Name: _____

MEREWETHER
HIGH SCHOOL

2021 YEAR 12 TRIAL HSC

Mathematics Standard 2

General Instructions:

- Reading time – 10 minutes
- Working time – 2 hours and 30 minutes
- Write using black pen
- Calculators approved by NESA may be used
- A reference sheet is provided
- For questions in Section II, show relevant mathematical reasoning and/or calculations

Total marks : 100

Section I – 15 marks (pages 2 – 8)

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

Section II – 85 marks (pages 9 – 32)

- Attempt Questions 16 – 44
- 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 A survey asked the following question: "What is your favourite ice-cream flavour?" How would the responses be classified?

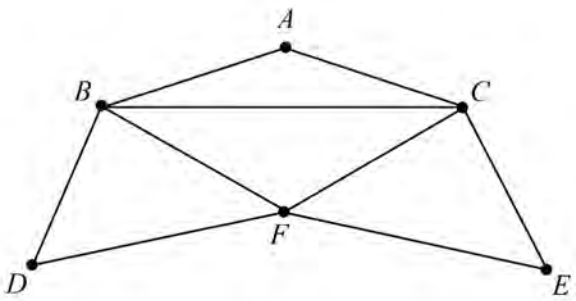
A. Categorical, ordinal

B. Categorical, nominal

C. Quantitative, discrete

D. Quantitative, continuous

2 The graph below shows a network.



The walk A-B-C-E-F-D is a

A. Trail

B. Path

C. Eulerian trail

D. Eulerian circuit

3 Jake owns a car. Which of the following is included in the cover of compulsory third-party insurance for his car?

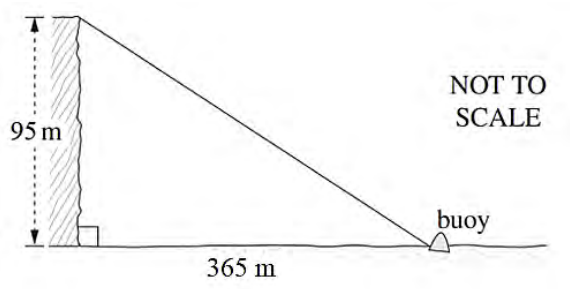
A. The injury to passengers

B. The theft of his car

C. Damage to his own car

D. Damage to another driver's car

4 A buoy is placed 365 metres from the base of a cliff that is 95 metres above sea level.



The angle of depression, in degrees and minutes, from the top of the cliff to the buoy is

A. $14^\circ 59'$

B. $75^\circ 41'$

C. $14^\circ 35'$

D. $75^\circ 25'$

5 Which of the following events has a probability of $\frac{1}{4}$?

A. Rolling a 4 on a standard six-sided die.

B. Choosing a boy from a class that consists of 10 boys and 30 girls.

C. Selecting 'October' when choosing a calendar month at random.

D. Choosing a vowel from the word COIL.

6 Heart rate is measured in beats per minute. Maximum heart rate (*MHR*) is calculated using the following formula:

$$MHR = 220 - \text{age}$$

Vivian measures her heart rate by counting her pulse for 25 seconds. She counted a total of 55 beats which is 75% of her *MHR*.

What is Vivian's age?

A. 44 years old

B. 52 years old

C. 60 years old

D. 70 years old

7 The table shows a linear relationship between *X* and *Y*.

X	– 3	– 1	1	3	***p***	10
Y	11	9	7	5	2	***q***

Which of the following are correct values for *p* and *q* in the table?

A. $p = 5$ and $q = 1$

B. $p = 6$ and $q = -2$

C. $p = 7$ and $q = -2$

D. $p = 8$ and $q = 1$

8 A rectangular paddock has a perimeter of 420 metres. If the ratio of its length to width is 4:3, the area of the paddock is

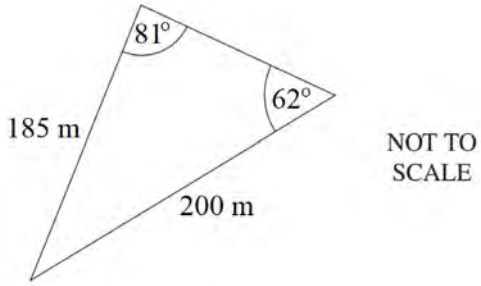
A. 10 800 m^2

B. 21 600 m^2

C. 34 400 m^2

D. 43 200 m^2

9 The diagram below shows a triangle with information.



The area of the triangle, to the nearest square metre, is approximately

A. 18 272 m^2

B. 16 335 m^2

C. 11 134 m^2

D. 10 667 m^2

10 A table of future value interest factors is shown.

Future values of a $1 annuity

Time period	*Interest rate*			
	1%	2%	3%	4%
1	1.0000	1.0000	1.0000	1.0000
2	2.0100	2.0200	2.0300	2.0400
3	3.0301	3.0604	3.0909	3.1216
4	4.0604	4.1216	4.1836	4.2465
5	5.1010	5.2040	5.3091	5.4163
6	6.1520	6.3081	6.4684	6.6330
7	7.2135	7.4343	7.6625	7.8983
8	8.2857	8.5830	8.8923	9.2142

Lilly invests $2000 at the end of every year for 6 years at 3% p.a. compounded annually.

How much interest will Lilly earn on her annuity?

A. $936.80

B. $8974.50

C. $12 936.80

D. $18 191.60

11 The table lists the maximum fortnightly payments for single people on youth allowance.

Your circumstances	**Maximum payment per fortnight**
No children, younger than 18, and live at parent's home	$244.10
No children, 18 years or older, and live at parent's home	$293.60
No children, younger than 18, and need to live away from parent's home	$445.80
No children, 18 years or older, and need to live away from parent's home	$445.80

Geordie is 19 years old and lives with his parents, who have a combined annual taxable income of $68 520. Geordie's annual youth allowance is reduced by 20 cents for every dollar his parent's taxable income exceeds $52 000.

If Georgie is paid for 26 fortnights in a year, which one of the following is his fortnightly youth allowance payment?

A. $127.08

B. $244.10

C. $293.60

D. $166.52

12 A stopwatch measured the time of a 100-metre run to a tenth of a second.
The percentage error of the measurement was 0.49%.

Which ONE of the following could be the time of the 100-metre run?

A. 9.204 seconds

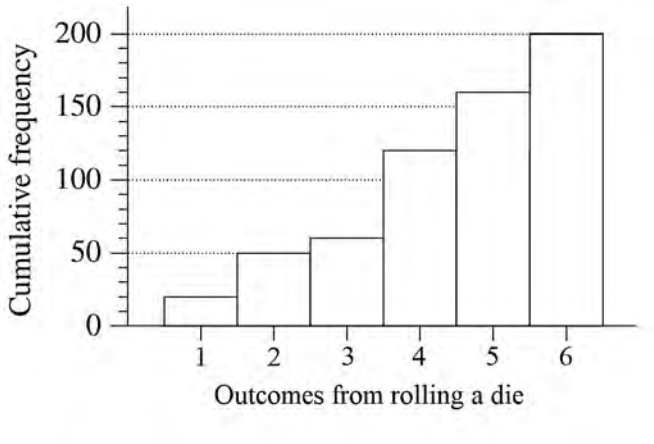
B. 10.204 seconds

C. 11.204 seconds

D. 12.204 seconds

13 A standard die was rolled 200 times and the results recorded.

The graph below displays the cumulative frequency histogram of the data.



What is the relative frequency of rolling a 3?

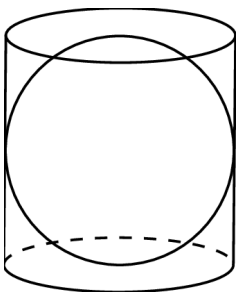
A. 60

B. 0.3

C. 10

D. 0.05

14 A sphere with volume 80 cm^3 fits exactly into a closed cylinder.



Which ONE of the following is the best approximation of the surface area of the closed cylinder?

A. 110 cm^2

B. 121 cm^2

C. 135 cm^2

D. 149 cm^2

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

$$BAC_{Male} = \frac{10N - 7.5H}{6.8M}$$

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.

Brandon, who weighs 75 kg, is planning on having a number of standard drinks on Saturday night. He will begin drinking at 6 pm and will stop drinking at 11 pm. The beers that he will be drinking are 1.5 standard drinks.

How many beers can he consume in full so that when he intends to drive at 11 pm he is below a BAC of 0.05?

A. 3

B. 4

C. 5

D. 6

MEREWETHER
HIGH SCHOOL

2021 Trial HSC Examination

Mathematics Standard 2

Section II – Answer Booklet

Student Name: _____

85 marks
Attempt Question 16 – 44
Allow about 2 hours and 5 minutes for this section

Instructions

- Write your name in the space above.
- 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.
- Extra writing space is provided at the back of this booklet. If you use this space, clearly indicate which question you are answering.

Please turn over

Question 16 (5 marks)

A teacher constructed a back-to-back stem-and-leaf plot of all 28 of her student's results in an exam with a total of 65 marks.

Marks, out of 65, in an exam

Females		*Males*
9	1	1 2 3
9 8 7	2	0 2 2 2 4
6 5 1	3	0 1 7
9 9 5 3	4	6 7
7 2 4	5	2
1	6	

(a) Michael scored 52 marks. What percentage of the exam did he get correct? **1**

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(b) What is the modal mark for the entire class? **1**

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(c) What is the range of the scores from the females? **1**

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(d) The teacher told her students that the females did better than the males in the exam. Is the teacher correct? Justify your answer by referring to the median and skewness of the two sets of data. **2**

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Question 17 (2 marks)

A new computer was purchased for $1155 including 10% GST. Calculate the computer's pre-GST price. **2**

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Question 18 (3 marks)

This table is used to calculate income tax for individuals.

Taxable income ($)	*Tax payable*
$0 – $18 200	Nil
$18 201 – $37 000	19c for each $1 over $18 200
$37 001 – $87 000	$3572 plus 32.5c for each $1 over $37 000
$87 001 – $180 000	$19 822 plus 37c for each $1 over $87 000
$180 001 and over	$54 232 plus 45c for each $1 over $180 000

Tayla earns a gross income of $120 500 and has allowable tax deductions totalling $12 300. The Medicare levy to be paid is 2% of taxable income.
Tayla has already paid $31 600 in PAYG instalments throughout the financial year.

Will Tayla receive a tax refund? Justify your answer with calculations. **3**

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Question 19 (2 marks)

The volume (V) of water, in litres, in a silo is being drained over time (t) minutes can be modelled by the linear relationship: $V = 570 - 25t$.

(a) What is the gradient of the linear relationship and what does it represent? **1**

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(b) After how many minutes will the tank have a third of the initial volume of water? **1**

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Question 20 (2 marks)

Solve the equation $\frac{5x-4}{3} = 2(10-x)$. **2**

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Question 21 (4 marks)

On the 1st of February 2018, Stevie bought 600 shares of a company called *LOL* for a total of $3300, with zero commission.

The table below outlines the market price of the share over the three-year period as well as the date at which the annual dividend is paid and the amount of dividend paid:

Date	*LOL* market price	Activity
01/02/2018	***A***	600 shares purchased
01/02/2019	$12.23	$0.39 dividend paid per share
01/02/2020	$13.76	$0.52 dividend paid per share
01/02/2021	$16.08	$0.49 dividend paid per share
01/02/2021	$16.08	600 shares sold

(a) Calculate the value of *A*. **1**

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(b) Calculate the dividend yield of the dividend paid on the 1st of February 2020. **1**

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(c) Stevie sold all 600 shares on the 1st of February 2021. There was zero commission on the sale of the shares. Calculate the amount of profit Stevie made from investing in the shares. **2**

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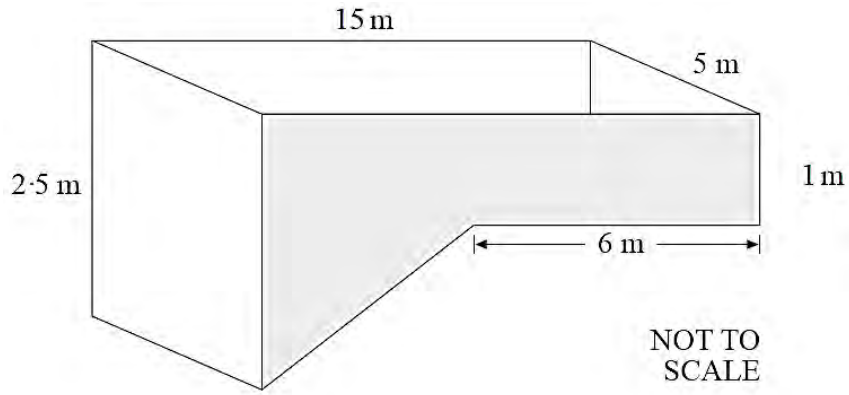
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Question 22 (3 marks)

The diagram shows a swimming pool. The pool is 15 metres long and 5 metres wide and has a shallow end with depth of 1 metre and a deep end with a depth of 2.5 metres. The depth begins to increase at a constant rate 6 metres from the start of the shallow end of the pool.



Calculate the capacity of the pool, in kilolitres. **3**

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Question 23 (2 marks)

Alexis invests $5000 into an investment account that pays 6% p.a. compounded monthly. The investment remains in the account for 18 years.

Calculate the future value of the investment. **2**

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Question 24 (2 marks)

Borja lives in Madrid (UTC +2) and is travelling to Sydney (UTC +10), via a stop-over in Singapore. His flight leaves Madrid on Saturday 17th of July at 9.50 pm local time and arrives into Sydney on Monday 19th July at 9.30 am. The total flying time, excluding the stop-over, is 22 hours.

How long is Borja's stop-over in Singapore? **2**

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Question 25 (2 marks)

Theo drove his car from Newcastle to Canberra. The distance from Newcastle to Canberra is 450 km. Theo's car has a petrol tank capacity of 45L.

Theo filled his car in Newcastle from empty to full. When he arrived in Canberra, the car's petrol tank was $\frac{2}{5}$ full.

(a) What is the fuel economy of Theo's car, in L/100km? **1**

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(b) When Theo was in Canberra, he put $35 worth of petrol into his car that was priced at $1.75 per litre.

How many kilometres could Theo now travel with the additional amount of petrol? **1**

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Question 26 (2 marks)

Sven is a full time employee and works a 35-hour week at rate of $43 per hour.
He receives annual leave loading which is $17\frac{1}{2}$% of four weeks pay.

Calculate Sven's total holiday pay. **2**

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Question 27 (2 marks)

Jen achieved a result of 88% in her Mathematics exam with normally distributed results which recorded a mean of 75%. Her friend received an exam mark of 82% which had a z-score of 1.3.

Calculate the z-score of Jen's mark, to one decimal place. **2**

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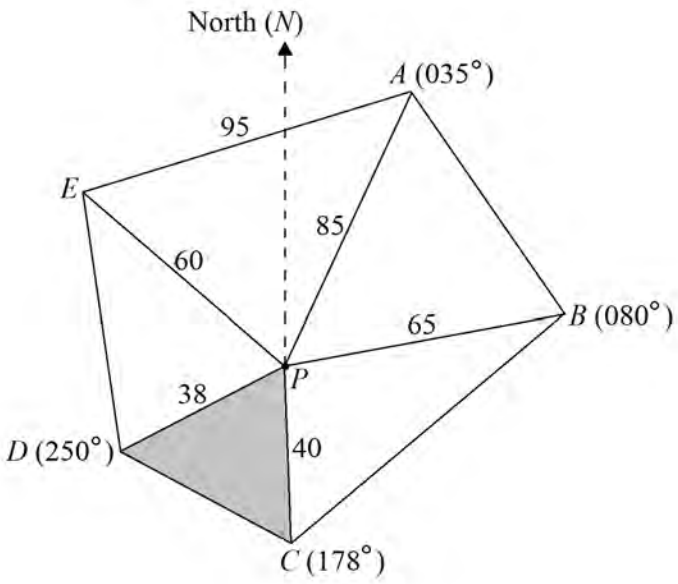
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Question 28 (5 marks)

A radial survey has been undertaken on a proposed construction site *ABCDE*, as shown below.

All measurements are in metres.



The section *PCD* of the site is proposed as a green space.

(a) Use the Cosine rule to determine the distance between *C* and *D*, to the nearest metre. **2**

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(b) Calculate the bearing of *P* from *E*. **3**

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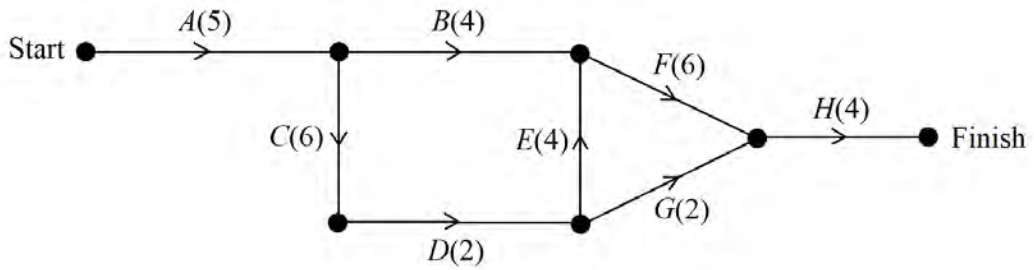
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Question 29 (5 marks)

A project requires the completion of all ten activities *A* to *H*. The network diagram shows the activities and their completion times in hours.



(a) Complete the following activity table: **2**

Activity	Predecessors	Time (in hours)
A		
B		
C		
D		
E		
F		
G		
H		

(b) List the activities which make up the critical path for this activity. **1**

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(c) What is the float time for activity *G*? **1**

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(d) If the project begins at 9am, what is the earliest time that activity *G* can begin? **1**

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Question 30 (3 marks)

The following formula gives the comparison between the dosage (D) of medicine (in millilitres) for a child of age y (years) when compared to an adult's dosage.

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

(a) Change the subject of this formula to A. **2**

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(b) Hence, what is the adult dosage of a particular medicine if an 18-month-old child is given 5 mL? **1**

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Questions 16 – 30 are worth 44 marks in total

Question 31 (2 marks)

A monitor with an energy rating of 5 stars, consumes 218 kwh/year. The same size monitor with an energy rating of 3 stars, consumes *U* kwh/year.

Energy costs are 28.55 cents/kwh.

2

The approximate saving in energy costs over a 10-year period by using the 5 star rated monitor compared to the 3 star rated television was $743. To the nearest kwh, what is the energy consumption per year (*U*) of the 3 star monitor?

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Question 32 (3 marks)

Bradley has a credit card which has no interest free period. Interest is charged at the end of each month at 14.25% per annum, compounded daily from the purchase date (included) to the last day of the month (included). There is a minimum payment of 2.5% of the closing balance after the interest is added.

Bradley started the month of June with a zero balance and made purchases of $250 on the 7th of June and $435.50 on the 21st of June.

Calculate the minimum payment required at the end of June. **3**

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Question 33 (3 marks)

A car was purchased for $60 000 and depreciated by 10% of its value each year for 20 years. After 20 years, the car become a collectable and then appreciated in value by 10% each year for the next 20 years.

(a) What was the car's value after 20 years? **2**

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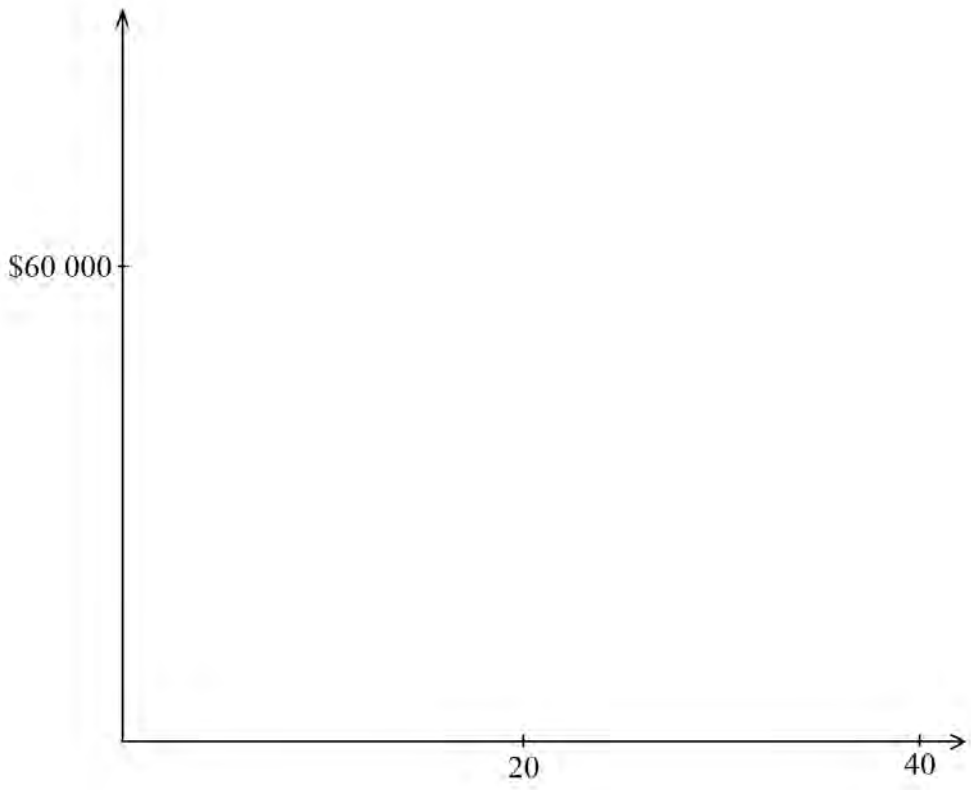
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(b) On the axis below, sketch a possible curve for the value of the car from the year of purchase to 40 years since ownership. **1**

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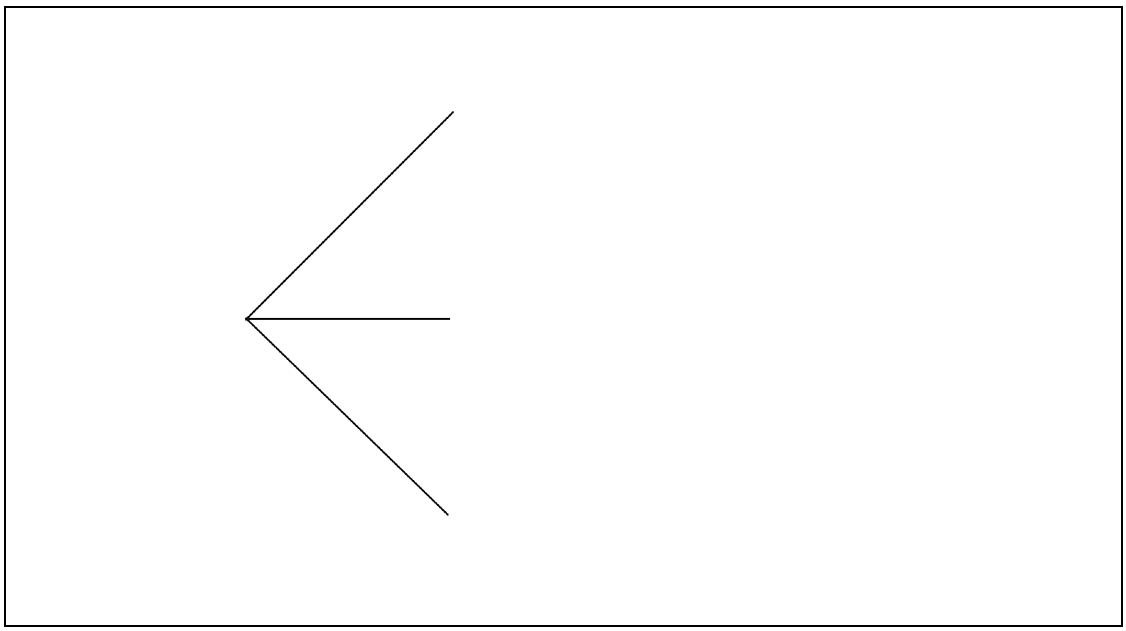
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Question 34 (5 marks)

Ten coloured balls are placed in a bag. Three of the balls are red, five are green and two are yellow. Two balls are selected from random from the bag without replacement.

(a) Construct a tree diagram in the box below to show the outcomes and their probabilities. **2**



(b) Calculate the probability of selecting two red balls. **1**

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(c) Calculate the probability of selecting two balls of different colour. **2**

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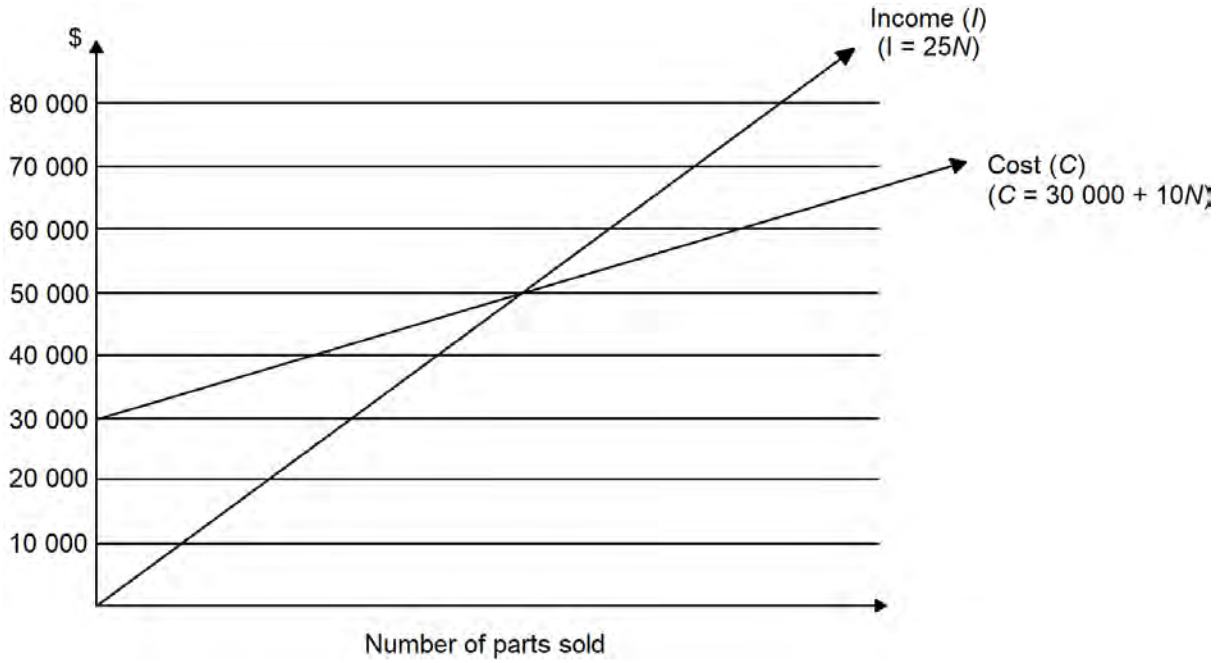
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Question 35 (3 marks)

A manufacturer outlays $30 000 for a machine that produces a part for electric scooters.

The graphs representing the manufacturer's cost (C) and income (I) from the sale of the parts are shown below with their respective equations.



(a) At the break-even point, how many parts are sold? **1**

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(b) How many parts need to be sold for a profit of $90 000 to be made? **2**

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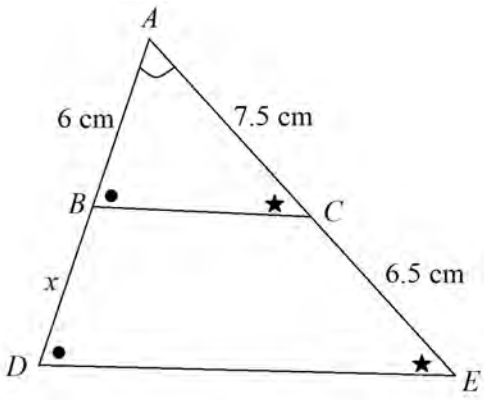
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Question 36 (3 marks)

The diagram below consists of two triangles where ΔABC and ΔADE are similar.

As shown below, AB = 6 cm, AC = 7.5 cm and CE = 6.5 cm.



Calculate the value of x. **3**

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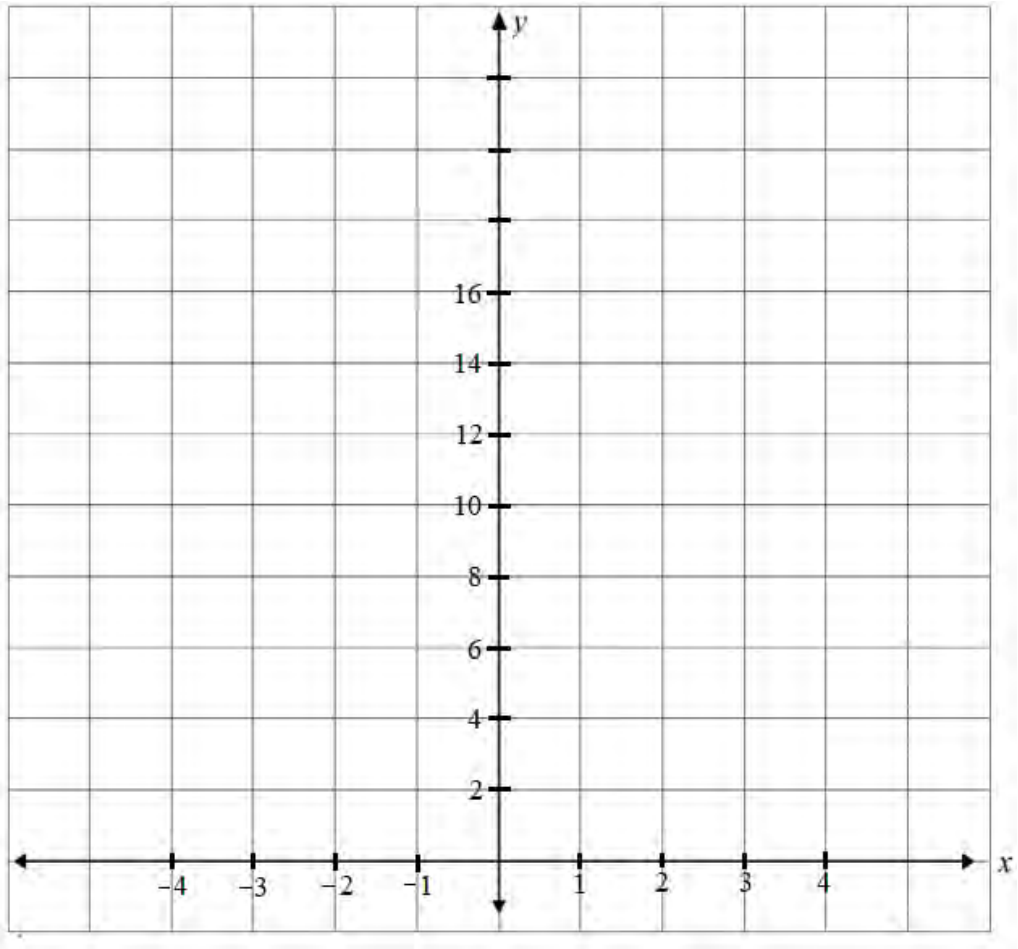
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Question 37 (3 marks)

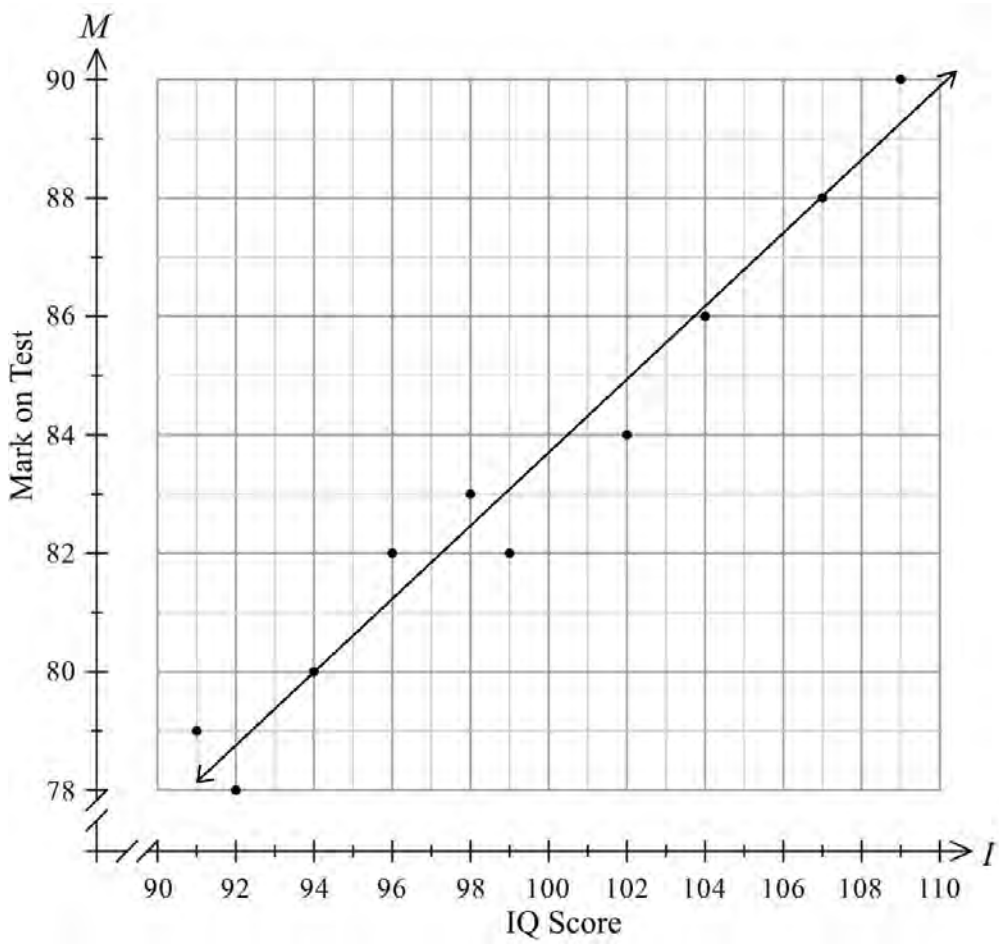
Graph the quadratic function given by $y = x^2 - 2x + 6$, showing all intercepts and vertex. **3**



Question 38 (3 marks)

The bivariate data in the scatterplot below compares the recorded IQ scores of students with their mark on a class test out of 100.

A line of best fit, that passes through (94, 80) and (107, 88) is drawn.



(a) Describe the direction and strength of the relationship between the IQ and marks. **1**

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(b) Write down the equation of the line of best fit that is shown. **2**

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Question 39 (3 marks)

Anna borrows $1000 at an interest rate of 15% per annum, compounded monthly. She intends to repay the loan by making three monthly payments of $335.

The amount left owing on the loan immediately after the nth repayment is given by the recurrence relation

$$A_n = A_{n-1}(1.0125) - 335 \qquad \text{where } n = 1, 2, 3\ldots \text{ and } A_0 = 1000$$

By using the recurrence relation, show that Anna, after the three monthly repayments, still owes $20.36 (to the nearest cent). **3**

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Question 40 (1 mark)

A farmer catches and tags 40 wild pigs on his property. A week later he catches 9 wild pigs and finds that 5 of them are tagged.

Using appropriate calculations, estimate the population of wild pigs on the farmer's property. **1**

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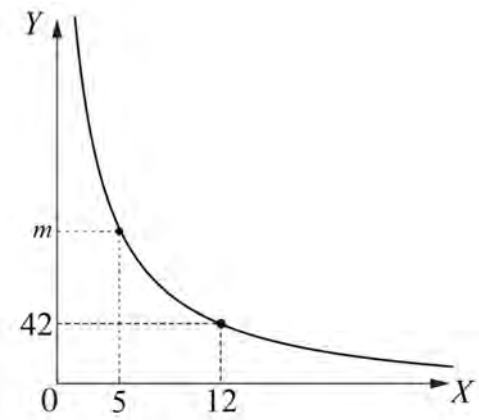
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Question 41 (2 mark)

The variable Y varies inversely with X, as shown in the graph below.

The points (12, 42) and (5, m) lie on the hyperbola.



Find the value of m **2**

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Question 42 (3 marks)

The scale diagram shows an aerial view of a block of land being divided into two equal blocks. The length of the block of land, *AB*, is known to be 50 metres.

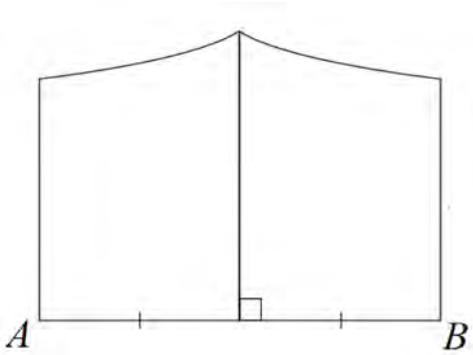


DIAGRAM
TO
SCALE

Calculate the approximate area of the block of land, using two applications of the trapezoidal rule. **3**

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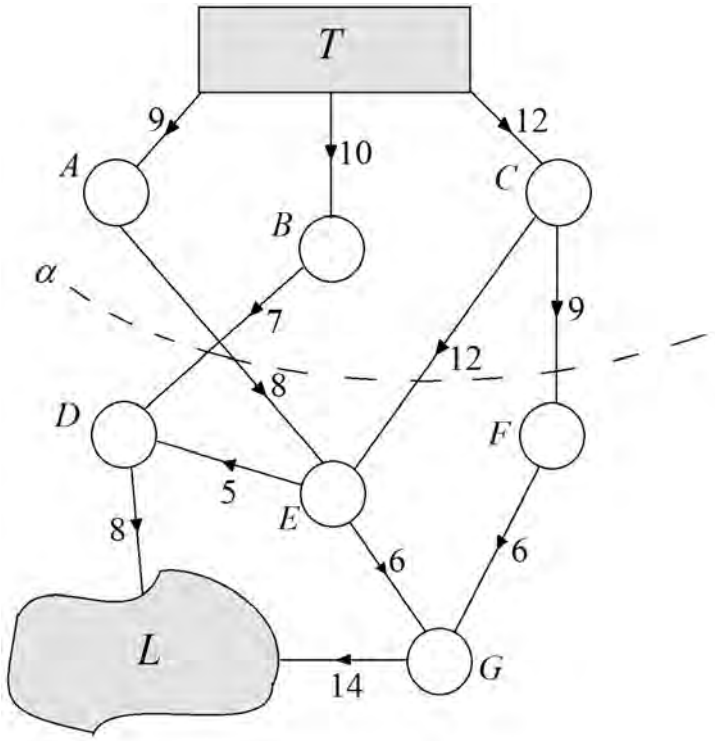
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Question 43 (3 marks)

A water tank (T) supplies water through a network of 12 underground pipes to 7 different points of labelled from A to G. The water then will flow to an artificial lake (L), as seen on the network diagram below. The diagram shows the amount of water in kilolitres per hour that can flow through the pipes at any given time.

α represents a cut through the network of the pipes.



(a) What is the capacity of the cut α shown on the diagram? **1**

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(b) What is the maximum flow of the diagram? **1**

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(c) The capacity of ONE pipe is to be increased to increase the maximum flow of the network. Which pipe capacity should be increased to achieve this result? By how much will this increase the flow of the network? **1**

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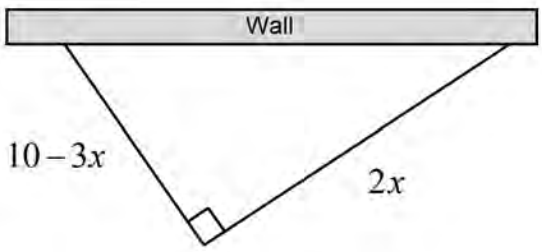
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Question 44 (4 marks)

A concrete slab in the shape of a right angled triangle is to be laid against a wall.

The triangle has base length $2x$ metres and perpendicular height $10-3x$ metres.



By first finding an expression for the area, calculate the maximum area of the triangle. **4**

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End of paper.

Section II extra writing space

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

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NSW Education Standards Authority

2020 **HIGHER SCHOOL CERTIFICATE EXAMINATION**

Mathematics Standard 1
Mathematics Standard 2

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

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

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

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

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

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

Straight-line method of depreciation

$$S = V_0 - Dn$$

Declining-balance method of depreciation

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

Statistical Analysis

An outlier is a score

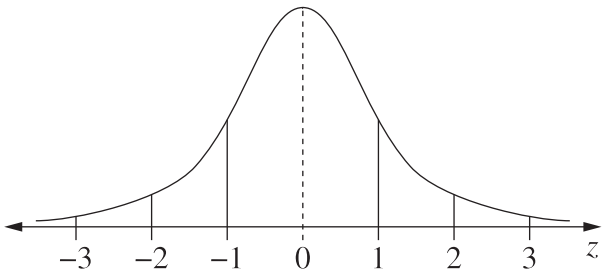
less than $Q_1 - 1.5 \times IQR$

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

Merewether High School 2021

Year 12 Mathematics Standard 2 TRIAL HSC

Multiple Choice Answer Sheet

Name: _____

Shade the most correct answer.

	A	B	C	D
1	⬭	⬭	⬭	⬭
2	⬭	⬭	⬭	⬭
3	⬭	⬭	⬭	⬭
4	⬭	⬭	⬭	⬭
5	⬭	⬭	⬭	⬭
6	⬭	⬭	⬭	⬭
7	⬭	⬭	⬭	⬭
8	⬭	⬭	⬭	⬭
9	⬭	⬭	⬭	⬭
10	⬭	⬭	⬭	⬭
11	⬭	⬭	⬭	⬭
12	⬭	⬭	⬭	⬭
13	⬭	⬭	⬭	⬭
14	⬭	⬭	⬭	⬭
15	⬭	⬭	⬭	⬭

Name: Solutions

MEREWETHER
HIGH SCHOOL

2021 YEAR 12 TRIAL HSC

Mathematics Standard 2

General Instructions:

- Reading time – 10 minutes
- Working time – 2 hours and 30 minutes
- Write using black pen
- Calculators approved by NESA may be used
- A reference sheet is provided
- For questions in Section II, show relevant mathematical reasoning and/or calculations

Total marks : 100

Section I – 15 marks (pages 2 – 8)

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

Section II – 85 marks (pages 9 – 32)

- Attempt Questions 16 – 44
- 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 A survey asked the following question: "What is your favourite ice-cream flavour?" How would the responses be classified?

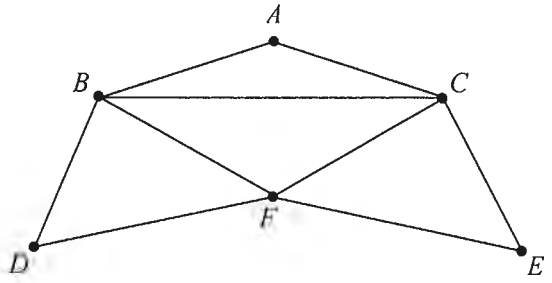
A. Categorical, ordinal

B. Categorical, nominal

C. Quantitative, discrete

D. Quantitative, continuous

2 The graph below shows a network



The walk A-B-C-E-F-D is a

A. Trail

B. Path

C. Eulerian trail

D. Eulerian circuit

3 Jake owns a car. Which of the following is included in the cover of compulsory third-party insurance for his car?

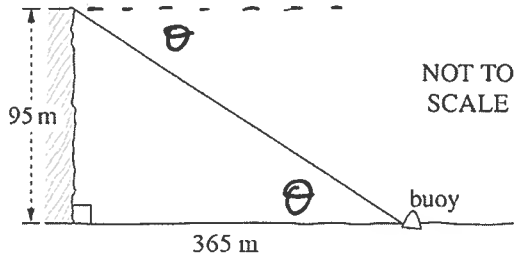
(A.) The injury to passengers

B. The theft of his car

C. Damage to his own car

D. Damage to another driver's car

4 A buoy is placed 365 metres from the base of a cliff that is 95 metres above sea level.



The angle of depression, in degrees and minutes, from the top of the cliff to the buoy is

A. 14°59'

B. 75°41'

(C.) 14°35'

D. 75°25'

$\tan\theta = \frac{95}{365}$

$\theta = \tan^{-1}\left(\frac{95}{365}\right)$

$\theta = 14°35'$

5 Which of the following events has a probability of $\frac{1}{4}$?

A. Rolling a 4 on a standard six-sided die.

(B.) Choosing a boy from a class that consists of 10 boys and 30 girls.

C. Selecting 'October' when choosing a calendar month at random.

D. Choosing a vowel from the word COIL.

6 Heart rate is measured in beats per minute. Maximum heart rate (*MHR*) is calculated using the following formula:

$$MHR = 220 - \text{age}$$

Vivian measures her heart rate by counting her pulse for 25 seconds. She counted a total of 55 beats which is 75% of her *MHR*.

What is Vivian's age?

A. 44 years old

B. 52 years old

C. 60 years old

D. 70 years old

55 beats / 25 sec

2·2 beats / sec

∴ 132 bpm

75% × m = 132

∴ MHR = 176

∴ Age = 44

7 The table shows a linear relationship between X and Y.

X	−3	−1	1	3	p	10
Y	11	9	7	5	2	q

Which of the following are correct values for p and q in the table?

A. $p = 5$ and $q = 1$

B. $p = 6$ and $q = -2$

C. $p = 7$ and $q = -2$

D. $p = 8$ and $q = 1$

$Y = -X + 8$

$\therefore 2 = -X + 8$

$\therefore X = 6$

8 A rectangular paddock has a perimeter of 420 metres. If the ratio of its length to width is 4:3, the area of the paddock is

A. 10 800 m^2

B. 21 600 m^2

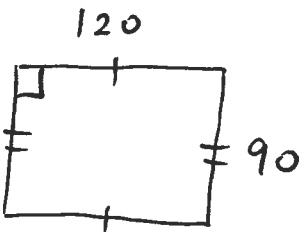
C. 34 400 m^2

D. 43 200 m^2

420 ÷ 7 = 60

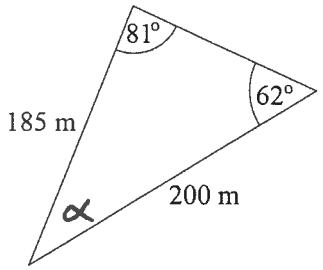
∴ 4 parts = 240

3 parts = 180



∴ A = 120 × 90

9 The diagram below shows a triangle with information.



NOT TO SCALE

$\alpha = 180 - (81 + 62)$

$\alpha = 37$

The area of the triangle, to the nearest square metre, is approximately

A. 18 272 m^2

B. 16 335 m^2

C. 11 134 m^2

D. 10 667 m^2

$A = \frac{1}{2} \times 185 \times 200 \times \sin 37$

$= 11\,133.6\ m^2$

10 A table of future value interest factors is shown.

Future values of a $1 annuity

Time period	*Interest rate*			
	1%	2%	3%	4%
1	1.0000	1.0000	1.0000	1.0000
2	2.0100	2.0200	2.0300	2.0400
3	3.0301	3.0604	3.0909	3.1216
4	4.0604	4.1216	4.1836	4.2465
5	5.1010	5.2040	5.3091	5.4163
6	6.1520	6.3081	6.4684	6.6330
7	7.2135	7.4343	7.6625	7.8983
8	8.2857	8.5830	8.8923	9.2142

Lilly invests $2000 at the end of every year for 6 years at 3% p.a. compounded annually.

How much interest will Lilly earn on her annuity?

A. $936.80

B. $8974.50

C. $12 936.80

D. $18 191.60

2000×6.4684

$= \$12\,936.80$

$\therefore I = 12936.80 - 6 \times 2000$

$= 936.80$

11 The table lists the maximum fortnightly payments for single people on youth allowance.

Your circumstances	**Maximum payment per fortnight**
No children, younger than 18, and live at parent's home	$244.10
No children, 18 years or older, and live at parent's home	$293.60
No children, younger than 18, and need to live away from parent's home	$445.80
No children, 18 years or older, and need to live away from parent's home	$445.80

Geordie is 19 years old and lives with his parents, who have a combined annual taxable income of $68 520. Geordie's annual youth allowance is reduced by 20 cents for every dollar his parent's taxable income exceeds $52 000.

If Georgie is paid for 26 fortnights in a year, which one of the following is his fortnightly youth allowance payment?

A. $127.08

B. $244.10

C. $293.60

D. $166.52

$68\,520 - 52\,000$

$= 16\,520 \times 0.2$

$= 3304 \div 26$

$= \$127.077$ less per fn.

$\therefore \$293.60 - \$127.077$

12 A stopwatch measured the time of a 100-metre run to a tenth of a second.
The percentage error of the measurement was 0.49%.

Which ONE of the following could be the time of the 100-metre run?

A. 9.204 seconds

B. 10.204 seconds

C. 11.204 seconds

D. 12.204 seconds

$$P.E. = \frac{\frac{1}{2} \times \text{precision}}{\text{time}}$$

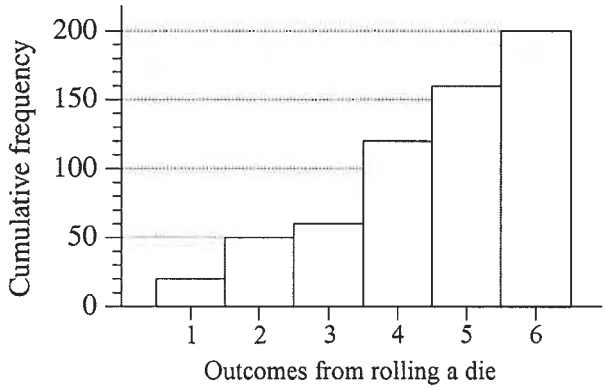
$$0.0049 = \frac{\frac{1}{2} \times 0.1}{\text{time}}$$

$$\text{time} = \frac{0.05}{0.0049}$$

$$= 10.204$$

13 A standard die was rolled 200 times and the results recorded.

The graph below displays the cumulative frequency histogram of the data.



x	f	c.f
1	20	20
2	30	50
3	10	60
4	60	120
5	40	160
6	40	200

What is the relative frequency of rolling a 3?

A. 60

B. 0.3

C. 10

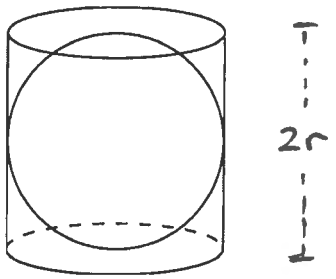
D. 0.05

$= \frac{10}{200}$

$= \frac{1}{20}$

$= 0.05$

14 A sphere with volume 80 cm^3 fits exactly into a closed cylinder.



Which ONE of the following is the best approximation of the surface area of the closed cylinder?

A. 110 cm^2

B. 121 cm^2

C. 135 cm^2

D. 149 cm^2

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

$80 = \frac{4}{3}\pi r^3$

$r = 3\sqrt{\frac{60}{\pi}}$

$\therefore r = 2.673$

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

$= 2\pi(2.673)^2 + 2\pi(2.673) \times 2(2.673)$

$= 134.679\ldots$

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

$$BAC_{Male} = \frac{10N - 7.5H}{6.8M}$$

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.

Brandon, who weighs 75 kg, is planning on having a number of standard drinks on Saturday night. He will begin drinking at 6 pm and will stop drinking at 11 pm. The beers that he will be drinking are 1.5 standard drinks.

How many beers can he consume in full so that when he intends to drive at 11 pm he is below a BAC of 0.05?

A. 3

B. 4

C. 5

D. 6

$$0.05 = \frac{10 \times 1.5N - 7.5 \times 5}{6.8 \times 75}$$

$$25.5 = 15N - 37.5$$

$$63 = 15N$$

$$\therefore N = 4.2$$

MEREWETHER
HIGH SCHOOL

2021 Trial HSC Examination

Mathematics Standard 2

Section II – Answer Booklet

Student Name: _____

85 marks
Attempt Question 16 – 44
Allow about 2 hours and 5 minutes for this section

Instructions

- Write your name in the space above.
- 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.
- Extra writing space is provided at the back of this booklet. If you use this space, clearly indicate which question you are answering.

Please turn over

Question 16 (5 marks)

A teacher constructed a back-to-back stem-and-leaf plot of all 28 of her student's results in an exam with a total of 65 marks.

Marks, out of 65, in an exam

Females		*Males*
9	1	1 2 3
9 8 7	2	0 2 2 2 4
6 5 1	3	0 1 7
9 9 5 3	4	6 7
7 2 4	5	2
1	6	

(a) Michael scored 52 marks. What percentage of the exam did he get correct? 1

$\frac{52}{65} \times 100 = 80\%$

(b) What is the modal mark for the entire class? 1

22

(c) What is the range of the scores from the females? 1

$61 - 19 = 42$

(d) The teacher told her students that the females did better than the males in the exam. Is the teacher correct? Justify your answer by referring to the median and skewness of the two sets of data. 2

The teacher is correct.
The median of the females is 43 whereas the median of the males is 24.
Also the female's data is symmetrical but the male's data is positively skewed.

Question 17 (2 marks)

A new computer was purchased for $1155 including 10% GST. Calculate the computer's pre-GST price. 2

$1155 = P \times 1.1$

$\therefore P = 1155 \div 1.1$

$\therefore P = \$1050$

Question 18 (3 marks)

This table is used to calculate income tax for individuals.

Taxable income ($)	*Tax payable*
$0 – $18 200	Nil
$18 201 – $37 000	19c for each $1 over $18 200
$37 001 – $87 000	$3572 plus 32.5c for each $1 over $37 000
$87 001 – $180 000	$19 822 plus 37c for each $1 over $87 000
$180 001 and over	$54 232 plus 45c for each $1 over $180 000

Tayla earns a gross income of $120 500 and has allowable tax deductions totalling $12 300. The Medicare levy to be paid is 2% of taxable income.
Tayla has already paid $31 600 in PAYG installments throughout the financial year.

Will Tayla receive a tax refund? Justify your answer with calculations. 3

Taxable Income = 120 500 − 12 300

= $108 200

∴ Tax payable = 19 822 + 0.37 × 21 200

= $27 666

+ M.L. of 2% × 108 200 = 2164

∴ Total tax = $29 830

∴ 31 600 − 29 830 = $1770 refund.

Question 19 (2 marks)

The volume (V) of water, in litres, in a silo is being drained over time (t) minutes can be modelled by the linear relationship: $V = 570 - 25t$.

(a) What is the gradient of the linear relationship and what does it represent? 1

$m = -25$ which represents the loss of water in litres per minute.

(b) After how many minutes will the tank have a third of the initial volume of water? 1

$V = 570 - 25t$

$\frac{1}{3} \times 570 = 570 - 25t$

$190 = 570 - 25t$

$\therefore \quad 25t = 380$

$t = 15 \cdot 2$ minutes

Question 20 (2 marks)

Solve the equation $\frac{5x-4}{3} = 2(10-x)$. 2

$\frac{5x-4}{3} = 20 - 2x$

$5x - 4 = 60 - 6x$

$11x = 64$

$\therefore \quad x = \frac{64}{11}$

Question 21 (4 marks)

On the 1st of February 2018, Stevie bought 600 shares of a company called *LOL* for a total of $3300, with zero commission.

The table below outlines the market price of the share over the three-year period as well as the date at which the annual dividend is paid and the amount of dividend paid:

Date	*LOL* market price	Activity
01/02/2018	*A*	600 shares purchased
01/02/2019	$12.23	$0.39 dividend paid per share
01/02/2020	$13.76	$0.52 dividend paid per share
01/02/2021	$16.08	$0.49 dividend paid per share
01/02/2021	$16.08	600 shares sold

(a) Calculate the value of *A*. **1**

$5.50

(b) Calculate the dividend yield of the dividend paid on the 1st of February 2020. **1**

$\frac{0.52}{13.76} \times 100 = 3.779\%$

(c) Stevie sold all 600 shares on the 1st of February 2021. There was zero commission on the sale of the shares. Calculate the amount of profit Stevie made from investing in the shares. **2**

$600 \times (16.08 - 5.50) = \$6348$

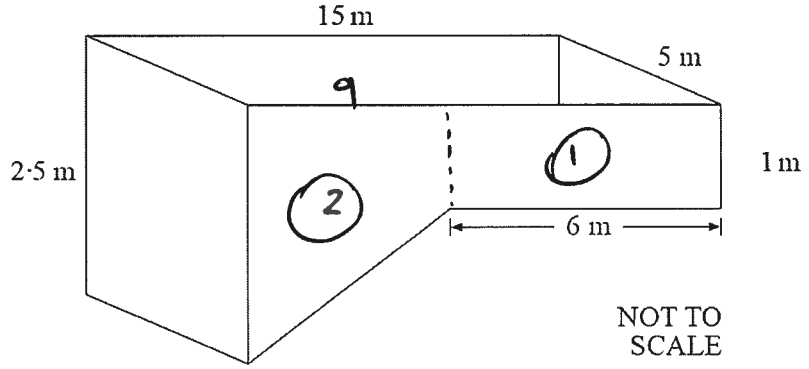
Dividends $= 600(0.39 + 0.52 + 0.49)$

$= 840$

$\therefore$ Profit $= \$7188$

Question 22 (3 marks)

The diagram shows a swimming pool. The pool is 15 metres long and 5 metres wide and has a shallow end with depth of 1 metre and a deep end with a depth of 2.5 metres. The depth begins to increase at 6 metres from the start of the shallow end of the pool.



Calculate the capacity of the pool, in kilolitres. 3

$A_1 + A_2 = 6 \times 1 + \frac{9}{2}(1 + 2{\cdot}5)$

$A = 21{\cdot}25$

$\therefore V = 21{\cdot}25 \times 5$

$= 108{\cdot}75 m^3$ $\quad 1m^3 = 1kL$

$\therefore$ Capacity of pool is $108{\cdot}75$ kL

Question 23 (2 marks)

Alexis invests $5000 into an investment account that pays 6% p.a. compounded monthly. The investment remains in the account for 18 years.

Calculate the future value of the investment. 2

$n = 18 \times 12$

$r = 6\% \div 12$

$FV = 5000\left(1 + \frac{6\%}{12}\right)^{216}$

$FV = \$14\,683.83$

Question 24 (2 marks)

Borja lives in Madrid (UTC +2) and is travelling to Sydney (UTC +10), via a stop-over in Singapore. His flight leaves Madrid on Saturday 17th of July at 9.50 pm local time and arrives into Sydney on Monday 19th July at 9.30 am. The total flying time, excluding the stop-over, is 22 hours.

How long is Borja's stop-over in Singapore? 2

9.50 pm Madrid = 5.50 am Sydney
+8

Flight time = 5.50 am Sunday → 9.30 am Monday.

= 27 hours and 40 mins

∴ Stop over = 5 hours and 40 mins.

Question 25 (2 marks)

Theo drove his car from Newcastle to Canberra. The distance from Newcastle to Canberra is 450 km. Theo's car has a petrol tank capacity of 45L.

Theo filled his car in Newcastle from empty to full. When he arrived in Canberra, the car's petrol tank was $\frac{2}{5}$ full.

(a) What is the fuel economy of Theo's car, in L/100km? **1**

$\frac{3}{5} \times 45\,L = 27\,L$

$27\,L / 450\,km \div 4.5$

$= 6\,L / 100\,km$

(b) When Theo was in Canberra, he put \$35 worth of petrol into his car that was priced at \$1.75 per litre.

How many kilometres could Theo now travel with the additional amount of petrol? **1**

If $27\,L \rightarrow 450\,km$

$18\,L \rightarrow 300\,km$

$\$35 \div 1.75 = 20\,L$

If $6\,L / 100\,km$

then $20\,L \rightarrow 333\,km$.

$\therefore 633\,km$

Question 26 (2 marks)

Sven is a full time employee and works a 35-hour week at rate of $43 per hour.
He receives annual leave loading which is $17\frac{1}{2}\%$ of four weeks pay.

Calculate Sven's total holiday pay. **2**

$35 \times 43 = \$1505$ p/w

$\therefore$ Holiday pay $= 1505 \times 4 \times 1.175$

$= \$7073.50$

Question 27 (2 marks)

Jen achieved a result of 88% in her Mathematics exam with normally distributed results which recorded a mean of 75%. Her friend received an exam mark of 82% which had a z-score of 1.3.

Calculate the z-score of Jen's mark, to one decimal place. **2**

Jen's friend: $1.3 = \frac{82-75}{\sigma}$

$1.3 = \frac{7}{\sigma}$ $\therefore \sigma = 5.3846...$

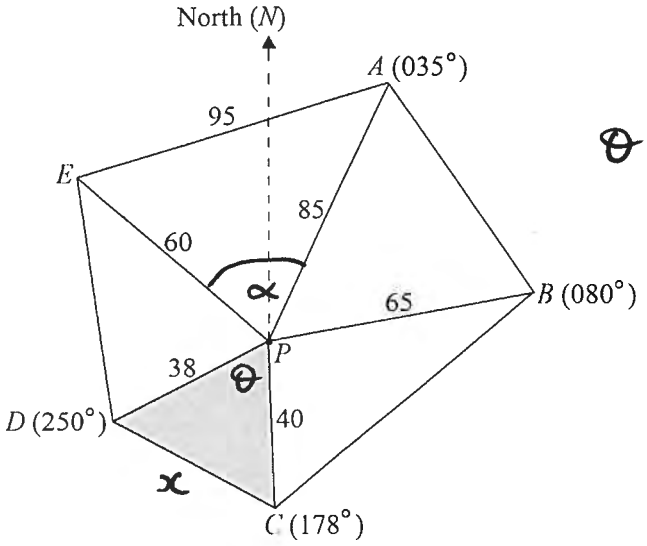
Jen: $z = \frac{88-75}{5.3846...}$

$\therefore z = 2.4$ (1 dp)

Question 28 (5 marks)

A radial survey has been undertaken on a proposed construction site *ABCDE*, as shown below.

All measurements are in metres.



$\theta = 250 - 178$

$= 72°$

The section *PCD* of the site is proposed as a green space.

(a) Use the Cosine rule to determine the distance between *C* and *D*, to the nearest metre. 2

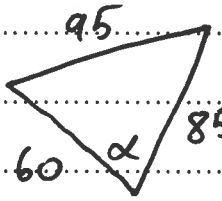
$x^2 = 40^2 + 38^2 - 2 \times 40 \times 38 \cos 72$

$x^2 = 2104.588\ldots$

$x = 45.886\ldots$

$x = 46$ m (nearest m)

(b) Calculate the bearing of *P* from *E*. 3



$\cos\alpha = \dfrac{60^2 + 85^2 - 95^2}{2 \times 60 \times 85}$

$\therefore \alpha = \cos^{-1}\left(\frac{3}{17}\right)$

$\therefore \alpha = 79°50'$

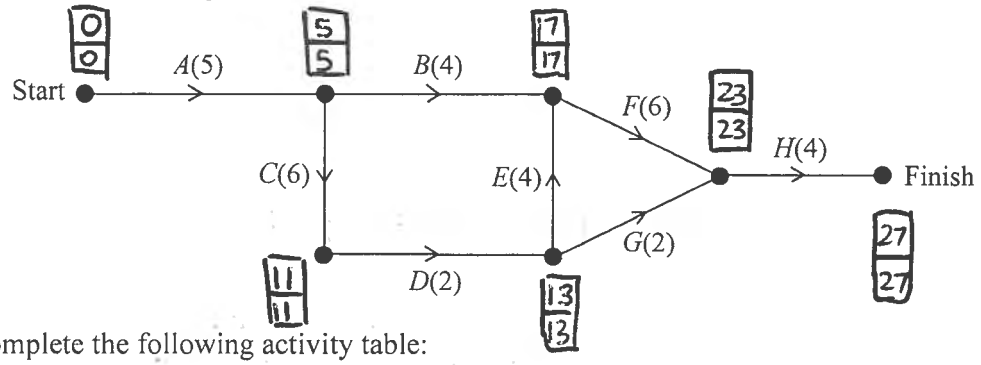
$\therefore 79°50' - 35° = 44°50'$

$\therefore$ Bearing $= 135°50'$

$= 136°T$

Question 29 (5 marks)

A project requires the completion of all ten activities A to H. The network diagram shows the activities and their completion times in hours.



(a) Complete the following activity table: 2

Activity	Predecessors	Time (in hours)
A	-	5
B	A	4
C	A	6
D	C	2
E	D	4
F	B, E	6
G	D	2
H	F, G	4

(b) List the activities which make up the critical path for this activity. 1

ACDEFH

(c) What is the float time for activity G? 1

23 − 13 − 2 = 8 hours

(d) If the project begins at 9am, what is the earliest time that activity G can begin? 1

9am + 13 hours = 10pm

Question 30 (3 marks)

The following formula gives the comparison between the dosage (D) of medicine (in millilitres) for a child of age y (years) when compared to an adult's dosage.

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

(a) Change the subject of this formula to A. 2

$D(y+12) = yA$

$\therefore A = \dfrac{D(y+12)}{y}$

(b) Hence, what is the adult dosage of a particular medicine if an 18-month-old child is given 5 mL? 1

$A = \dfrac{5(1.5+12)}{1.5}$ $\quad y = 1.5$, $D = 5$

$\therefore A = 45$ mL

Questions 16 – 30 are worth 44 marks in total

Question 31 (2 marks)

A monitor with an energy rating of 5 stars, consumes 218 kwh/year. The same size monitor with an energy rating of 3 stars, consumes U kwh/year.

Energy costs are 28.55 cents/kwh.

2

The approximate saving in energy costs over a 10-year period by using the 5 star rated monitor compared to the 3 star rated television was \$743. To the nearest kwh, what is the energy consumption per year (U) of the 3 star monitor?

$(U - 218) \times 10 \text{ years} \times \$0.2855 = 743$

$2.855U - 622.39 = 743$

$2.855U = 1365.39$

$U = 478 \text{ kWh/yr.}$

Question 32 (3 marks)

Bradley has a credit card which has no interest free period. Interest is charged at the end of each month at 14.25% per annum, compounded daily from the purchase date (included) to the last day of the month (included). There is a minimum payment of 2.5% of the closing balance after the interest is added.

Bradley started the month of June with a zero balance and made purchases of \$250 on the 7th of June and \$435.50 on the 21st of June.

$r = \frac{14.25\%}{365}$

Calculate the minimum payment required at the end of June. 3

7/6 → 30/6 = 24 days.

21/6 → 30/6 = 10 days.

$A_1 = 250\left(1 + \frac{14.25\%}{365}\right)^{24} + 435.50\left(1 + \frac{14.25\%}{365}\right)^{10}$

$= \$689.5562429 \times 2.5\%$

∴ Minimum payment = \$17.24 (nearest cent)

Question 33 (3 marks)

A car was purchased for \$60 000 and depreciated by 10% of its value each year for 20 years. After 20 years, the car become a collectable and then appreciated in value by 10% each year for the next 20 years.

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

(a) What was the car's value after 20 years? 2

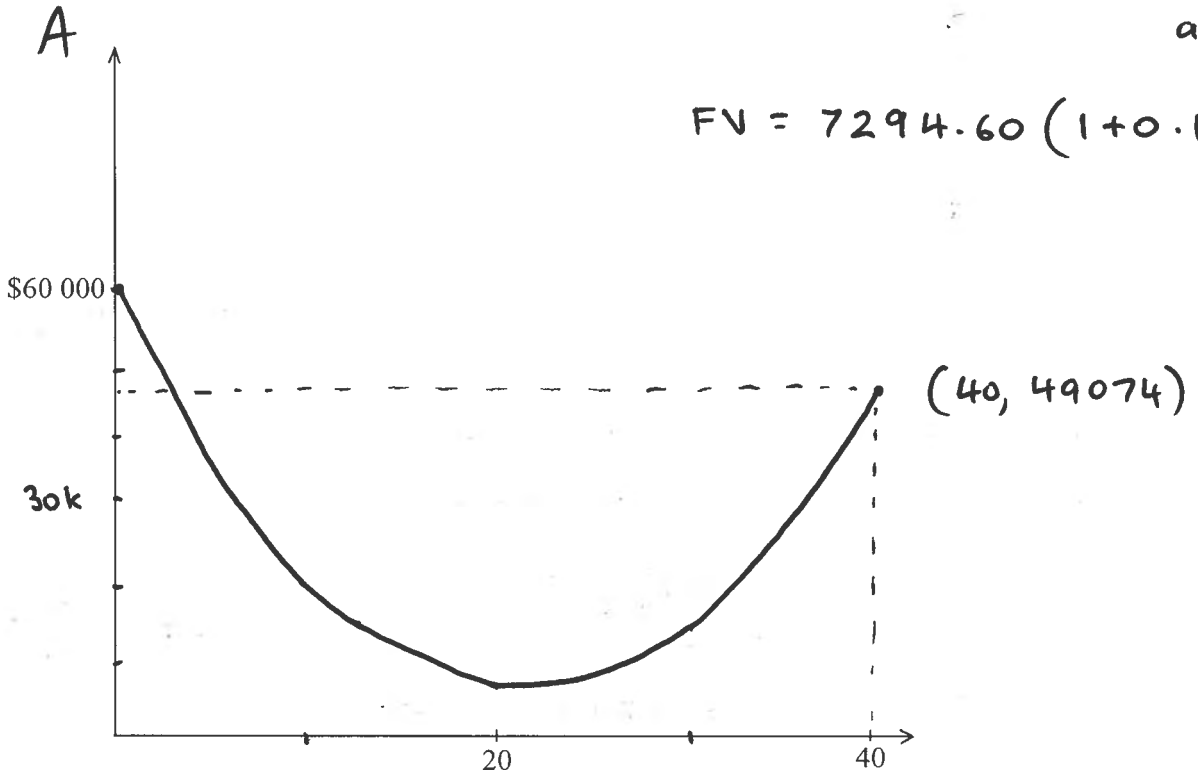
$S = 60\,000(1-0.1)^{20}$

$= \$7294.60$

(b) On the axis below, sketch a possible curve for the value of the car from the year of purchase to 40 years since ownership. 1

n	0	10	20	30	40
A	60000	20920	7294	18920	49074

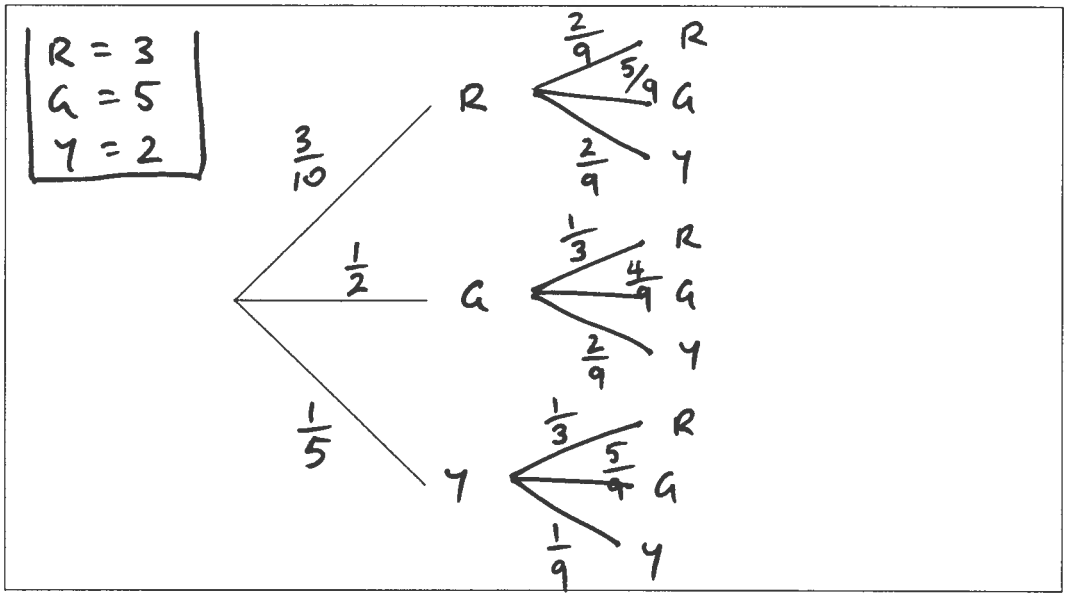
$S = 60\,000(1-0.1)^n$ and $FV = 7294.60(1+0.1)^n$



Question 34 (5 marks)

Ten coloured balls are placed in a bag. Three of the balls are red, five are green and two are yellow. Two balls are selected from random from the bag without replacement.

(a) Construct a tree diagram in the box below to show the outcomes and their probabilities. 2



(b) Calculate the probability of selecting two red balls. 1

$P(R,R) = \frac{3}{10} \times \frac{2}{9}$

$= \frac{1}{15}$

(c) Calculate the probability of selecting two balls of different colour. 2

$P(\text{Different colour}) = 1 - (P(R,R) + P(G,G) + P(YY))$

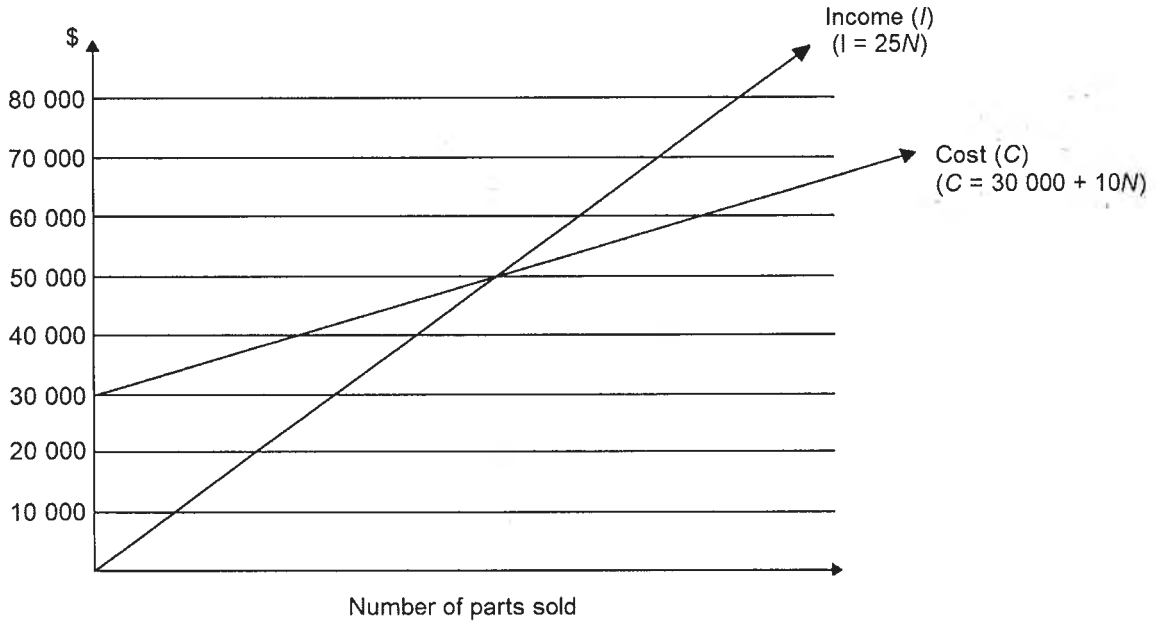
$= 1 - \left(\frac{1}{15} + \frac{2}{9} + \frac{1}{45}\right)$

$= \frac{31}{45}$

Question 35 (3 marks)

A manufacturer outlays $30 000 for a machine that produces a part for electric scooters.

The graphs representing the manufacturer's cost (C) and income (I) from the sale of the parts are shown below with their respective equations.



(a) At the break-even point, how many parts are sold? 1

Break-even point when $I = C$

$\therefore 25N = 30\,000 + 10N$

$15N = 30\,000$

$N = 2000$ $\therefore$ 2000 parts sold.

(b) How many parts need to be sold for a profit of $90 000 to be made? 2

Profit equation given by $P = I - C$

$\therefore P = 25N - (30\,000 + 10N)$

$90\,000 = 25N - 30\,000 - 10N$

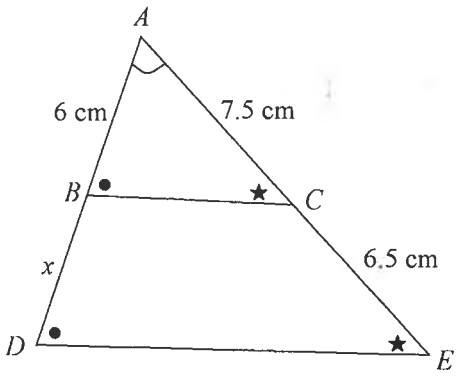
$120\,000 = 15N$

$\therefore N = 8000$ parts.

Question 36 (3 marks)

The diagram below consists of two triangles where ΔABC and ΔADE are similar.

As shown below, $AB = 6$ cm, $AC = 7.5$ cm and $CE = 6.5$ cm.



Calculate the value of x. 3

In similar triangles, lengths of sides are in the same ratio:

$$\frac{AB}{AD} = \frac{AC}{AE}$$

$$\therefore \frac{6}{x+6} = \frac{7.5}{14}$$

× mult:

$$\therefore 84 = 7.5x + 45$$

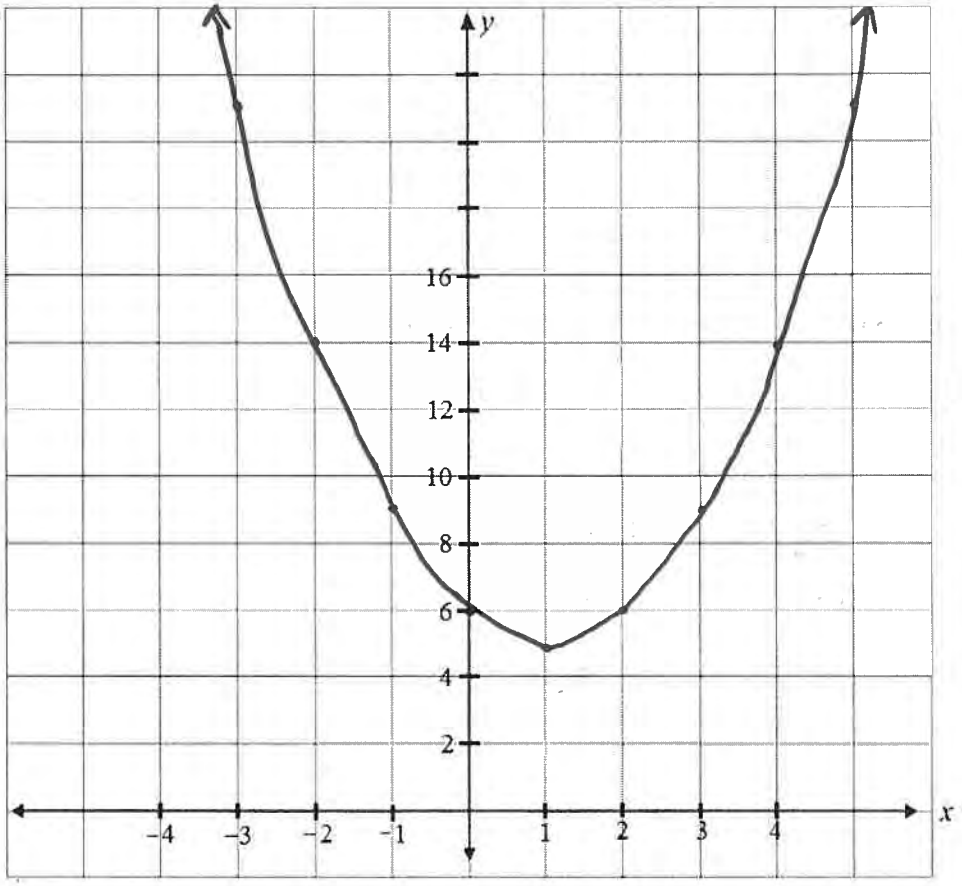
$$39 = 7.5x$$

$$\therefore x = 5.2 \text{ cm}$$

Question 37 (3 marks)

Graph the quadratic function given by $y = x^2 - 2x + 6$, showing all intercepts and vertex. **3**

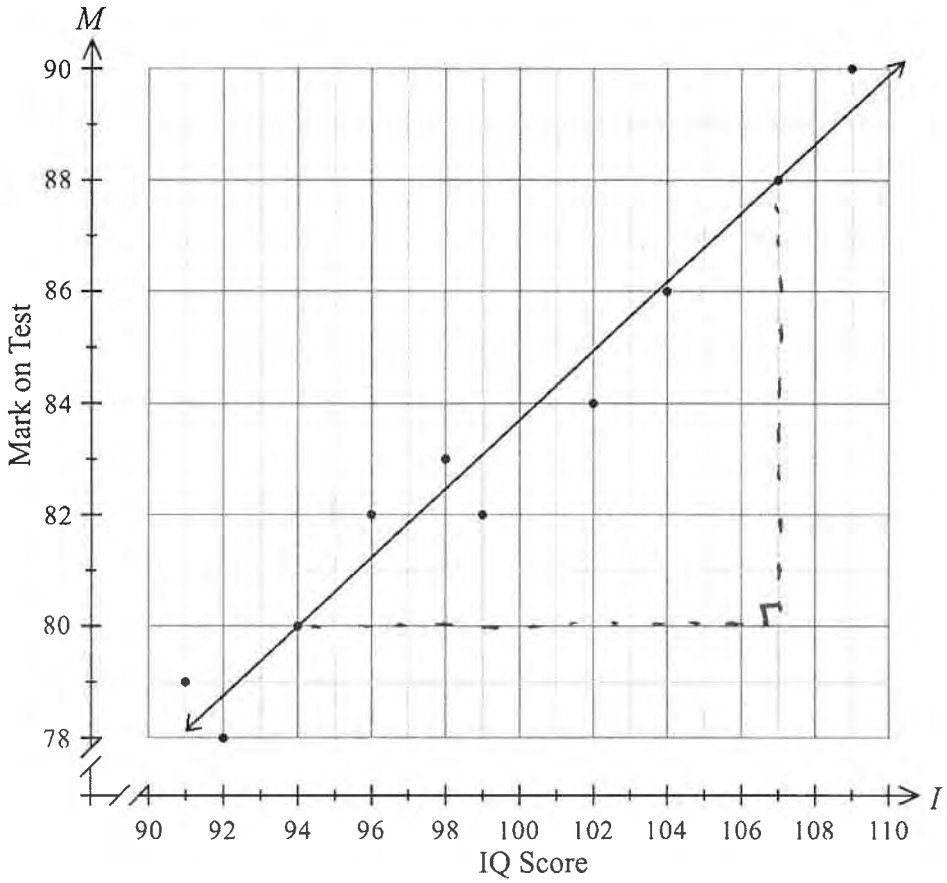
x	-3	-2	-1	0	1	2	3
y	21	14	9	6	5	6	9



Question 38 (3 marks)

The bivariate data in the scatterplot below compares the recorded IQ scores of students with their mark on a class test out of 100.

A line of best fit, that passes through (94, 80) and (107, 88) is drawn.



(a) Describe the direction and strength of the relationship between the IQ and marks. **1**

Strong positive

(b) Write down the equation of the line of best fit that is shown. **2**

$m = \frac{rise}{run}$ $\therefore M = \frac{8}{13}I + b$

$= \frac{8}{13}$ Sub in $(94, 80)$

$\rightarrow 80 = \frac{8}{13} \times 94 + b$ $\therefore b = 22 \cdot 16$

$\therefore M = \frac{8}{13}I + 22 \cdot 16$

Question 39 (3 marks)

Anna borrows \$1000 at an interest rate of 15% per annum, compounded monthly. She intends to repay the loan by making three monthly payments of \$335.

The amount left owing on the loan immediately after the nth repayment is given by the recurrence relation

$$A_n = A_{n-1}(1.0125) - 335 \qquad \text{where } n = 1, 2, 3\ldots \text{ and } A_0 = 1000$$

By using the recurrence relation, show that Anna, after the three monthly repayments, still owes \$20.36 (to the nearest cent). 3

$A_1 = A_0(1.0125) - 335$

$= 1000(1.0125) - 335$

$= 677.50$

$A_2 = 677.50(1.0125) - 335$

$= 350.96875$

$A_3 = 350.96875(1.0125) - 335$

$= 20.355\ldots$

$\therefore$ \$20.36 left owing.

Question 40 (1 mark)

A farmer catches and tags 40 wild pigs on his property. A week later he catches 9 wild pigs and finds that 5 of them are tagged.

Using appropriate calculations, estimate the population of wild pigs on the farmer's property. **1**

$\frac{40}{P} = \frac{5}{9}$

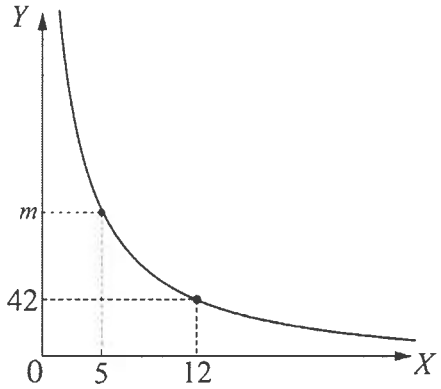
$5P = 360$

$\therefore P = 72$ pigs

Question 41 (2 mark)

The variable Y varies inversely with X, as shown in the graph below.

The points (12, 42) and (5, m) lie on the hyperbola.



Find the value of m **2**

$y = \frac{k}{x}$

$42 = \frac{k}{12}$ $\therefore y = \frac{504}{x}$

$\therefore k = 504$ $\therefore m = \frac{504}{5}$

$= 100.8$

Question 42 (3 marks)

The scale diagram shows an aerial view of a block of land being divided into two equal blocks. The length of the block of land, AB, is known to be 50 metres.

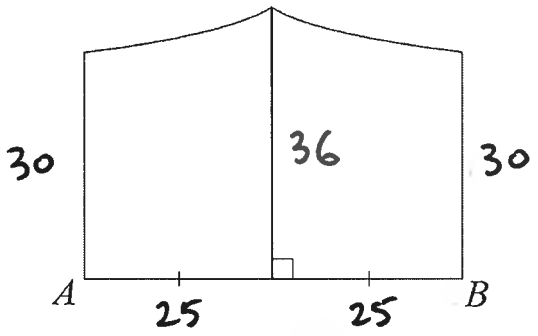


DIAGRAM TO SCALE

Calculate the approximate area of the block of land, using two applications of the trapezoidal rule. 3

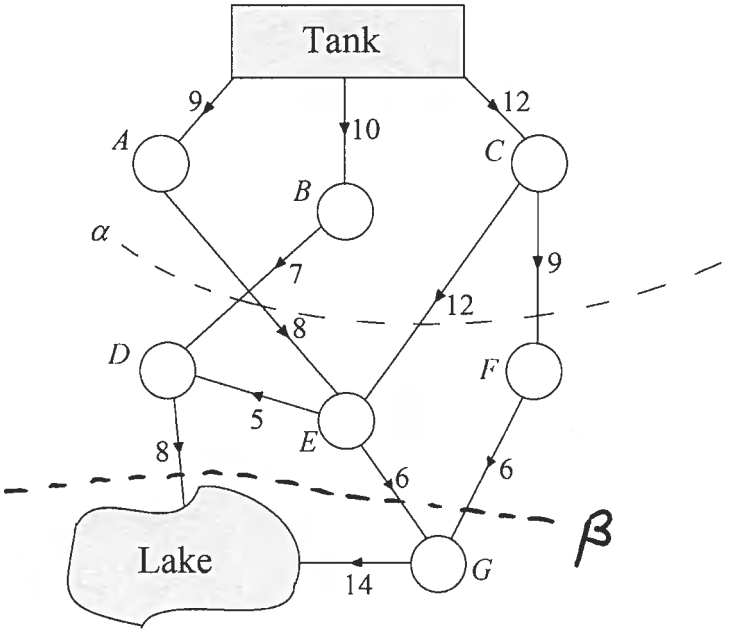
$A = \frac{25}{2}(30+36) + \frac{25}{2}(30+36)$

$A = 1650\text{m}^2$

Question 43 (3 marks)

A water tank supplies water through a network of 12 underground pipes to 7 different points of labelled from *A* to *G*. The water then will flow to an artificial lake, as seen on the network diagram below. The diagram shows the amount of water in kilolitres per hour that can flow through the pipes at any given time.

α represents a cut through the network of the pipes.



(a) What is the capacity of the cut α shown on the diagram? 1

7 + 8 + 12 + 9 = 36

(b) What is the maximum flow of the diagram? 1

Cut β = 20

(c) Which ONE pipe's capacity could be increased, and by how much, so that the maximum flow of the network is also increased? 1

FG by 2 or

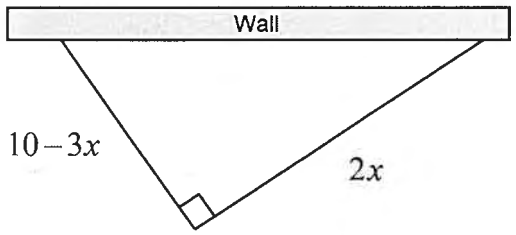
EG by 2

DL by 2

Question 44 (4 marks)

A concrete slab in the shape of a right angled triangle is to be laid against a wall.

The triangle has length $2x$ and perpendicular height $10-3x$.



By first finding an expression for the area, calculate the maximum area of the triangle. **4**

$A = \frac{1}{2} \times 2x(10-3x)$

$= x(10-3x)$

$\therefore A = 10x - 3x^2$

Maximum at Axis of Symmetry:

$a = -3$

$x = -\frac{b}{2a}$ $\quad b = 10$

$x = \frac{-10}{2 \times -3}$

$x = \frac{10}{6}$

$\therefore A = 10\left(\frac{10}{6}\right) - 3\left(\frac{10}{6}\right)^2$

$A = 8\frac{1}{3}\ m^2$

End of paper.