
Student Number

12MAS – Ms Stephens

Class

Caringbah High School

2022 HIGHER SCHOOL CERTIFICATE TRIAL EXAMINATION

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 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 (pages 2–5)

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

Section II – 85 marks (pages 7–23)

- Attempt Questions 16–39
- Allow about 2 hours and 5 minutes for this section

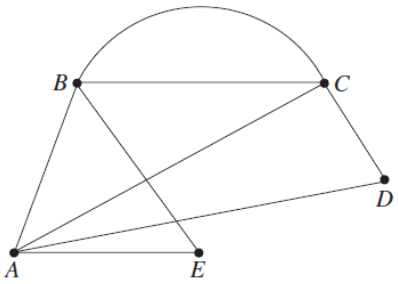
Section I	Section II	Total
/15	/85	/100

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. Consider the network diagram.



How many edges does the network have?

A. 5

B. 6

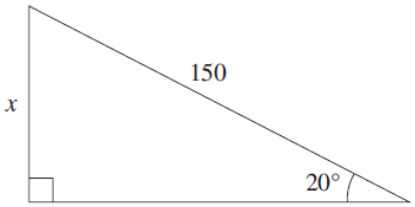
C. 7

D. 8

2. The solution for the pair of simultaneous equations $3x-2y=12$ and $2x+5y=-11$ has the value of x equal to 2. What is the value of y?

A. -3
B. -2
C. 1.4
D. 3

3. Consider the triangle.



NOT TO SCALE

Which of the following gives the value of x?

A. $150\cos 20^\circ$

B. $\dfrac{150}{\sin 20^\circ}$

C. $\dfrac{150}{\cos 20^\circ}$

D. $150\sin 20^\circ$

4. Alessia works 42 hours per week at a rate of $32.50 per hour. She decides to take four weeks of annual leave. While she is on annual leave, she is paid a loading of 17.5% on her wage.
What is Alessia's total wage for the period of time that she is on annual leave?

A. $955.50
B. $1365
C. $5460
D. $6415.50

5. The scale of a map is 1 cm = 125 m.
If the actual distance between two points is 650 m, what is the distance between these points on the map?

A. 0.2 cm
B. 2 cm
C. 2.5 cm
D. 5.2 cm

6. Which data collected about a virus could be classified as "categorical nominal"?

A. The number of people who contracted the virus
B. The place of origin of the virus
C. The rate at which the virus spread throughout the population
D. The length of time taken to control the spread of the virus

7. There are five more black marbles in a bag than there are white marbles.
All marbles in the bag are either black or white.
The probability of randomly selecting a black marble from the bag is $\frac{3}{5}$.
How many white marbles are in the bag?

A. 10
B. 15
C. 20
D. 25

8. The amount of a particular medication in an intravenous (IV) solution is 250 mg per 15 mL. A patient is prescribed 3500 mg of the medication.
How much IV solution should be given to the patient?

A. 0.93 mL
B. 14 mL
C. 21 mL
D. 210 mL

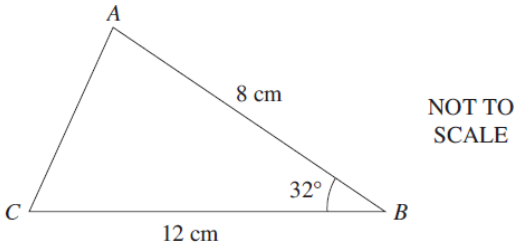
9. The test scores of a Mathematics class and their frequencies are shown in the table.

Score	*Frequency*
52	4
54	8
56	12
58	2
60	2

Which of the following measures will change if another score of 60 is added to the dataset?

A. mean
B. range
C. median
D. mode

10. In the triangle *ABC*, *AB* has a length of 8 cm, *BC* has length of 12 cm, and angle *ABC* is 32°.



What is the area of triangle *ABC*?

A. 25.4 cm^2
B. 26.6 cm^2
C. 26.7 cm^2
D. 48.0 cm^2

11. The height of a building is measured. It is found to be 480 m, to the nearest 10 m.
The lower and upper limits of the true measurement are, respectively,

A. 450 m and 460 m.
B. 470 m and 490 m.
C. 475 m and 485 m.
D. 400 m and 500 m.

12. Dominic's car uses fuel at a rate of 7.2 L per 100 km for long-distance driving and 10.4 L per 100 km for short-distance driving. Dominic drove his car 851 km to Melbourne. The journey included 112 km of short-distance driving.

How much fuel did Dominic's car use on the journey, correct to the nearest litre?

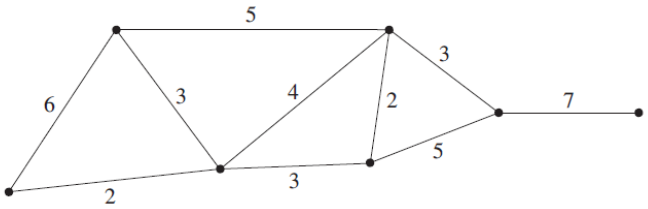
A. 63 L
B. 64 L
C. 65 L
D. 66 L

13. Last month, Jessica purchased 550 shares at a market price of $4.00 per share. The market price is now $4.60 per share. Jessica receives a dividend of $0.40 per share.

What is the dividend yield, to the nearest percent?

A. 8%
B. 9%
C. 10%
D. 11%

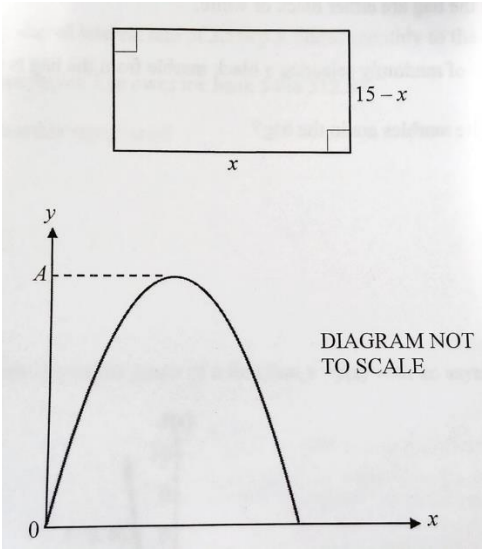
14. The diagram represents a network with weighted edges.



What is the total length of the minimum spanning tree?

A. 17
B. 20
C. 24
D. 27

15. To determine the maximum area (A) of a rectangle with a perimeter of 30m, Melanie sketched the following diagrams in her notebook.



The point A is the turning point on the parabolic graph.
Melanie correctly determined the maximum area of the rectangle (in square metres) by finding the value of A.

What is the value?

A. 48
B. 50
C. 56.25
D. 100

End of Section 1

Mathematics Standard 2

Section II Booklet 1

Student Number

Section II

85 marks
Attempt Questions 16–39
Allow about 2 hours and 5 minutes for this section

Booklet 1 — Attempt Questions 16–31 (55 marks)
Booklet 2 — Attempt Questions 32–39 (30 marks)

Instructions

- Write your Student Number at the top of this page.
- 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 on pages 24-25. If you use this space, clearly indicate which question you are answering.

Please turn over

Question 16 (2 marks)

Solve the equation: $5-2(x+1)=x$ **2**

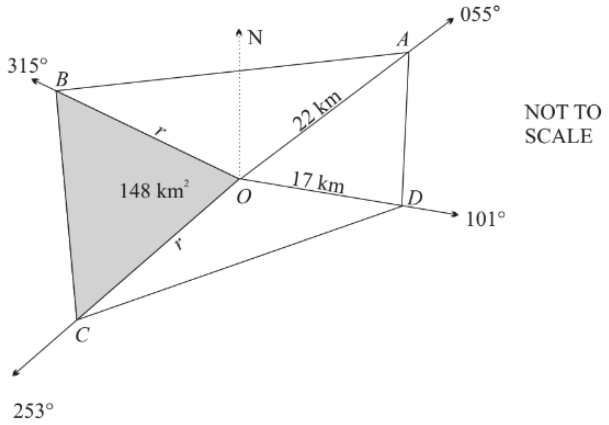
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Question 17 (3 marks)

A radial survey is taken on a plot of land. Points B and C are equal distance in kilometres from O. Point B is on a bearing of 315° and point C is on a bearing of 253°. The area of BOC is 148 km^2.



What is the distance OB, correct to one decimal place? **3**

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Question 18 (2 marks)

Three unbiased six-sided dice are rolled simultaneously 1080 times. **2**
How many times would it be expected that all three dice show a 4?

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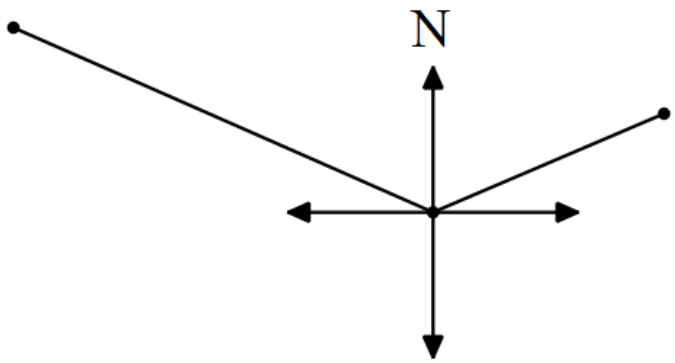
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Question 19 (6 marks)

Two hikers decide to leave a campsite (C) to visit some natural landmarks in the area. One hiker walks 16 km on a bearing of 65° to see a lake (L); the other hiker walks 26 km on a bearing of 285° to reach the top of a mountain (M).

a) Complete the diagram to display the scenario. Include lengths and bearings from the question above. **1**



b) Calculate the distance between the mountain and the lake, correct to the nearest kilometre. **2**

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c) Hence, using your answer from part b) and the sine rule, find the bearing of the lake from the mountain, correct to the nearest degree. **3**

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Question 20 (2 marks)

An original manuscript sold at a recent auction for $45 000.

It is assumed that the manuscript will increase in value by 7.25% annually.

Use the formula: $FV = PV(1 + r)^n$ to estimate how much the manuscript is likely to increase in value by over the next 5 years. Give your answer to the nearest dollar. **2**

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Question 21 (4 marks)

A formula for the dosage in mL (D) of medicine required for a child aged between 1 and 12 years (y) compared to an adult's dosage (A) is:

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

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

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b) A 6-year-old child is to take 5mL of a prescribed medicine three times per day. What is the equivalent daily adult dosage for this medicine? **2**

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Question 22 (3 marks)

On a rail station, a train is scheduled to arrive at 9:00am each morning.
The following data shows the times the train arrived on seven consecutive days.

9:03am, 9:04am, 9:02am, 9:11am, 9:02am, 9:03am, 9:01am

With the aid of calculation, determine whether the arrival time of 9:11am could be considered an outlier for the presented data. **3**

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Question 23 (2 marks)

A manufacturing plant produces steel balls with masses that are normally distributed.

The mean mass of the balls is 20 g with a standard deviation of 0.5 g.

In quality control testing of the manufactured balls, any ball with a mass greater than 21.5 g and less than 18.5 g is rejected.

From a sample of 5000 steel balls tested, how many would be expected to be rejected? **2**

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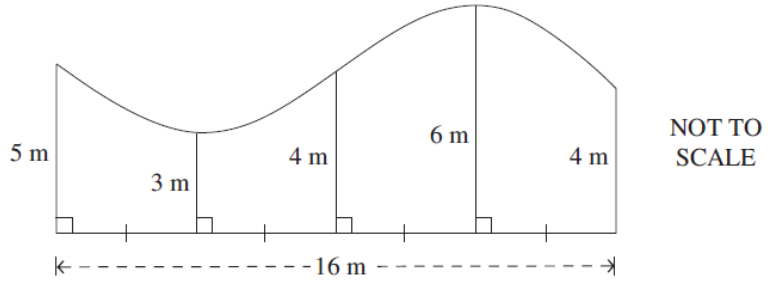
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Question 24 (4 marks)

Luka is installing a pond in his backyard. The pond will have three straight edges and one curved edge. The depth of the pond will be 2 metres throughout. Luka took measurements and drew an overhead view of the pond to assist the builder, as shown in the diagram.



a) Using four applications of the trapezoidal rule, estimate the area of the bottom of the pond. **2**

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b) Calculate how many litres of water will be required to fill the pond. **2**

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Question 25 (2 marks)

Richard plays on his game console for three hours every day. The game console uses 350 watts of energy per hour. The cost of electricity usage is $0.45 per kWh. **2**

Calculate the yearly cost for Richard to play his game console, correct to the nearest cent.

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Question 26 (3 marks)

The frequency (F) (number of vibrations per second) measured in Hertz (Hz), of a string on a harp, varies inversely with the square root of the length of the string (L) measured in cm.

A string of length 25 cm on a harp has frequency of 10 Hz.

a) Show that the situation can be modelled by the equation: $F = \frac{50}{\sqrt{L}}$ **1**

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b) What length of string would produce a frequency of 12.5 Hz on the harp? **2**

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Question 27 (4 marks)

Aaron wants to purchase an apartment. The bank manager has provided them with a table of monthly payments for a loan of **$1000** for varying interest rates.

Interest rate per annum	*Term of loan in years*					
	5	*10*	*15*	*20*	*25*	*30*
6.0%	19.33	11.10	8.44	7.16	6.44	6.00
6.5%	19.57	11.35	8.71	7.46	6.75	6.32
7.0%	19.80	11.61	8.99	7.75	7.07	6.65
7.5%	20.04	11.87	9.27	8.06	7.39	6.99
8.0%	20.28	12.13	9.56	8.36	7.72	7.34

Aaron has savings of $95 000 to put towards the purchase price of his $620 000 apartment.

a) Aaron decides to purchase the apartment using $50 000 of his savings as a deposit and to borrow the balance over 20 years at a rate of 6.5% p.a. Find Aaron's monthly repayment. **2**

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b) After reviewing their financial position with the bank manager, Aaron realises he can't afford to pay any more than $2200 per month. The bank will lend at 6.0% per annum over 30 years provided Aaron uses all of his savings as a deposit. The owner of the apartment is prepared to drop the sale price of the apartment by $10 000. Can Aaron afford this apartment? **2**

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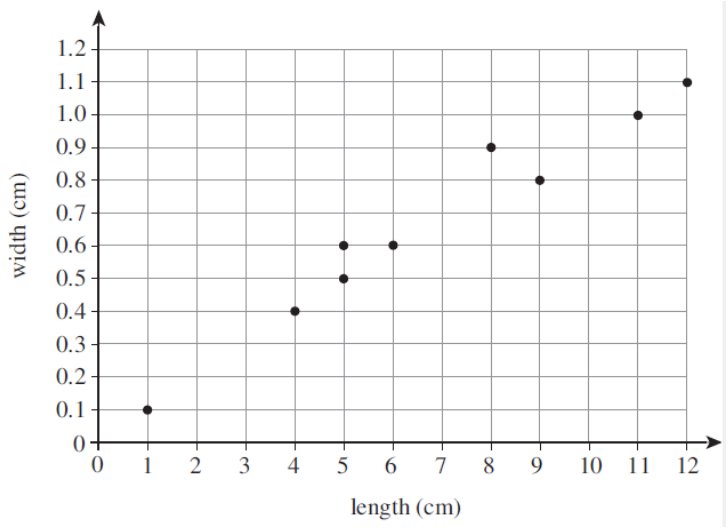
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Question 28 (6 marks)

A set of bivariate data is collected by measuring the lengths and widths of a population of slugs. A scatterplot of this data is shown.



a) Calculate Pearson's correlation coefficient for the data, correct to two decimal places. **1**

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b) Identify the direction and strength of the linear relationship between the lengths and widths of the slugs. **2**

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c) Find the equation of the least-squares regressions line in the form:

$$width = B \times length + A$$

and use the equation to predict the length of a slug that has a width of 0.3 cm correct to one decimal place. **3**

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Question 29 (3 marks)

Scarlett uses a credit card that has an interest rate of r % per annum, simple interest, daily. The card does not have an interest-free period. Interest is calculated to include the day of transaction and the day on which the account balance is paid. During December, Scarlett makes the following transactions.

Credit card statement

Date	*Transaction*	*Amount*
12 December	clothing store	$84.00
19 December	shoe store	$150.00
21 December	supermarket	$170.00

If Scarlett pays her account balance of $407.05 on 5 January in full, what is the annual interest rate, to 2 d.p.? **3**

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Question 30 (4 marks)

After 5 years, the value of a piece of farm machinery has reduced to $25 000.
The original value of the machinery when purchased new was $80 000.

a) If the straight-line method was used to depreciate the machinery, what was the annual loss in value as a percentage of the purchase price? **2**

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b) Show that if the declining balance method was used to depreciate the machinery, the annual loss in value as a percentage of the purchase price was 20.76% **2**

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Question 31 (5 marks)

Ollie just got their P's and is trying to save up to buy their first car. They have decided to contribute a certain amount from each monthly pay slip into a high interest savings account. Ollie has created an Excel spreadsheet to keep track of the monthly contributions. A screenshot of the spreadsheet is below:

	A	B	C	D	E	F	G
1	**End of month**	**P**	**I**	**P+I**	**P + I + R**		
2	**1**	500.00	1.00	501.00	1001.00		
3	**2**	1001.00	2.00	1003.00	1503.00		**interest rate p.a.**
4	**3**	1503.00	3.01	1506.01	2006.01		**2.40%**
5	**4**	2006.01	4.01	2010.02	2510.02		
6	**5**						
7	**6**						
8							

a) What amount has Ollie decided to contribute into the account each month? **1**

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b) By continuing the calculations, what is the amount in cell E7? **2**

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c) What amount could Ollie have contributed initially (PV) into this account, without making any further contributions, to have the same financial outcome after 6 months? **2**

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2022 HIGHER SCHOOL CERTIFICATE TRIAL EXAMINATION

Mathematics Standard 2

Student Number

Section II Answer Booklet 2

Booklet 2 — Attempt Questions 32–39 (30 marks)

Instructions

- Write your Student Number at the top of this page.
- 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 on pages 24-25. If you use this space, clearly indicate which question you are answering.

Please turn over

Question 32 (4 marks)

The table below shows the distances of the roads linking 7 towns on Stephen's Island, all distances are in kilometres.

	A	*B*	*C*	*D*	*E*	*F*	*G*
A	–	66	70	–	–	–	–
B	66	–	85	50	–	80	–
C	70	85	–	65	50	–	–
D	–	50	65	–	70	25	–
E	–	–	50	70	–	20	55
F	–	80	–	25	20	–	30
G	–	–	–	–	55	30	–

a) Draw a weighted network to represent the roads that link the towns **2**

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b) What is the shortest path, and its length, from town A to town G? **2**

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Question 33 (6 marks)

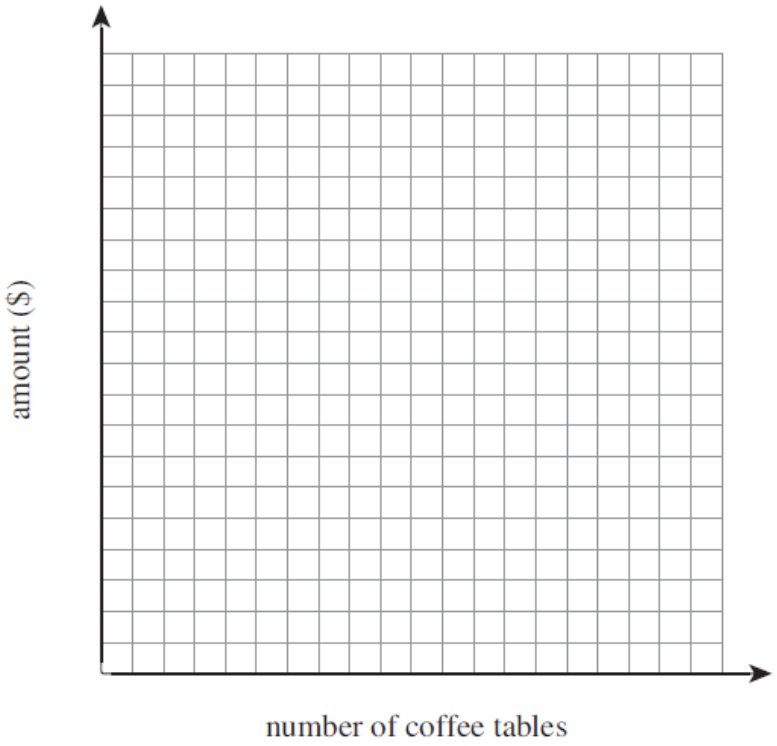
Domenica is a furniture maker who builds and sells wooden coffee tables. She has a fixed cost of $360 to cover the equipment that she uses, and the materials for one table cost her $180. She sells each table for $200.

a) The income from selling the coffee tables (I) can be modelled by the equation $I = 200n$. **1**

Write down the equation for the cost (C) associated with the number of coffee tables made (n).

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b) On the grid below, draw the graphs of both equations from part a). **2**



c) State an estimation for the coordinates of the point of intersection of the two lines drawn in part b). Briefly explain the significance of this point of intersection. **2**

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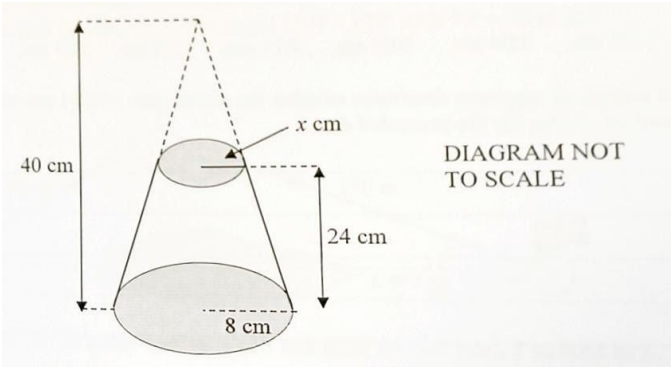
d) Calculate how much profit Domenica will earn when she makes 30 coffee tables. **1**

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Question 34 (2 marks)

The top section of a solid cone of height 40 cm and base radius 8 cm is cut off leaving what is referred to as a "frustum" of height 24 cm, as shown in the diagram below.



What is the length of the radius (x) of the top circular face of the frustum? **2**

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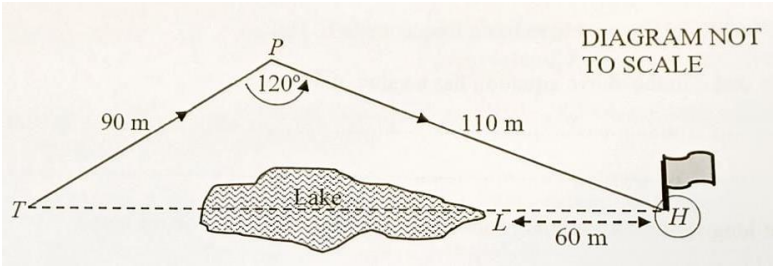
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Question 35 (3 marks)

From the "T" position on a golf course, the hole (H) on the green is 60 m beyond the furthest edge L of a lake and due east of T, as shown in the diagram.

The point P on the golf course is such that angle $TPH = 120°$ with $TP = 90$ m and $PH = 110$ m.



Use the Cosine rule to determine how far a golf ball must fly east from T to land at L. **3**

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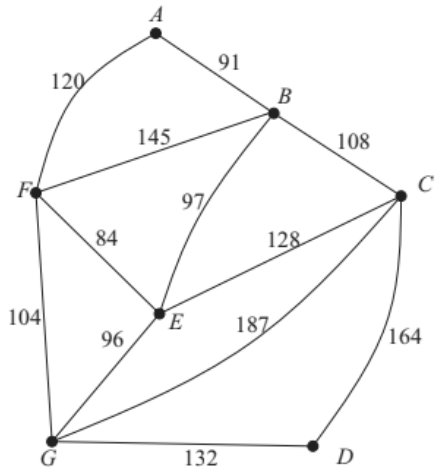
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Question 36 (3 marks)

The network diagram shows the electrical wires connecting 7 buildings on a school campus. The vertices A to G represent the buildings. The weights on the edges represent the length of wire in metres used to connect the buildings.



a) Draw the minimum spanning tree to show the minimum length of wire required to connect all the buildings with electricity. **2**

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b) If the electrician charges $55 per hour and the wire costs $26.50 per metre, how much will it cost to wire the school if they are working on the job from 7:30am – 4pm? **1**

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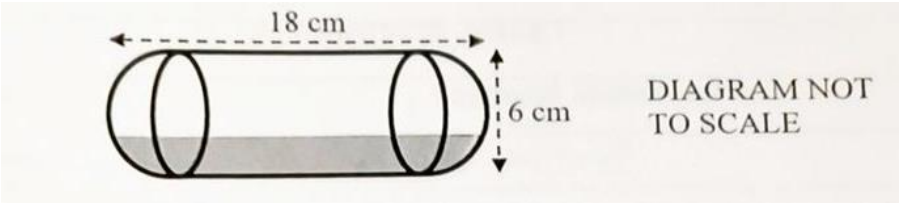
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Question 37 (6 marks)

A capsule of length 18 cm and diameter 6 cm is formed by joining an open hemisphere at each end of an open cylinder, as shown in the diagram.



Water is poured into the capsule and fills one third of its capacity.

a) Show that the volume of water in the capsule is 48π cm^3. **3**

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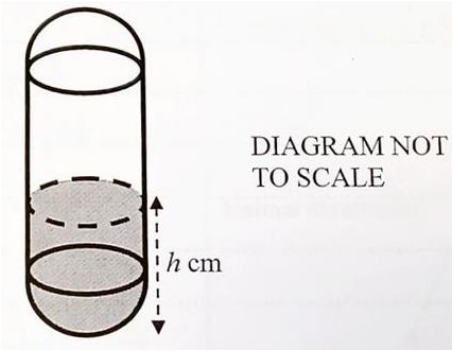
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b) The capsule is rotated 90° so that it sits vertically on one of its hemispherical ends, as shown in the following diagram.



What is the height (h) correct to one decimal place, of the water level in the capsule? **3**

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Question 38 (3 marks)

The table below gives the present value of an annuity of $1 at the given interest rate for the given period.

Present Value Interest Factors (PVA)								
$1	Interest Rate Per Period							
N	1%	2%	3%	4%	5%	6%	7%	8%
1	0.9901	0.9804	0.9709	0.9615	0.9524	0.9434	0.9346	0.9269
2	1.9704	1.9416	1.9135	1.8861	1.8594	1.8334	1.8080	1.7833
3	2.9410	2.8839	2.8286	2.7751	2.7232	2.6730	2.6243	2.5771
4	3.9020	3.8077	3.7171	3.6299	3.5460	3.4651	3.3872	3.3121
5	4.8545	4.7135	4.5797	4.4518	4.3295	4.2124	4.1002	3.9927
6	5.7955	5.6014	5.4172	5.2421	5.0757	4.9173	4.7665	4.6229
7	6.7282	6.4720	6.2303	6.0021	5.7864	5.5824	5.3893	5.2064
8	7.6517	7.3255	7.0197	6.7327	6.4632	6.2098	5.9713	5.7466
9	8.5660	8.1622	7.7861	7.4353	7.1078	6.8017	6.5152	6.2469
10	9.4713	8.9826	8.5302	8.1109	7.7217	7.3601	7.0236	6.7101

Shaon takes out a loan of $12000 to buy a car. This loan is to be repaid half yearly over 4 years at an interest rate of 8% per year. By first using the Present Value Interest Factor table to find his half yearly repayments, calculate the amount of interest Shaon will pay over the life of his loan. **3**

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Question 39 (3 marks)

Zane achieved a mark of 68/80 for his Biology Assessment task 3 exam. The scores for this exam are normally distributed, with a standard deviation of 3.2% and a mean of 80%. If he wants to perform at the same level in the HSC Trial exam, and the mean increases by 5% and the standard deviation decreases by 2%, what mark must he achieve, to the nearest whole mark, if the exam is out of 70? **3**

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END OF EXAM

Student Number

12MAS – Ms Stephens

Class

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

Caringbah High School

2022 HIGHER SCHOOL CERTIFICATE TRIAL EXAMINATION

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 at the back of this paper
- For questions in Section II, show relevant mathematical reasoning and/ or calculations

Total marks:
~~100~~ 101

Section I – 15 marks (pages 2–5)
- Attempt Questions 1–15
- Allow about 25 minutes for this section

Section II – 85 marks (pages 7–23)
- Attempt Questions 16–39
- Allow about 2 hours and 5 minutes for this section

SOLUTIONS.

Section I	Section II	Total
/15	/85	~~/100~~

101

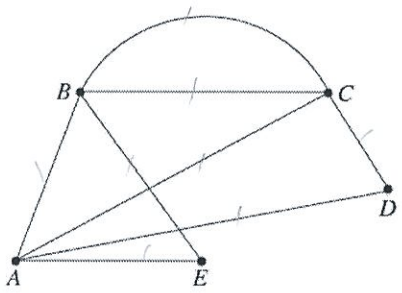
Section I – 15 marks

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. Consider the network diagram.



How many edges does the network have?

A. 5

B. 6

C. 7

D. 8

2. The solution for the pair of simultaneous equations $3x-2y=12$ and $2x+5y=-11$ has the value of x equal to 2. What is the value of y?

A. -3

B. -2

C. 1.4

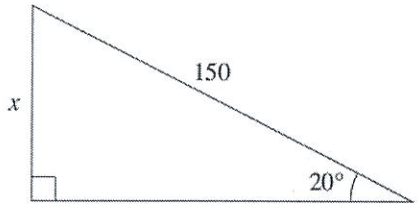
D. 3

$3(2)-2y=12$

$-2y=6$

$y=-3$

3. Consider the triangle.



NOT TO SCALE

Which of the following gives the value of x?

A. $150\cos 20^\circ$

B. $\dfrac{150}{\sin 20^\circ}$

C. $\dfrac{150}{\cos 20^\circ}$

D. $150\sin 20^\circ$

$\sin 20^\circ = \dfrac{x}{150}$

$x = 150\sin 20$

4. Alessia works 42 hours per week at a rate of $32.50 per hour. She decides to take four weeks of annual leave. While she is on annual leave, she is paid a loading of 17.5% on her wage.
What is Alessia's total wage for the period of time that she is on annual leave?

A. $955.50
B. $1365
C. $5460
D. $6415.50

$42 \times 32.50 \times 4 \times 117.5\%$

5. The scale of a map is 1 cm = 125 m.
If the actual distance between two points is 650 m, what is the distance between these points on the map?

A. 0.2 cm
B. 2 cm
C. 2.5 cm
D. 5.2 cm

$\frac{650}{125} = 5.2$

6. Which data collected about a virus could be classified as "categorical nominal"?

A. The number of people who contracted the virus
B. The place of origin of the virus
C. The rate at which the virus spread throughout the population
D. The length of time taken to control the spread of the virus

7. There are five more black marbles in a bag than there are white marbles.
All marbles in the bag are either black or white.

The probability of randomly selecting a black marble from the bag is $\frac{3}{5}$.

How many white marbles are in the bag?

A. 10
B. 15
C. 20
D. 25

$b = x + 5$
$w = x$

$\frac{x+5}{2x+5} = \frac{3}{5}$
$5x + 25 = 6x + 15$
$x = 10$

8. The amount of a particular medication in an intravenous (IV) solution is 250 mg per 15 mL. A patient is prescribed 3500 mg of the medication.
How much IV solution should be given to the patient?

A. 0.93 mL
B. 14 mL
C. 21 mL
D. 210 mL

$\frac{3500}{250} = 14.$

$14 \times 15 =$

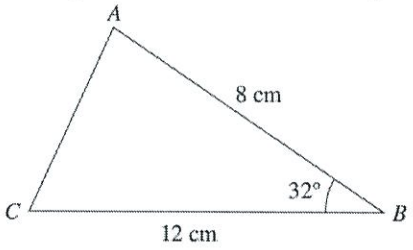
9. The test scores of a Mathematics class and their frequencies are shown in the table.

Score	*Frequency*
52	4
54	8
56	12
58	2
60	2 3

Which of the following measures will change if another score of 60 is added to the dataset?

A. mean
B. range
C. median
D. mode

10. In the triangle ABC, AB has a length of 8 cm, BC has length of 12 cm, and angle ABC is 32°.



What is the area of triangle ABC?

A. 25.4 cm^2
B. 26.6 cm^2
C. 26.7 cm^2
D. 48.0 cm^2

$\frac{1}{2} \times 8 \times 12 \times \sin 32$

11. The height of a building is measured. It is found to be 480 m, to the nearest 10 m.

The lower and upper limits of the true measurement are, respectively,

A. 450 m and 460 m.
B. 470 m and 490 m.
C. 475 m and 485 m.
D. 400 m and 500 m.

$\pm 5m$.

12. Dominic's car uses fuel at a rate of 7.2 L per 100 km for long-distance driving and 10.4 L per 100 km for short-distance driving. Dominic drove his car 851 km to Melbourne. The journey included 112 km of short-distance driving.

How much fuel did Dominic's car use on the journey, correct to the nearest litre?

A. 63 L
B. 64 L
C. 65 L
D. 66 L

112 Short: 1.12×10.4

739 long: 7.39×7.2

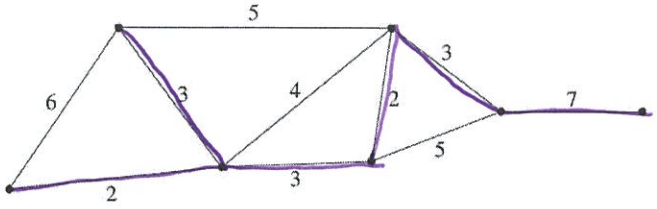
13. Last month, Jessica purchased 550 shares at a market price of $4.00 per share. The market price is now $4.60 per share. Jessica receives a dividend of $0.40 per share.

What is the dividend yield, to the nearest percent?

A. 8%
B. 9%
C. 10%
D. 11%

$$\frac{0.40}{4.60} \times 100$$

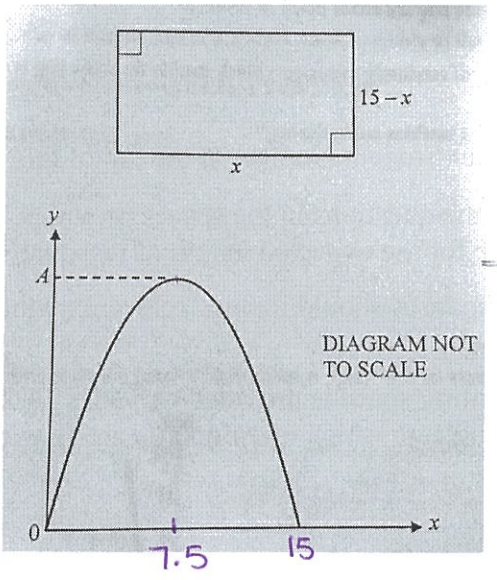
14. The diagram represents a network with weighted edges.



What is the total length of the minimum spanning tree?

A. 17
B. 20
C. 24
D. 27

15. To determine the maximum area (A) of a rectangle with a perimeter of 30m, Melanie sketched the following diagrams in her notebook.



The point A is the turning point on the parabolic graph.
Melanie correctly determined the maximum area of the rectangle (in square metres) by finding the value of A.

What is the value?

A. 48
B. 50
C. 56.25
D. 100

$$x(15-x)$$
$$= -x^2 + 15x$$
$$= -(7.5)^2 + 15(7.5)$$

End of Section 1

10:45

Mathematics Standard 2

Section II Booklet 1

Student Number

Section II

85 marks
Attempt Questions 16–39
Allow about 2 hours and 5 minutes for this section

Booklet 1 — Attempt Questions 16–31 (55 marks)
Booklet 2 — Attempt Questions 32–39 (30 marks)

Instructions

- Write your Student Number at the top of this page.
- 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 on pages 24-25. If you use this space, clearly indicate which question you are answering.

Please turn over

Question 16 (2 marks)

Solve the equation: $5-2(x+1)=x$ **2**

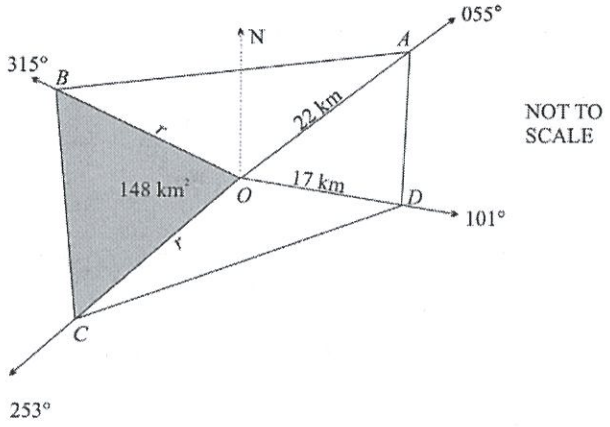
$5-2x-2=x$

$3=3x$

$x=1$

Question 17 (3 marks)

A radial survey is taken on a plot of land. Points B and C are equal distance in kilometres from O. Point B is on a bearing of 315° and point C is on a bearing of 253°. The area of BOC is 148 km^2. **3**



NOT TO SCALE

What is the distance OB, correct to one decimal place?

$148=\frac{1}{2}\times r^2\times \sin 62$

$r^2=335.24$

$r=18.3\text{km}$

Question 18 (2 marks)

Three unbiased six-sided dice are rolled simultaneously 1080 times. **2**
How many times would it be expected that all three dice show a 4?

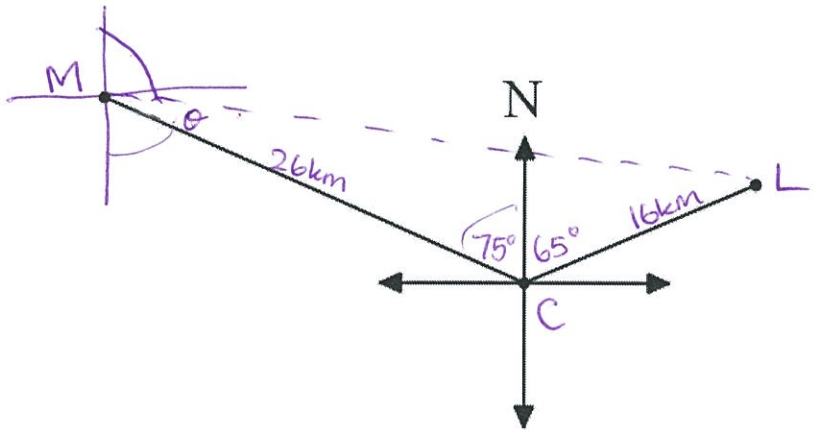
$1/6\times 1/6\times 1/6=1/216$

$1/216\times 1080=5$

Question 19 (6 marks)

Two hikers decide to leave a campsite (C) to visit some natural landmarks in the area. One hiker walks 16 km on a bearing of 65° to see a lake (L); the other hiker walks 26 km on a bearing of 285° to reach the top of a mountain (M).

a) Complete the diagram to display the scenario. Include lengths and bearings from the question above. **1**



b) Calculate the distance between the mountain and the lake, correct to the nearest kilometre. **2**

$c^2 = 26^2 + 16^2 - 2 \times 26 \times 16 \times \cos 140°$

$= 1569.34...$

$c = 39.615...$

$c \approx 40\text{km}$

c) Hence, using your answer from part b) and the sine rule, find the bearing of the lake from the mountain, correct to the nearest degree. **3**

$\frac{\sin\theta}{16} = \frac{\sin 140}{40}$

$\sin\theta = \frac{16 \sin 140}{40}$

$\theta = 14.89...$

Bearing $= 180 - 75 - \theta \approx 90°$

$= 90°6'$

Question 20 (2 marks)

An original manuscript sold at a recent auction for \$45 000.

It is assumed that the manuscript will increase in value by 7.25% annually.

Use the formula: $FV = PV(1 + r)^n$ to estimate how much the manuscript is likely to increase in value over the next 5 years. Give your answer to the nearest dollar. **2**

$45000(1 + 0.0725)^5$

$= 63855.6\ldots$

$63855.6\ldots - 45000 = \$18\,855.60$

$\approx \$18856$

Question 21 (4 marks)

A formula for the dosage in mL (D) of medicine required for a child aged between 1 and 12 years compared to an adult's dosage (A) is:

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

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

$Dy + 12D = yA$

$A = \dfrac{Dy + 12D}{y}$

b) A 6-year-old child is to take 5mL of a prescribed medicine three times per day. What is the equivalent daily adult dosage for this medicine? **2**

15mL per day: $A = \dfrac{15 \times 6 + 12 \times 15}{6}$

$= 45\text{mL / day}$

Question 22 (3 marks)

3

On a rail station, a train is scheduled to arrive at 9:00am each morning.
The following data shows the times the train arrived on seven consecutive days.

9:03am, 9:04am, 9:02am, 9:11am, 9:02am, 9:03am, 9:01am

With the aid of calculation, determine whether the arrival time of 9:11am could be considered an outlier for the presented data.

9:01 9:02 9:02 9:03 9:03 9:04 9:11

IQR = 2 mins.

9:04 + 1.5 × 2

= 9:07 ∴ yes, 9:11 is an outlier as it is > 9:07

Question 23 (2 marks)

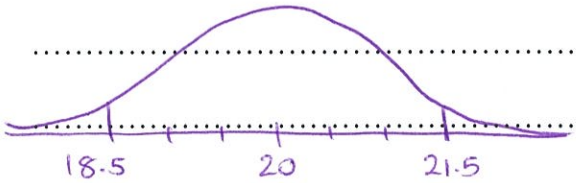
2

A manufacturing plant produces steel balls with masses that are normally distributed.

The mean mass of the balls is 20 g with a standard deviation of 0.5 g.

In quality control testing of the manufactured balls, any ball with a mass greater than 21.5 g and less than 18.5 g is rejected.

From a sample of 5000 steel balls tested, how many would be expected to be rejected?



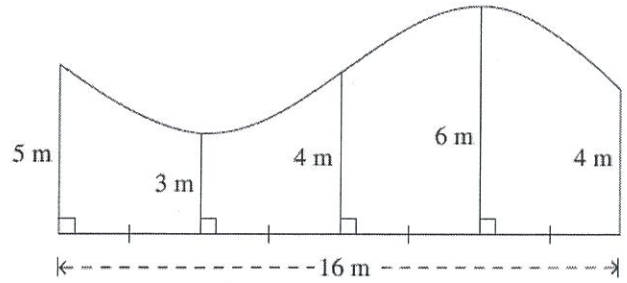
100 − 99.7

= 0.3%

0.003 × 5000 = 15 will be rejected.

Question 24 (4 marks)

Luka is installing a pond in his backyard. The pond will have three straight edges and one curved edge. The depth of the pond will be 2 metres throughout. Luka took measurements and drew an overhead view of the pond to assist the builder, as shown in the diagram.



a) Using the trapezoidal rule, estimate the area of the bottom of the pond. **2**

$A \approx \frac{4}{2}[(5+3)+(3+4)+(4+6)+(6+4)]$ **2**

$\approx 70\ m^2$

b) Calculate how many litres of water will be required to fill the pond.

$70 \times 2 = 140 m^3$ $\times 1000$ $1m^3 = 1000L$

$= 140\,000L$

Question 25 (2 marks)

Richard plays on his game console for three hours every day. The game console uses 350 watts of energy per hour. The cost of electricity usage is \$0.45 per kWh. **2**

Calculate the yearly cost for Richard to play his game console, correct to the nearest cent.

$0.35 \times 3 \times 365 \times 0.45$

$= \$172.46$

Question 26 (4 marks)

The frequency (F) (number of vibrations per second) measured in Hertz (Hz), of a string on a harp, varies inversely with the square root of the length of the string (L) measured in cm.

A string of length 25 cm on a harp has frequency of 10 Hz.

a) Show that the situation can be modelled by the equation: $F = \frac{50}{\sqrt{L}}$ **1**

$F = \frac{50}{\sqrt{L}}$ $F = \frac{50}{\sqrt{L}}$

$10 = \frac{50}{\sqrt{25}}$ OR $F = \frac{50}{5}$

$10 = \frac{50}{5}$ ✓ $F = 10$ ✓

b) What length of string would produce a frequency of 12.5 Hz on the harp? **2**

$12.5 = \frac{50}{\sqrt{L}}$ $\sqrt{L} = 4$

$L = 16\text{cm}$.

$\sqrt{L} = \frac{50}{12.5}$

Question 27 (5 marks)

Aaron wants to purchase an apartment. The bank manager has provided them with a table of monthly payments for a loan of $1000 for varying interest rates.

Interest rate per annum	*Term of loan in years*					
	5	*10*	*15*	*20*	*25*	*30*
6.0%	19.33	11.10	8.44	7.16	6.44	6.00
6.5%	19.57	11.35	8.71	7.46	6.75	6.32
7.0%	19.80	11.61	8.99	7.75	7.07	6.65
7.5%	20.04	11.87	9.27	8.06	7.39	6.99
8.0%	20.28	12.13	9.56	8.36	7.72	7.34

3

Aaron has savings of $95 000 to put towards the purchase price of his $620 000 apartment.

a) Aaron decides to purchase the apartment using $50 000 of his savings as a deposit and to borrow the balance over 20 years at a rate of 6.5% p.a. calculating his monthly loan repayment,

2

620 000 - 50 000

= 570 000

570 × 7.46 = 4252.20

b) After reviewing their financial position with the bank manager, Aaron realises he can't afford to pay any more than $2200 per month. The bank will lend at 6.0% per annum over 30 years provided Aaron uses all of his savings as a deposit. The owner of the apartment is prepared to drop the sale price of the apartment by $10 000. Can Aaron afford this apartment?

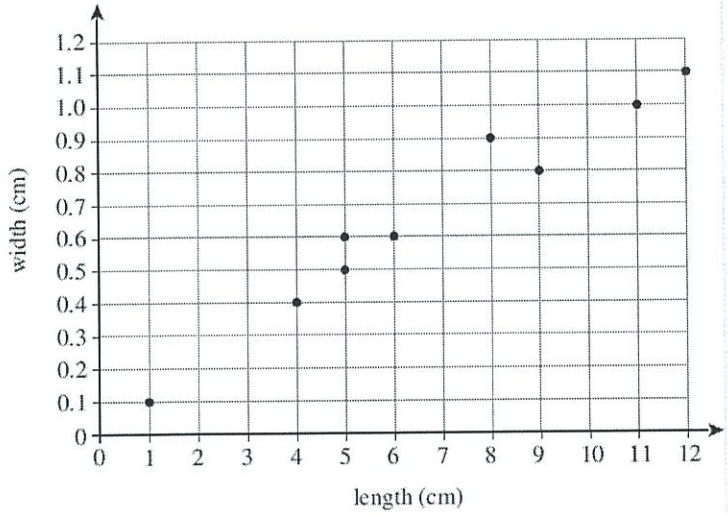
~~BT~~ 610 000 - 95000

= 515 000

515 × 6 = 3090 ∴ no, he can't afford it.

Question 28 (6 marks)

A set of bivariate data is collected by measuring the lengths and widths of a population of slugs. A scatterplot of this data is shown.



a) Calculate Pearson's correlation coefficient for the data, correct to two decimal places. **1**

$r = 0.98$

b) Identify the direction and strength of the linear relationship between the lengths and widths of the slugs. **2**

strong, positive, linear relationship

c) Find the equation of the least-squares regressions line in the form: **3**

$width = B \times length + A$

and use the equation to predict the length of a slug that has a width of 0.3 cm correct to one decimal place.

$A = 0.072$ $\quad width = 0.088\,length + 0.072$

$B = 0.088$

$0.3 = 0.088 \times length + 0.072$

$length = 2.59\,cm$

25:45

Question 29 (3 marks)

Scarlett uses a credit card that has an interest rate of r % per annum, simple interest, daily. The card does not have an interest-free period. Interest is calculated to include the day of transaction and the day on which the account balance is paid. During December, Scarlett makes the following transactions.

Credit card statement

Date	*Transaction*	*Amount*
12 December	clothing store	$84.00
19 December	shoe store	$150.00
21 December	supermarket	$170.00

If Scarlett pays her account balance of $407.05 on 5 January in full, what is the annual interest rate, to 2 d.p.? **3**

$407.05 - 404 = 3.05$

$(84 \times 25 \times r) + (150 \times 18 \times r) + (170 \times 16 \times r) = 3.05$

$2100r + 2700r + 2720r = 3.05$

$7520r = 3.05$

$r = 0.0004\ldots \times 365 \times 100$

rate p.a. $= 14.80\%$

Question 30 (4 marks)

After 5 years, the value of a piece of farm machinery has reduced to $25 000.
The original value of the machinery when purchased new was $80 000.

a) If the straight-line method was used to depreciate the machinery, what was the annual loss in value as a percentage of the purchase price? **2**

$25000 = 80000 - 5D$

$D = 11000$

as a % $\frac{11000}{80000} \times 100 = 13.75\%$

b) Show that if the declining balance method was used to depreciate the machinery, the annual loss in value as a percentage of the purchase price was 20.76% **2**

$25000 = 80000(1-r)^5$

$(1-r)^5 = 0.3125$

$1 - r = \sqrt[5]{0.3125}$

$1 - r = 0.792\ldots$

$r = 0.2075\ldots$

$\approx 20.76\%$ p.a.

Question 31 (5 marks)

Ollie just got their P's and is trying to save up to buy their first car. They have decided to contribute a certain amount from each monthly pay slip into a high interest savings account. Ollie has created an Excel spreadsheet to keep track of the monthly contributions. A screenshot of the spreadsheet is below:

	A	B	C	D	E	F	G
1	**End of month**	**P**	**I**	**P+I**	**P + I + R**		
2	**1**	500.00	1.00	501.00	1001.00		
3	**2**	1001.00	2.00	1003.00	1503.00		**interest rate p.a.**
4	**3**	1503.00	3.01	1506.01	2006.01		**2.40%**
5	**4**	2006.01	4.01	2010.02	2510.02		
6	**5**						
7	**6**						
8							

a) What amount has Ollie decided to contribute into the account each month? **1**

$500

b) By continuing the calculations, what is the amount in cell E7? **2**

$2510.02\left(1+\frac{0.024}{12}\right)+500=3015.04$

$3015.04\left(1+\frac{0.024}{12}\right)+500=3521.07$

c) What amount could Ollie have contributed initially (PV) into this account, without making any further contributions, to have the same financial outcome after 6 months? **2**

$3521.07=P\left(1+\frac{0.024}{12}\right)^6$

$P=\frac{3521.07}{\left(1+\frac{0.024}{12}\right)^6}$

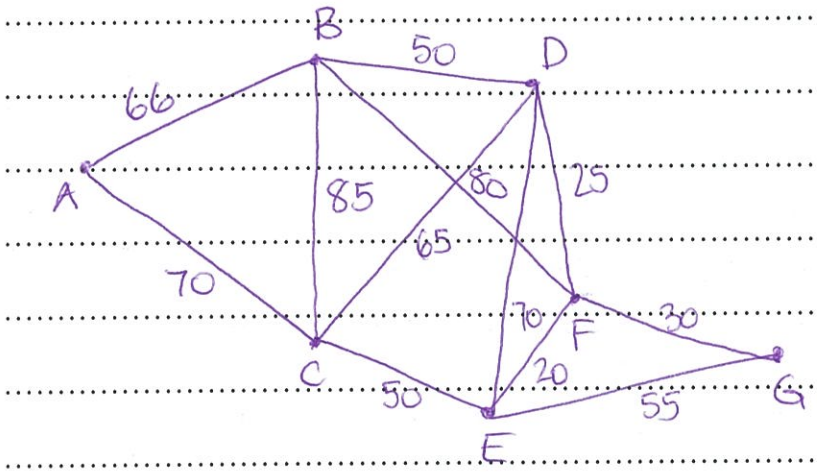
$=\$3479.11$

Question 32 (4 marks)

The table below shows the distances of the roads linking 7 towns on Stephen's Island, all distances are in kilometres.

	A	B	C	D	E	F	G
A	–	66	70	–	–	–	–
B	66	–	85	50	–	80	–
C	70	85	–	65	50	–	–
D	–	50	65	–	70	25	–
E	–	–	50	70	–	20	55
F	–	80	–	25	20	–	30
G	–	–	–	–	55	30	–

a) Draw a weighted network to represent the roads that link the towns **2**



b) What is the shortest path, and its length, from town A to town G? **2**

A B D F G = 171

A B F G = 176

A C E F G = 170 A C E F G = 170km

22:40

2022 HIGHER SCHOOL CERTIFICATE TRIAL EXAMINATION

Mathematics Standard 2

Section II Answer Booklet 2

Student Number

Booklet 2 — Attempt Questions 32–39 (30 marks)

Instructions

- Write your Student Number at the top of this page.
- Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.
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Please turn over

Question 33 (6 marks)

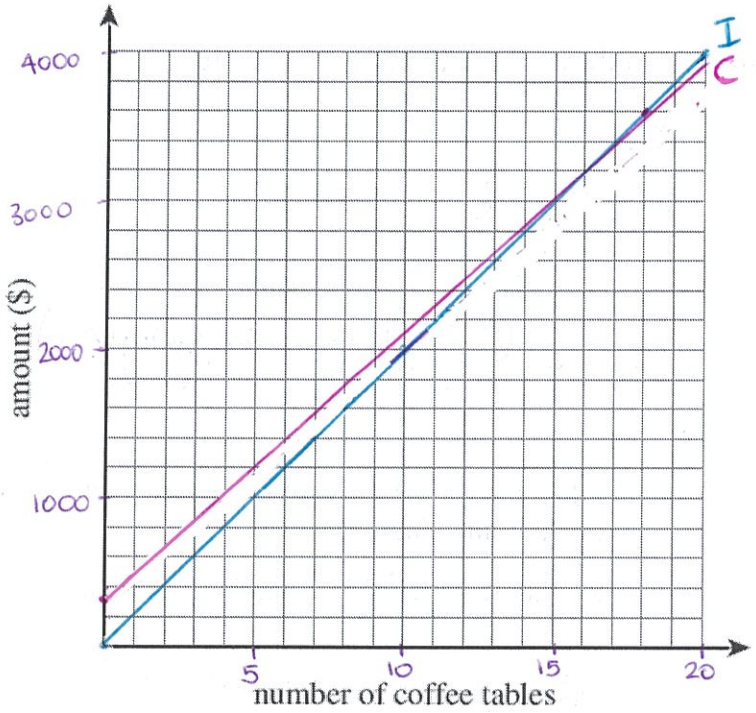
Domenica is a furniture maker who builds and sells wooden coffee tables. She has a fixed cost of $360 to cover the equipment that she uses, and the materials for one table cost her $180. She sells each table for $200.

a) The income from selling the coffee tables (I) can be modelled by the equation $I = 200n$. **1**

Write down the equation for the cost (C) associated with the number of coffee tables made (n).

$C = 360 + 180n$

b) On the grid below, draw the graphs of both equations from part a). **2**



c) State the coordinates of the point of intersection of the two lines drawn in part b). Briefly explain the significance of this point of intersection. **2**

Approx. (18, 3600)

If she ~~4ek~~ sells 10 coffee tables, she will make her money back. More than 10 tables and she starts earning a profit.

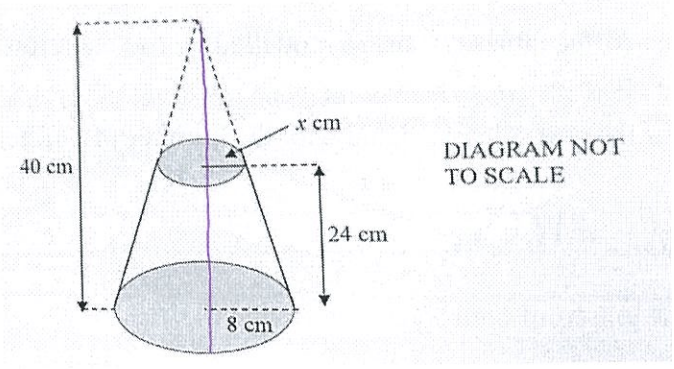
d) Calculate how much profit Domenica will earn when she makes 30 coffee tables. **1**

$C = 360 + 180(30) = 5760$ Profit = $240

$I = 200 \times 30 = 6000$

Question 34 (2 marks)

The top section of a solid cone of height 40 cm and base radius 8 cm is cut off leaving what is referred to as a "frustum" of height 24 cm, as shown in the diagram below. **2**



What is the length of the radius (x) of the top circular face of the frustum?

40 - 24 = 16.

$x = 3.2$cm

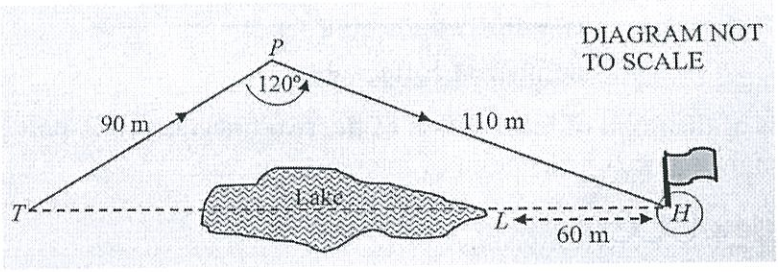
$\frac{x}{8} = \frac{16}{40}$

(similar triangles)

Question 35 (3 marks)

From the "T" position on a golf course, the hole (H) on the green is 60 m beyond the furthest edge L of a lake and due east of T, as shown in the diagram. **3**

The point P on the golf course is such that angle $TPH = 120°$ with $TP = 90$ m and $PH = 110$ m.



Use the Cosine rule to determine how far a golf ball must fly east from T to land at L.

$c^2 = 90^2 + 110^2 - 2 \times 90 \times 110 \times \cos 120$

$= 30100$

$c = 173.49...$

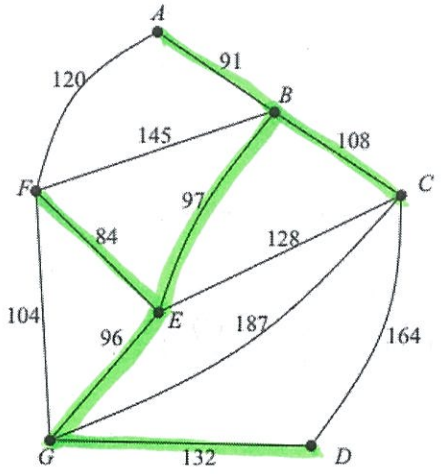
$TL = 173.49... - 60$

$= 113.49...$

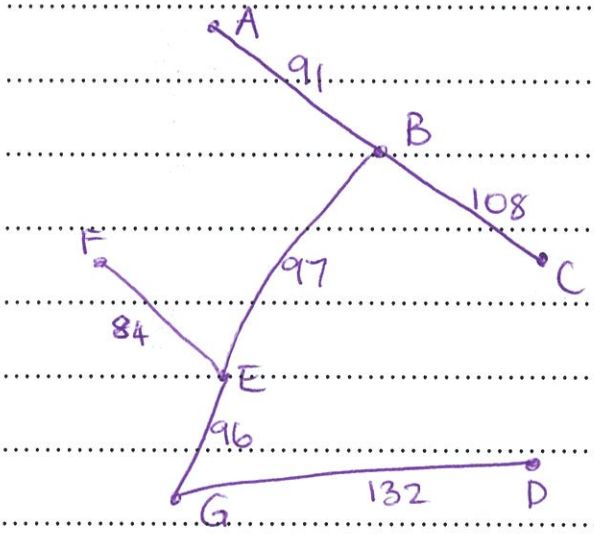
≈ 113.5m

Question 36 (3 marks)

The network diagram shows the electrical wires connecting 7 buildings on a school campus. The vertices A to G represent the buildings. The weights on the edges represent the length of wire in metres used to connect the buildings.



a) Draw the minimum spanning tree to show the minimum length of wire required to connect all the buildings with electricity. **2**

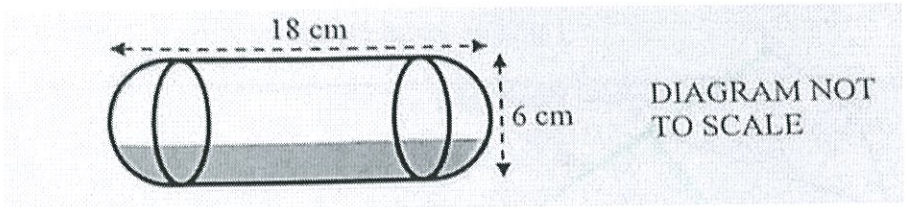


b) If the electrician charges \$55 per hour and the wire costs \$26.50 per metre, how much will it cost to wire the school if they are working on the job from 7:30am – 4pm? **1**

(608 * 26.50) + (55 × 8.5) = \$16579.50

Question 37 (6 marks)

A capsule of length 18 cm and diameter 6 cm is formed by joining an open hemisphere at each end of an open cylinder, as shown in the diagram.



Water is poured into the capsule and fills one third of its capacity.

a) Show that the volume of water in the capsule is 48π cm^3. **3**

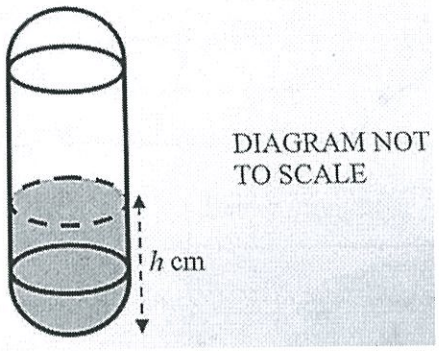
$V = \left(\frac{4}{3} \times 3^3 \times \pi\right) + \left(\pi \times 3^2 \times 12\right)$

$= 36\pi + 108\pi$

$= 144\pi \div 3$

$= 48\pi$ cm^3

b) The capsule is rotated 90° so that it sits vertically on one of its hemispherical ends, as shown in the following diagram.



What is the height (h) correct to one decimal place, of the water level in the capsule? **3**

$48\pi = \left(\frac{1}{2} \times \frac{4}{3} \times 3^3 \times \pi\right) + \left(\pi \times 3^2 \times h\right)$

$= 18\pi + 9\pi h$

$30\pi = 9\pi h$

$h = \frac{30\pi}{9\pi} = 3\frac{1}{3}$ cm + 3 (radius)

$= 6\frac{1}{3}$ cm

Question 38 (3 marks)

The table below gives the present value of an annuity of $1at the given interest rate for the given period.

Present Value Interest Factors (PVA)								
$1	Interest Rate Per Period							
N	1%	2%	3%	4%	5%	6%	7%	8%
1	0.9901	0.9804	0.9709	0.9615	0.9524	0.9434	0.9346	0.9269
2	1.9704	1.9416	1.9135	1.8861	1.8594	1.8334	1.8080	1.7833
3	2.9410	2.8839	2.8286	2.7751	2.7232	2.6730	2.6243	2.5771
4	3.9020	3.8077	3.7171	3.6299	3.5460	3.4651	3.3872	3.3121
5	4.8545	4.7135	4.5797	4.4518	4.3295	4.2124	4.1002	3.9927
6	5.7955	5.6014	5.4172	5.2421	5.0757	4.9173	4.7665	4.6229
7	6.7282	6.4720	6.2303	6.0021	5.7864	5.5824	5.3893	5.2064
8	7.6517	7.3255	7.0197	6.7327	6.4632	6.2098	5.9713	5.7466
9	8.5660	8.1622	7.7861	7.4353	7.1078	6.8017	6.5152	6.2469
10	9.4713	8.9826	8.5302	8.1109	7.7217	7.3601	7.0236	6.7101

8

Shaon takes out a loan of $12000 to buy a car. This loan is to be repaid half yearly over 4 years at an interest rate of 8% per year. By first using the Present Value Interest Factor table to find his half yearly repayments, calculate the amount of interest Shaon will pay over the life of his loan. **3**

4%

12000 ÷ 6.7327 = 1782.34...

total repayed = 1782.34... × 4 × 2

= 14258.76...

Interest = 14258.76... − 12000

= $2258.77

Question 39 (3 marks)

Zane achieved a mark of 68/80 for his Biology Assessment task 3 exam. The scores for this exam are normally distributed, with a standard deviation of 3.2% and a mean of 80%. If he wants to perform at the same level in the HSC Trial exam, and the mean increases by 5% and the standard deviation decreases by 2%, what mark must he achieve, to the nearest whole mark, if the exam is out of 70? **3**

$\frac{68}{80}$ = 85%

$z = \frac{85-80}{3.2} = 1.5625$

$1.5625 = \frac{x-85}{1.2}$

$1.875 = x - 85$

$x = 86.875$

$\frac{y}{70} \times 100 = 86.875$

$y = 60.81...$

$\approx \frac{61}{70}$

END OF EXAM