



Student Number: \_\_\_\_\_

**2019** TRIAL HIGHER SCHOOL CERTIFICATE EXAMINATION

# Mathematics Standard 2

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## General Instructions

- Reading time – 10 minutes
- Working time –  $2\frac{1}{2}$  hours
- Write using black pen
- Calculators approved by NESA may be used
- A reference sheet is provided at the back of this paper
- In Questions 16–36, show relevant mathematical reasoning and/or calculations

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**Total marks:** **Section I – 15 marks** (pages 2–5)  
**100**

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

**Section II – 85 marks** (pages 6–24)

- Attempt Questions 16–36
- Allow about 2 hours and 5 minutes for this section

## Section I

15 marks

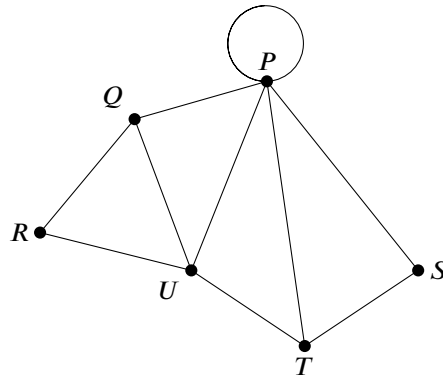
Attempt Questions 1–15

Allow about 25 minutes for this section

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

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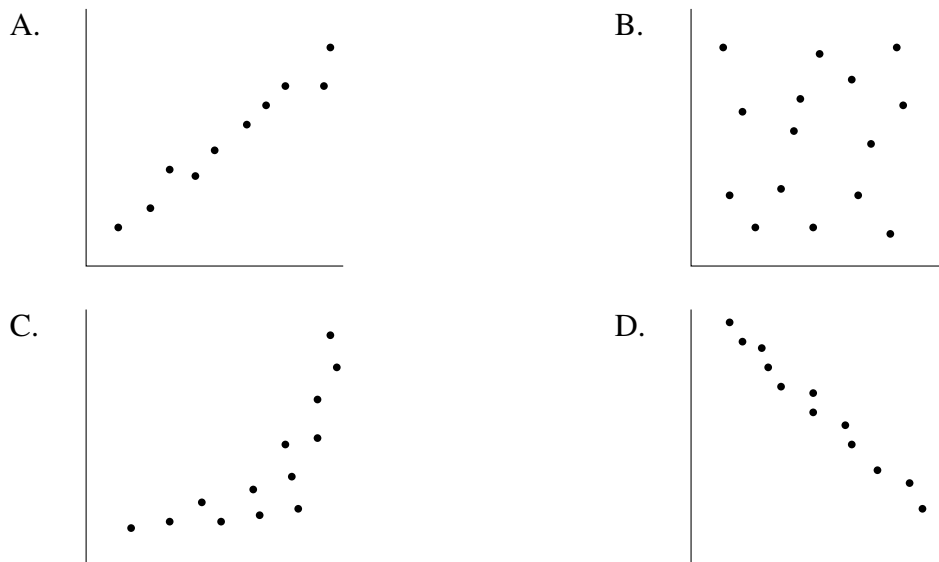
- 1 The diagram below shows a network with a loop at vertex  $P$ .



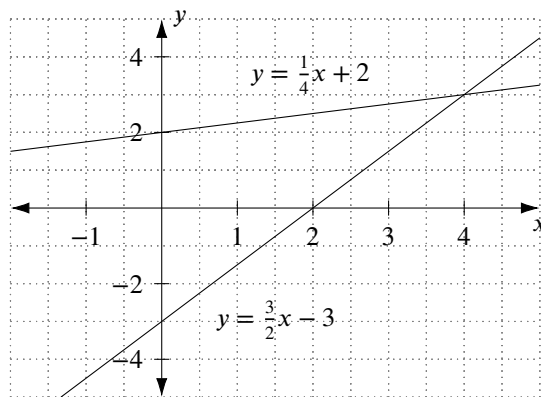
What is the degree of vertex  $P$  in the network below?

- A. 3                      B. 4                      C. 5                      D. 6
- 

- 2 Which of the scatter plots below is most likely to have the highest correlation coefficient?



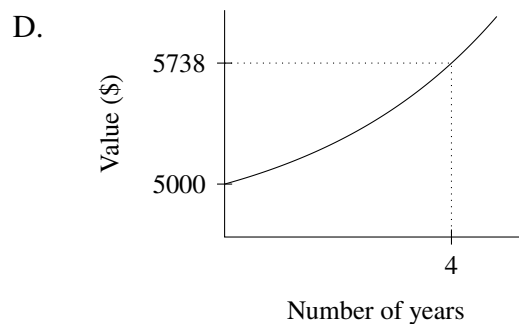
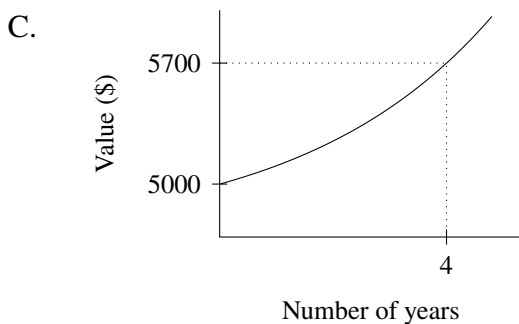
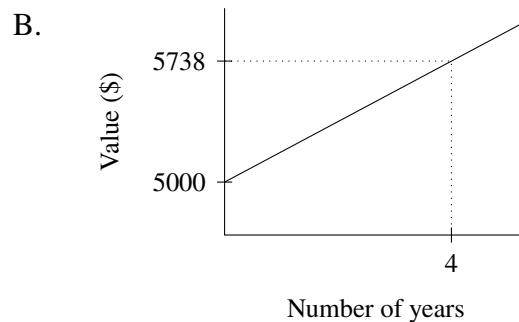
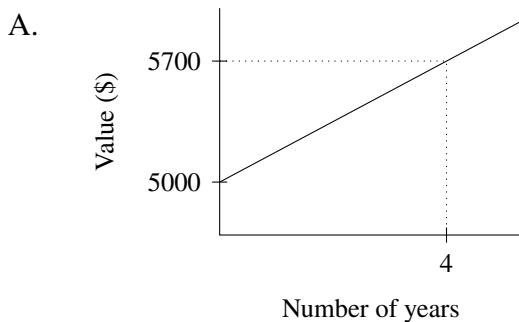
- 3 The simultaneous equations  $y = \frac{3}{2}x - 3$  and  $y = \frac{1}{4}x + 2$  are shown on the graph below.



Which values below satisfy both equations simultaneously?

- A.  $x = 0, y = -3$     B.  $x = 2, y = 2$     C.  $x = 3, y = 4$     D.  $x = 4, y = 3$

- 4 Which of the following graphs best shows the growth of an investment of \$5000 over 4 years with an annual compound interest rate of 3.5%?



- 5 Alex has a Blood Alcohol Content ( $BAC$ ) of 0.08 after he stops drinking. His  $BAC$  will reduce according to the linear function

$$BAC = 0.08 - 0.015H$$

where  $H$  is the number of hours after drinking stops. Approximately how long will it take for Alex's  $BAC$  to reach zero?

- A. 3 hours 20 minutes                      B. 3 hours 54 minutes  
C. 5 hours 20 minutes                      D. 5 hours 33 minutes

- 
- 6 The cost (\$ $C$ ) of production of water tanks in a factory is given by the equation

$$C = 700 + 35n$$

where  $n$  is the number of water tanks produced.

The income (\$ $I$ ) received from the sale of these tanks is given by the equation

$$I = 125n$$

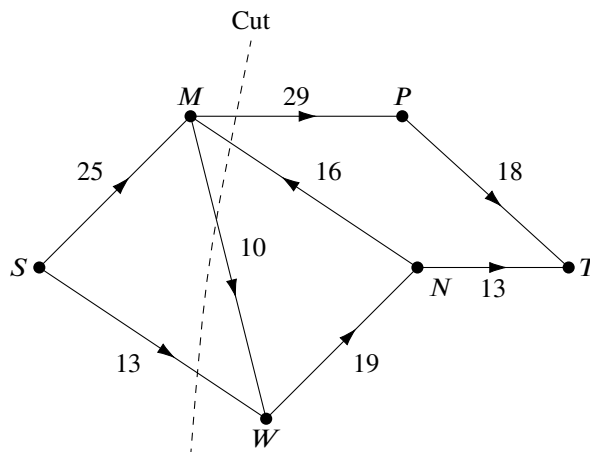
Which of the following calculations gives the profit from producing and selling 40 tanks?

- A.  $90 \times 40 + 700$                       B.  $90 \times 40 - 700$   
C.  $160 \times 40 + 700$                       D.  $160 \times 40 - 700$
- 

- 7 The stamp duty on a new vehicle is 3% of the first \$45 000 and 5% on the remainder of the marked price. Lulu buys a new vehicle with a marked price of \$55 000. What stamp duty must Lulu also pay?

- A. \$1350                      B. \$1650                      C. \$1850                      D. \$2750
- 

- 8 What is the capacity of the cut shown in the directed graph below?



- A. 36                      B. 42                      C. 52                      D. 68
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- 9 A washing machine has a power rating of 1500 watts. The machine is used in a self-service laundrette for 6 hours each day. The cost of running the machine is \$0.12 per kWh. What is the total cost of running the machine for 7 days?

- A. \$5.20                      B. \$7.56                      C. \$9.36                      D. \$12.28
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**10** Jade has a student credit card which is issued by a bank. The bank charges fees as follows.

- Interest on Purchases: 19.75% p.a., compounded daily on balances owing
- Fee for Cash Advances: \$2.50 or 2% of the transaction amount, whichever is greater
- Interest on Cash Advances: 21.24% p.a., compounded daily until the amount is repaid in full

Jade made her minimum monthly payment 10 days ago. After making the payment her outstanding balance was \$225. On the same day as making the payment, Jade took out a cash advance of \$195.

Jade has made no more purchases on the card since then. What is the current balance on Jade's card?

- A. \$412.22      B. \$420.85      C. \$422.36      D. \$426.27
- 

**11** Four parcels are weighed before delivery. The mean weight is 4 kg, the median weight is 4.5 kg and the mode weight is 5 kg. What is the weight of the lightest parcel?

- A. 2 kg      B. 2.5 kg      C. 3 kg      D. 3.5 kg
- 

**12** A network has  $x$  edges. Which expression below gives the sum of the degrees of the vertices in the network?

- A.  $x$       B.  $x + 1$       C.  $2x$       D.  $2x + 1$
- 

**13** The volume of a sphere is given by  $V = \frac{4}{3}\pi r^3$ . A sphere has a volume of  $100 \text{ cm}^3$ . What is the radius of the sphere, correct to the nearest millimetre?

- A. 29 mm      B. 35 mm      C. 62 mm      D. 75 mm
- 

**14** During a storm, 25 mm of rain fell on to James' roof and drained off into a storage tank. James measured the amount of water to be 4500 litres. What is the area of James' roof?

- A.  $150 \text{ m}^2$       B.  $180 \text{ m}^2$       C.  $200 \text{ m}^2$       D.  $270 \text{ m}^2$
- 

**15** An asset depreciates to half its original value after 4 years using the declining balance method. What is the approximate annual rate of depreciation?

- A. 8.5%      B. 10.5%      C. 15.9%      D. 18.4%
-

## Section II

85 marks

Attempt Questions 16–36

Allow about 2 hours and 5 minutes for this section

Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.

Your responses should include relevant mathematical reasoning and/or calculations.

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### Question 16 (2 marks)

Young’s formula to calculate the dosage of medicine for a child. The formula is: 2

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

where  $D$  is the recommended dosage for the child,  $A$  is the adult dosage and  $y$  is the child’s age in years.

Calculate the dosage of medication for a 4-year-old child if the adult dosage is 50 mL.

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### Question 17 (2 marks)

At E S Marks Athletic Field, Charlotte measured the length of the inside running lane to be 407 metres.

- (a) From the measurement provided, what is the precision of the instrument that Charlotte used to make the measurement? 1

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- (b) Calculate the percentage error for Charlotte’s measurement. 1  
Give your answer as a percentage, correct to 2 decimal places.

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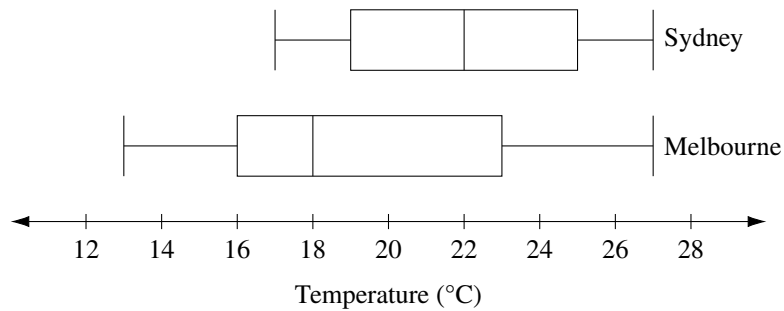
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**Question 18** (3 marks)

Tiffany recorded the average monthly maximum temperatures for Sydney and Melbourne and displayed them on the box-and-whisker plot below.



- (a) Calculate the interquartile range of temperatures for Melbourne. **1**

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- (b) What percentage of months in Sydney have an average maximum temperature greater than 25°C? **1**

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- (c) Briefly describe the skewness of the average monthly maximum temperatures for Melbourne. **1**

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**Question 19** (5 marks)

An investor decides to purchase 750 shares in Wesfarmers Ltd at a price of \$38.86 per share. There is a brokerage fee of 1% of the value of any purchase or sale of shares.

- (a) Find the total cost of purchasing these shares. **2**

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- (b) The company releases its dividend at \$1.20 per share. How much will this investor receive in dividends? **1**

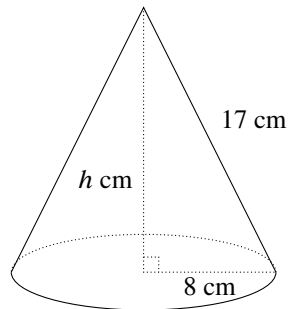
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- (c) Calculate the dividend yield. Express your answer as a percentage, correct to 2 decimal places. **2**

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**Question 20** (3 marks)

A cone has dimensions as shown in the diagram below.



- (a) Show that the perpendicular height ( $h$ ) of the cone is 15 cm. **1**

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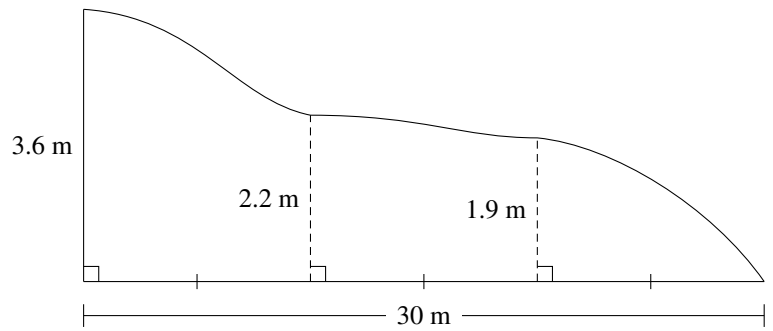


(b) Find the volume of the cone. Give your answer correct to 1 decimal place. 2

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**Question 21** (3 marks)

The cross-section of a rocky outcrop in a quarry is shown in the diagram below. 3



The cross-section has a width of 30 metres and a height of 3.6 metres at its highest point. At equal intervals across the width of the outcrop perpendicular distances of 2.2 metres and 1.9 metres are taken to the top of the rock face.

Using three applications of the Trapezoidal rule, find an estimate for the area of the cross-section of the rocky outcrop.

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**Question 22** (4 marks)

Time zone and location details for two cities are given in the table below.

|           | Melbourne | Dubai |
|-----------|-----------|-------|
| Latitude  | 38°S      | 24°N  |
| Longitude | 145°E     | 55°E  |
| Time Zone | UTC+10    | UTC+4 |

- (a) Calculate the difference in latitude between Melbourne and Dubai. **1**

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- (b) A plane leaves Melbourne on Friday at 11:30 pm. The flight time to Dubai is 15 hours. **3**  
What will be the time and the day in Dubai when the plane is due to land?

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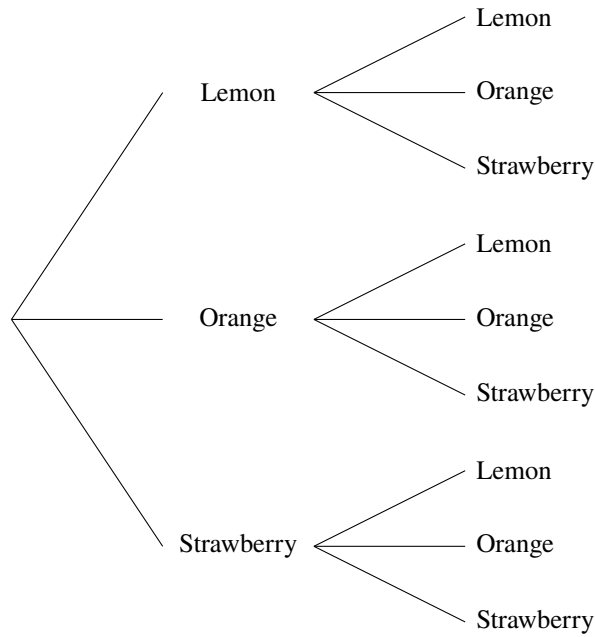
**Question 23** (5 marks)

A packet of 40 sweets contains 24 lemon, 9 orange and 7 strawberry sweets. Caroline takes a packet into the movies and randomly chooses sweets throughout the movie.

- (a) What is the probability that the first sweet she chooses is lemon flavoured? **1**

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The tree diagram below represents the possibilities of her first two choices.



- (b) Complete the tree diagram above by writing the correct probability on each branch. 2
- (c) Calculate the probability that Caroline chooses two sweets with the same flavour. 2

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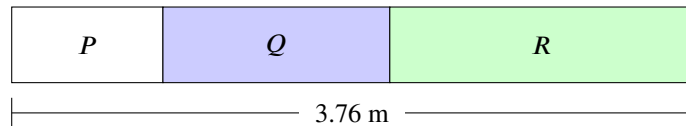
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**Question 24** (4 marks)

Three pieces of timber, *P*, *Q* and *R*, have been joined together to make one longer section, shown in the diagram below.



The total length of the single piece is 3.76 metres. The ratio of the length of piece *P* to the length of piece *Q* is 1 : 3. The ratio of the length of piece *Q* to the length of piece *R* is 5 : 9.

- (a) Show that the ratio of the length of piece *P* to the length of piece *R* is 5 : 27. 2

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(b) Calculate the length of piece  $Q$ .

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**Question 25** (4 marks)

Ross works as a sign-writer and earns a salary of \$61 495 per annum. In one year he has investments which earn \$964 and allowable taxable deductions of \$1470.

| Taxable Income       | Tax on Taxable Income                        |
|----------------------|--|
| \$1 – \$35 000       | 29¢ for each \$1                             |
| \$35 001 – \$80 000  | \$10 150 plus 30¢ for each \$1 over \$35 000 |
| \$80 001 – \$180 000 | \$23 650 plus 37¢ for each \$1 over \$80 000 |
| \$180 001 and over   | \$ $T$ plus 45¢ for each \$1 over \$180 000  |

(a) Show that Ross' taxable income is \$60 989.

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(b) Using the tax table above, calculate the income tax payable on Ross' taxable income.

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(c) Find the value of  $T$  in the above table.

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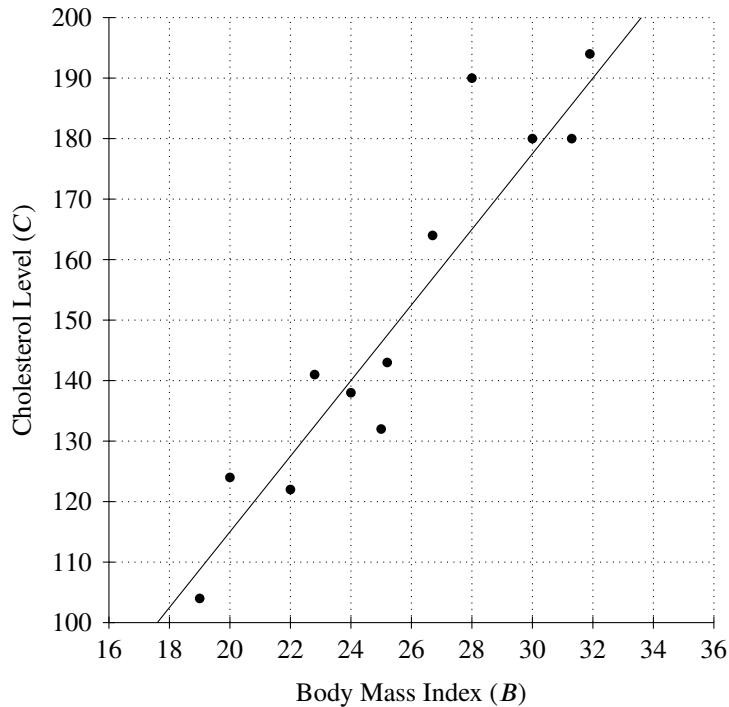
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**Question 26** (4 marks)

The body mass index (BMI) is one of several measures used to determine a person’s health as indicated by their weight and height.

The amount of cholesterol is also a measure of a person’s health, and is indicated by the amount fat in a person’s blood, recorded in milligrams per decilitre (mg/dL).

The results of a study indicating the relationship between the BMI and the level of cholesterol in twelve randomly selected people are shown in the scatterplot below. A line of best fit is drawn is included.



- (a) Explain why the line of best fit has been suitably placed for the recorded data. **1**

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- (b) How many people in the study had a cholesterol level less than 130 and a BMI between 21 and 28? **1**

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- (c) Describe the correlation suggested by the recorded data. **1**

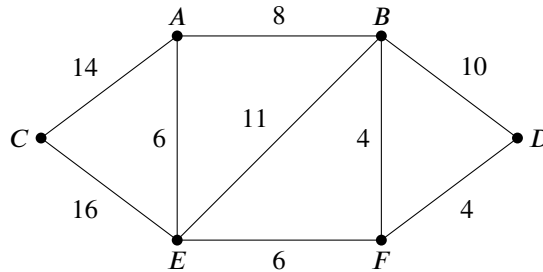
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- (d) The line of best fit drawn can be modelled on the equation  $C = 6.25B - 10$ . If a person has a BMI of 31, what would be this person’s predicted cholesterol level? **1**

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**Question 27** (6 marks)

Six computer terminals in different offices of a building need to be connected to each other with internet cabling. The six terminals are represented as *A*, *B*, *C*, *D*, *E* and *F* in the network diagram below.



The numbers in the network diagram show the length of cable (in metres) which is needed to connect two particular computer terminals.

- (a) Before the cable was laid, a consultant was asked to determine the minimum amount of cable needed to connect the terminals. She decided to draw a minimum spanning tree for the cable network. **1**

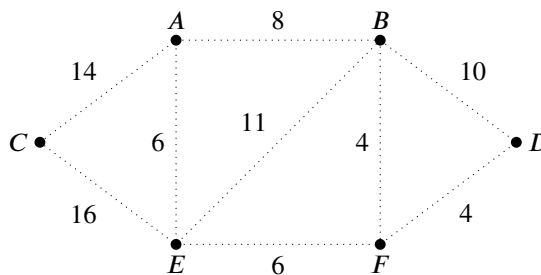
Briefly describe how drawing a minimum spanning tree would help the consultant?

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- (b) On the diagram below, draw the minimum spanning tree for the network. **3**



- (c) The cable can be supplied and laid for this network at a cost of \$17.30 per metre. What is the minimum possible cost of laying the cable? **2**

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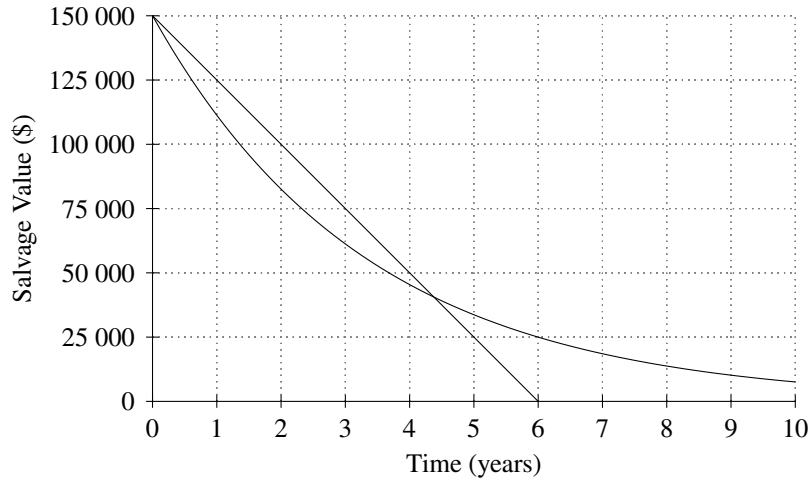
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**Question 28** (4 marks)

Olivia and Tom both purchase office equipment with an initial value of \$150 000. Olivia uses the declining balance method to calculate the depreciation of her equipment. Tom uses the straight line method. The graph below illustrates the depreciation of both Olivia's and Tom's equipment.



- (a) During which year does the equipment both have the same salvage value? **1**

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- (b) What is the value of Olivia's office equipment after 3 years? **1**

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- (c) Find the annual amount of depreciation for Tom's equipment. **1**

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- (d) Using your answer to (c), find the equation of the straight line. **1**

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**Question 29** (4 marks)

The basal metabolic rate (BMR) of a person refers to the minimum amount of energy (in kilojoules) needed to sustain basic bodily functions (that is, to keep the person alive) for a 24-hour period.

The energy output needed is then given by:

$$\text{Energy out} = \text{basal metabolic rate (BMR)} \times \text{physical activity level (PAL)}$$

The Harris-Benedict Model can be used to estimate BMR, in kJ/day. It is given by:

- $\text{BMR}_{\text{male}} = 278 + 57.5W + 20.9H - 28.2A$
- $\text{BMR}_{\text{female}} = 2783 + 40.0W + 7.7H - 19.6A$

where  $W$  is weight (in kg),  $H$  is height (in cm) and  $A$  is age (in years).

- (a) A 25-year-old woman weighs 62 kg and she has a height of 159 cm. Use the Harris-Benedict Model to estimate the woman's BMR. **2**  
Give your answer to the nearest kJ/day.

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- (b) The woman undertakes an activity with a PAL of 12.8. What would be the amount of energy expended in one hour of undertaking this activity? **2**  
Give your answer to the nearest kJ.

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**Question 30** (4 marks)

The table below shows the present value of an annuity of \$1 at various interest rates over various periods.

**Present value of an Annuity of \$1**

| Number of Periods | Interest rate per period |        |        |        |        |
|-------------------|--------------------------|--------|--------|--------|--------|
|                   | 0.1%                     | 0.2%   | 0.3%   | 0.4%   | 0.5%   |
| 120               | 113.03                   | 106.59 | 100.65 | 95.16  | 90.07  |
| 180               | 164.65                   | 151.04 | 138.93 | 128.14 | 118.50 |
| 240               | 213.28                   | 190.46 | 170.91 | 154.09 | 139.58 |
| 300               | 259.07                   | 225.43 | 197.63 | 174.52 | 155.21 |
| 360               | 302.20                   | 256.45 | 219.95 | 190.60 | 166.79 |

Jasmin takes out a home loan for \$375 000 over 25 years. Reducible interest is charged at 4.8% p.a.

- (a) Use the table above to determine the monthly repayment amount. **2**

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- (b) What is the total amount that Jasmin will repay on the loan? **1**

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- (c) What is the total interest charged over the life of the loan? **1**

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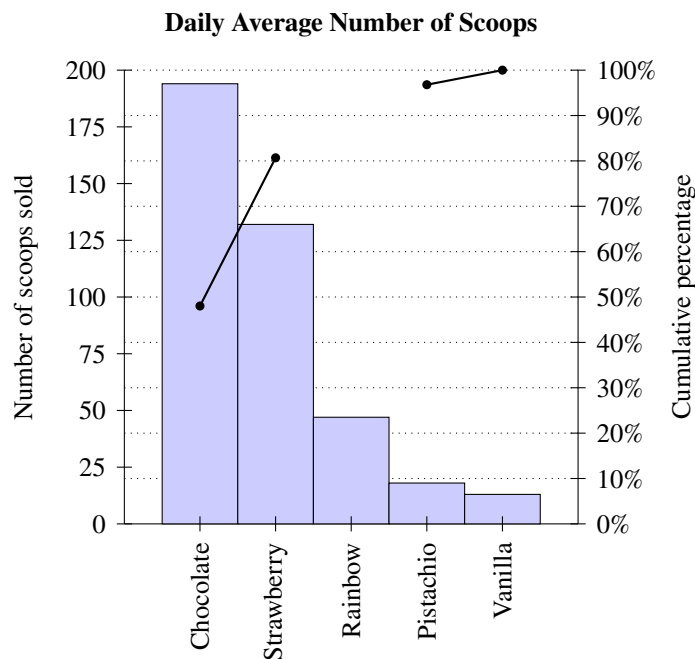
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**Question 31** (5 marks)

Over the month of April, the local ice-cream shop recorded the average number of scoops sold per day for each of its flavours. The figures are shown in the table below.

| Flavour    | Cumulative Frequency |
|------------|----------------------|
| Chocolate  | 194                  |
| Strawberry | 326                  |
| Rainbow    | 373                  |
| Pistachio  | 391                  |
| Vanilla    | 404                  |

These results are also shown in the following Pareto chart.



- (a) What was the average number of scoops of Strawberry ice-cream sold per day in April? **1**

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- (b) Part of the line graph for the cumulative frequency is missing. Find the cumulative percentage for the Rainbow flavour. Give your answer correct to 1 decimal place. **1**

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- (c) Using your answer to (b), complete the line graph above. **1**

- (d) As winter approaches and sales decline, the shop wants to reduce the amount of ice-cream in storage to prevent wastage. By applying the Pareto principle, which flavours would you advise the store to keep in stock. Justify your answer with appropriate reasoning. 2

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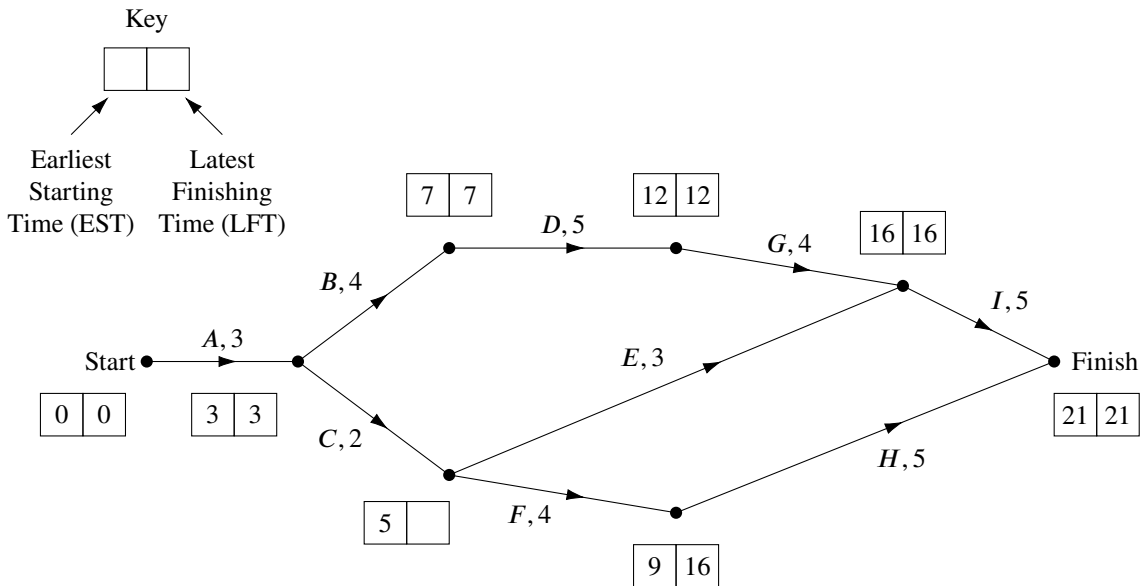
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**Question 32** (5 marks)

A particular project is comprised of nine activities. An activity chart for the project is shown below. Each path shows an activity and its duration in days.



- (a) Determine the LFT for activity C. 1

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- (b) List the activities which are critical for the completion of this project. 1

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- (c) What is the expected duration of the project? 1

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(d) Briefly explain the meaning of the term *float time*. 1

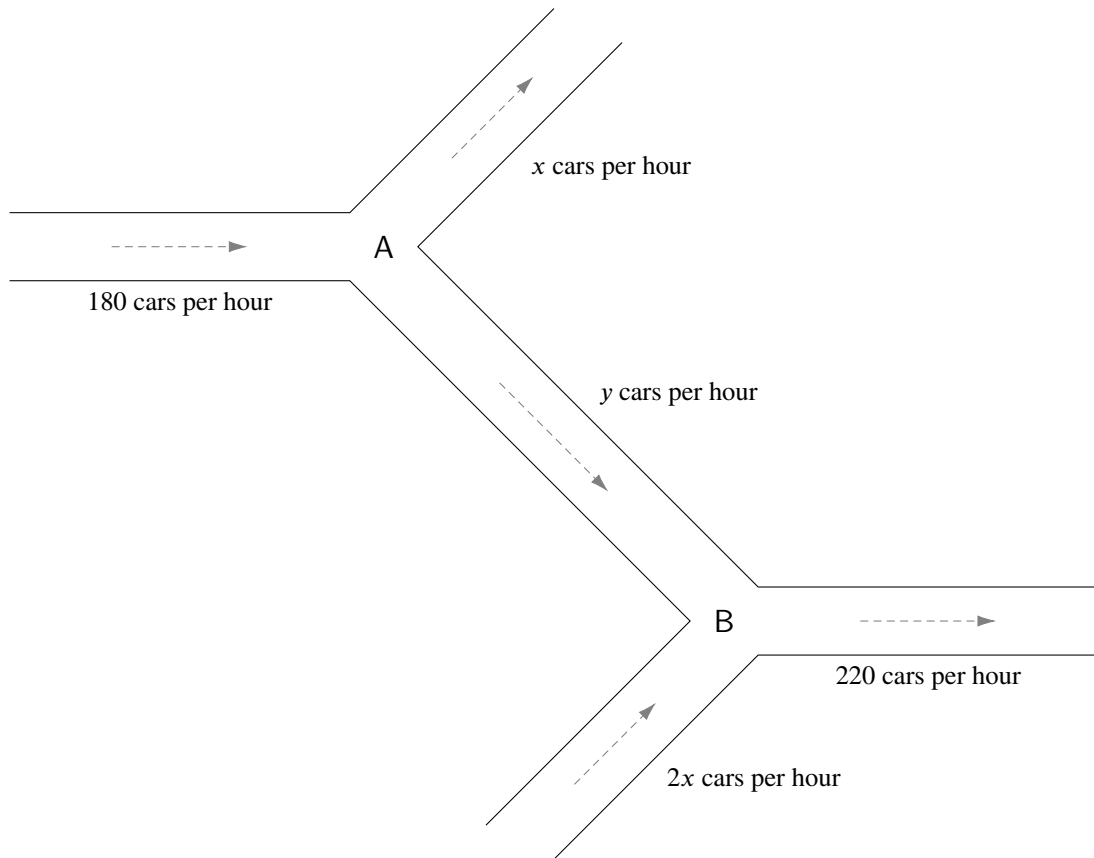
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(e) Which activity has the greatest float time? 1

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**Question 33** (5 marks)

The diagram below shows a road network with two intersections *A* and *B*. Intersection *A* has one entry and two exits. Intersection *B* has two entries and one exit.



The road network is working at maximum flow. The flow rate of cars entering and exiting the intersections are shown, and the direction of flow is indicated by the arrows.

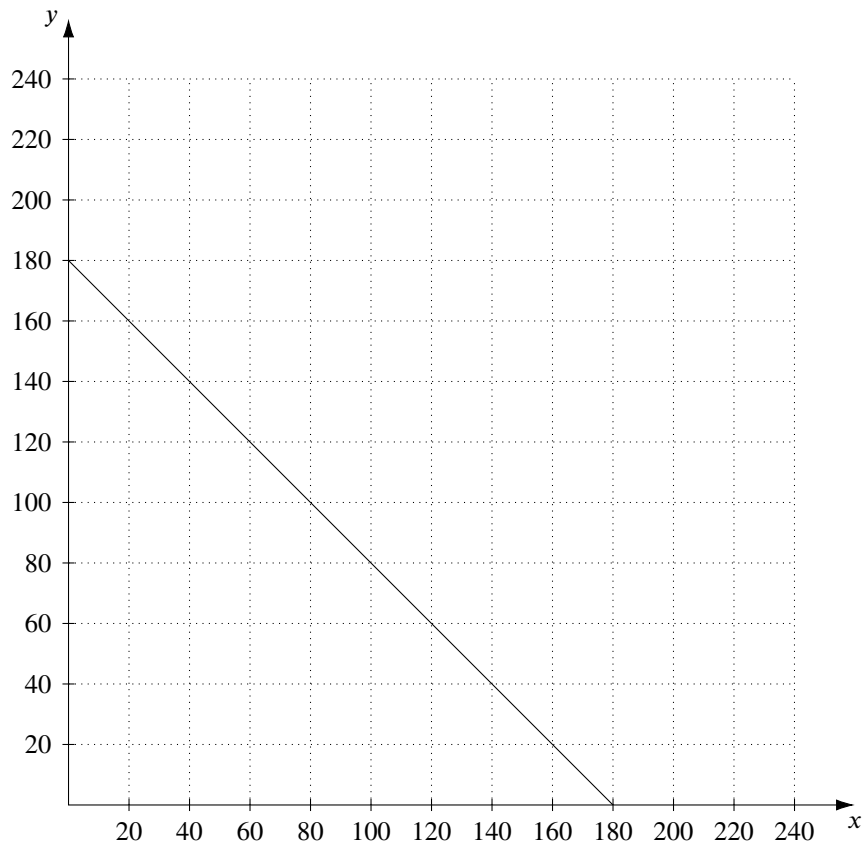
(a) An equation which relates the traffic flow entering and exiting intersection *A* is: 1  
 $x + y = 180$

Write down the equation which relates the traffic flow entering and exiting intersection *B*.

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(b) The graph of the equation for intersection *A* is shown in the number plane below.

**2**



On the same number plane, draw the line given by your equation in (i).

(c) Write down the coordinates of the point of intersection of the two straight lines. **1**

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(d) What is the flow rate of cars travelling from intersection *A* to intersection *B*? **1**

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**Question 34** (6 marks)

The table below shows the future value of an annuity with a contribution of \$1 at various interest rates over various periods of time.

| Number of Periods | Interest rate per period |        |        |        |        |
|-------------------|--------------------------|--------|--------|--------|--------|
|                   | 1%                       | 1.25%  | 1.5%   | 1.75%  | 2%     |
| 1                 | 1.0000                   | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 2                 | 2.0100                   | 2.0125 | 2.0150 | 2.0175 | 2.0200 |
| 3                 | 3.0301                   | 3.0377 | 3.0452 | 3.0528 | 3.0604 |
| 4                 | 4.0604                   | 4.0756 | 4.0909 | 4.1062 | 4.1216 |
| 5                 | 5.1010                   | 5.1266 | 5.1523 | 5.1781 | 5.2040 |
| 6                 | 6.1520                   | 6.1907 | 6.2296 | 6.2687 | 6.3081 |
| 7                 | 7.2135                   | 7.2680 | 7.3230 | 7.3784 | 7.4343 |
| 8                 | 8.2857                   | 8.3589 | 8.4328 | 8.5075 | 8.5830 |

Grace deposits \$2400 into an annuity fund at the end of June and at the end of December every year for 4 years. Interest is paid half-yearly at a rate of 3.5% p.a.

- (a) Use the table above to calculate the amount in Grace’s annuity fund at the end of 4 years. **1**

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- (b) How much interest will Grace earn at the end of the 4 years? **2**

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- (c) What single amount would Grace need to invest under compound interest to achieve the same future value at the same interest rate over the same period of time? **2**

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- (d) Which investment strategy would be the better option for Grace? Justify your answer with appropriate reasoning and calculations. **1**

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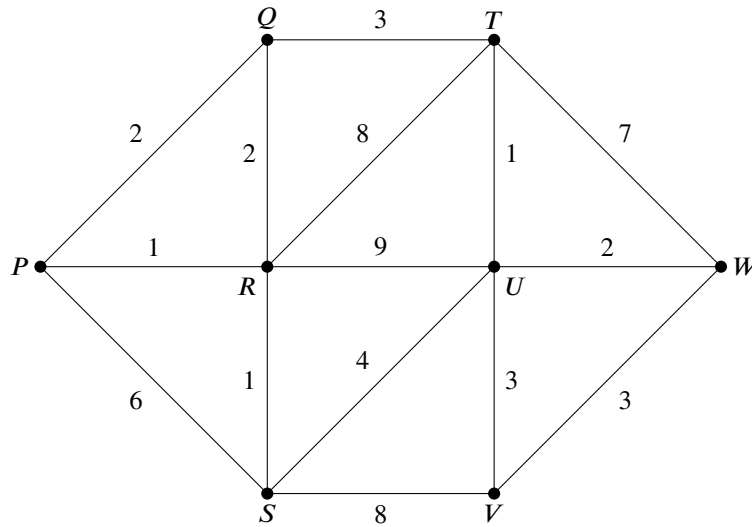
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**Question 35** (3 marks)

The diagram below shows a network of roads. The weight on each edge represents the number of traffic lights along that road. 3



Use Dijkstra's algorithm to find the two possible routes from  $P$  to  $W$  that have the minimum number of traffic lights.

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**Question 36** (4 marks)

Rick worked at a fish and chip shop near the beach. He suspected that the shop’s takings were dependent on temperature that day. To investigate, he recorded the maximum temperature each day for a week against the shop’s takings.

|   |      |      |      |      |      |      |      |
|---|------|------|------|------|------|------|------|
| Maximum temperature ( $x^{\circ}\text{C}$ ) | 23   | 18   | 27   | 19   | 25   | 20   | 22   |
| Total takings (\$y)                         | 4290 | 3188 | 5106 | 3829 | 5057 | 4264 | 4485 |

- (a) Construct a linear model to represent the shop’s takings against the maximum temperature each day, and use your model to predict the shop’s takings on a day with a maximum temperature of  $35^{\circ}\text{C}$ . **3**

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- (b) Briefly comment on the validity of your prediction. **1**

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Student Number: \_\_\_\_\_

**Mathematics Standard 2**  
**2019 Trial HSC Examination**

**Section I**  
**Answer Sheet**

|          |   |   |   |   |           |   |   |   |   |
|----------|---|---|---|---|-----------|---|---|---|---|
| <b>1</b> | A | B | C | D | <b>9</b>  | A | B | C | D |
| <b>2</b> | A | B | C | D | <b>10</b> | A | B | C | D |
| <b>3</b> | A | B | C | D | <b>11</b> | A | B | C | D |
| <b>4</b> | A | B | C | D | <b>12</b> | A | B | C | D |
| <b>5</b> | A | B | C | D | <b>13</b> | A | B | C | D |
| <b>6</b> | A | B | C | D | <b>14</b> | A | B | C | D |
| <b>7</b> | A | B | C | D | <b>15</b> | A | B | C | D |
| <b>8</b> | A | B | C | D |           |   |   |   |   |



## Reference Sheet

### Measurement

#### Limits of Accuracy

Absolute Error =  $\frac{1}{2} \times$  Precision

Upper bound = measurement + absolute error

Lower bound = measurement – absolute error

#### Length

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

#### Area

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

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

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

#### Surface Area

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

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

#### Volume

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

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

#### Trigonometry

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

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

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

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

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

### Financial Mathematics

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

#### Straight-line Method of Depreciation

$$S = V_0 - Dn$$

#### Declining-balance Method of Depreciation

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

### Statistical Analysis

An outlier is a score

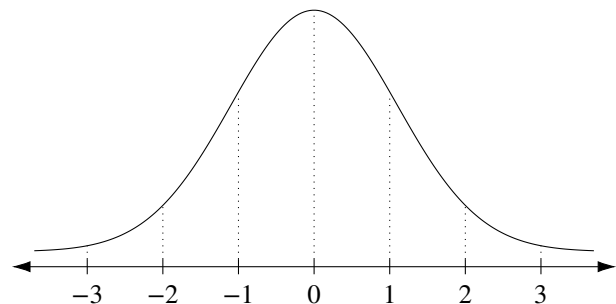
less than  $Q_L - 1.5 \times IQR$

or

more than  $Q_U + 1.5 \times IQR$

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

#### Normal distribution



- approximately 68% of scores have z-scores between  $-1$  and  $1$
- approximately 95% of scores have z-scores between  $-2$  and  $2$
- approximately 99.7% of scores have z-scores between  $-3$  and  $3$

2 UNIT STANDARD MATHEMATICS  
2019 TRIAL HSC EXAMINATION

SECTION I

1 1 D

2 2 A

3 3 D

4 4 D

5 When  $BAC = 0$ : 5 C

$$\begin{aligned}0 &= 0.08 - 0.015H \\-0.08 &= -0.015H \\0.015H &= 0.08 \\H &= 5.333333333 \text{ h} \\&= 5 \text{ hours } 20 \text{ minutes}\end{aligned}$$

$\therefore$  It will take approximately 5 hours 20 minutes for Alex's  $BAC$  to reach zero.

6 Profit =  $I - C$  6 B

$$\begin{aligned}&= 125n - (700 + 35n) \\&= 125n - 700 - 35n \\&= 90n - 700\end{aligned}$$

$$\begin{aligned}\text{When } n = 40, \text{ Profit} &= 90 \times 40 - 700 \\&= \$2900\end{aligned}$$

or

$$\begin{aligned}\text{When } n = 40, \\ \text{Cost} &= 700 + 35 \times 40 \\&= \$2100 \\ \text{Income} &= 125 \times 40 \\&= \$5000 \\ \text{Profit} &= \text{Income} - \text{Cost} \\&= 5000 - 2100 \\&= \$2900\end{aligned}$$

The calculation which gives this amount is B.

7 Stamp duty = (3% of \$45 000) + (5% of \$10 000) 7 C

$$\begin{aligned}&= (0.03 \times 45000) + (0.05 \times 10000) \\&= \$1850\end{aligned}$$

8 Edges  $MP$ ,  $MW$  and  $SW$  are all flowing away from the source. 8 C

$$\begin{aligned}\text{Edge } NM \text{ is flowing towards the source, so we ignore this edge.} \\ \text{Cut capacity} &= 29 + 10 + 13 \\&= 52\end{aligned}$$

- 9 Number of hours used =  $7 \times 6$  9 **B**  
 $= 42$
- Total energy used =  $42 \times 1500$   
 $= 63000 \text{ Wh}$   
 $= 63 \text{ kWh}$
- $\therefore$  Cost =  $63 \times 0.12$   
 $= \$7.56$
- 10 Balance on outstanding purchases =  $P(1 + r)^n$  10 **D**  
 $= 225 \left( 1 + \frac{0.1975}{365} \right)^{10}$   
 $= \$226.22$
- Fee for cash advance = 2% of \$195  
 $= 0.02 \times 195$   
 $= \$3.90$
- Balance on cash advance =  $P(1 + r)^n$   
 $= 195 \left( 1 + \frac{0.2124}{365} \right)^{10}$   
 $= \$196.14$
- $\therefore$  Amount owing on card =  $226.22 + 3.90 + 196.14$   
 $= \$426.26$
- 11 If the mode is 5 kg, then there must be at least two parcels with a weight of 5 kg. 11 **A**
- If the median weight is 4.5 kg, then this is less than the mode weight. As there are only four parcels, there can only be two parcels with a weight of 5 kg, otherwise the median would be 5 kg. To have a median of 4.5 kg, the second parcel must weigh 4 kg.
- Now we know that the mean weight is 4 kg.  
Let  $w$  be the weight of the lightest parcel. We have:
- $$\frac{w + 4 + 5 + 5}{4} = 4$$
- $$\frac{w + 14}{4} = 4$$
- $$w + 14 = 16$$
- $$w = 2$$
- $\therefore$  The weight of the lightest parcel is 2 kg.
- 12 The sum of the degrees of the vertices of a network is equal to twice the number of edges. 12 **C**
- $\therefore$  If there are  $x$  edges then the sum of the degrees of the vertices is  $2x$ .

13  $V = \frac{4}{3}\pi r^3$  13 A

$$100 = \frac{4}{3}\pi r^3$$

$$300 = 4\pi r^3$$

$$r^3 = \frac{300}{4\pi}$$

$$= 23.87324146$$

$$r = 2.879411911$$

$$\approx 2.9 \text{ cm}$$

$$\approx 29 \text{ mm}$$

14 Volume of water = 4500 litres 14 B

$$= 4.5 \text{ kL}$$

$$= 4.5 \text{ m}^3$$

$\therefore$  Volume =  $Ah$

$$4.5 = A \times 0.025$$

$$0.025A = 4.5$$

$$A = 180 \text{ m}^2$$

$\therefore$  The area of James' roof is  $180 \text{ m}^2$ .

15 Let  $S = \frac{1}{2}V_0$  15 C

Now, using the declining balance method:

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

$$\frac{1}{2}V_0 = V_0(1 - r)^4$$

$$\frac{1}{2} = (1 - r)^4$$

$$(1 - r)^4 = 0.5$$

Try  $r = 0.10$ :  $(1 - 0.10)^4 = 0.6561$ , but we need this to be 0.5.

Try  $r = 0.20$ :  $(1 - 0.20)^4 = 0.4096$ , so the value of  $r$  must be between 0.10 and 0.20.

Try  $r = 0.15$ :  $(1 - 0.15)^4 = 0.5220$ , so the value of  $r$  must be between 0.15 and 0.20.

Try  $r = 0.16$ :  $(1 - 0.16)^4 = 0.4979$ , so the value of  $r$  must be between 0.15 and 0.16.

$\therefore$  The annual rate of depreciation must be between 15% and 16%.

Of the options available, the annual rate of depreciation is 15.9%.

**or**

Suppose the asset has an original value of \$1000.

$\therefore$  The salvage value of the asset after 4 years is \$500.

Now, using the declining balance method:

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

$$500 = 1000(1 - r)^4$$

$$\frac{1}{2} = (1 - r)^4$$

$$(1 - r)^4 = 0.5$$

Try  $r = 0.10$ :  $(1 - 0.10)^4 = 0.6561$ , but we need this to be 0.5.

Try  $r = 0.20$ :  $(1 - 0.20)^4 = 0.4096$ , so the value of  $r$  must be between 0.10 and 0.20.

Try  $r = 0.15$ :  $(1 - 0.15)^4 = 0.5220$ , so the value of  $r$  must be between 0.15 and 0.20.

Try  $r = 0.16$ :  $(1 - 0.16)^4 = 0.4979$ , so the value of  $r$  must be between 0.15 and 0.16.

∴ The annual rate of depreciation must be between 15% and 16%.

Of the options available, the annual rate of depreciation is 15.9%.

## SECTION II

### QUESTION 16

$$\begin{aligned} D &= \frac{yA}{y + 12} \\ &= \frac{4 \times 50}{4 + 12} \\ &= \frac{200}{16} \\ &= 12.5 \text{ mL} \end{aligned}$$

### QUESTION 17

(a) Precision = 1 m

(b) Absolute error =  $\frac{1}{2} \times 1$   
= 0.5 m

$$\begin{aligned} \text{Percentage error} &= \frac{0.5}{407} \times \frac{100}{1} \\ &= 0.1228501229 \\ &= 0.12\% \end{aligned}$$

### QUESTION 18

(a) Interquartile range =  $23 - 16$   
=  $7^\circ\text{C}$

(b) 25%

(c) The average monthly temperatures in Melbourne are positively skewed.

### QUESTION 19

- (a) Cost of shares =  $750 \times 38.86$   
= \$29 145  
Brokerage fee = 1% of \$29 145  
=  $0.01 \times 29145$   
= \$291.45  
Total cost =  $29145 + 291.45$   
= \$29 436.45
- (b) Dividend =  $1.20 \times 750$   
= \$900
- (c) Dividend yield =  $\frac{1.20}{38.86} \times \frac{100}{1}$   
= 3.088008235  
 $\approx 3.09\%$

### QUESTION 20

- (a) Using Pythagoras' theorem:  
 $17^2 = h^2 + 8^2$   
 $289 = h^2 + 64$   
 $h^2 = 225$   
 $h = 15$   
 $\therefore$  The perpendicular height of the cone is 15 cm.
- (b) Volume =  $\frac{1}{3}\pi r^2 h$   
=  $\frac{1}{3} \times \pi \times 8^2 \times 15$   
= 1005.309649  
 $\approx 1005.3 \text{ cm}^3$

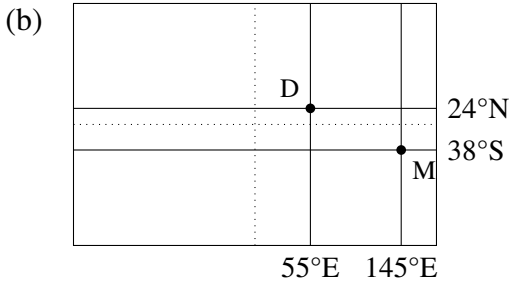
### QUESTION 21

$$\begin{aligned} \text{Area} &\approx \frac{h}{2}[d_f + d_l] + \frac{h}{2}[d_f + d_l] + \frac{h}{2}[d_f + d_l] \\ &\approx \frac{10}{2}[3.6 + 2.2] + \frac{10}{2}[2.2 + 1.9] + \frac{10}{2}[1.9 + 0] \\ &\approx 5[5.8] + 5[4.1] + 5[1.9] \\ &\approx 59 \text{ m}^2 \end{aligned}$$



**QUESTION 22**

(a) Difference in latitude =  $38 + 24$   
 $= 62^\circ$



Time difference =  $10 - 4$   
 $= 6$  hours

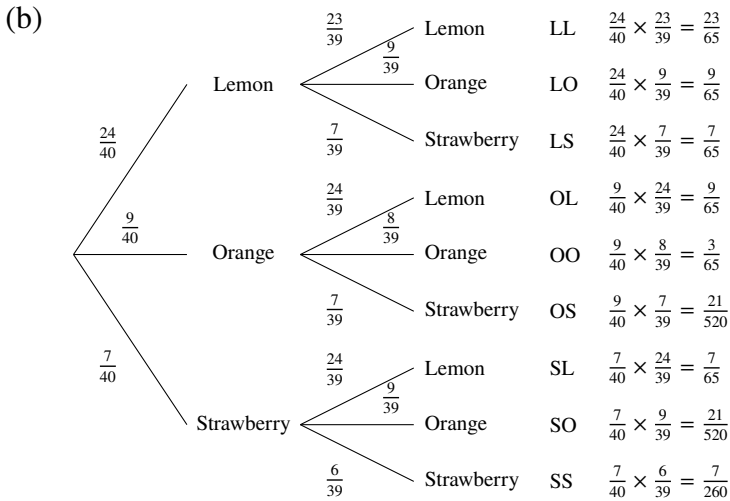
Time of flight = 15 hours

|                   | Melbourne    | Dubai       |
|-------------------|--------------|-------------|
| Time of departure | 11:30 pm Fri | 5:30 pm Fri |
| Time of arrival   |              | 8:30 am Sat |

$\therefore$  The flight arrives in Dubai at 8:30 am on Saturday morning.

**QUESTION 23**

(a)  $P(\text{lemon}) = \frac{24}{40}$   
 $= \frac{3}{5}$



(c)  $P(\text{same flavour}) = \frac{23}{65} + \frac{3}{65} + \frac{7}{260}$   
 $= \frac{111}{260}$

### QUESTION 24

- (a) Ratio of  $P : Q = 1 : 3$   
 $= 5 : 15$   
Ratio of  $Q : R = 5 : 9$   
 $= 15 : 27$

Since we now have a common term, we can combine the terms of the two ratios.

$$P : Q : R = 5 : 15 : 27$$

Taking the two terms we need, we have:

$$P : R = 5 : 27$$

- (b) The terms in the combined ratio add to 47. Using the unitary method,  
47 parts = 3.76 m  
1 part =  $3.76 \div 47$   
 $= 0.08$   
15 parts =  $0.08 \times 15$   
 $= 1.2$  m  
 $\therefore$  Piece  $Q$  is 1.2 metres long.

### QUESTION 25

- (a) Taxable income =  $61495 + 964 - 1470$   
 $= \$60\,989$
- (b) Income tax =  $10150 + 0.30 \times (60989 - 35000)$   
 $= \$17\,946.70$
- (c) For a taxable income of \$180 000 (at the top of the previous bracket):  
Income tax =  $23650 + 0.37 \times (180000 - 80000)$   
 $= \$60\,650$   
 $\therefore T = 60\,650$

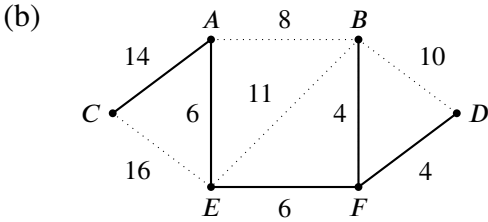
### QUESTION 26

- (a) The line of best fit is suitably placed because there is an equal number of points (6) above and below the line.
- (b) 1 person
- (c) The data suggests a strong positive correlation.
- (d) When  $B = 31$ ,  
 $C = 6.25(31) - 10$   
 $= 183.75$

The person would have a predicted cholesterol level of approximately 184 mg/dL.

**QUESTION 27**

- (a) A minimum spanning tree will use the minimum number of edges required to connect all the vertices of the network with the minimum possible total weight to make those connections. This will enable the consultant to determine the minimum possible length of table required to connect the six terminals.



- (c) Minimum weight =  $4 + 4 + 6 + 6 + 14$   
 $= 34 \text{ m}$   
 $\therefore$  Minimum cost =  $34 \times 17.30$   
 $= \$588.20$

**QUESTION 28**

- (a) Both have the same value during the fifth year.  
 (b) Olivia's office equipment is worth about \$62 500 after 3 years.  
 (c) Using the salvage value formula,  

$$S = V_0 - Dn$$

$$0 = 150000 - D \times 6$$

$$0 = 150000 - 6D$$

$$6D = 150000$$

$$D = 25000$$
 $\therefore$  Tom's equipment depreciates at \$25 000 per year.  
 (d) The equation of the straight line is  $S = 150000 - 25000n$ .

**QUESTION 29**

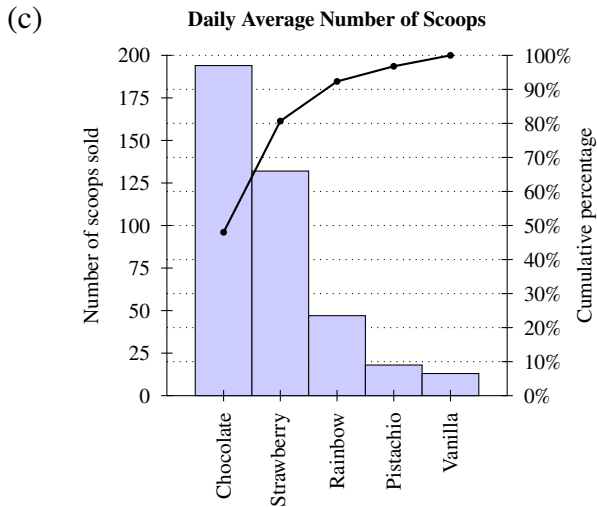
- (a)  $BMR = 2783 + 40.0W + 7.7H - 19.6A$   
 $= 2783 + 40.0(62) + 7.7(159) - 19.6(25)$   
 $= 5997.3$   
 $\approx 5997 \text{ kJ/day}$
- (b) Energy out per day =  $BMR \times PAL$   
 $= 5997 \times 12.8$   
 $= 76761.6 \text{ kJ}$   
 Energy out per hour =  $76761.6 \div 24$   
 $= 3198.4$   
 $\approx 3198 \text{ kJ}$

**QUESTION 30**

- (a)  $r = 4.8\%$  p.a.  
 $= 0.4\%$  per month  
 $n = 25 \times 12$   
 $= 300$  months  
 $\therefore$  Monthly repayment  $= 375000 \div 174.52$   
 $= \$2148.75$
- (b) Total repaid  $= 2148.75 \times 300$   
 $= \$644\,625$
- (c) Interest  $= 644625 - 375000$   
 $= \$269\,625$

**QUESTION 31**

- (a) Average number of scoops of Strawberry  $= 326 - 194$   
 $= 132$
- (b) Cumulative percentage  $= \frac{373}{404} \times \frac{100}{1}$   
 $= 92.32673267$   
 $= 92.3\%$



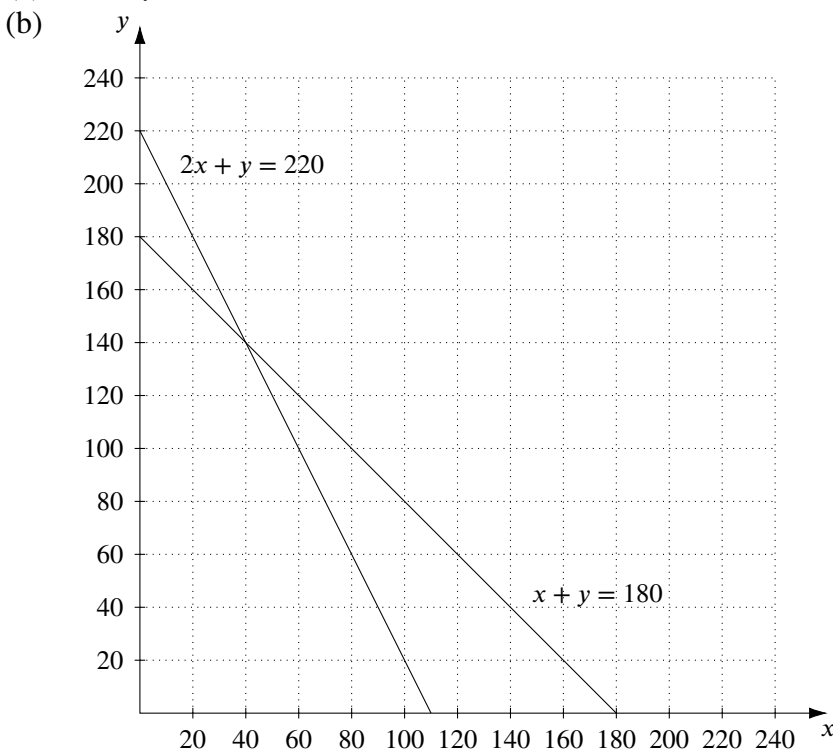
- (d) Using the Pareto principle, or the 80/20 rule, the shop should keep chocolate and strawberry flavours in stock. If they run out of the other flavours, this will only impact 20% of their sales.

### QUESTION 32

- (a) Using backward scanning:  
From the end of activity  $G$ ,  $16 - 3 = 13$   
From the end of activity  $F$ ,  $16 - 4 = 12$   
 $\therefore$  LST = 12
- (b) Critical activities are  $A$ ,  $B$ ,  $D$ ,  $G$  and  $I$ .
- (c) The project is expected to take 21 days to complete.
- (d) Float time is the maximum delay possible before starting an activity without affecting the overall completion time of the project.
- (e) Float time for  $H = 21 - 9 - 5$   
 $= 7$   
Float time for  $E = 16 - 5 - 3$   
 $= 8$   
Float time for  $F = 16 - 5 - 4$   
 $= 7$   
 $\therefore$  Activity  $E$  has the greatest float time.

### QUESTION 33

(a)  $2x + y = 220$



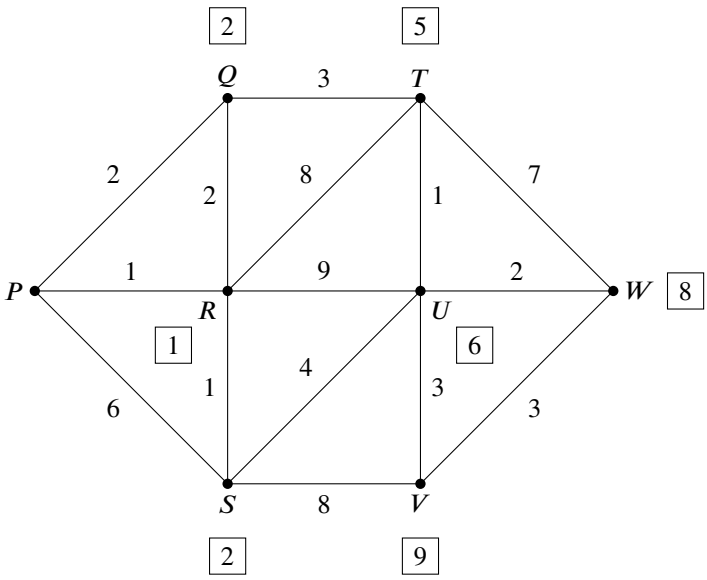
(c) (40, 140)

(d) 140 cars per hour

**QUESTION 34**

- (a)  $r = 3.5\%$  p.a.  
 $= 1.75\%$  per half year  
 $n = 4$  years  
 $= 8$  half years  
 Future value  $= 2400 \times 8.5075$   
 $= \$20\,418$
- (b) Amount invested  $= 2400 \times 8$   
 $= \$19\,200$   
 $\therefore$  Interest earned  $= 20418 - 19200$   
 $= \$1218$
- (c) Using the compound interest formula:  
 $FV = PV(1 + r)^n$   
 $20418 = PV(1 + 0.0175)^8$   
 $20418 = PV(1.0175)^8$   
 $20418 = PV \times 1.148881783$   
 $PV = 17772.0635$   
 $\therefore$  Grace would need to invest a single amount of \$17 772.06 under compound interest.
- (d) To reach the same future value, Grace would need to invest \$19 200 in regular contributions or a single amount of \$17 772.06. Investing a large amount up front will then earn more in interest, so less will be required in contributions to reach the same future value. Grace should try to invest the single amount at the start of the 4 years.

**QUESTION 35**



Using Dijkstra’s algorithm, there are two possible ways of reaching  $U$  from  $P$  passing through only 6 sets of lights.  
 From there, the shortest route is directly to  $W$ , with another two sets of lights.  
 $\therefore$  There are two routes from  $P$  to  $W$  that pass through the minimum number of 8 traffic lights.  
 Those routes are  $PQUTUW$  and  $PRSUW$ .

### QUESTION 36

- (a) Entering the data into a calculator gives the equation for the least-squares line of best fit.

$$y = 191x + 115$$

Using this model, when  $x = 35$ ,

$$\begin{aligned}y &= 191(35) + 115 \\ &= 6800\end{aligned}$$

$\therefore$  When the maximum temperature is  $35^{\circ}\text{C}$ , the shop's takings should be \$6800.

- (b) The validity of this prediction is questionable for a number of reasons. Firstly, this is a case of extrapolation. The temperature lies well outside the range of data provided, so the prediction may not be all that reliable. Secondly, temperatures are seasonal, and less people will visit the beach during cooler seasons. We don't know the time of year when these records were kept, so the model may only be valid for part of the year.