



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

**2020** TRIAL HSC 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 16–38, 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 16–38
- 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 What is the largest share if \$798 is divided in the ratio 3 : 4 : 7?

- A. \$171                      B. \$228                      C. \$266                      D. \$399
- 

2 A gym gathered information from their members on their height and weight. Which of the following is true?

- A. Only weight is discrete data  
B. Only height is continuous data  
C. Both height and weight are discrete data  
D. Both height and weight are continuous data
- 

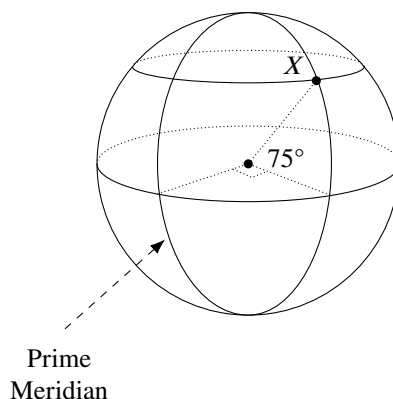
3 A network contains 50 vertices. How many edges are required to form a spanning tree?

- A. 24                      B. 25                      C. 49                      D. 50
- 

4 Which of the following expressions is equivalent to  $7 - 3(5x + 2)$ ?

- A.  $1 - 15x$                       B.  $9 - 15x$                       C.  $20x + 2$                       D.  $20x + 8$
- 

5 What are the position coordinates of  $X$  in the diagram below?



- A.  $75^\circ\text{S}, 90^\circ\text{E}$                       B.  $75^\circ\text{S}, 90^\circ\text{W}$                       C.  $75^\circ\text{N}, 90^\circ\text{E}$                       D.  $75^\circ\text{N}, 90^\circ\text{W}$
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- 6 The New England Building Society has the following monthly loan repayment table for each \$1000 borrowed.

**Monthly Repayment on a Loan of \$1000**

| Interest Rate<br>(% p.a.) | Period of Loan |         |          |          |
|---------------------------|----------------|---------|----------|----------|
|                           | 6 years        | 8 years | 10 years | 12 years |
| 7                         | \$17.05        | \$13.63 | \$11.61  | \$10.28  |
| 8                         | \$17.53        | \$14.14 | \$12.13  | \$10.82  |
| 9                         | \$18.03        | \$14.65 | \$12.67  | \$11.38  |
| 10                        | \$18.53        | \$15.17 | \$13.22  | \$11.95  |

Jessica wants to borrow \$245 000 to buy a unit in Tamworth. She will repay the loan over a period of 8 years at an interest rate of 10% p.a. Using the loan repayment table above, what is Jessica's monthly repayment?

- A. \$12.13      B. \$15.17      C. \$2971.85      D. \$3716.65
- 

- 7 When Robbie exercises, he aims to keep his heart rate between 60% and 85% of his maximum heart rate. Robbie is 30 years old with a maximum heart rate of 190 beats per minute. Which heart rate is within Robbie's target heart rate range?

- A. 95 bpm      B. 130 bpm      C. 165 bpm      D. 190 bpm
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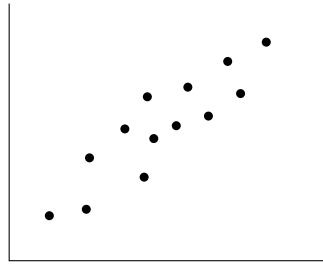
- 8 Emma is the driver at fault in a car accident. Which of the following is covered by Emma's compulsory third-party (CTP) insurance?

- A. Repairs to Emma's car  
B. Injury to the other driver  
C. Damage to the other driver's car  
D. Cost of repairing a building damaged in the accident
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- 9 The marks from an examination are normally distributed with a mean of 55 and a standard deviation of 9. What is the percentage of students who scored a mark between 46 and 73?

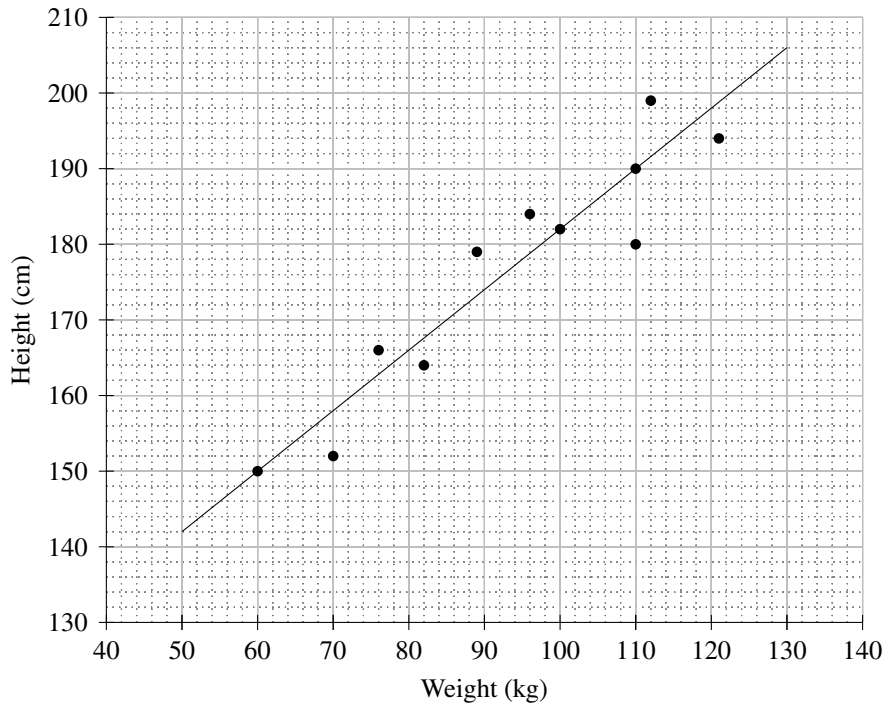
- A. 47.5%      B. 68%      C. 81.5%      D. 95%
-

10 Which of the following values is closest to the correlation coefficient for this scatterplot?



- A.  $-0.8$                       B.  $-0.2$                       C.  $0.2$                       D.  $0.8$

11



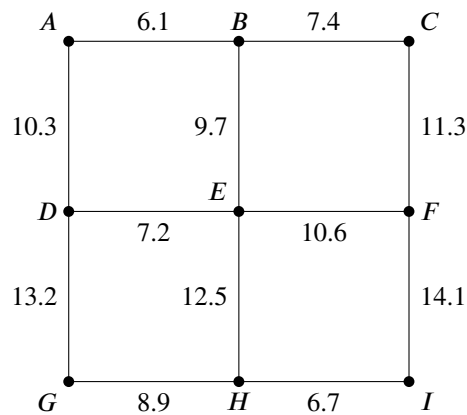
The heights,  $H$ , and weights,  $W$ , of several people were taken and a line of best fit drawn. What is the equation of the line of best fit?

- A.  $H = 0.8W + 102$                       B.  $H = 0.8W + 135$   
 C.  $W = 0.8H + 102$                       D.  $W = 0.8H + 135$

12 Mark is playing a game which involves rolling two standard dice. To win on a given roll, he needs to get either a total of 7 or 10. What is the probability he will successfully do this?

- A.  $\frac{1}{2}$                       B.  $\frac{1}{3}$                       C.  $\frac{1}{4}$                       D.  $\frac{1}{6}$

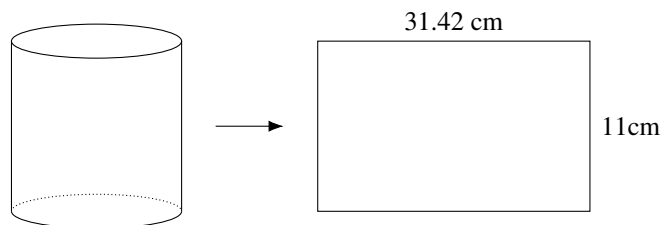
- 13 The following network shows the length, in kilometres, of roads connecting nine villages. A programme of resurfacing some roads is undertaken to ensure that each village can access all other villages along a resurfaced road.



Using a minimum spanning tree, what length of road, in kilometres, will connect all nine villages while keeping the amount of road to be resurfaced to a minimum?

- A. 66.9      B. 67.6      C. 67.9      D. 69.1

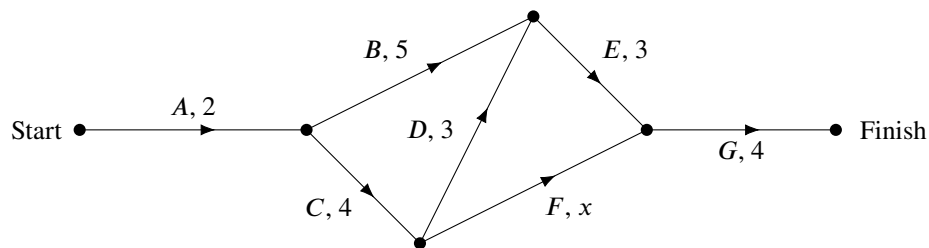
- 14 A tin of chopped tomatoes has a paper label wrapped completely around the side with no overlap. The label is removed from the can and laid out flat. The dimensions of the rectangular label are shown in the diagram below.



What is the approximate volume of the tin?

- A.  $173 \text{ cm}^3$       B.  $346 \text{ cm}^3$       C.  $864 \text{ cm}^3$       D.  $1901 \text{ cm}^3$

- 15 The activity chart below represents the schedule of activities in a particular project. The duration (in hours) of each activity is shown. The duration of activity  $F$  is missing and is represented by  $x$ .



Which of the following values for  $x$  would make  $F$  a critical activity?

- A. 1      B. 3      C. 5      D. 7

## Section II

85 marks

Attempt Questions 16–38

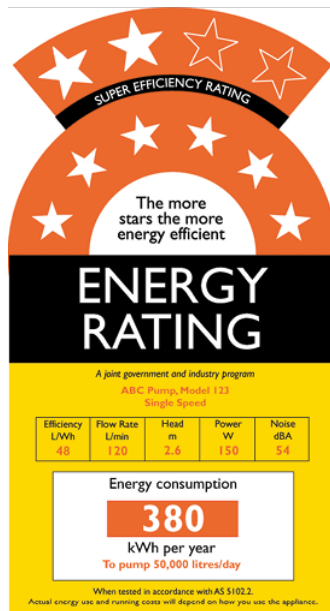
Allow about 2 hours and 5 minutes for this section

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.

### Question 16 (2 marks)

The cost of a new water pump is \$435. It uses energy according to the following energy label. 2



Energy is charged at the rate of \$0.36 per kWh.

How much will it cost in total to purchase and then run this pump for 6 months.

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**Question 17** (2 marks)

A seven year old child weighs 28 kg. He needs to have the correct dosage of medicine. **2**  
The dosage ( $D$ ) is calculated using the formula:

$$D = \frac{mA}{70}$$

where  $m$  is the mass of the child in kilograms and  $A$  is the adult dosage.

The adult dosage is 5 mL three times a day. For how many days will a 240 mL bottle of medicine last for the child?

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**Question 18** (4 marks)

The length of the Sydney Harbour Bridge has been measured as 1149 m, correct to the nearest metre.

(a) What is the precision of this measurement? **1**

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(b) What is the absolute error of this measurement? **1**

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(c) Calculate the percentage error for this measurement? **2**  
Give your answer correct to 2 decimal places.

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**Question 19** (2 marks)

The table below shows the fortnightly Abstudy allowances available to independent indigenous students.

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**Fortnightly Abstudy Allowances**

| Conditions for Eligibility                 | Maximum Fortnightly Payment |
|--|-----------------------------|
| Single, no children, living at home        |                             |
| Under 16                                   | \$34.80                     |
| 16–17 years                                | \$253.30                    |
| 18–21 years                                | \$304.60                    |
| 22 years or older                          | \$565.70                    |
| Single, no children, living away from home |                             |
| Under 16                                   | \$462.50                    |
| 16–21 years                                | \$462.50                    |
| 22 years or older                          | \$565.70                    |
| Partnered, no children                     |                             |
| 16–21 years                                | \$462.50                    |
| 22 years or older                          | \$510.80                    |
| Single, with dependent child               |                             |
| 16–21 years                                | \$606.00                    |
| 22 years or older                          | \$612.00                    |
| Partnered, with dependent child            |                             |
| 16–21 years                                | \$507.90                    |
| 22 years or older                          | \$510.80                    |

Source: Services Australia

Cory and Emma are indigenous students in a de facto relationship with no children. Cory is 24 while Emma is 21. Calculate their combined fortnightly allowance.

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**Question 20** (2 marks)

Using a scale of 1 : 1 000 000, what length on a scale drawing would represent an actual length of 160 km? Give your answer to the nearest cm. **2**

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**Question 21** (5 marks)

Ellie borrowed \$17 450 to complete payment for a used car. Reducible interest on the loan was charged at 4.2% p.a., with repayments of \$395.57 due at the end of every month. The table below sets out her monthly repayment schedule for the first four months.

| Month | Amount owing at start of month | Interest charged at end of month | Repayment | Amount owing at end of month |
|-------|--------------------------------|----------------------------------|-----------|------------------------------|
| 1     | <i>A</i>                       | 61.08                            | 395.57    | 17 115.51                    |
| 2     | 17 115.51                      | <i>X</i>                         | 395.57    | 16 779.84                    |
| 3     | 16 779.84                      | 58.73                            | 395.57    | 16 443.00                    |
| 4     | 16 443.00                      | 57.55                            | 395.57    | <i>B</i>                     |

(a) Some values in the table are missing. Write down the values for *A* and *B*. **2**

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(b) Calculate the interest (*X*) charged on the loan at the end of the second month. **2**

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(c) Ellie repays this loan after 4 years. What is the total amount that she spends on the loan? **1**

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**Question 22** (5 marks)

Arisa has a gross annual income of \$81 797. She has allowable deductions of \$6947. She must pay tax on all taxable income. Her employer has deducted \$19 100 in PAYG tax throughout the financial year.

- (a) Show that Arissa’s taxable income is \$74 850. **1**

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- (b) Using the tax table below, calculate the income tax that Arissa must pay. **2**

| Taxable Income       | Tax on Taxable Income                         |
|----------------------|---|
| \$1 – \$6000         | Nil   |
| \$6001 – \$25 000    | 15¢ for each \$1 over \$6000                  |
| \$25 001 – \$75 000  | \$2850 plus 30¢ for each \$1 over \$25 000    |
| \$75 001 – \$150 000 | \$17 850 plus 40¢ for each \$1 over \$75 000  |
| \$150 001 and over   | \$47 850 plus 45¢ for each \$1 over \$150 000 |

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- (c) The Medicare levy is charged at 2% of taxable income. Calculate Arissa’s Medicare levy. **1**

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- (d) Will Arissa receive a refund or will she need to pay an additional amount in tax? What is the amount of her refund or tax bill? **1**

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**Question 23** (4 marks)

The formula below can be used to estimate the blood alcohol content (*BAC*) for females.

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

where *N* is the number of standard drinks consumed, *H* is the number of hours of drinking, and *M* is the person's weight in kilograms.

The number of hours required for a person to reach a zero *BAC* after they stop drinking alcohol is given by the formula:

$$\text{Time} = \frac{BAC}{0.015}$$

The number of standard drinks in a typical serving is shown in the table below.

|                  | Number of Standard Drinks |
|------------------|---------------------------|
| Beer (1 glass)   | 1.1                       |
| Spirits (1 shot) | 1                         |
| Wine (1 glass)   | 1.2                       |

Lucy was out on Saturday night celebrating her team's win. The celebrations started at 8 pm and continued until the team's 11:30 pm curfew. During this time, she consumed 5 glasses of wine and 2 shots of spirits. She then stopped drinking alcohol. Using the information and formulas above, and the fact that Lucy weighs 72 kg, determine what day and time her BAC should reach zero.

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**Question 24** (3 marks)

Angela owns a credit card that has no annual fee and charges 17.2% p.a. interest, compounded daily, on all purchases. Interest is charged from the day of purchase up until the day that purchase is fully repaid.

- (a) Show that the daily interest rate is approximately 0.0471%. **1**

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- (b) On 28 July, Angela bought a flatscreen TV for \$699 using her credit card. Angela paid her credit card account in full on 8 August. How much interest was she charged for the television? **2**

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**Question 25** (2 marks)

A tap is dripping water at a rate of 70 drops per minute. Each drop is 0.2 mL. How many litres of water drip from the tap in a day? **2**

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**Question 26** (3 marks)

Fiona is driving at 45 km/h. A bus suddenly pulls out into the road ahead and she decides to apply the brakes. Her reaction time is 1.8 seconds. Her braking distance ( $D$  metres) is given by  $D = 0.01v^2$ , where  $v$  is her speed in km/h.

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What is Fiona's stopping distance? Give your answer correct to the nearest metre.

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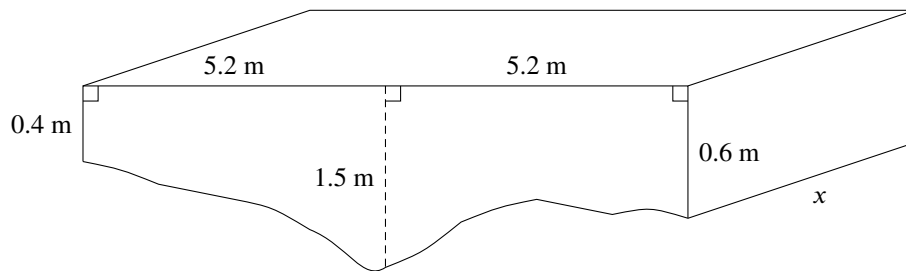
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**Question 27** (4 marks)

Gaynor has a dam on her property which has a uniform cross-section, as shown in the diagram below.



- (a) Use two applications of the trapezoidal rule to show that the area of the cross section is approximately 10.4 m<sup>2</sup>.

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- (b) Gaynor knows that when the dam is full it has a capacity of 416 kL. What is the length ( $x$ ) of the dam? 2

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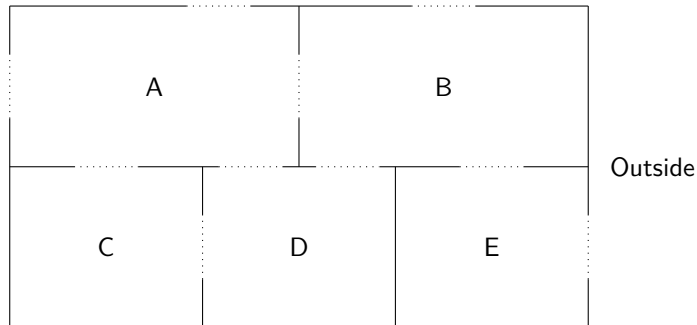
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**Question 28** (4 marks)

The diagram below shows a floor plan of a new building with five rooms. Each room has a number of doors to another room or to the outside.



- (a) Complete the matrix below, indicating the number of possible doors between each room and an adjacent room or the outside ( $O$ ). 2

|          | <i>A</i> | <i>B</i> | <i>C</i> | <i>D</i> | <i>E</i> | <i>O</i> |
|----------|----------|----------|----------|----------|----------|----------|
| <i>A</i> | –        |          |          |          |          |          |
| <i>B</i> |          | –        |          |          |          |          |
| <i>C</i> |          |          | –        |          |          |          |
| <i>D</i> |          |          |          | –        |          |          |
| <i>E</i> |          |          |          |          | –        |          |
| <i>O</i> |          |          |          |          |          | –        |

- (b) Bob the builder needs to inspect each door. He wants to start outside the building, then check every door, and finish outside the building again, passing through each doorway once and once only. Is this possible? Use your answer to (a) or the floor plan to justify your answer. 2

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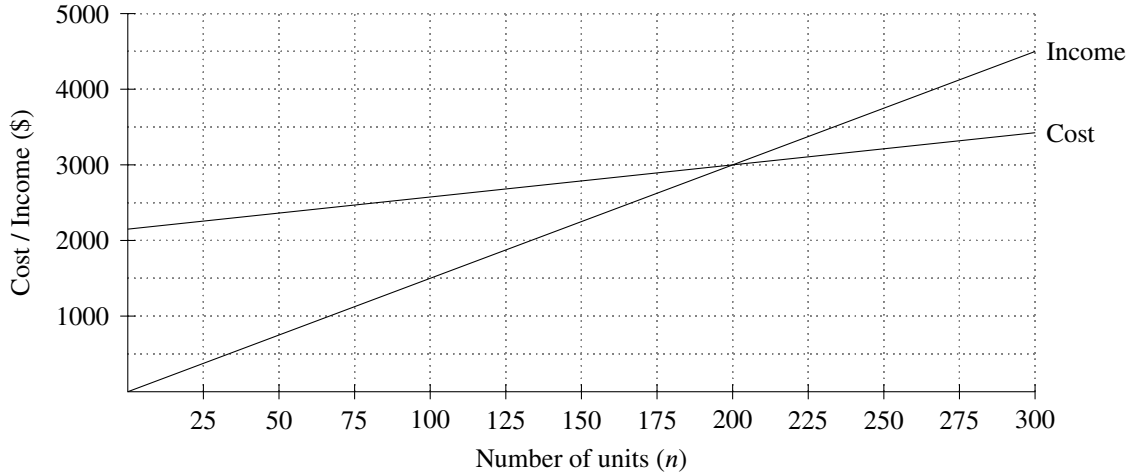
**Question 29** (5 marks)

The cost ( $C$ ) and income ( $I$ ) equations for the Super Product Company are given below.

Cost:  $C = 2150 + \frac{17n}{4}$

Income:  $I = 15n$

where the value is measured in dollars and  $n$  is the number of units produced or sold.



- (a) How many units need to be sold for the company to break even? **1**

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- (b) What are the costs for the company when the break-even point has been reached? **1**

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- (c) What is the gradient of the cost line, and what does that value represent in the context of this question? **1**

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- (d) Calculate the profit made by the company when 360 units are produced and sold. **2**

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**Question 30** (2 marks)

Sophie opens an investment account on the day of her 18th birthday. She decides to deposit \$120 at the end of every month until she reaches her 25th birthday. At this time, Sophie intends to withdraw the money and use it as a deposit for a new car. The financial institution where the account is held pays interest at 6% p.a., compounded monthly. How much will Sophie be able to use as a deposit for a new car?

2

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

| Number of Periods | Interest rate per period |        |        |        |        |
|-------------------|--------------------------|--------|--------|--------|--------|
|                   | 0.25%                    | 0.3%   | 0.5%   | 0.75%  | 1%     |
| 6                 | 6.04                     | 6.05   | 6.08   | 6.11   | 6.15   |
| 7                 | 7.05                     | 7.06   | 7.11   | 7.16   | 7.21   |
| 8                 | 8.07                     | 8.08   | 8.14   | 8.21   | 8.29   |
| 9                 | 9.09                     | 9.11   | 9.18   | 9.27   | 9.37   |
| 12                | 12.17                    | 12.20  | 12.34  | 12.51  | 12.68  |
| 24                | 24.70                    | 24.85  | 25.43  | 26.19  | 26.97  |
| 36                | 37.62                    | 37.96  | 39.34  | 41.15  | 43.08  |
| 48                | 50.93                    | 51.55  | 54.10  | 57.52  | 61.22  |
| 60                | 64.65                    | 65.63  | 69.77  | 75.42  | 81.67  |
| 72                | 78.78                    | 80.23  | 86.41  | 95.01  | 104.71 |
| 84                | 93.34                    | 95.37  | 104.07 | 116.43 | 130.67 |
| 96                | 108.35                   | 111.06 | 122.83 | 139.86 | 159.93 |

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**Question 31** (4 marks)

A petroleum company offered share packages to its shareholders. No brokerage fees or stamp duty was charged. Shares were offered according to the following schedule.

| Number of shares<br>( $n$ ) | Cost of shares<br>(\$ $C$ ) |
|-----------------------------|-----------------------------|
| 55                          | 1485                        |
| 111                         | 2997                        |
| 148                         | 3996                        |
| 185                         | 4995                        |

- (a) The cost ( $C$ ) of purchasing shares varies directly with the number of shares ( $n$ ) purchased. **2**  
Find an equation in the form  $C = kn$  that relates  $n$  to  $C$ .

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- (b) Explain the significance of  $k$ , the constant of proportionality, in your equation in part (a). **1**

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- (c) How much would it cost to purchase 800 shares under this plan? **1**

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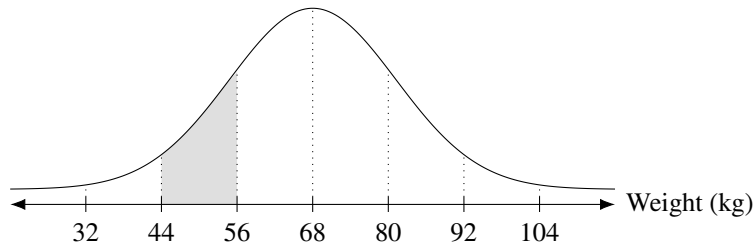
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**Question 33** (5 marks)

The diagram below shows the spread of weights, in kilograms, of 800 students. The spread is normally distributed and has a mean of 68 kg.



- (a) Show that the standard deviation of the distribution is 12. **1**

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- (b) How many students have a weight within the shaded region? **2**

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- (c) Elizabeth is part of the group of students. Her weight is 62 kg. What is her corresponding z-score? **1**

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- (d) A student from the group is selected at random. What is the probability that they have a weight less than 80 kg? **1**

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**Question 34** (4 marks)

Alex purchased a new car for \$15 000. After 3 years, using the straight line method of depreciation, the salvage value of the car is \$9213.

- (a) Find the annual amount of depreciation,  $D$ , according to the straight line method of depreciation. **2**

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- (b) If Alex decided to use the declining balance method instead, what would be the annual rate of depreciation,  $r$ , if the car was worth the same amount after 3 years? **2**

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**Question 35** (5 marks)

A project requires activities *A* to *G* to be completed. The activity table shows the immediate prerequisite(s) and duration (in days) for each activity.

| Activity | Duration (days) | Immediate Prerequisite(s) |
|----------|-----------------|---------------------------|
| <i>A</i> | 5               | –                         |
| <i>B</i> | 4               | –                         |
| <i>C</i> | 3               | <i>A</i>                  |
| <i>D</i> | 7               | <i>B</i>                  |
| <i>E</i> | 8               | <i>B</i>                  |
| <i>F</i> | 2               | <i>C</i>                  |
| <i>G</i> | 6               | <i>D, E</i>               |

(a) In the space below draw an activity chart to represent the information in the table above. **2**

(b) Determine the minimum time (in days) for the project to be completed. **2**

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(c) Calculate the float time of activity *D*. **1**

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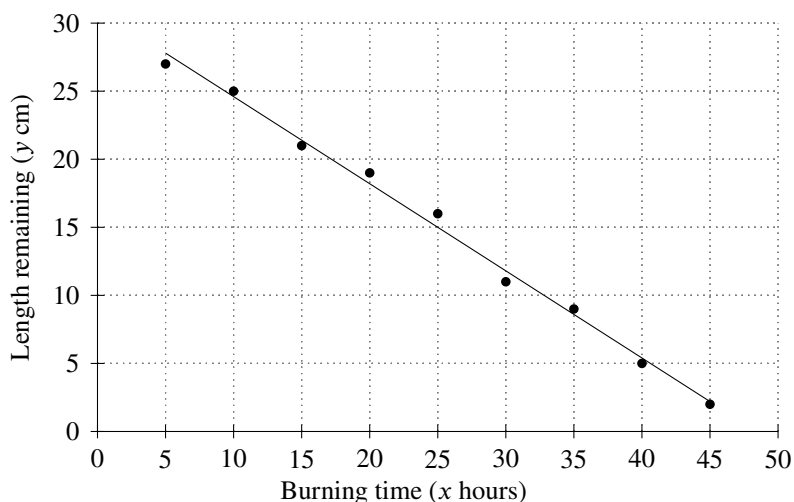
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**Question 36** (5 marks)

Peter, a church warden, decides to investigate the lifetime of a particular brand of wax candle. Each candle is 30 cm in length. From a box containing a large number of wax candles, he selects one candle at random. He lights the candle and, after it has burned continuously for  $x$  hours, he records its remaining length,  $y$  cm, to the nearest centimetre. His results are shown in the table below.

|                            |    |    |    |    |    |    |    |    |    |
|----------------------------|----|----|----|----|----|----|----|----|----|
| Burning time ( $x$ hours)  | 5  | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 |
| Length remaining ( $y$ cm) | 27 | 25 | 21 | 19 | 16 | 11 | 9  | 5  | 2  |

The points from the table are plotted in the scatterplot below and the least-squares line of best fit has been added to the scatterplot.



- (a) The equation of the least-squares line of best fit can be written in the form  $y = c - mx$ . **2**  
Use your calculator to find the values of  $c$  and  $m$ .

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- (b) What does your value of  $m$  represent in the context of this question? **1**

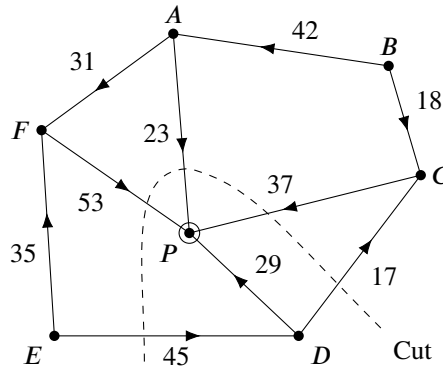
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- (c) It is claimed by the candle manufacturer that the total length of time that such candles are likely to burn for is at least 50 hours. Comment on this claim, using appropriate calculations and reasoning to justify your answer. **2**

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**Question 37** (4 marks)

The network below shows the routes along corridors from two arrival gates to the passport control area,  $P$ , in an airport. The number on each edge represents the maximum number of passengers that can travel along a particular corridor in one minute.



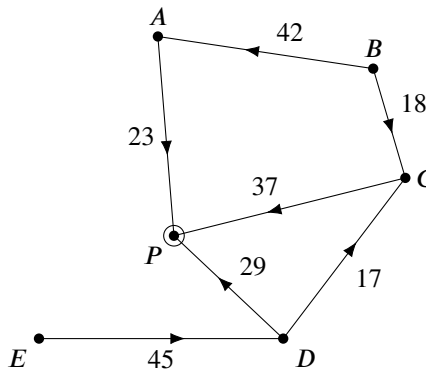
- (a) Which vertices represent the two arrival gates? 1

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 .....

- (b) Find the value of the cut shown in the diagram above. 1

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- (c) On a particular day, there is an obstruction at  $F$  so corridors in and out of that intersection cannot be used. The diagram below shows the available network for that day. 2

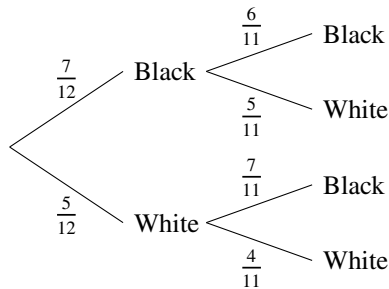


Calculate the maximum flow of passengers in one minute through this network while this obstruction is occurring.

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**Question 38** (5 marks)

Georgie’s sock drawer contains 7 black socks and 5 white socks. She selects two socks at random from the drawer. A tree diagram for this situation is shown below.



- (a) Calculate the probability that the socks Georgie selects are the same colour. **2**

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- (b) Georgie washes and dries her socks and puts them back in the drawer. The following week she adds 8 more socks to the drawer. All of the additional socks are black or white. After this has been done, Georgie selects a sock at random from the drawer. The probability that this sock is black is  $\frac{3}{5}$ . How many black socks and white socks were added to the drawer? **3**

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

**Mathematics Standard 2**  
**2020 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

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

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

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

#### 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

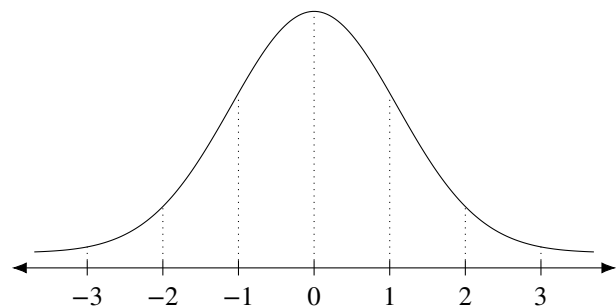
less than  $Q_1 - 1.5 \times IQR$

or

more than  $Q_3 + 1.5 \times IQR$

$$z = \frac{x - \mu}{\sigma}$$

#### 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  
2020 TRIAL HSC EXAMINATION**

**SECTION I**

- 1** Using the unitary method: **1 D**

$$\begin{aligned} 14 \text{ parts} &= \$798 \\ 1 \text{ part} &= 798 \div 14 \\ &= 57 \\ 7 \text{ parts} &= 57 \times 7 \\ &= \$399 \end{aligned}$$

$\therefore$  The largest share is \$399.

- 2** Height and weight are both continuous data. **2 D**

- 3** A spanning tree has one less edge than the number of vertices. **3 C**

$\therefore$  A network with 50 vertices will need 49 edges to create a spanning tree.

- 4**  $7 - 3(5x + 2) = 7 - 15x - 6$  **4 A**  
 $= 1 - 15x$

- 5** **5 C**

- 6** Monthly repayment =  $15.17 \times 245$  **6 D**  
 $= \$3716.65$

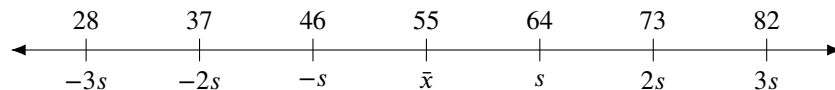
- 7** Minimum = 60% of 190 **7 B**  
 $= 0.60 \times 190$   
 $= 114$

$$\begin{aligned} \text{Maximum} &= 85\% \text{ of } 190 \\ &= 0.85 \times 190 \\ &= 161.5 \\ &\approx 162 \end{aligned}$$

$\therefore$  130 bpm is within the target heart rate range.

- 8** CTP insurance provides cover for injury to the other driver. **8 B**

- 9** **9 C**



$$\begin{aligned} \therefore \text{Percentage} &= \frac{1}{2}(68 + 95) \\ &= 81.5\% \end{aligned}$$

- 10** **10 D**

11 Straight line passes through (60, 150) and (110, 190)

11 A

$$\begin{aligned}\text{Gradient} &= \frac{\text{Change in } H}{\text{Change in } W} \\ &= \frac{190 - 150}{110 - 60} \\ &= \frac{40}{50} \\ &= 0.8\end{aligned}$$

∴ Equation is  $H = 0.8W + c$

Since curve passes through (60, 150),

$$150 = 0.8(60) + c$$

$$150 = 48 + c$$

$$c = 102$$

∴ Equation is  $H = 0.8W + 102$

12

|   |          |          |          |           |           |           |
|---|----------|----------|----------|-----------|-----------|-----------|
|   | 1        | 2        | 3        | 4         | 5         | 6         |
| 1 | 2        | 3        | 4        | 5         | 6         | <b>7</b>  |
| 2 | 3        | 4        | 5        | 6         | <b>7</b>  | 8         |
| 3 | 4        | 5        | 6        | <b>7</b>  | 8         | 9         |
| 4 | 5        | 6        | <b>7</b> | 8         | 9         | <b>10</b> |
| 5 | 6        | <b>7</b> | 8        | 9         | <b>10</b> | 11        |
| 6 | <b>7</b> | 8        | 9        | <b>10</b> | 11        | 12        |

12 C

$$\begin{aligned}\therefore P(\text{Mark wins}) &= \frac{9}{36} \\ &= \frac{1}{4}\end{aligned}$$

13 Using Kruskal's algorithm, we list all the possible paths. We then use the paths with the shortest distance in the spanning tree.

13 D

$$AB = 6.1$$

$$HI = 6.7$$

$$DE = 7.2$$

$$BC = 7.4$$

$$GH = 8.9$$

$$BE = 9.7$$

$AD = 10.3$ , but this cannot be used as it would create a cycle

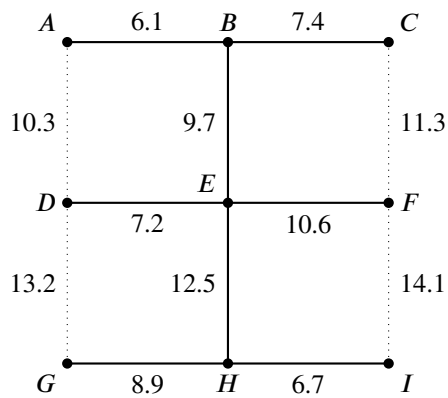
$$EF = 10.6$$

$CF = 11.3$ , but this cannot be used as it would create a cycle

$$EH = 12.5$$

$$DG = 13.2$$

$$FI = 14.1$$



$$\begin{aligned} \therefore \text{Minimum distance} &= 6.1 + 6.7 + 7.2 + 7.4 + 8.9 + 9.7 + 10.6 + 12.5 \\ &= 69.1 \text{ km} \end{aligned}$$

- 14 Since the circumference of circular base is 31.42 cm:

14 C

$$\begin{aligned} C &= 2\pi r \\ 31.42 &= 2\pi r \\ r &= \frac{31.42}{2\pi} \\ &= 5.000648312 \end{aligned}$$

$$\begin{aligned} \therefore \text{Volume} &= \pi r^2 h \\ &= \pi \times 5.000648312^2 \times 11 \\ &= 864.1620348 \\ &\approx 864 \text{ cm}^3 \end{aligned}$$

- 15 Possible paths through the activity chart are:

15 D

$$\begin{aligned} ABEG: \quad \text{Duration} &= 2 + 5 + 3 + 4 = 14 \\ ACDEG: \quad \text{Duration} &= 2 + 4 + 3 + 3 + 4 = 16 \\ ACFG: \quad \text{Duration} &= 2 + 4 + x + 4 = 10 + x \end{aligned}$$

If  $F$  is a critical activity (or lies on the critical path), then when we do a forward scan, the duration of that path will be the maximum of all possible paths. So  $10 + x$  must be greater than 16.

$$\begin{aligned} 10 + x &> 16 \\ x &> 6 \end{aligned}$$

$\therefore$  The only possible value for  $x$  is 7.

## SECTION II

### QUESTION 16

$$\text{Cost of heater} = \$435$$

$$\begin{aligned}\text{Energy consumption} &= 380 \times 0.5 \\ &= 190 \text{ kWh}\end{aligned}$$

$$\begin{aligned}\text{Cost of energy} &= 190 \times 0.36 \\ &= \$68.40\end{aligned}$$

$$\begin{aligned}\therefore \text{Total cost to run heater} &= \text{Purchase cost} + \text{Energy cost} \\ &= 435 + 68.40 \\ &= \$503.40\end{aligned}$$

### QUESTION 17

$$\begin{aligned}\text{Child's dosage} &= \frac{mA}{70} \\ &= \frac{28 \times 5}{70} \\ &= 2 \text{ mL}\end{aligned}$$

$$\begin{aligned}\text{Number of doses in bottle} &= 240 \div 2 \\ &= 120\end{aligned}$$

$$\begin{aligned}\therefore \text{Number of days} &= 120 \div 3 \\ &= 40 \text{ days}\end{aligned}$$

### QUESTION 18

(a) Precision = 1 m

(b) Absolute error = 0.5 m

$$\begin{aligned}\text{(c) Percentage error} &= \frac{\text{Absolute error}}{\text{Measurement}} \times \frac{100}{1} \\ &= \frac{0.5}{1149} \times \frac{100}{1} \\ &= 0.04351610096 \\ &= 0.04\%\end{aligned}$$

### QUESTION 19

$$\text{Cory's allowance} = \$510.80$$

$$\text{Emma's allowance} = \$462.50$$

$$\begin{aligned}\text{Combined allowance} &= 510.80 + 462.50 \\ &= \$973.30\end{aligned}$$

## QUESTION 20

$$\text{Scale} = 1 : 1000000$$

$$\begin{aligned}\text{Map distance} &= 160 \div 1000000 \\ &= 0.00016 \text{ km} \\ &= 0.00016 \times 1000 \\ &= 0.16 \text{ m} \\ &= 0.16 \times 100 \\ &= 16 \text{ cm}\end{aligned}$$

## QUESTION 21

$$(a) \quad A = \$17\,450$$

$$\begin{aligned}B &= 16443.00 + 57.55 - 395.57 \\ &= \$16\,104.98\end{aligned}$$

$$\begin{aligned}(b) \quad X &= Prn \\ &= 17115.51 \times 0.0035 \times 1 \\ &= \$59.90\end{aligned}$$

$$\begin{aligned}(c) \quad \text{Total amount} &= 48 \times 395.57 \\ &= \$18\,987.36\end{aligned}$$

## QUESTION 22

$$\begin{aligned}(a) \quad \text{Taxable income} &= 81797 - 6947 \\ &= \$74\,850\end{aligned}$$

$$\begin{aligned}(b) \quad \text{Income tax} &= 2850 + 0.30 \times (74850 - 25000) \\ &= \$17\,805\end{aligned}$$

$$\begin{aligned}(c) \quad \text{Medicare levy} &= 2\% \text{ of } \$74\,850 \\ &= 0.02 \times 74850 \\ &= \$1497\end{aligned}$$

$$\begin{aligned}(d) \quad \text{Total tax} &= 17805 + 1497 \\ &= \$19\,302\end{aligned}$$

$$\begin{aligned}\therefore \text{Arissa's tax bill} &= 19302 - 19100 \\ &= \$202\end{aligned}$$



### QUESTION 23

$$\begin{aligned}\text{Number of standard drinks} &= (5 \times 1.2) + (2 \times 1) \\ &= 8\end{aligned}$$

$$\begin{aligned}\text{Lucy's BAC} &= \frac{10N - 7.5H}{5.5M} \\ &= \frac{10(8) - 7.5(3\frac{1}{2})}{5.5(72)} \\ &= \frac{53.75}{396} \\ &= 0.1357323232\end{aligned}$$

$$\begin{aligned}\text{Time for BAC to reduce to zero} &= \frac{BAC}{0.015} \\ &= \frac{0.1357323232}{0.015} \\ &= 9.048821549 \text{ hours} \\ &\approx 9 \text{ h } 3 \text{ min}\end{aligned}$$

$\therefore$  Lucy's BAC will reduce to zero at approximately 8:32 am on Sunday morning.

### QUESTION 24

$$\begin{aligned}\text{(a) Interest rate} &= 17.2 \div 365 \\ &= 0.047123288 \\ &\approx 0.0471\% \text{ per day}\end{aligned}$$

$$\begin{aligned}\text{(b) Number of days} &= 4 + 8 \\ &= 12\end{aligned}$$

$$\begin{aligned}\text{Final balance} &= P(1 + r)^n \\ &= 699(1 + 0.000471)^{12} \\ &= 699(1.000471)^{12} \\ &= 702.9609985 \\ &= \$702.96\end{aligned}$$

$$\begin{aligned}\therefore \text{Interest charged} &= 702.96 - 699 \\ &= \$3.96\end{aligned}$$

### QUESTION 25

$$\begin{aligned}\text{Rate} &= 70 \text{ drops per minute} \\ &= 70 \times 60 \\ &= 4200 \text{ drops per hour} \\ &= 4200 \times 24 \\ &= 100800 \text{ drops per day} \\ &= 100800 \times 0.2 \\ &= 20160 \text{ mL per day} \\ &= 20160 \div 1000 \\ &= 20.16 \text{ L per day}\end{aligned}$$

### QUESTION 26

$$\begin{aligned}\text{Speed} &= 45 \text{ km/h} \\ &= 45 \times 1000 \\ &= 45000 \text{ m/h} \\ &= 45000 \div 60 \div 60 \\ &= 12.5 \text{ m/s}\end{aligned}$$

$$\text{Time} = 1.8 \text{ s}$$

$$\begin{aligned}\text{Reaction distance} &= ST \\ &= 12.5 \times 1.8 \\ &= 22.5 \text{ m}\end{aligned}$$

$$\begin{aligned}\text{Braking distance} &= 0.01v^2 \\ &= 0.01(45)^2 \\ &= 20.25 \text{ m}\end{aligned}$$

$$\begin{aligned}\therefore \text{Total stopping distance} &= 22.5 + 20.25 \\ &= 42.75 \\ &\approx 43 \text{ m}\end{aligned}$$

### QUESTION 27

$$\begin{aligned}\text{(a) Area} &\approx \frac{h}{2}[d_f + d_m] + \frac{h}{2}[d_f + d_m] \\ &\approx \frac{5.2}{2}[0.4 + 1.5] + \frac{5.2}{2}[1.5 + 0.6] \\ &\approx 4.94 + 5.46 \\ &\approx 10.4 \text{ m}^2\end{aligned}$$

(b) A capacity of 416 kL is equivalent to a volume of  $416 \text{ m}^3$ .

$$\begin{aligned}\text{Volume} &\approx Ah \\ 416 &\approx 10.4 \times x \\ 10.4x &\approx 416 \\ x &\approx 40\end{aligned}$$

$\therefore$  The length of the dam is approximately 40 m.

### QUESTION 28

(a)

|          | <i>A</i> | <i>B</i> | <i>C</i> | <i>D</i> | <i>E</i> | <i>O</i> |
|----------|----------|----------|----------|----------|----------|----------|
| <i>A</i> | –        | 1        | 1        | 1        | 0        | 2        |
| <i>B</i> | 1        | –        | 0        | 1        | 1        | 1        |
| <i>C</i> | 1        | 0        | –        | 1        | 0        | 1        |
| <i>D</i> | 1        | 1        | 1        | –        | 0        | 1        |
| <i>E</i> | 0        | 1        | 0        | 0        | –        | 1        |
| <i>O</i> | 2        | 1        | 1        | 1        | 1        | –        |

- (b) Degree of room  $A = 5$   
 Degree of room  $B = 4$   
 Degree of room  $C = 3$   
 Degree of room  $D = 4$   
 Degree of room  $E = 2$   
 Degree of outside = 6

It is not possible to Bob to start outside, then inspect every doorway, and finish outside the building. For this to occur, the degree for each of the rooms (vertices) would need to be even. Here we have two odd vertices.

### QUESTION 29

- (a) When 200 units are produced and sold the company will break even.
- (b) When the company breaks even, costs are \$3000.
- (c) The gradient of the cost line is  $\frac{17}{4}$  or 4.25. This means that each item costs \$4.25 to produce.
- (d) When  $n = 360$ ,

$$\begin{aligned} \text{Cost} &= 2150 + \frac{17(360)}{4} \\ &= \$3680 \end{aligned}$$

$$\begin{aligned} \text{Income} &= 15(360) \\ &= \$5400 \end{aligned}$$

$$\begin{aligned} \therefore \text{Profit} &= 5400 - 3680 \\ &= \$1720 \end{aligned}$$

### QUESTION 30

$$\begin{aligned} \text{Future value} &= 120 \times 104.07 \\ &= \$12\,488.40 \end{aligned}$$

### QUESTION 31

- (a) Equation is  $C = kn$   
 When  $n = 185$ ,  $C = 4995$ .  
 $4995 = k \times 185$   
 $185k = 4995$   
 $k = 27$

$$\therefore \text{Equation is } C = 27n$$

- (b) The value of  $k$  represents the share price. In this case, the price is \$27 per share.
- (c) When  $n = 800$ ,  
 $C = 27 \times 800$   
 $= 21600$

$\therefore$  It would cost \$21 600 to purchase 800 shares under this plan.

## QUESTION 32

(a)  $\text{Cost} = 15 + 23$   
 $= \$38$

(b) Starting from *R*, travelling one vertex away, possible options are:

|           |    |
|-----------|----|
| <i>RS</i> | 15 |
| <i>RT</i> | 9  |
| <i>RU</i> | 10 |

Starting from *R*, travelling two vertices away, possible options are:

|            |           |
|------------|-----------|
| <i>RST</i> | 24        |
| <i>RSV</i> | 29        |
| <i>RSW</i> | <b>38</b> |
| <i>RTS</i> | 18        |
| <i>RTV</i> | 23        |
| <i>RTU</i> | 20        |
| <i>RUT</i> | 21        |
| <i>RUV</i> | 22        |
| <i>RUW</i> | <b>35</b> |

Of these, the smallest cost is \$35, using route *RUW*.

For the routes that have not yet reached Wentworth, we look at those which are less than \$35.

Starting from *R*, travelling three vertices away, possible options are:

|             |           |
|-------------|-----------|
| <i>RSTU</i> | 35        |
| <i>RSTV</i> | 38        |
| <i>RSVU</i> | 41        |
| <i>RSVW</i> | <b>40</b> |
| <i>RTSV</i> | 32        |
| <i>RTSW</i> | <b>41</b> |
| <i>RTVS</i> | 37        |
| <i>RTVU</i> | 35        |
| <i>RTVW</i> | <b>34</b> |
| <i>RTUV</i> | 32        |
| <i>RTUW</i> | <b>45</b> |
| <i>RUTS</i> | 30        |
| <i>RUTV</i> | 35        |
| <i>RUVS</i> | 36        |
| <i>RUVW</i> | <b>33</b> |

Of these, the smallest cost is \$33, using route *RUVW*.

For the routes that have not yet reached Wentworth, we look at those which are less than \$33.

Starting from *R*, travelling four vertices away, possible options are:

|              |           |
|--------------|-----------|
| <i>RTSVU</i> | 44        |
| <i>RTSVW</i> | <b>43</b> |
| <i>RTUVS</i> | 46        |
| <i>RTUVW</i> | <b>43</b> |
| <i>RUTSV</i> | 44        |
| <i>RUTSW</i> | <b>53</b> |

All these routes cost more than \$33.

∴ The cheapest route from Roseby to Wentworth costs \$33 and passes through Upton and Vineyard.

### QUESTION 33

(a) Standard deviation =  $80 - 68$   
= 12

(b) Percentage =  $\frac{1}{2}(95 - 68)$   
= 13.5%

$\therefore$  Number of students = 13.5% of 800  
=  $0.135 \times 800$   
= 108

(c) z-score =  $\frac{x - \mu}{s}$   
=  $\frac{62 - 68}{12}$   
=  $\frac{-6}{12}$   
= -0.5

(d) Percentage =  $50 + \frac{1}{2} \times 68$   
= 84%

$\therefore$  The probability of a student with a weight less than 80 kg is 84% or  $\frac{21}{25}$ .

### QUESTION 34

(a) Using the straight line method:

$$S = V_0 - Dn$$
$$9213 = 15000 - D(3)$$
$$9213 = 15000 - 3D$$
$$3D = 5787$$
$$D = 1929$$

$\therefore$  The annual amount of depreciation is \$1929.

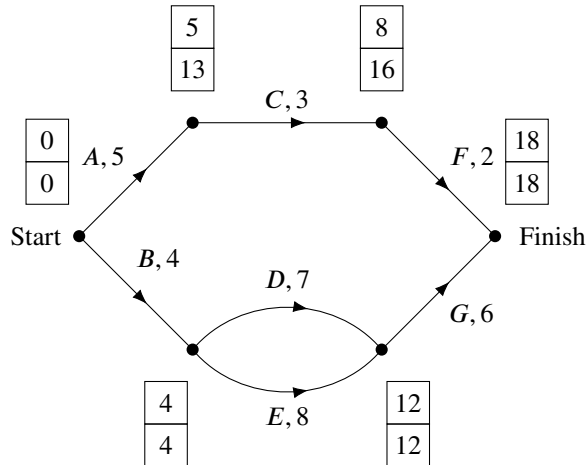
(b) Using the declining balance method:

$$S = V_0(1 - r)^n$$
$$9213 = 15000(1 - r)^3$$
$$0.6142 = (1 - r)^3$$
$$(1 - r)^3 = 0.6142$$
$$1 - r = \sqrt[3]{0.6142}$$
$$= 0.8500346007$$
$$r = 0.1499653994$$

$\therefore$  The annual rate of depreciation is approximately 15%.

### QUESTION 35

(a)



(b) See diagram above for ESTs and LSTs.

$\therefore$  Minimum completion time = 18 days

(c) Float time for activity  $D = 12 - 4 - 7$   
 $= 1$  day

### QUESTION 36

(a)  $c = 31$  and  $m = 0.64$

The equation of the line of best fit is  $y = 31 - 0.64x$

(b) The value of  $m$  represents the expected rate that the candle burns. In this case we expect a candle to burn at approximately 0.64 cm per hour.

(c) After 50 hours,

$$y = 31 - 0.64(50)$$

$$= -1$$

$\therefore$  We expect a candle to burn out before 50 hours. The manufacturer should not make this claim.

**or**

When the candle burns out it has 0 cm remaining.

When  $y = 0$ ,

$$0 = 31 - 0.64x$$

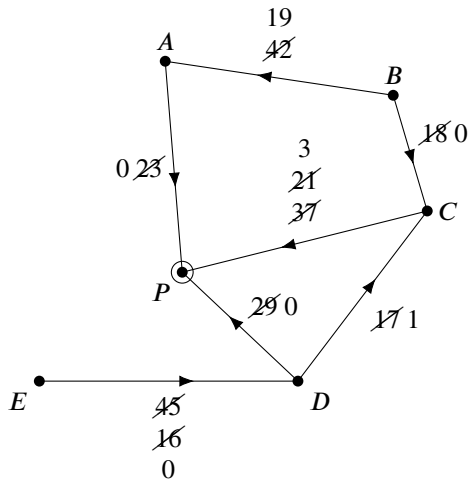
$$0.64x = 31$$

$$x = 48.4375$$

$\therefore$  We expect a candle to burn out before 50 hours. The manufacturer should not make this claim.

### QUESTION 37

- (a)  $B$  and  $E$  represent the arrival gates.  
 (b) Value of cut =  $45 + 53 + 23 + 37$   
 = 158  
 (c)



Possible routes are:

|               |    |
|---------------|----|
| $EDP$         | 29 |
| $EDCP$        | 16 |
| $BAP$         | 23 |
| $BCP$         | 18 |
| Maximum flow: | 86 |

$\therefore$  The maximum flow with the obstruction is 86 passengers per minute.

### QUESTION 38

- (a)
- |                |                |                      |                      |   |   |
|----------------|----------------|----------------------|----------------------|---|---|
| $\frac{7}{12}$ | Black          | $\frac{6}{11}$ Black | $BB$                 | $\frac{7}{12} \times \frac{6}{11} = \frac{7}{22}$   |   |
|                |                | $\frac{5}{11}$ White | $BW$                 | $\frac{7}{12} \times \frac{5}{11} = \frac{35}{132}$ |   |
|                | $\frac{5}{12}$ | White                | $\frac{7}{11}$ Black | $WB$  | $\frac{5}{12} \times \frac{7}{11} = \frac{35}{132}$ |
|                |                |                      | $\frac{4}{11}$ White | $WW$  | $\frac{5}{12} \times \frac{4}{11} = \frac{5}{33}$   |

$$P(\text{socks same colour}) = \frac{7}{22} + \frac{5}{33}$$

$$= \frac{31}{66}$$

(b) Let  $n$  be the number of black socks added to the drawer.

Now there are  $n + 7$  black socks in the drawer.

Since we started with 12 socks and 8 socks are added, we have a total of 20 socks in the drawer.

We need:

$$\frac{n + 7}{20} = \frac{3}{5}$$

$$5(n + 7) = 60$$

$$5n + 35 = 60$$

$$5n = 25$$

$$n = 5$$

$\therefore$  5 black socks and 3 white socks were added to the drawer.