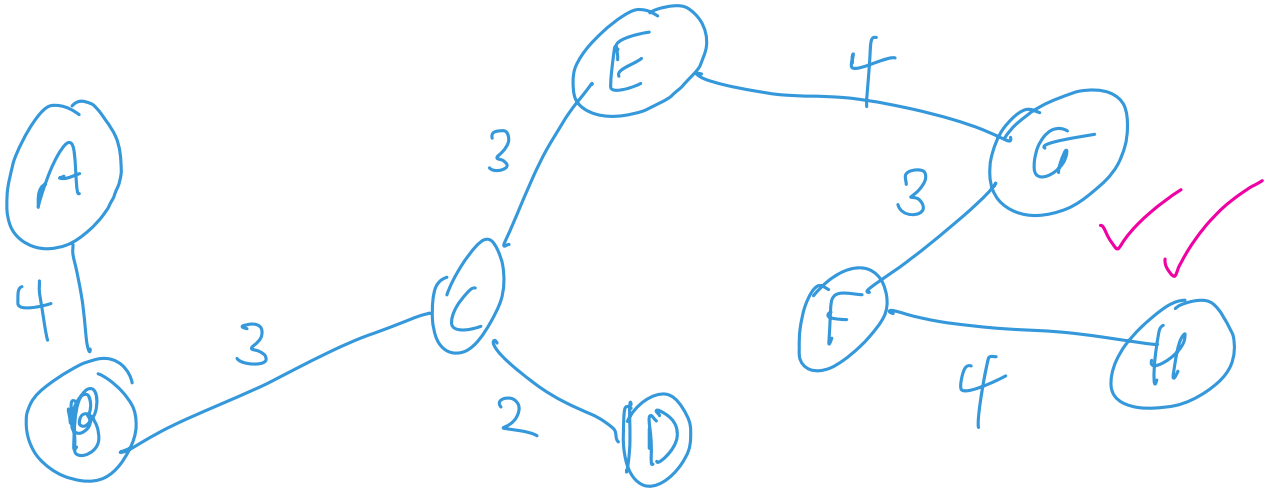


(a) State the vertices that identify the shortest path from A to H. **2**

A B C E G F H.

Pink highlight 1 - mark for progress..

(b) Draw a minimum spanning tree for this network and determine its length. **3**

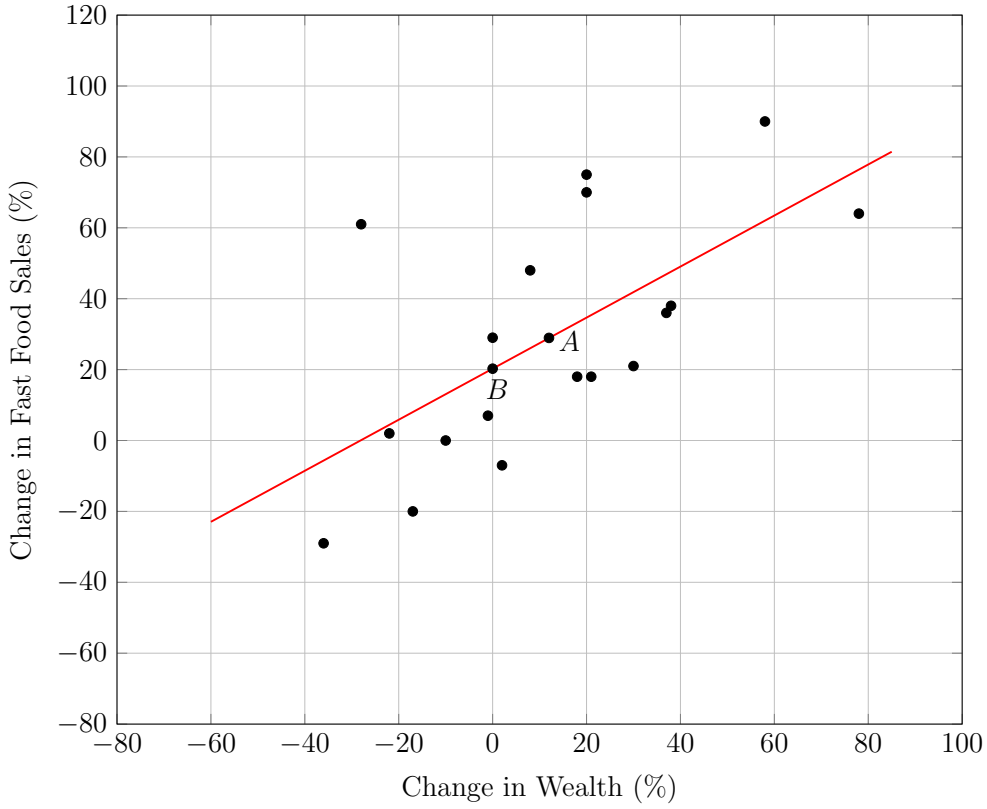


Length of minimum spanning tree = 23 = 4 + 3 + 3 + 2 + 4 + 3 + 4.

QUESTION NINETEEN (3 marks)

The graph below is adapted from a diagram in the New York Times series "Planet Fat". It shows how as the countries prosper, the fast-food sales also increase.

The two quantitative variables in this scatterplot are the percentage change of gross domestic product per capita (horizontal axis, x) and the percentage change in fast food sales from 2010 to 2015 (vertical axis, y).



Using the data provided, the least-squares regression line was found as shown above. It passes through $A\,(12,\ 28.94)$ and $B\,(0,\ 20.3)$. The correlation coefficient was 0.63.

(a) Describe the relationship between percentage change of gross domestic product per capita and percentage change in fast food sales from 2010 to 2015. **1**

moderate, linear, positive ✓

(b) Find the equation of the regression line. **2**

$M = \dfrac{28.94 - 20.3}{12 - 0}$ ✓

$y = 0.72x + 20.3$ ✓

QUESTION TWENTY (2 marks)

Ricardo has a credit card which has no interest-free period. Interest is charged at 19% p.a. compounding daily, on the amount owing. During the month, Ricardo bought a new bicycle for $2300 using the credit card. The full amount owing was repaid 19 days later. **2**

Calculate the amount of interest charged on the credit card for the purchase of the bicycle, assuming that interest is charged for the 19 days.

Amount owed $= 2300\left(1 + \frac{19\%}{365}\right)^{19}$

$= 2322.85$ ✓

Interest $= 2322.85 - 2300 = \$22.85$ ✓

QUESTION TWENTY ONE (3 marks)

Mandy buys a 60-inch OLED television which consumes approximately 118.5 watts of electricity when switched on and uses 0.5 watts of electricity in standby mode. Mandy uses the television for an average of 6 hours a day and it is on standby the rest of the time. **3**

If electricity is charged at 40 c/kWh, how much does it cost Mandy to run the television per year?

C = usage × device × rate

$= 6 \times 365 \times \frac{118.5}{1000} \times 0.4$

$= \$103.806$ When on

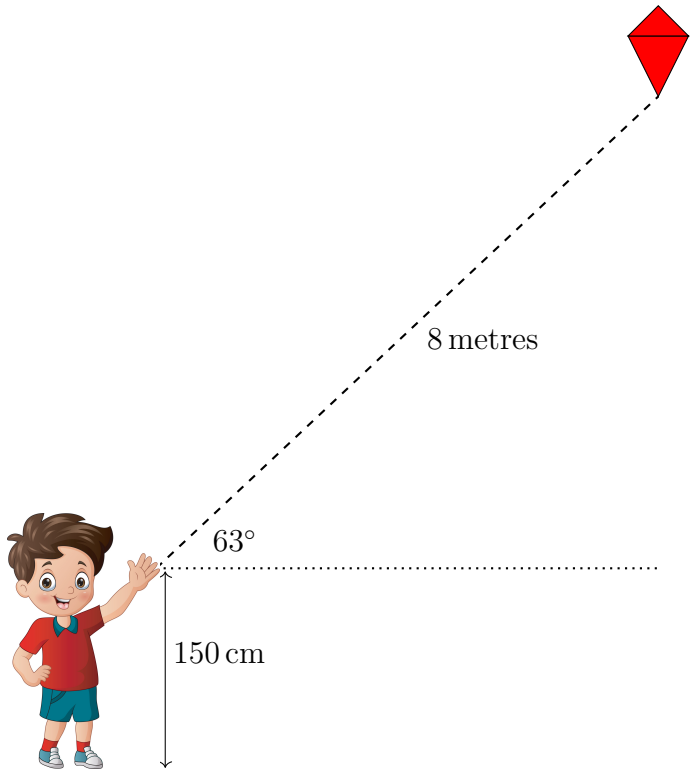
$C = 18 \times 365 \times \frac{0.5}{1000} \times 0.4$

$= \$1.314$

Total $= 103.806 + 1.314 =$ \$105.12 ✓

QUESTION TWENTY TWO (3 marks)

Bertie is flying a kite. The handle is held 150 cm above the ground and the kite is on a string 8 metres long. The string makes an angle of 63° with the horizontal.



How high is the bottom of the kite above the ground? Give your answer in metres correct to 3 significant figures. **3**

$\sin 63° = \frac{x}{8}$ ✓

$x = 8 \sin 63°$ ✓

height is $1{\cdot}5 + 8 \sin 63° = 8{\cdot}6280\ldots$

$= 8{\cdot}63$ m (3 sf) ✓

3 marks includes a rounding mark for 3 sig figs.

QUESTION TWENTY THREE (5 marks)

A table of future value interest factors for an annuity of \$1 is shown.

Period \ Rate	0.25%	1%	2%	4%
2	2.0025	2.0100	2.0200	2.0400
4	4.0150	4.0604	4.1216	4.2465
6	6.0376	6.1520	6.3081	6.6330
8	8.0704	8.2857	8.5830	9.2142
10	10.1133	10.4622	10.9497	9.2142

Kim plans to deposit \$4000 into a savings account at the end of each quarter for 2 years to save for a trip overseas. The interest rate is 4% per annum compounding quarterly.

(a) Find the amount of money in Kim's savings account after the 2 years. **2**

FVA = 4000 × 8.2857

= \$33142.80

(b) Calculate the total interest earned. **1**

Interest = 33142.80 − 32000

= \$1142.80

(c) Instead, Kim decides to invest a single amount into a fixed term deposit account for 2 years. The interest rate is 4% per annum compounding annually. **2**

How much does she need to invest to have the same amount at the end of 2 years as the savings account?

$33142.80 = PV(1+4\%)^2$

$\frac{33142.80}{1.0816} = PV$

PV = \$30642.38

QUESTION TWENTY FOUR (4 marks)

A house has a square-shaped roof, with each side being x metres. During a period of rainfall, the amount of rainwater (W litres) collected is directly proportional to the square of x. The roof collects 79 380 litres when the value of x is 14 m.

(a) Find the equation relating W and x. **2**

$W = k \times x^2$

$79380 = k \times 14^2$

$k = \frac{79380}{14^2}$

$k = 405$

$\therefore W = 405x^2$

Equation must be shown for 2nd mark.

(b) Find the side length of a square roof that would collect 131 220 litres. **2**

$131220 = 405 \times x^2$

$324 = x^2$

$x = 18$

$\therefore$ 18 metres

if x used in equation instead of x^2, then 1 mark awarded as MQE.

QUESTION TWENTY FIVE (4 marks)

Germaine purchased 600 shares valued at \$37.90 each. Brokerage fees were 2.3% of the total purchase price. A few months later, Germaine is paid a dividend of \$492.

(a) Calculate the total cost of purchasing the shares. **2**

$600 \times 37.90 \times 102.3\%$ ✓

$= \$23263.02$ ✓

(b) Calculate the dividend yield. **2**

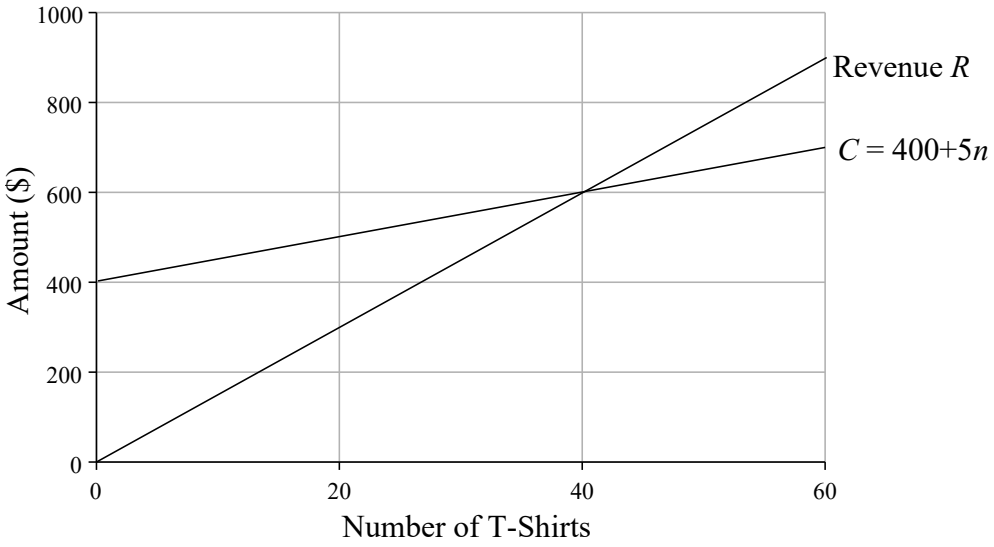
$\frac{492}{600 \times 37.90} \times 100 = 2.16\%$

doesn't include fees.

QUESTION TWENTY SIX (4 marks)

A manufacturer makes and sells T-shirts. The cost of producing a batch of T-shirts ($\$C$) is represented by the equation $C = 400 + 5n$ where n is the number of T-shirts made.

The graph shows planned revenue and cost when a T-shirt price is \$15.



(a) How many T-shirts need to be sold to break even? **1**

40

(b) Find the loss if only 25 T-shirts are sold. **1**

profit or loss = Revenue - Cost

$15 \times 25 - (400 + 5 \times 25) = -150$

loss of \$150

1 mark for correct cost.

(c) The manufacturer plans to sell 60 T-shirts and wants to make a profit of \$500. What should be the price of a T-shirt, assuming all 60 will be sold? **2**

$60n - (400 + 5 \times 60) = 500$ ✓

$60n - 700 = 500$

$60n = 1200$

$n = 20$

∴ should be \$20 ✓

QUESTION TWENTY SEVEN (5 marks)

The table shows monthly repayments for each $1000 borrowed.

Monthly repayment table

Principal and Interest per $1000 borrowed						
Interest rate (per annum)	*Term of loan*(years)					
	5	10	15	20	25	30
6.5%	19.57	11.35	8.71	7.46	6.75	6.32
7.0%	19.80	11.61	8.99	7.75	7.07	6.65
7.5%	20.04	11.87	9.27	8.06	7.39	6.99
8.0%	20.28	12.13	9.56	8.36	7.72	7.34

(a) Alan borrows $1 080 000 to buy a house at 7% per annum over 25 years. How much does he repay in total for this loan? **2**

$\frac{1080000}{1000} \times 7.07 = \$7635.60$

$\$7635.60 \times 12 \times 25 = \$2290680$ ✓

(b) How much interest will Alan pay over the loan period? **1**

Interest $= 2290680 - 1080000$

$= \$1210680$ ✓

implies $I = Prn$ ie simple is flat

(c) Calculate the equivalent flat rate of interest that Alan pays over the life of the loan. Give your answer as a percentage, correct to 1 decimal place. **2**

$I = Prn$ ✓

$1210680 = 1080000 \times r \times 25$

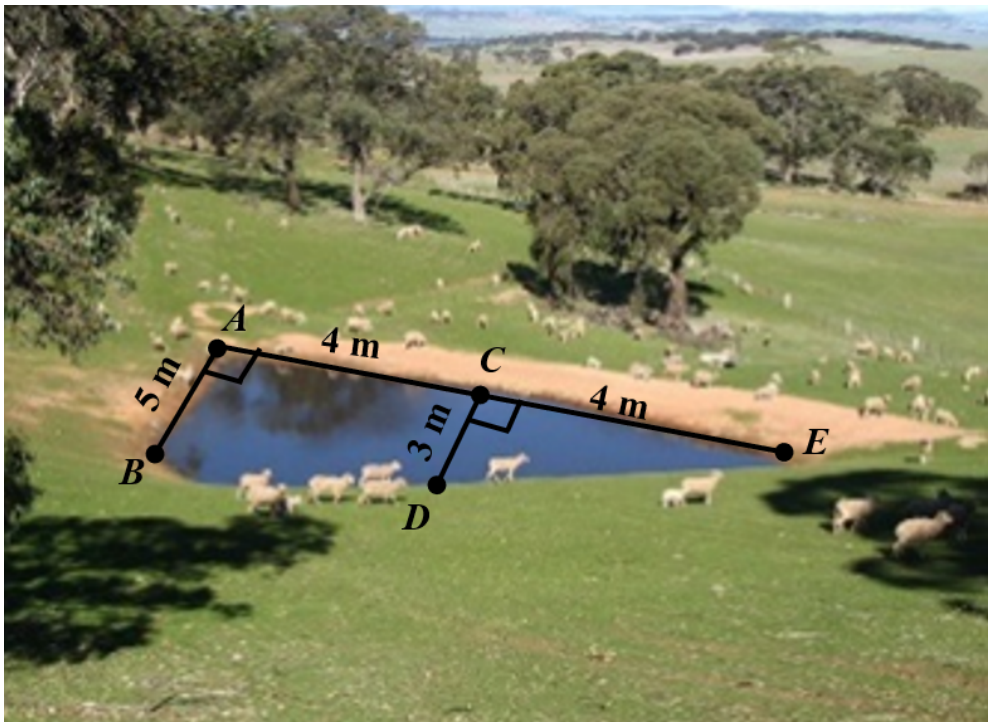
$r = \frac{1210680}{1080000 \times 25}$

$r = 0.04484$

4.5% p.a. (1 dp) ✓

QUESTION TWENTY EIGHT (4 marks)

The photograph shows an irregular-shaped lake. The length of the lake is 8 m. Some measurements taken of the width of the lake at AB and CD are shown as 5 m and 3 m respectively.



(a) Use the trapezoidal rule to estimate the area of the lake. **2**

$A \doteqdot \frac{4}{2}(0 + 5 + 3 \times 2)$

$= 2 \times 11 = 22 \text{ m}^2$

1 mark for using trapezoidal or equivalent merit.

(b) The lake has an average depth of 2.5 m. Calculate the approximate volume of the lake in litres. **2**

$V \doteqdot 22 \times 2.5$

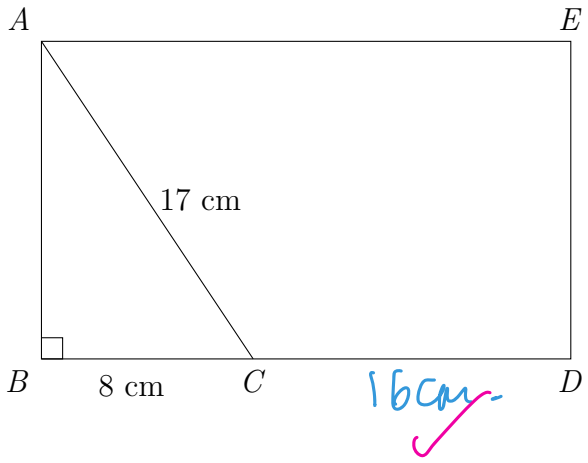
$\doteqdot 55 \text{ m}^3$ ✓

$1000\text{L} = 1\text{m}^3$

$\doteqdot 55\,000$ litres ✓

QUESTION TWENTY NINE (4 marks)

The diagram shows rectangle $ABDE$ and right-angled triangle ABC. The length of AC is 17 cm and the length of BC is 8 cm. **4**



NOT TO SCALE

If the ratio of sides $BC : CD = 1 : 2$, find the area of rectangle $ABDE$.

$AB^2 = 17^2 - 8^2$

$AB^2 = 225$

$AB = 15$ ✓

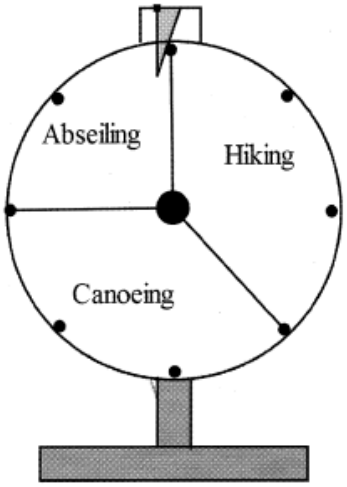
Area $= 15 \times (16 + 8)$ ✓

$= 15 \times 24$

$= 360 \text{ cm}^2$ ✓

QUESTION THIRTY (3 marks)

The diagram shows a wheel that boys spin to see which two activities will be included in their Form IV camp program. Boys must try two different activities and are not permitted to do the same activity twice.



(a) Calculate the probability of a boy abseiling and then hiking. **2**

$\frac{2}{8} \times \frac{3}{6} = \frac{1}{8}$ ✓ ✓

No replacement

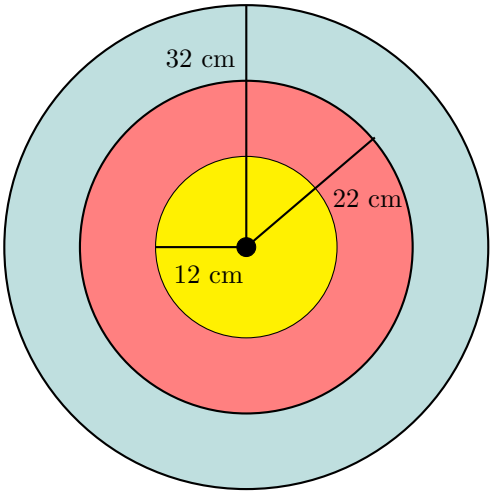
(b) From a group of 192 boys, how many would you expect to go abseiling and then hiking? **1**

$192 \times \frac{1}{8} = 24$ ✓ ecf.

QUESTION THIRTY ONE (4 marks)

The diagram shows the target at an archery range. The centre of the target is at a height of 2.45 m above the ground.

Hitting inside the inner circle of radius 12 cm with a yellow bullseye scores 10 points. The next circle has a radius of 22 cm with the red, middle ring scoring 8 points. The final circle has a radius of 32 cm with the blue, outer ring scoring 6 points.



(a) The height, in metres, of an arrow x metres horizontally from the archer is given by the formula $h = 0.015x + 1.55$. The target is 70 metres from the archer. **1**

Find the height the arrow reaches when it hits the target.

$h = 0.015 \times 70 + 1.55$

$h = 2.6$ m. ✓

(b) Find the score obtained by the shot. **1**

$h = 2.6 - 2.45 = 1.5$ cm

$\therefore$ red region $\Rightarrow$ 8 points. ✓

(c) A second shot from the same distance is influenced by air resistance and the equation describing the height is now given by $h_2 = -0.001x^2 + 0.0791x + 1.55$. **2**

Find the score obtained by the second shot.

mark awarded for sub.

$h = -0.001(70)^2 + 0.0791(70) + 1.55$ (1)

$= 2.187$m

$2.45 - 2.187 = -0.263$ or 26.3cm

$\therefore$ blue region + scores 6 (1)

QUESTION THIRTY TWO (2 marks)

The table shows personal income tax rates for different taxable incomes. **2**

Income tax rates for Australian residents	
Taxable income	Tax on this income
\$0–\$18 200	Nil
\$18 201–\$45 000	16c for each \$1 over \$18 200
\$45 001–\$135 000	\$4288 plus 30c for each \$1 over \$45 000
\$135 001–\$190 000	\$31 288 plus 37c for each \$1 over \$135 000
\$190 001 and over	\$51 638 plus 45c for each \$1 over \$190 000

Karen earns \$147 140 in a year. Her allowable deductions total \$3240. Use the tax table to calculate her tax payable. Ignore the Medicare Levy.

$147140 - 3240 = \$143900$ ✓

$143900 - 135000 = \$8900$

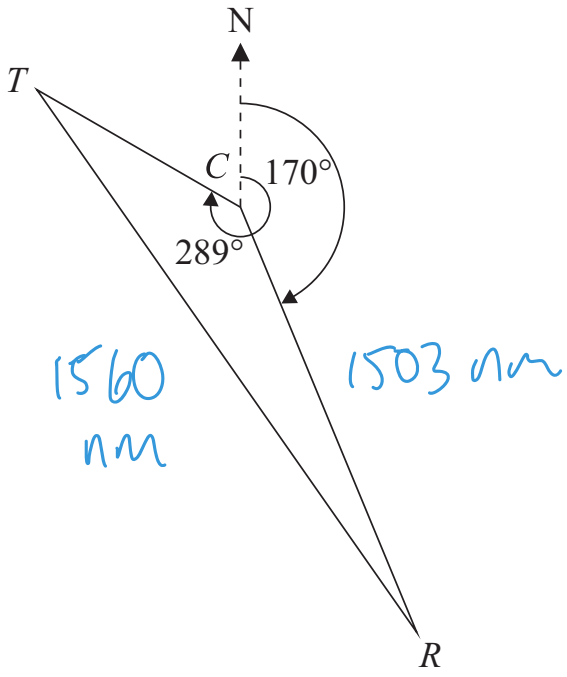
$\therefore$ Tax payable $= 8900 \times 0.37 + 31288$

$= \$34581$ ✓

QUESTION THIRTY THREE (5 marks)

The Carpathium was a passenger steamship which rescued all the survivors of a ship called the Titanium. When sailing towards another ship, the Rijeki, the Carpathium received a distress signal from the Titanium. While not the closest ship, the Carpathium swiftly altered its bearing from 170°T to 289°T and reached the scene first.

At the time the signal was received, the Carpathium was 1503 nautical miles from Rijeki. The distance between the Titanium and Rijeki was 1560 nautical miles. The diagram below illustrates the positions of the Titanium (T), the Carpathium (C), and Rijeki (R) at that moment.



1560 nm

1503 nm

(a) Find angle RTC, correct to 1 decimal place. **3**

$\angle C = 289° - 170° = 119°$ ✓

$\frac{\sin x}{1503} = \frac{\sin 119°}{1560}$ ✓

$\sin x = \frac{1503 \sin 119°}{1560}$ ✓

$x = 57.4223°$ $= 57.4°$ (1 dp)

(b) Hence, by using the **cosine rule**, find the distance between the Titanium (T) and the Carpathium (C) when it changed its course. Give your answer correct to the nearest nautical mile. **2**

$C = 180^\circ - 57.4^\circ - 119^\circ$

$= 3.5776^\circ$

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

$= 1560^2 + 1503^2 - 2 \times 1560 \times 1503 \times \cos 3.5776^\circ$

$= 12387.6232$

$\fallingdotseq 111.299$

$\doteq 111$ nm (nearest)

If used $\cos 3.6^\circ$ then 112 nm also accepted.

QUESTION THIRTY FOUR (4 marks)

Young's Formula, given below, is used to determine the dosage of medication for children aged 1–12 years based on the adult dosage.

$$D = \frac{yA}{y + 12}$$

D is the dosage for children aged 1–12 years

A is the adult dosage

y is the age of the child in years

Sara buys a prescription for 250 mg of medicine. The adult dose is 20 mg and the recommended dose for Sara's child is 5 mg.

(a) Using the formula, calculate the age of Sara's child. **2**

$5 = \frac{20y}{y+12}$ ✓

$5y + 60 = 20y$

$60 = 15y$

$y = 4$

$\therefore$ Sara's child is 4 years old ✓

(b) How many doses for Sara's child are contained in the prescription? **1**

$250 \div 5 = 50$ doses ✓

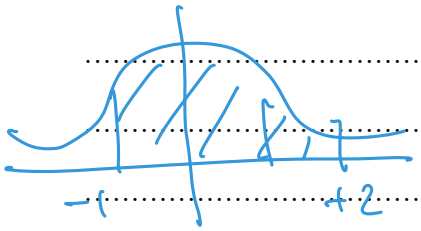
(c) It is recommended the medicine be take 5 times a day. How many days will the prescription last when taken at this rate? **1**

$50 \div 5 = 10$ days ✓

QUESTION THIRTY FIVE (7 marks)

Sparks produces 1500 boxes of Clown Pops cereal every day. The weights of boxes are normally distributed with a mean of 501 g and a standard deviation of 13 g. Only boxes with a weight between 488 g and 527 g will sell. They sell for \$7 per box.

(a) Find the probability that a box of Clown Pops, chosen at random, is sold. **2**



68% + 13.5% = 81.5%

68% + 13.5%

(b) Calculate Sparks' expected daily income from these sales. **2**

81.5% × 1500 × 7 = \$8557.50

or 81.5% × 1500 = 1222.5 boxes ≈ 1223 } also accepted

1223 × 7 = \$8561 Boxes-

or 1222 × 7 = \$8554

(c) Nettles, a different cereal manufacturer, produces boxes of Ready Oats cereal with weights that are normally distributed with a mean of 495 g and a standard deviation of 10 g. A randomly selected box of Clown Pops and and a randomly selected box of Ready Oats both have the same weight and the same z-score. **3**

By first forming an equation, calculate the weight of the randomly selected boxes. Give your answer correct to one decimal place.

$\frac{x-501}{13} = \frac{x-495}{10}$ 1 mark for z-score equation.

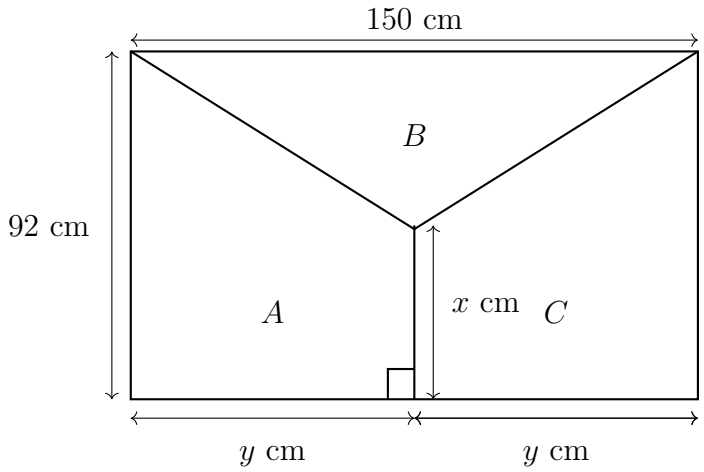
$10(x-501) = 13(x-495)$

$x = 475$ g

(2 marks max if no equation)

QUESTION THIRTY SIX (4 marks)

The diagram below represents a rectangular flag with dimensions 150 cm by 92 cm. The flag is divided into three regions A, B and C. The areas of regions A, B and C are equal.



(a) Calculate the total area of the flag. **1**

$92 \times 150 = 13800 \text{ cm}^2$ ✓

(b) Find the value of x. **3**

$\frac{13800}{3} = 4600 \text{ cm}^2 = \text{area } A$.

$A = \frac{(92+x)}{2} \times 75$ $\left(y = \frac{150}{2} = 75\right)$

$4600 \times 2 = 6900 \times 75x$

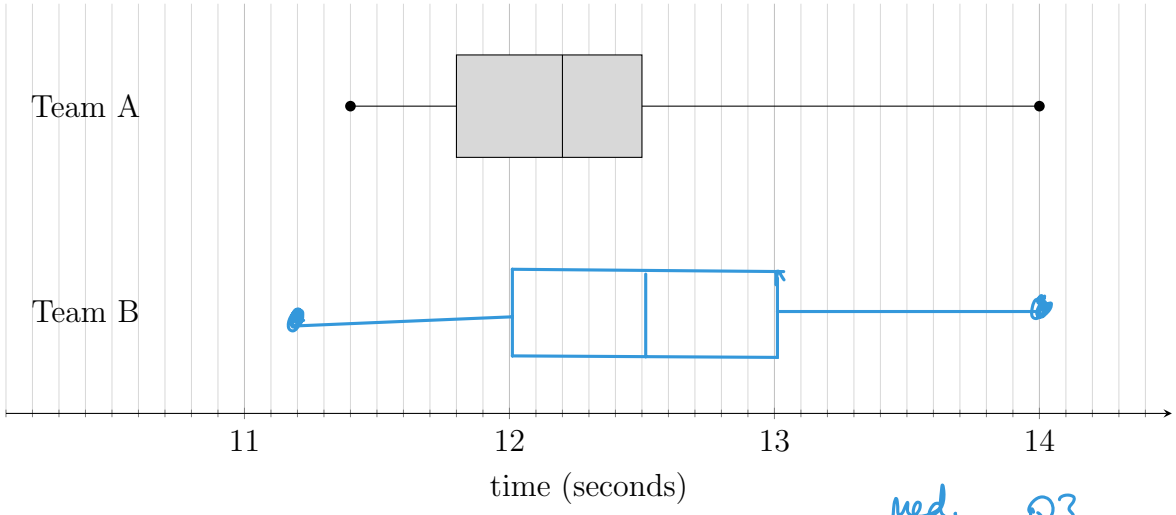
$9200 - 6900 = 75x$

$2300 = 75x$

$x = 30.6$ or $30\frac{2}{3}$ cm

QUESTION THIRTY SEVEN (6 marks)

Two athletic teams, each with 12 members, participated in a 100 m sprint competition. All results for Team A are unique, as are the results for Team B.
The results for Team A are displayed in the box plot below.



min Q1 Q2 med. Q3 max

(a) The five-number-summary for Team B's results is 11.2, 12, 12.5, 13, 13.5. **2**
Draw a box plot to display Team B's results below that of Team A.

(b) Describe the shape of the distribution for Team A. **1**

positively skewed

(c) One member from each team is selected at random. Find the probability that at least one of them spent less than 12.5 seconds in the 100 m sprint. **3**

$P(A < 12.5) = 0.75$
$P(B < 12.5) = 0.5$
} 1 mark.

$0.75 - 0.5$
$0.25 - 0.5$
-0.5
} or 1 mark.

$1 - (1/4 \times 1/2) = \frac{7}{8}$
at least for a mark.

full 3 marks.

END OF PAPER