A C E
EXAM
PAPER

Student name: _____

PAPER 3

YEAR 12
YEARLY
EXAMINATION

Mathematics Standard 2

General Instructions

- Working time - 150 minutes
- Write using black pen
- NESA approved calculators may be used
- A reference sheet is provided at the back of this paper
- For questions in Section II, show relevant mathematical reasoning and/or calculations

Total marks: 100

Section I – 15 marks

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

Section II – 85 marks

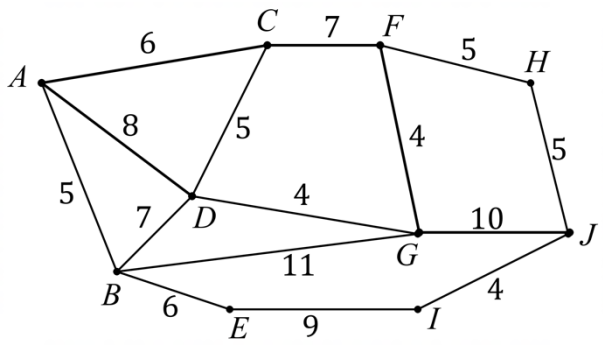
- Attempt all questions in Section II
- Allow about 2 hours and 5 minutes for this section

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

1. The network diagram below shows the kilometres between towns.



What is length of the shortest path from *A* to *J*?

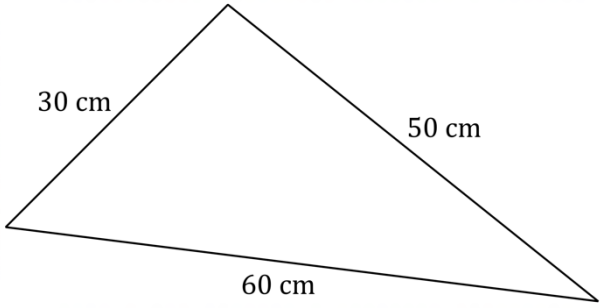
(A) 21 km

(B) 22 km

(C) 23 km

(D) 24 km

2. The following triangle has sides 30 cm, 50 cm and 60 cm.



Not to scale

Angle *C* is the largest angle. Which of the following expressions is correct for angle *C*?

(A) $\cos\angle C = \dfrac{50^2 + 30^2 - 60^2}{2 \times 50 \times 30}$

(B) $\cos\angle C = \dfrac{30^2 + 60^2 - 50^2}{2 \times 30 \times 60}$

(C) $\cos\angle C = \dfrac{50^2 + 60^2 - 350^2}{2 \times 50 \times 60}$

(D) $\cos\angle C = \dfrac{50^2 + 30^2 - 60^2}{2 \times 50 \times 60}$

3. The scale on an aerial photograph is given as 1 mm = 200 m. If the length of land is 350 m, what is the map length between these points?

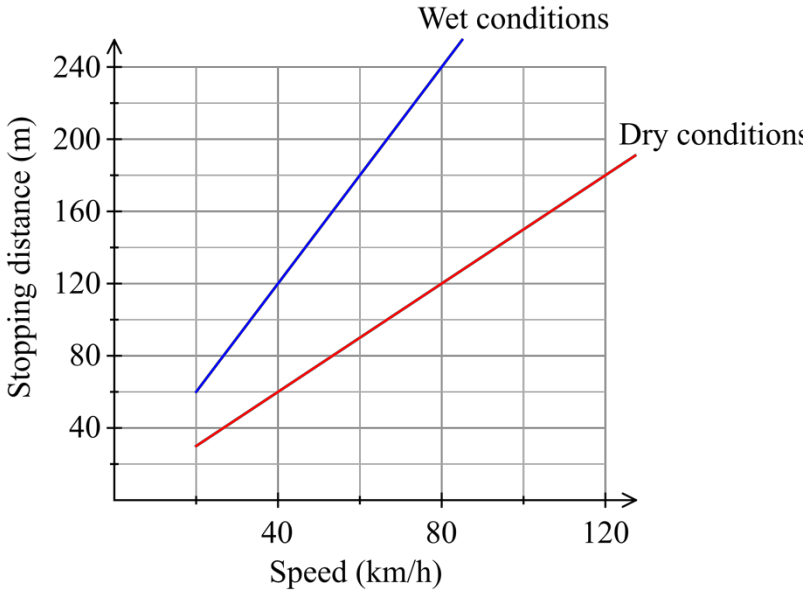
(A) 0.25 mm

(B) 0.57 mm

(C) 1.75 mm

(D) 2.00 cm

4. The graph below shows the stopping distance for a car travelling at speeds greater than 20 km/h.



Zoe is driving at 80 km/h on a dry road. If the road was wet, by how much (in km/h) should Zoe reduce her speed in order to keep the same stopping stance?

(A) 40

(B) 55

(C) 80

(D) 120

5. The number of residents at Ashcroft is expected to increase using the formula $N = 3000t^3$, where N is the number of residents and t is the time in years. What is the expected number of residents of Ashcroft after three years?

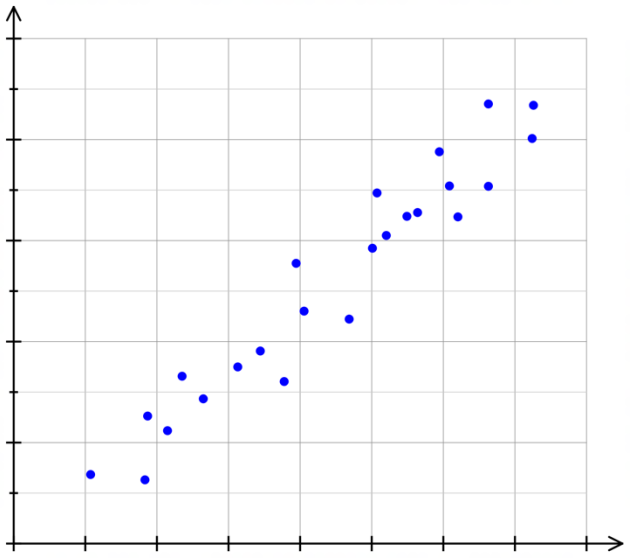
(A) 9000

(B) 27 000

(C) 78 000

(D) 81 000

6.



What is the correlation between the variables in this scatterplot?

(A) Weak negative

(B) Weak Positive

(C) Moderate negative

(D) Moderate positive

7. Grace and William purchased a campervan for $87 500. It depreciates at 16% per year. How much has the campervan depreciated over four years?

(A) $31 500.00

(B) $43 563.74

(C) $43 936.26

(D) $56 000.00

8. Which of the following is the best price for a litre of petrol?

(A) $1.36 for 1 L

(B) $2.00 for 1.75 L

(C) $1.50for 0.75 L

(D) $1.00 for 750 mL

9. What is the point of intersection of the lines $y = x + 3$ and $y = -x + 3$?

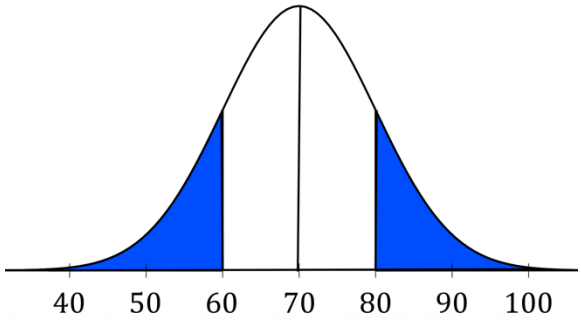
(A) $(0, 0)$

(B) $(3, 0)$

(C) $(0, 3)$

(D) $(3, 3)$

10. The normal distribution shows the results of a mathematics assessment task. It has a mean of 70 and a standard deviation of 10



What percentage of results lie in the shaded region?

(A) 16%

(B) 32%

(C) 34%

(D) 68%

11. The table below shows the present value of a $1 annuity.

Present value of $1				
End of year	3%	4%	5%	6%
5	4.5797	4.4518	4.3295	4.2124
6	5.4172	5.2421	5.0757	4.9173
7	6.2303	6.0021	5.7864	5.5824
8	7.0197	6.7327	6.4632	6.2098

What is the present value of an annuity where $12,000 is contributed each year for six years into an account earning 3% per annum compound interest?

(A) $15 183.83

(B) $54 956.40

(C) $65 006.40

(D) $72 000.00

12. A bank charges 0.07751% compound interest per day on the amount owing on a credit card. What is the interest charged in four weeks on a balance of $3500?

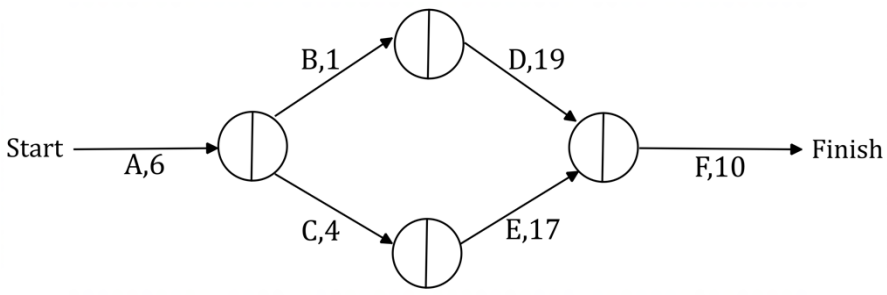
(A) $10.86

(B) $76.76

(C) $1217.95

(D) $24 805.10

13.



What is the critical path in the above network?

(A) *ABDF*

(B) *ABEF*

(C) *ACDF*

(D) *ACEF*

14. Aiden class achieved a 72% mean and 8% standard deviation for their project work. What was Aiden's mark if he achieved a z-score of –2.5?

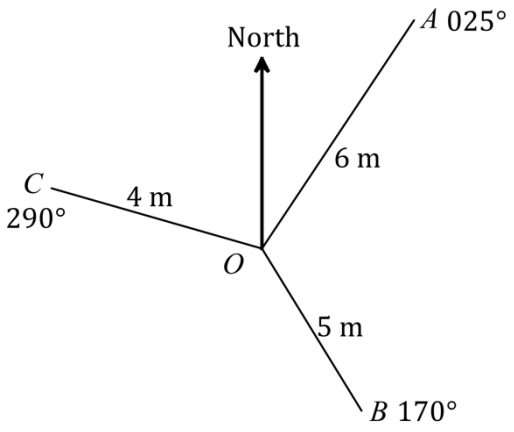
(A) 52%

(B) 64%

(C) 80%

(D) 92%

15. A radial survey is shown below.



Not to scale

Find the area of ΔAOC correct to the nearest square metre.

(A) 5 m^2

(B) 9 m^2

(C) 11 m^2

(D) 12 m^2

Section II

85 marks
Attempt all questions
Allow about 2 hours and 5 minutes for this section

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

Question 16 (2 marks) **Marks**

The variables profit made and amount spent on advertising are strongly correlated with a correlation coefficient $r = 0.9$. What conclusions can you draw from this information? **2**

Question 17 (4 marks)

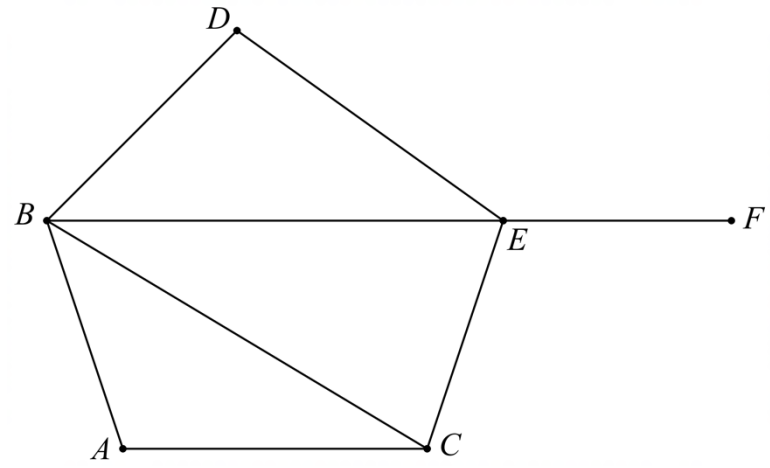
Stella uses the declining balance method to calculate the depreciation of her office computers every six months. The current value of her computers is \$9200 and the depreciation rate is 24% p.a.

(a) What will be the value of the computers after 3.5 years? Answer correct to the nearest cent. **2**

(b) When will the computers have a salvage value of \$2000? Answer correct to the nearest whole number. **2**

Question 18 (4 marks) **Marks**

Consider the following network.



(a) How many edges are there? **1**

(b) How vertices have degree 3? **1**

(c) Is this a connected graph? Justify your answer. **1**

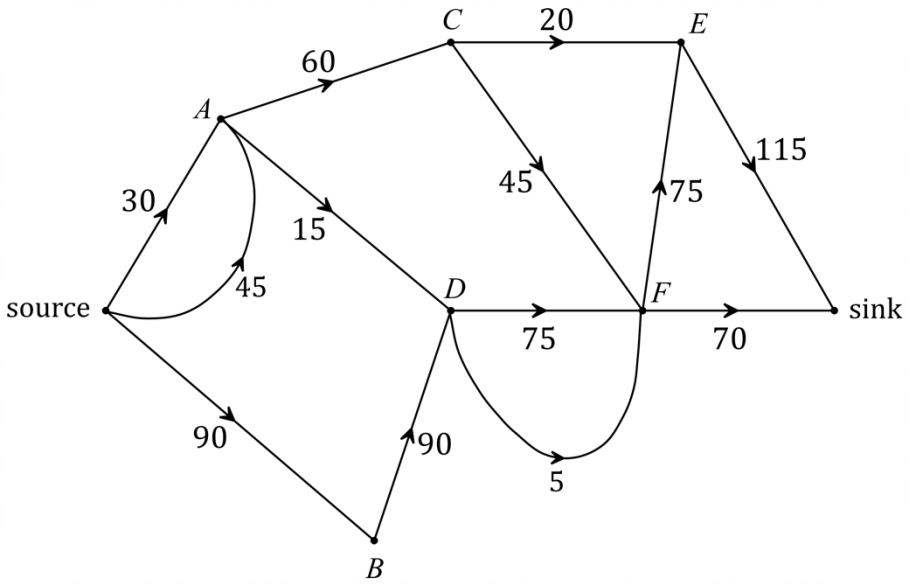
(d) List three different cycles that begin at vertex *D*? **1**

Question 19 (2 marks)

Ann uses a 900W microwave for a total of 36 hours. What is the cost of using the microwave if electricity is \$0.2435 per kWh? **2**

Question 20 (4 marks) **Marks**

The network diagram below shows the flow of water (in litres) through a series of pipes from the source to the sink.



(a) What is the outflow of vertex *C*? **1**

(b) Find the minimum cut for this network **2**

(c) What is the maximum flow for this network? **1**

Question 21 (2 marks) **Marks**

The age of an investment (n) in years is linked by a line of fit to its current value (v) in \$1000 by $v = 21 + 3n$. Use this equation to predict the:

(a) Value of the investment after three years. **1**

(b) Age of the investment if its value is \$48 000. **1**

Question 22 (3 marks)

A table for \$350 000 at 5.4% p.a. reducible interest is shown below.

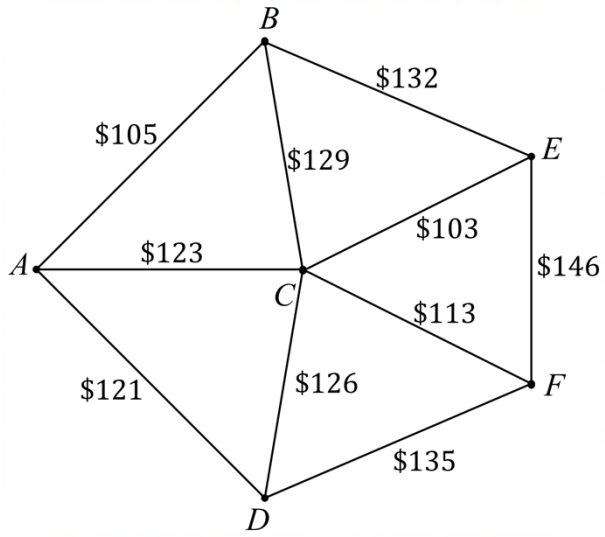
Loan period in years	15	20	25	30
Monthly repayments	\$2737	\$2370	\$2167	\$2046

(a) Find the total amount to be repaid if the loan is taken over 20 years. **1**

(b) How much extra is repaid if the loan is taken over 25 years rather than 20 years? **2**

Question 23 (4 marks) **Marks**

The network diagram below shows the cost to lay pipes to certain parts of a garden.



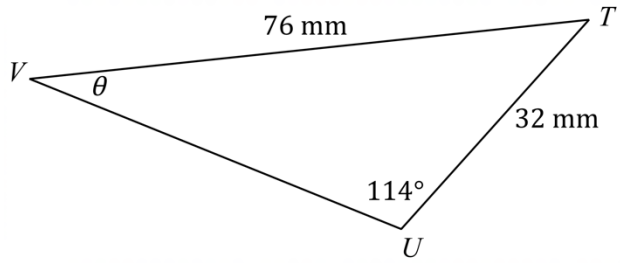
(a) Draw a network table to represent the network. **1**

(b) Draw a minimum spanning tree that will ensure all parts of the garden are connected by pipes, but also minimises the amount of pipes required. **2**

(c) What is the minimum cost of pipes to connect all parts of the garden? **1**

Question 24 (3 marks) **Marks**

ΔTUV has sides TU = 32 mm, TV = 76 mm and $\angle TUV = 114°$



Not to scale

(a) What is the size of $\angle UVT$? Give your answer to the nearest degree. **1**

(b) What is the area of ΔTUV? Answer to the nearest square millimetre. **2**

Question 25 (3 marks)

(a) Tom invests \$9 000 over 5 years at a compound interest rate of 4.6%p.a. Calculate the future value after 5 years. Answer correct to the nearest cent. **1**

(b) Calculate the present value of an annuity whose future value is \$480,000 over 8 years with an interest rate of 8.2% per annum compounded monthly. Answer correct to the nearest cent. **2**

Question 26 (3 marks) **Marks**

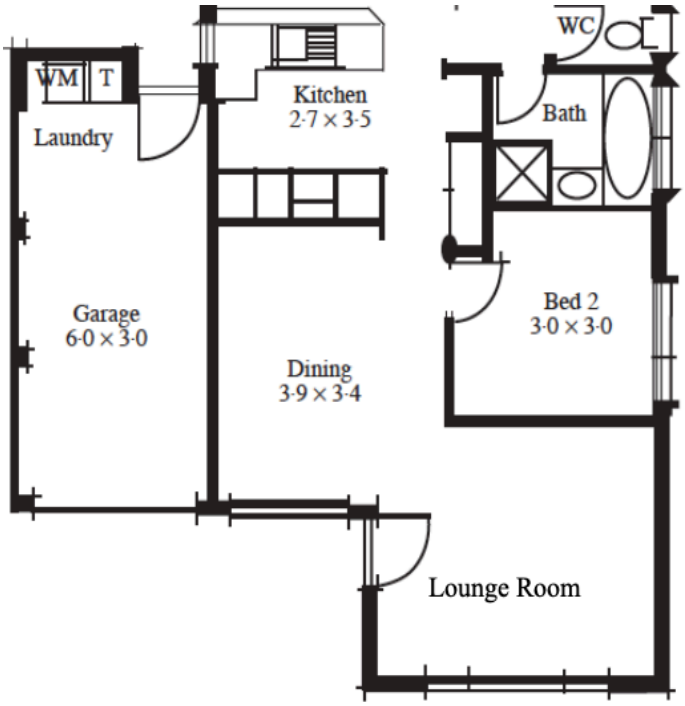
The time taken (t) to fit insulation in a school varies inversely with the number (n) of people employed. It takes 5 people 2 days to fit insulation in a school.

(a) How long does it take 4 people to fit the same insulation in the school? **2**

(b) How many people are required to fit the insulation in 1 day? **1**

Question 27 (4 marks)

Part of a building plan is shown below. All dimensions are in metres.



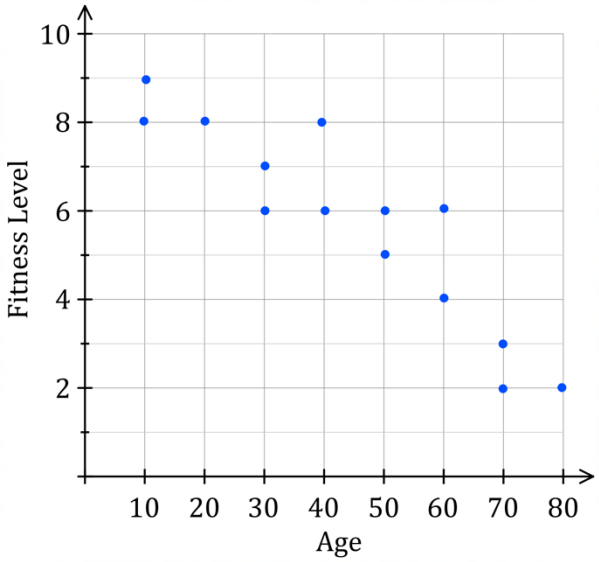
(a) By measurement, estimate a scale for this plan. **1**

(b) Calculate the area of the lounge room. Answer to the nearest m^2. **2**

(c) What is the approximate cost of carpeting the lounge room if the cost of the carpet is \$150 per square metre? **1**

Question 28 (5 marks) **Marks**

The scatterplot below shows the relationship between age and fitness level.



(a) Draw a line of best fit on the scatterplot. Find the gradient of this line. **2**

(b) Lachlan is 30 years old. What is his expected fitness level? **1**

(c) Calculate the value of the Pearson's correlation coefficient. Answer correct to two decimal places. **2**

Question 29 (2 marks)

Ben bought 1500 shares for $1.70 each. In July he received a dividend of 24 cents per share.

(a) How much did Ben receive in dividends? **1**

(b) In July the market value of the shares was $1.80 per share. **1**
What is the dividend yield? Answer correct to one decimal place.

Question 30 (2 marks) **Marks**

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

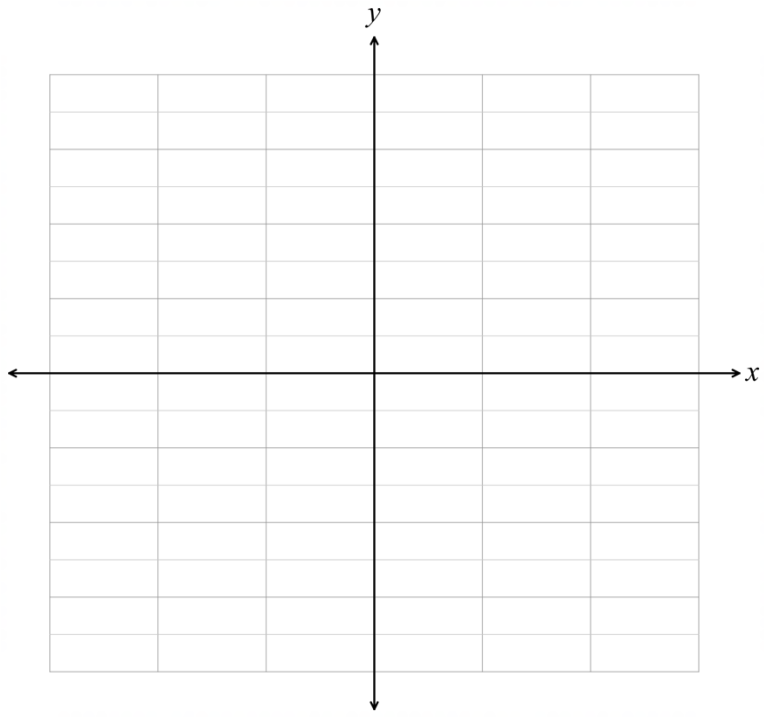
(a) Quality control requires any aluminium rod with a z-score less than –1 to be rejected. What is the minimum weight that will be accepted? **1**

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

Question 31 (3 marks)

Draw the graph of $y = 2^{-x}$ by completing the table of values. **3**

x	–3	–2	–1	0	1	2	3
y							



Question 32 (2 marks) **Marks**

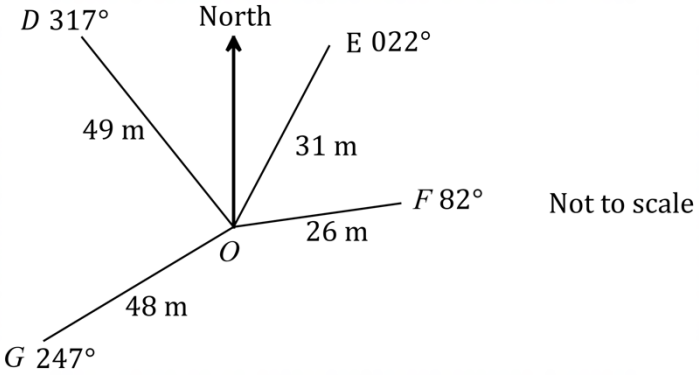
2

	A	*B*	*C*	*D*	*E*
A	–	1	–	5	4
B	1	–	3	–	–
C	–	3	–	2	6
D	5	–	2	–	7
E	4	–	6	7	–

Represent the table shown above as a weighted network.

Question 33 (3 marks)

A radial survey of land *DEFG* is shown below



(a) What is the size of $\angle DOG$? **1**

(b) What is the length of *DG* correct to the nearest metre? **2**

Question 34 (2 marks) **Marks**

The table below shows the future value of a $1 annuity.

Future value of $1				
End of year	4%	6%	8%	10%
1	1.00	1.00	1.00	1.00
2	2.04	2.06	2.08	2.10
3	3.12	3.18	3.25	3.31
4	4.25	4.37	4.51	4.64

(a) What would be the future value of a $32 000 per year annuity at 8% per annum for 4 years, with interest compounding annually? **1**

(b) An annuity of $6300 is invested every six months at 8% per annum, compounded biannually for 2 years. What is the future value of the annuity? **1**

Question 35 (2 marks)

What is the gradient of the line that passes through the points (−3, 0) and (0, 6)? **2**

Question 36 (2 marks)

The angle of depression from a roof of a building to a car is 77°. What is the distance of the car from the foot of the building, if the roof is 10 m above the ground? Answer correct to two decimal places. **2**

Question 37 (6 marks) **Marks**

A manufacture sells digital cameras to retail outlets. The income received is calculated using the formula $I = 80n$ where n is the number of cameras sold. Costs associated will selling the digital cameras are calculated using the formula $C = 20n + 1500$.

(a) What are the fixed costs if there are no digital cameras manufactured? **1**

(b) What is the income from selling 400 cameras to retail outlets? **1**

(c) What is the cost of manufacturing 400 cameras? **1**

(d) What profit does the manufacturer make if 400 cameras are sold? **1**

(e) How many cameras need to be sold to break-even? **2**

Question 38 (3 marks) **Marks**

Alice's credit card statement for April shows an opening balance of \$8 400, a purchase of \$780 on April 5, and another of \$250 on April 15. The minimum payment each month is 3% on the closing balance. The credit card has a compound interest rate of 24% p.a.

(a) What is closing balance on this credit card for April? **1**

(b) What is the minimum payment required for the month of April? **1**

(c) Calculate the amount owing at the end of May if Alice paid the minimum amount for April and made no purchases in May? **1**

Question 39 (2 marks)

Construct a recurrence relation in the form $V_{n+1} = V_n \times (1 + r) - D$ to model the balance of a loan of \$58 000 borrowed at 6% per annum, compounding monthly, with payments of \$810 per month. **2**

Question 40 (5 marks) **Marks**

Activity	*Duration (min)*	*Immediate predecessors*
A	7	–
B	2	–
C	12	*A*
D	9	*B*
E	22	*B*
F	17	*C, D*
G	4	*E*
H	12	*E*
I	8	*F, G*
J	5	*H*

(a) Construct a network diagram using the activity chart. Show the earliest starting times (EST) and latest starting times (LST). **3**

(b) What is the critical path? **1**

(c) What is the minimum time needed to complete the project? **1**

Question 41 (4 marks) **Marks**

The table below shows the mean and standard deviation of the times at a 100 metre freestyle race. The times are normally distributed.

	Mean	*Standard deviation*
Female	61.5	3.6
Male	59.2	5.8

(a) Victoria swims the 100 metre freestyle in 54.3 seconds. What is Victoria's z-score? **1**

(b) Edward swims the 100 metre freestyle in 53.4 seconds. What percentage of males had a lesser time than Edward? **2**

(c) Which swimmer performed better in comparison to the other swimmers of their respective gender? Justify your answer. **1**

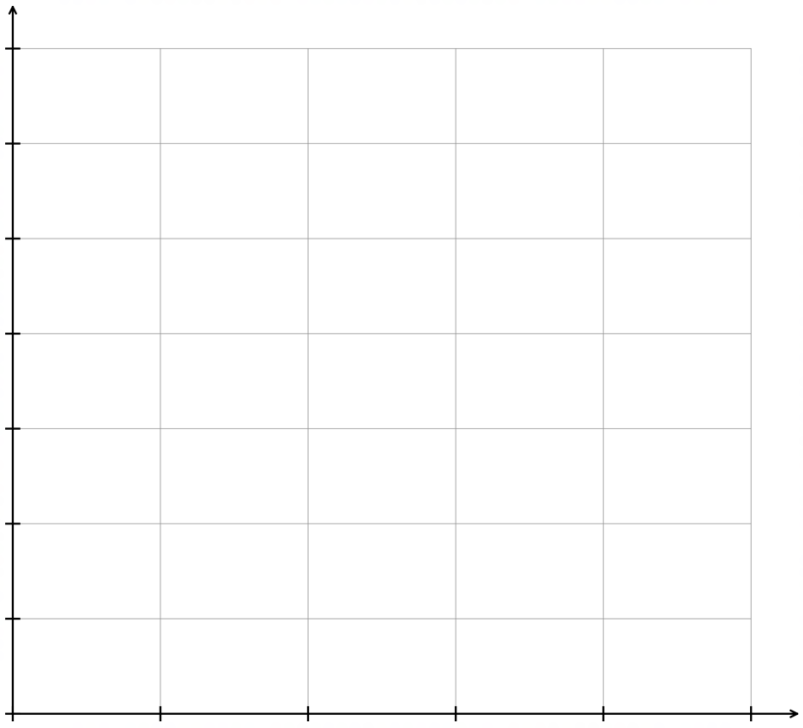
Question 42 (4 marks) **Marks**

The relationship between speed (s) and time (t) is modelled by $s = t^2 - 5t + 7$.

(a) Complete the following table of values. **1**

Time (t)	0	1	2	3	4	5
Speed (s)						

(b) Draw a number plane with t as the horizontal axis and s as the vertical axis. Plot the points and join them to make a parabola. **1**



(c) What time achieves the lowest speed? **1**

(d) What was the lowest speed? **1**

End of paper

NSW Education Standards Authority

HIGHER SCHOOL CERTIFICATE EXAMINATION

Mathematics Standard 1
Mathematics Standard 2

REFERENCE SHEET

Measurement

Precision

Absolute error = $\frac{1}{2} \times$ precision

Upper bound = measurement + absolute error

Lower bound = measurement – absolute error

Length, area, surface area and volume

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

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

$$A = \frac{h}{2}\left(x + y\right)$$

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

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

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

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

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

Trigonometry

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

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

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

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

Financial Mathematics

$$FV = PV\left(1 + r\right)^n$$

Straight-line method of depreciation

$$S = V_0 - Dn$$

Declining-balance method of depreciation

$$S = V_0\left(1 - r\right)^n$$

Statistical Analysis

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

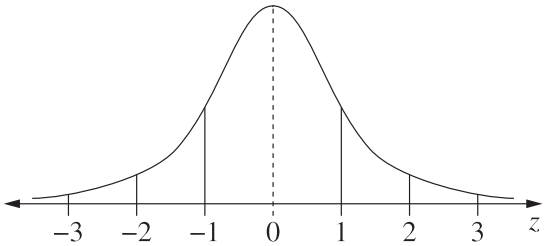
An outlier is a score

less than $Q_1 - 1.5 \times IQR$

or

more than $Q_3 + 1.5 \times IQR$

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