Name……..

Teacher's Name……

Pymble Ladies' College

Mathematics Standard 2
HSC Trial Examination
Term 3 2022

General Instructions

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

Total marks 100

Section 1 – 15 marks (pages 1 - 4)

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

Section II – 85 marks (pages 5 - 30)

- 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 What is 34 478 900 written in scientific notation, correct to three significant figures?

(A) 3.4×10^{7}

(B) 3.44×10^{7}

(C) 3.45×10^{7}

(D) 34.5×10^{6}

2 A car uses an average of 7 L of fuel per 100 km travelled.
How much fuel would the car use if it travels 382 km?

(A) 26.74 L

(B) 34.72 L

(C) 38.20 L

(D) 54.57 L

3 Evelyn worked for eight hours a day on Thursday and Friday at a rate of $19.20 per hour.
On Saturday she worked for six hours at time-and-a-half.
How much did Evelyn earn in total for working Thursday, Friday and Saturday?

(A) $268.80

(B) $307.20

(C) $480.00

(D) $691.20

4 Molly is concerned about the parrot population in her town. She gathers 170 parrots and tags them. A couple of months later she gathers 32 parrots and finds 10 of them are tagged.
What is Molly's estimate of the parrot population using the capture-recapture method?

(A) 524

(B) 544

(C) 572

(D) 588

5 The monthly repayments per $1000 on a bank home loan are shown in the table below.

Term	8.00%	8.25%	8.50%
20 years	$8.36	$8.52	$8.68
25 years	$7.72	$7.88	$8.05

What is the monthly repayment for a loan of $320 000 at 8.25% p.a. interest rate for 25 years?

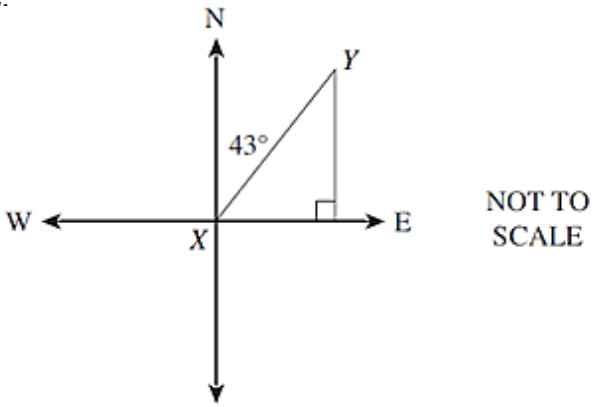
(A) $252.16

(B) $272.64

(C) $2521.60

(D) $2726.40

6 The compass bearing of Y from X is N43°E.
What is the compass bearing of X from Y?



(A) N47°E

(B) N43°E

(C) S47°W

(D) S43°W

7 In a raffle, the total prize money is shared among the first three tickets and drawn in the ratio 5:3:2. The prize for the third ticket drawn is $300.
What is the total prize money?

(A) $1500

(B) $150

(C) $1000

(D) $100

8 The stem-and-leaf plot shows the number of goals scored by a team in each of ten netball games.
What is the mode of this dataset?

(A) 5

(B) 18

(C) 25

(D) 29

0	6 8
1	2 4 5
2	1 5 5 9
3	5

9 Three years ago an appliance was valued at $2467. Its value has depreciated by 15% each year, based on the declining-balance method.
What is the salvage value of the appliance today, to the nearest dollar?

(A) $952

(B) $1110

(C) $1357

(D) $1515

10 The growth of bacteria in a culture can be modelled by the equation: $N = 75(1.05)^t$,
where N is the number of bacteria after t hours.
What type of graph would represent this model?

(A) Exponential

(B) Parabolic

(C) Linear

(D) Hyperbolic

11 A credit card has a daily interest rate of 0.06% per day (no interest free period).
What is the interest charged on $1700 for 15 days? Answer to the nearest cent.

(A) $1.02

(B) $15.36

(C) $102.00

(D) $4074.15

12 A 120-watt ceiling fan is run for 24 hours each day. If electricity is charged at 24.8 c/kWh, what is the cost of running the ceiling fan for 30 days, to the nearest cent?

(A) $15.68

(B) $21.43

(C) $86.40

(D) $2142.73

13 Young's formula is used to calculate the medicine dosage for children aged 1-12 years based on the adult dosage.
The formula is:

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

where D = dosage amount
y = age of child, in years
A = adult dosage.

If the adult dosage for a particular medicine is 60 mg and the child's dosage is 20 mg, how old is the child in years?

(A) 6

(B) 7

(C) 8

(D) 9

14 Which equation shows f as the subject of $a = cd + \frac{f}{k}$?

(A) $f = \frac{a+cd}{k}$

(B) $f = ak - kcd$

(C) $f = \frac{a}{cd} - k$

(D) $f = \frac{k-a}{cd}$

15 The table shows future value interest factors for \$1.

	Interest rate per period					
Period	*1%*	*2%*	*3%*	*4%*	*5%*	*6%*
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	2.0100	2.0200	2.0300	2.0400	2.0500	2.0600
3	3.0301	3.0604	3.0909	3.1216	3.1525	3.1836
4	4.0604	4.1216	4.1836	4.2465	4.3101	4.3746

An annuity of \$80 000 is invested into an account every six months for two years at an interest rate of 2% per annum.
Using data from the table, what is the future value of this annuity?

(A) \$160 800

(B) \$161 600

(C) \$324 832

(D) \$329 728

Name……..

Teacher's Name……

Mathematics Standard 2
Section II

85 marks
Attempt Questions 16 - 44
Allow about 2 hours and 5 minutes for this section

Instructions

- Answer in the spaces provided. These spaces provide guidance for the expected length of the answer.
- Your responses should include relevant mathematical reasoning and/or calculations
- Extra writing space is provided at the end of this booklet.

Marks

Question 16 **2**

A student tried to solve an equation, as shown. However, the student made a mistake in one of the lines.

$$5(x+2)-4(x+1)=-3$$

$$5x+10-4x+4=-3 \quad \text{Line 1}$$

$$x+14=-3 \quad \text{Line 2}$$

$$x=-17 \quad \text{Line 3}$$

Identify the line which has the mistake and give the correct working to solve the equation.

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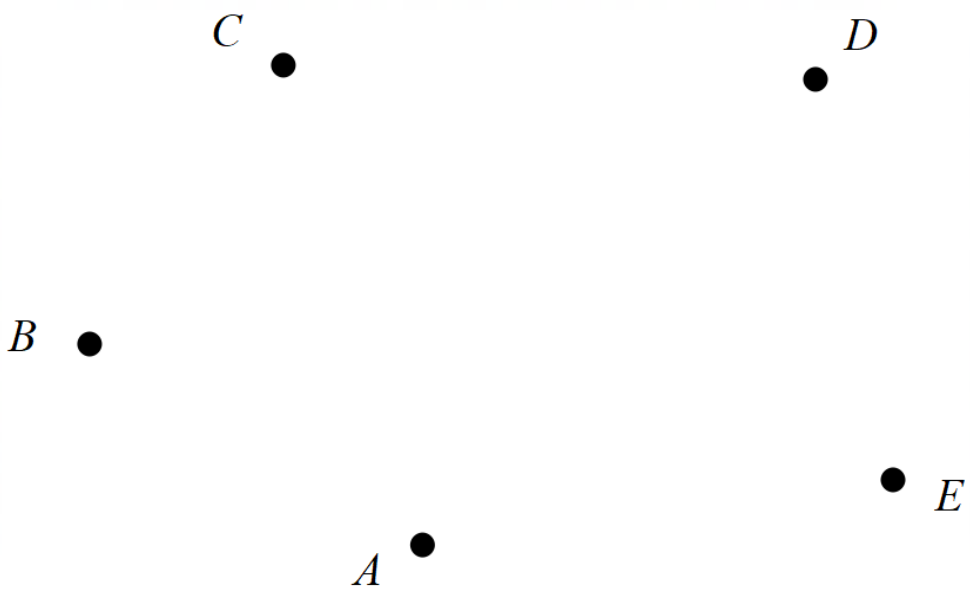
Marks

Question 17 **2**

The distances, in kilometres, between towns in a district, are shown in the following table.

	A	***B***	***C***	***D***	***E***
A	—	6	—	—	8
B	6	—	—	—	5
C	—	—	—	7	—
D	—	—	7	5	4
E	8	5	—	4	—

Use the table above to complete the following network diagram.



Marks

Question 18 **2**

The blood alcohol content (BAC) for males is calculated using the following formula:

$$\text{BAC}_{\text{male}} = \frac{10N - 7.5H}{6.8M}$$

where N = number of standard drinks

H = number of hours spent drinking

M = person's mass in kilograms.

Hunter weighs 87 kg and wants to stay under the legal limit of 0.05.
How many standard drinks can he consume over 3 hours without going over the limit?

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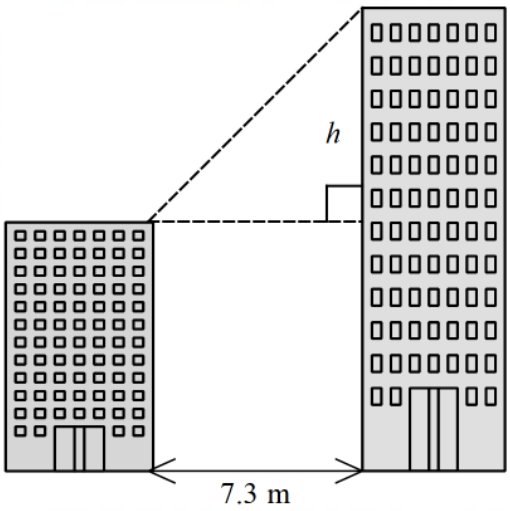
Question 19 **2**

The following two buildings are standing on level ground. The horizontal distance between the buildings is 7.3 metres and the angle of elevation between the top of each building is 49°.



NOT TO SCALE

What is the difference in height between the buildings, correct to one decimal place?

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Marks

Question 20 **2**

The arm lengths of a group of 20 000 people are normally distributed with a mean of 70 cm and a standard deviation of 3 cm.
How many people have arm lengths between 73 cm and 79 cm?

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Question 21 **2**

Lani takes a 14-hour flight from Edmonton, Canada (UTC-7) to Paris, France (UTC+5).
She leaves at 9 am on a Monday morning.
What is the time in Paris when she arrives?

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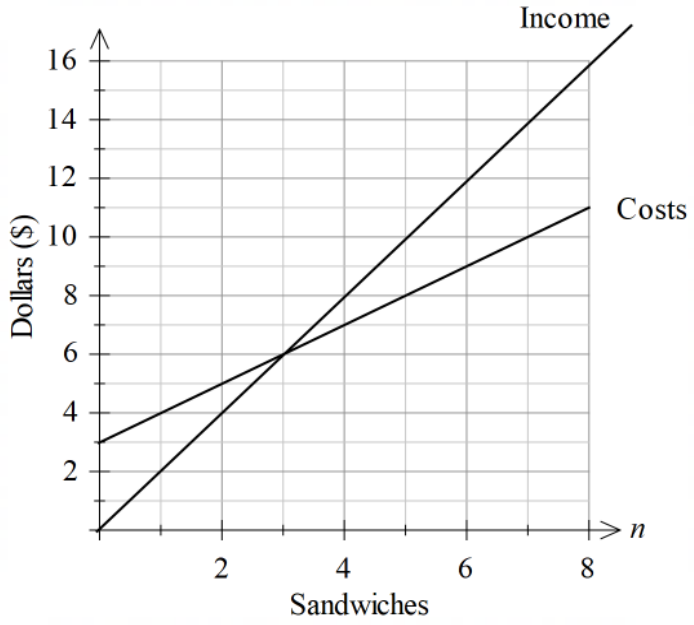
Marks

Question 22

The linear graphs below show the cost of making sandwiches and the income received from selling the sandwiches.



(a) Let the income received be $\$I$ and the number of sandwiches sold be n. **1**
Write a formula for the income.

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(b) Let the costs of making a sandwich be $\$C$ and the number of sandwiches sold be n.. **1**
Write a formula for the costs.

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(c) What is the profit if 7 sandwiches are sold? **1**

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(d) How many sandwiches are needed to be sold to break-even? **1**

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Marks

Question 23

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

Present value of $1					
Interest rate per period					
Period	**1%**	**2%**	**4%**	**6%**	**8%**
1	0.9901	0.9804	0.9615	0.9434	0.9259
2	1.9704	1.9416	1.8861	1.8334	1.7833
3	2.9410	2.8839	2.7751	2.6730	2.5771
4	3.9020	3.8077	3.6299	3.4651	3.3121
5	4.8534	4.7135	4.4518	4.2124	3.9927

(a) What would be the present value of a $9000 per year annuity at 6% per annum for 5 years, with interest compounding annually? **1**

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(b) An annuity of $6000 is invested each three months at 4% per annum, compounded quarterly for 1 year. What is the present value of the annuity? **1**

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(c) What is the value of an annuity that would provide a present value of $43 230 after 3 years at 8% per annum compound interest? Answer to the nearest dollar. **1**

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Marks

Question 24 **2**

A car is sold for $19 990. It will depreciate at 18% per annum.
Using the declining-balance method, what is the salvage value of the car after four years, correct to the nearest dollar?

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Question 25

The mass of a car is 1800 kg, rounded to the nearest 100 kg.

(a) What is the absolute error in this measurement? **1**

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(b) What are the upper and lower bounds for the measurement? **1**

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(c) Find the percentage error, correct to one decimal place. **1**

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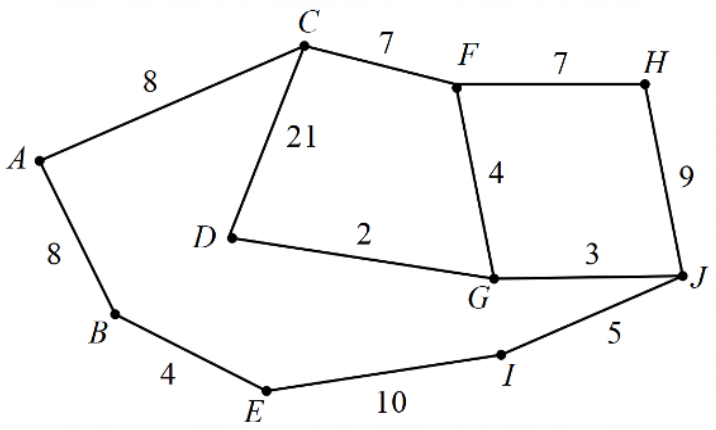
Marks

Question 26



(a) List the vertices with an odd degree. **1**

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(b) What is the length of the shortest path from A to J? **1**

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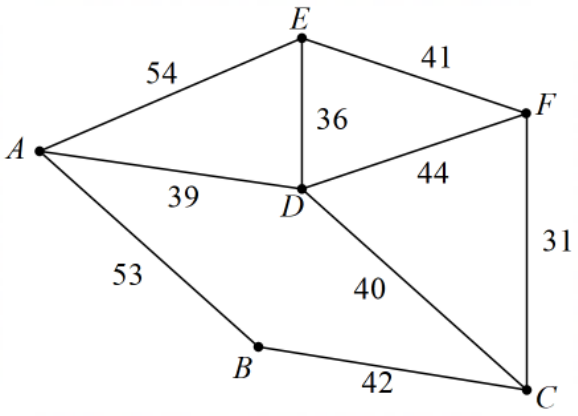
Marks

Question 27

There are 5 towns (B,C,D,E and F) that need to be linked by pipelines to a natural gas supply (A). The existing road links and the distance (in km) between the towns are shown in the network diagram below.



(a) Draw a minimum spanning tree that will ensure that all the towns are connected to the network, so as to minimise the amount of pipelines required. **2**

(b) What is the minimum length of pipeline to supply all the towns? **1**

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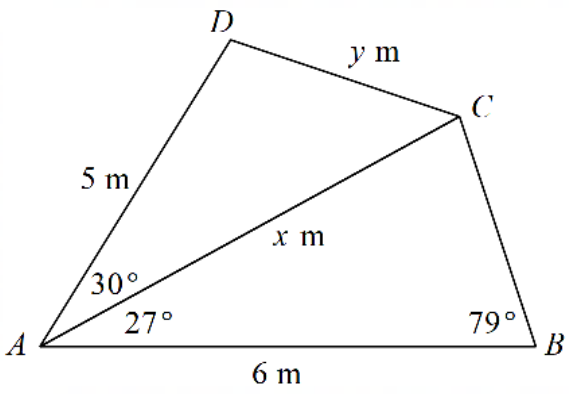
Marks

Question 28 **4**



NOT TO SCALE

Determine the values of x and y in the diagram above.
Give your answers correct to 2 decimal places.

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Question 29 **1**

The number of people in a town is given by $N = 1000(2.1)^t$ where N is the number of people and t is the time in years.

What is the population of the town after five years?

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Marks

Question 30 **2**

The volume, V, of gas varies inversely to the pressure, P, being applied to it.
The volume of gas is 400 cm^3 when pressure is 32 kg/cm^2.

What will be the volume of the gas if the pressure is increased to 40 kg/cm^2?

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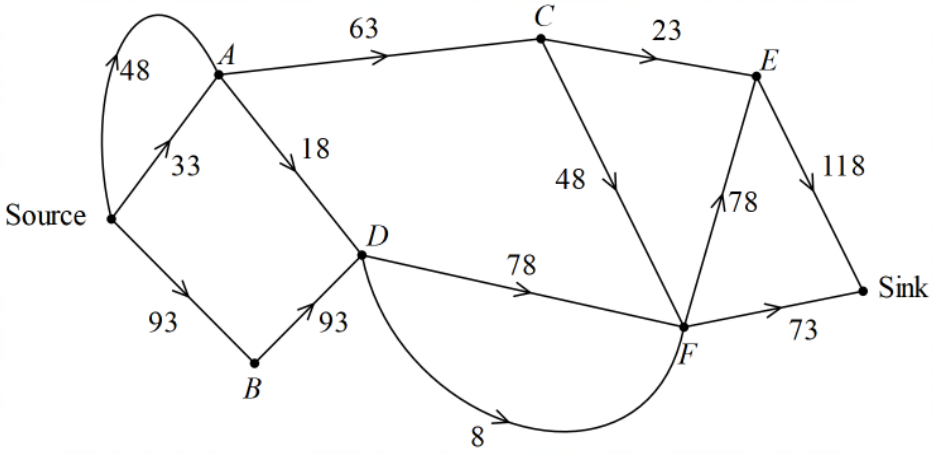
Question 31

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



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

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(b) Draw the minimum cut *on the network diagram above*. **1**

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

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Marks

Question 32

The back-to-back stem plot below displays the *jumping height*, in centimetres, of 29 cats and their *living situation* (domestic or feral).

Key **8** |**13**| **9** = 138 (domestic) and 139 (feral)

Domestic (13 cats)	*Jumping height (cm)*	Feral (16 cats)
8	13	9
774332	14	6
73	15	1335779
100	16	19
	17	11267
8	18	

(a) One of the variables, *jumping height*, or *living situation*, is categorical. Is the categorical variable ordinal or nominal? **1**

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(b) Use the information in the back-to-back stem plot to complete the missing values in the shaded boxes below. **2**

	Jumping height (cm)				
Living situation	minimum	Q_1	median (Q_2)	Q_3	Maximum
Domestic	138	143	147		188
Feral		143	158	171	177

(c) Can any of the domestic cats be called an outlier in terms of jumping height? Show working to justify your answer. **3**

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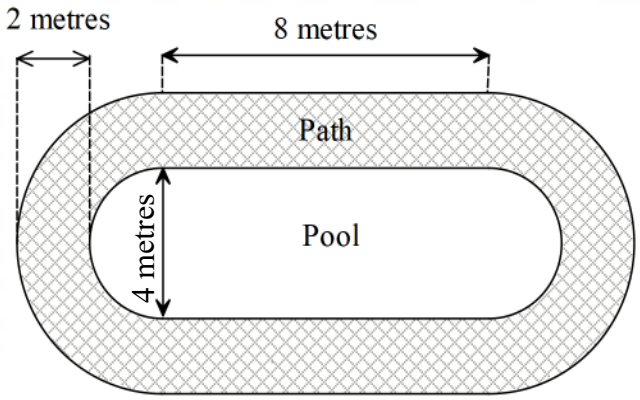
Marks

Question 33

A 2-metre-wide path is to be built around a pool as shown in the diagram below.



NOT TO SCALE

The path consists of two rectangular sections along the sides of the pool and two semi-circular sections at the ends of the pool.

(a) Calculate the area of the path, correct to one decimal place. **2**

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(b) The path is to be covered in pebble-crete that is sold in 50 kg bags. **2**
One bag will cover 15 m^2 and costs $35.
How much will it cost to pebble-crete the path?

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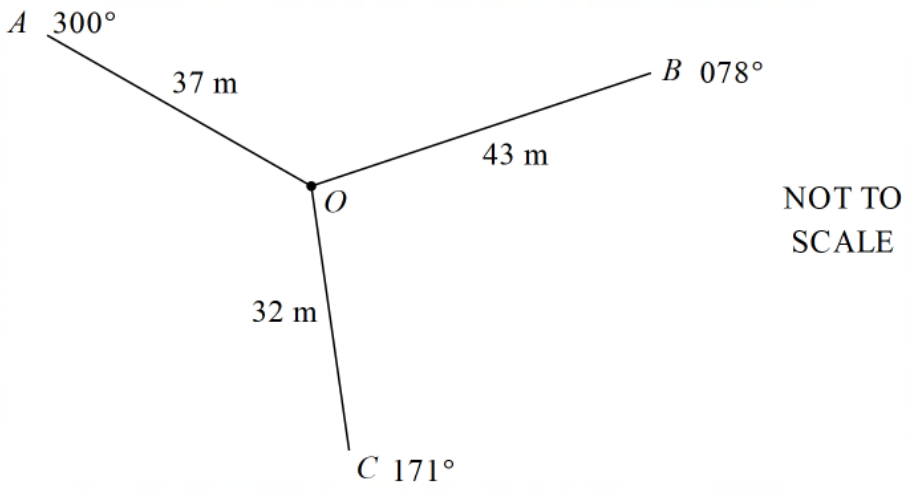
Marks

Question 34

The diagram shows the results of a compass radial survey of a triangular area of land.



(a) Find the size of angle AOB. **1**

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(b) Find the area of the triangle AOB to the nearest m^2. **2**

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Marks

Question 35 **3**

Winnie has $220 000 in a savings account, and uses it to pay a deposit on an investment property. The purchase price is $675 000. Winnie borrows the difference between the purchase price and the deposit.
Finance for her loan is arranged, and Winnie will make monthly repayments for 25 years at 6% p.a.

The table below shows the monthly principal and interest repayment per $1000 borrowed.

Principal and Interest per $1000 borrowed						
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

Calculate the amount of Winnie's monthly repayment.

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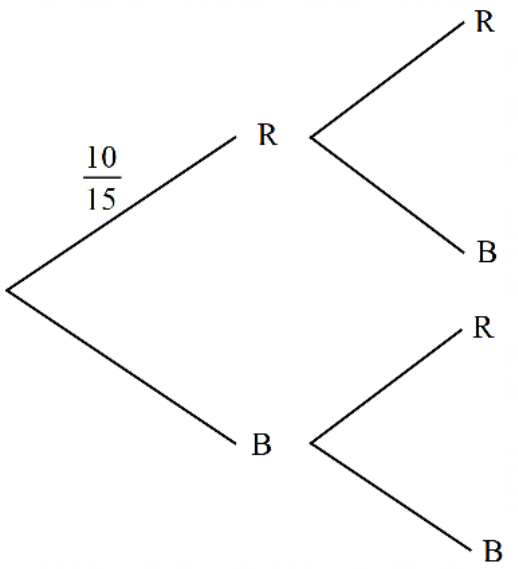
Marks

Question 36 **3**

In a bag there are 10 red marbles (R) and 5 blue marbles (B). Two marbles are selected at random, without replacement.
A partially completed probability tree is shown below.



Complete the probability tree and calculate the probability of selecting two marbles of different colours.

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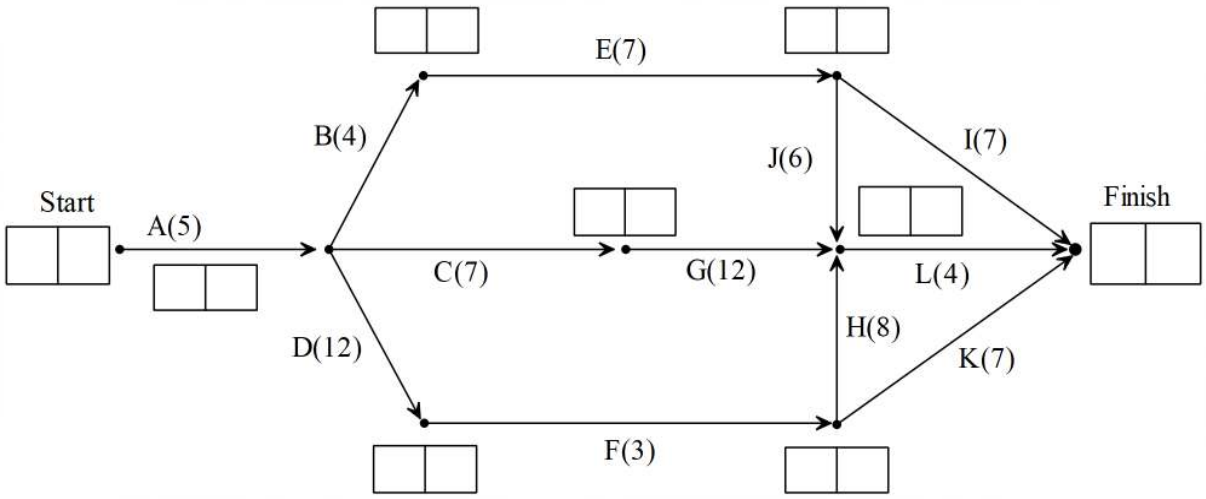
Marks

Question 37

The network diagram shows home renovation activities and their completion time in days.



(a) Which **two** activities immediately precede activity G? **1**

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(b) By completing the EST and LST on the diagram above, calculate the minimum time required to complete the renovation. **2**

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(c) Hence, what is the float time for activity E? **1**

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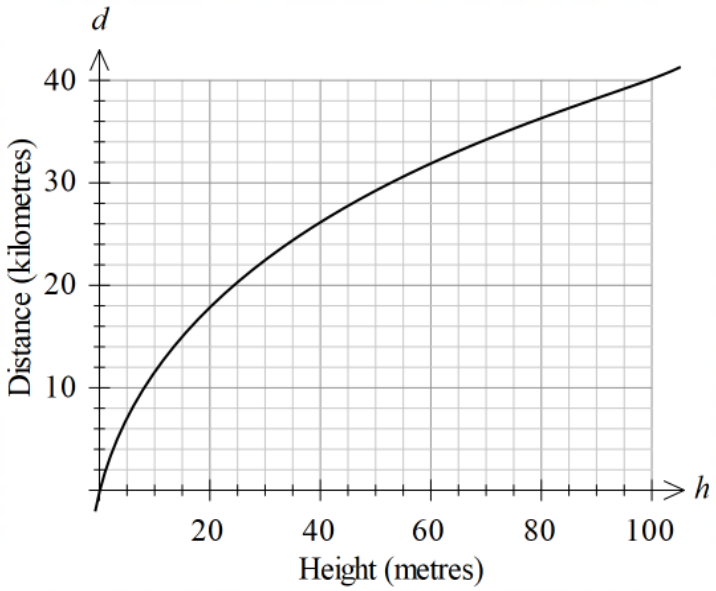
Marks

Question 38

The graph below shows the distance (d) in kilometres to the horizon that can be seen from different heights (h) above sea level.



(a) From the graph, what is the distance to the horizon if the height above sea level is 40 m? **1**

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(b) Steve records a distance of 20 km to the horizon from his position at a lookout. Steve climbs to a second lookout at a higher position above sea level where he can see a further 4 kilometres. What is the difference in the height of the two vantage points? Answer to the nearest metre. **1**

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(c) The formula $d = 8\sqrt{\frac{h}{4}}$ can be used to calculate the distance (d) to the horizon from a height (h) above sea level. Using this formula, calculate the distance to the horizon when the height above sea level is 75 metres. Answer to the nearest kilometre. **1**

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Marks

Question 39 **3**

In 2018 a researcher used the following method to estimate a population of frogs.

- 40 frogs were caught, tagged and released.
- Later, 160 frogs were caught at random.
- 20 of these 160 frogs had been tagged.

The estimated population of frogs in 2018 was 20% less than the estimated population for 2014.
What was the estimated population for 2014?

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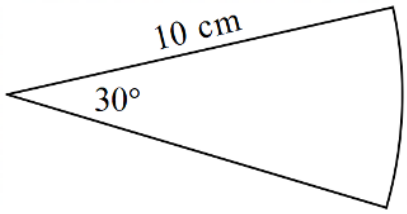
Marks

Question 40 **3**

Jenny has a flat piece of metal in the shape of a sector of a circle as shown below.



As part of a metalwork class, Jenny has been asked to melt the sector and reshape it into a flat circular disc, assuming the same thickness.
Jenny would like the disc to have a diameter of 6 cm. Is this possible?

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Question 41

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

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

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

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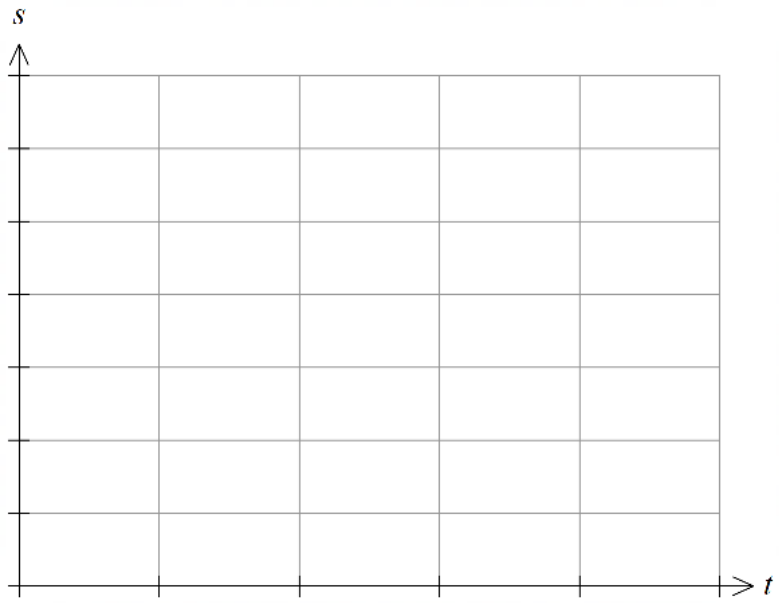
(b) Using the number plane with t as the horizontal axis and s as the vertical axis, plot the points and join them to make a parabola. **1**



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

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

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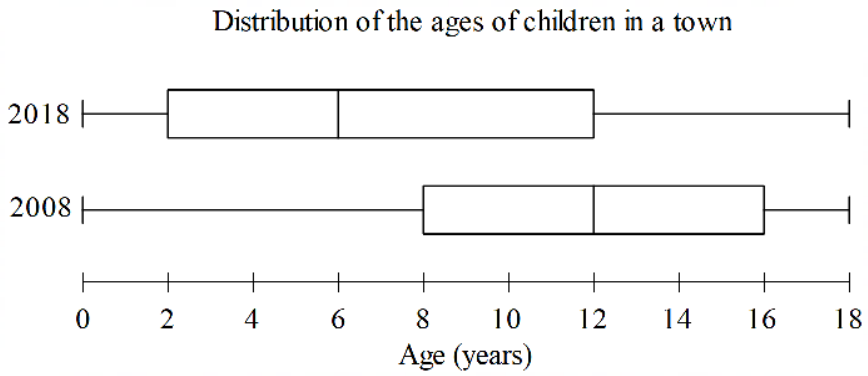
Marks

Question 42 **2**

The diagram shows the distribution of the ages of children in a town in 2008 and 2018.



In 2008 there were 1750 children aged 0-18 years.

The number of children aged 12-18 years was the same in both 2008 and 2018.

How many children aged 0-18 years were there in 2018?

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Marks

Question 43 **4**

The table shows the tax payable for different taxable incomes.

Taxable income	Tax payable on this income
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 01 – $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

Leslie has a gross annual salary of $92 000, and tax deductions of $1200 for work-related travel and $350 for stationery. The Medicare levy to be paid is 2% of the taxable income.
Leslie has already paid $22 400 in tax.

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

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Question 44 **4**

Mia wants to invest $42 000 for a total of 5 years. She has three investment options.

Option A – simple interest is paid at the rate of 6% per annum.
Option B – compound interest is paid at a rate of 5.5% per annum, compounded annually.
Option C – compound interest is paid at a rate of 4.8% per annum, compounded quarterly.

Determine Mia's best investment option. Support your answer with calculations.

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

Section II extra writing space.

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

Marking Criteria

Pymble Ladies' College

Mathematics Standard 2

HSC Trial Examination

Term 3 2022

General Instructions

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

Total marks 100

Section 1 – 15 marks (pages 1 - 4)

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

Section II – 85 marks (pages 5 - 30)

- 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

---

1 What is 34 478 900 written in scientific notation, correct to three significant figures?

(A) 3.4×10^7

(B) 3.44×10^7

(C) 3.45×10^7

(D) 34.5×10^6

34500000 → 3 sig fig

2 A car uses an average of 7 L of fuel per 100 km travelled.
How much fuel would the car use if it travels 382 km?

(A) 26.74 L

(B) 34.72 L

(C) 38.20 L

(D) 54.57 L

7L = 100km
÷100 ↓ ÷100
0.07L = 1km
×382 ↓ ×100
26.74L = 382km

3 Evelyn worked for eight hours a day on Thursday and Friday at a rate of $19.20 per hour.
On Saturday she worked for six hours at time-and-a-half.
How much did Evelyn earn in total for working Thursday, Friday and Saturday?

(A) $268.80

(B) $307.20

(C) $480.00

(D) $691.20

Thursday + Friday: $8\times2\times19.20 = \$307.20$
Saturday: $6\times1.5\times19.20 = \$172.80$
Total pay: $\$307.20 + \$172.80 = \$480$

4 Molly is concerned about the parrot population in her town. She gathers 170 parrots and tags them. A couple of months later she gathers 32 parrots and finds 10 of them are tagged.
What is Molly's estimate of the parrot population using the capture-recapture method?

(A) 524

(B) 544

(C) 572

(D) 588

$$\frac{170}{P} = \frac{10}{32}$$

$$32\times170 = 10\times P$$

$$\frac{5440}{10} = P$$

$$544 = P$$

5 The monthly repayments per $1000 on a bank home loan are shown in the table below.

Term	8.00%	8.25%	8.50%
20 years	$8.36	$8.52	$8.68
25 years	$7.72	$7.88	$8.05

What is the monthly repayment for a loan of $320 000 at 8.25% p.a. interest rate for 25 years?

(A) $252.16

(B) $272.64

(C) $2521.60

(D) $2726.40

$7{\cdot}88 \times 320 = \$2521{\cdot}60$

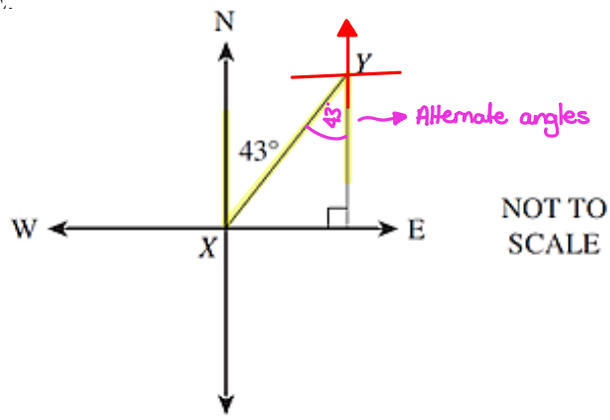
6 The compass bearing of Y from X is N43°E.
What is the compass bearing of X from Y?

(A) N47°E

(B) N43°E

(C) S47°W

(D) S43°W



7 In a raffle, the total prize money is shared among the first three tickets and drawn in the ratio 5:3:2. The prize for the third ticket drawn is $300.
What is the total prize money?

(A) $1500

(B) $150

(C) $1000

(D) $100

Total parts: $5+3+2 = 10$ parts

÷2 (2 parts = $300) ÷2

1 part = $150

×10 (10 parts = $1500) ×10

8 The stem-and-leaf plot shows the number of goals scored by a team in each of ten netball games.
What is the mode of this dataset?

(A) 5

(B) 18

(C) 25

(D) 29

0	6 8
1	2 4 5
2	1 5 5 9
3	5

9 Three years ago an appliance was valued at $2467. Its value has depreciated by 15% each year, based on the declining-balance method.
What is the salvage value of the appliance today, to the nearest dollar?

(A) $952

(B) $1110

(C) $1357

(D) $1515

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

$S = 2467(1-0.15)^3$

10 The growth of bacteria in a culture can be modelled by the equation: $N = 75(1.05)^t$, where N is the number of bacteria after t hours.
What type of graph would represent this model?

(A) Exponential

(B) Parabolic

(C) Linear

(D) Hyperbolic

11 A credit card has a daily interest rate of 0.06% per day (no interest free period).
What is the interest charged on $1700 for 15 days? Answer to the nearest cent.

(A) $1.02

(B) $15.36

(C) $102.00

(D) $4074.15

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

$FV = 1700(1+0.06\%)^{15}$

$= \$1715.36$

Interest $= \$1715.36 - \$1700$

$= \$15.36$

12 A 120-watt ceiling fan is run for 24 hours each day. If electricity is charged at 24.8 c/kWh, what is the cost of running the ceiling fan for 30 days, to the nearest cent?

$1\,kW = 1000\,W$

(A) $15.68

(B) $21.43

(C) $86.40

(D) $2142.73

Usage: $120 \times 24 \times 30 = 86400\,W$

$= 86400 \div 1000$

$= 86.4\,kW$

Cost: $86.4 \times 0.248 = 21.4272$

$\approx \$21.43$ (to nearest cent)

13 Young's formula is used to calculate the medicine dosage for children aged 1-12 years based on the adult dosage.
The formula is:

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

where D = dosage amount
y = age of child, in years
A = adult dosage.

If the adult dosage for a particular medicine is 60 mg and the child's dosage is 20 mg, how old is the child in years?

(A) 6
(B) 7
(C) 8
(D) 9

$20 = \frac{60y}{y+12}$
$20(y+12) = 60y$
$20y + 240 = 60y$
$240 = 40y$
$6 = y$

14 Which equation shows f as the subject of $a = cd + \frac{f}{k}$?

(A) $f = \frac{a+cd}{k}$
(B) $f = ak - kcd$
(C) $f = \frac{a}{cd} - k$
(D) $f = \frac{k-a}{cd}$

$a = cd + \frac{f}{k}$
$-cd \quad -cd$
$k \times a - cd = \frac{f}{k} \times k$
$k(a-cd) = f$
$ak - kcd = f$

15 The table shows future value interest factors for $1.

	Interest rate per period					
Period	*1%*	*2%*	*3%*	*4%*	*5%*	*6%*
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	2.0100	2.0200	2.0300	2.0400	2.0500	2.0600
3	3.0301	3.0604	3.0909	3.1216	3.1525	3.1836
4	4.0604	4.1216	4.1836	4.2465	4.3101	4.3746

An annuity of $80 000 is invested into an account every six months for two years at an interest rate of 2% per annum.
Using data from the table, what is the future value of this annuity?

(A) $160 800
(B) $161 600
(C) $324 832
(D) $329 728

Interest rate: $2\% \div 2 = 1\%$ per 6 monthly
Number of periods: $2 \times 2 = 4$
Future value: $4.0604 \times 80\,000 = \$324\,832$

Name……..

Teacher's Name……

Mathematics Standard 2
Section II

85 marks
Attempt Questions 16 - 44
Allow about 2 hours and 5 minutes for this section

Instructions

- Answer in the spaces provided. These spaces provide guidance for the expected length of the answer.
- Your responses should include relevant mathematical reasoning and/or calculations
- Extra writing space is provided at the end of this booklet.

Marks

Question 16 **2**

A student tried to solve an equation, as shown. However, the student made a mistake in one of the lines.

$$5(x+2)-4(x+1)=-3$$

$$5x+10-4x+4=-3 \quad \text{Line 1}$$

$$x+14=-3 \quad \text{Line 2}$$

$$x=-17 \quad \text{Line 3}$$

Identify the line which has the mistake and give the correct working to solve the equation.

Line 1

$5x+10-4x-4=-3$

$x+6=-3$

$x=-9$

① Identifies line

① Correct solution

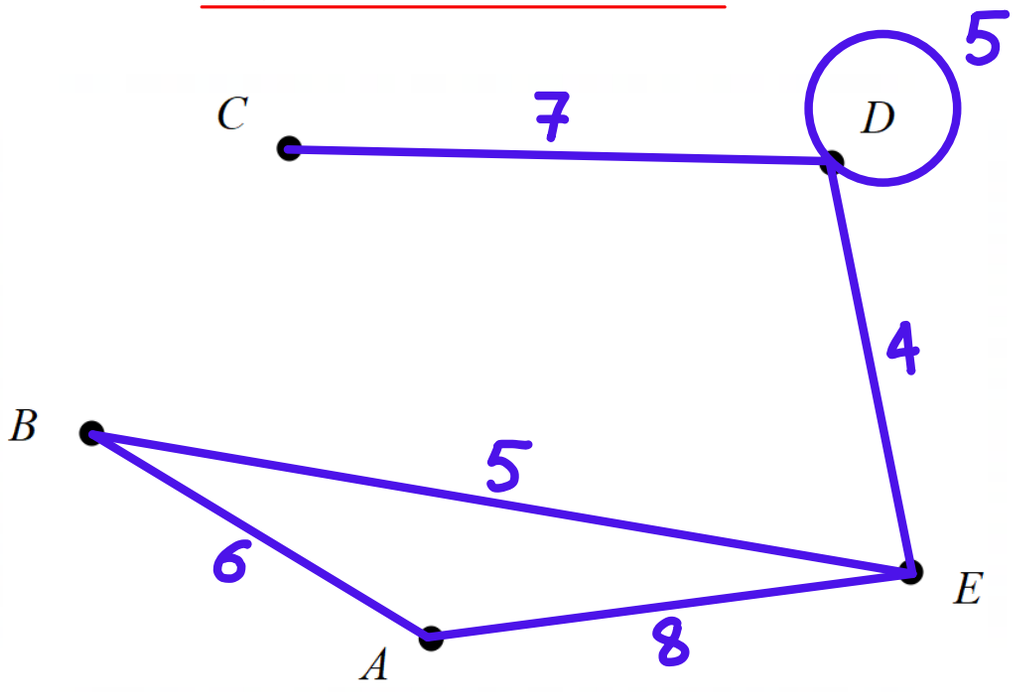
Marks

Question 17 **2**

The distances, in kilometres, between towns in a district, are shown in the following table.

	A	***B***	***C***	***D***	***E***
A	—	6	—	—	8
B	6	—	—	—	5
C	—	—	—	7	—
D	—	—	7	5	4
E	8	5	—	4	—

Use the table above to complete the following network diagram.



2	Correct answer
1	One error
0	More than 1 error

Marks

Question 18 **2**

The blood alcohol content (BAC) for males is calculated using the following formula:

$$\text{BAC}_{\text{male}} = \frac{10N - 7.5H}{6.8M}$$

where N = number of standard drinks

H = number of hours spent drinking

M = person's mass in kilograms.

Hunter weighs 87 kg and wants to stay under the legal limit of 0.05.
How many standard drinks can he consume over 3 hours without going over the limit?

$0.05 = \frac{10N - 7.5 \times 3}{6.8 \times 87}$

$0.05 = \frac{10N - 22.5}{591.60}$

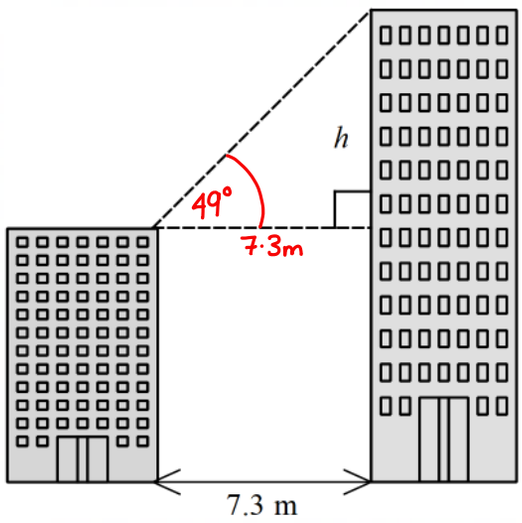
$29.58 = 10N - 22.5$

$52.08 = 10N$ ② 5 standard

$5.208 = N$ ∴ 5 standard drinks ① 5.2 standard/correct sub

Question 19 **2**

The following two buildings are standing on level ground. The horizontal distance between the buildings is 7.3 metres and the angle of elevation between the top of each building is 49°.



NOT TO SCALE

What is the difference in height between the buildings, correct to one decimal place?

Find h.

$\tan 49° = \frac{h}{7.3}$ ② Correct answer

$h = 7.3 \times \tan 49°$ ① Correct sub / ignore rounding

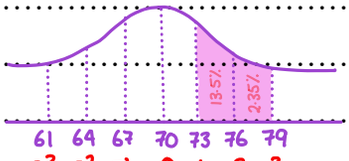
$h = 8.39768...$

$h \approx 8.4\text{m}$ (1dp) ∴ The difference in height is 8.4m

Marks

Question 20 **2**

The arm lengths of a group of 20 000 people are normally distributed with a mean of 70 cm and a standard deviation of 3 cm.
How many people have arm lengths between 73 cm and 79 cm?



13·5% + 2·35% = 15·85%

15·85% × 20000 = 3170

② Correct answer

① 15·85%

Question 21 **2**

Lani takes a 14-hour flight from Edmonton, Canada (UTC-7) to Paris, France (UTC+5).
She leaves at 9 am on a Monday morning.
What is the time in Paris when she arrives?

Time difference: 7+5 = 12 hours

Time in Canada: Monday 9am

Time in France: Monday 9pm (+12 hours)

Tuesday 11am (+14 hour flight)

∴ Lani will arrive on Tuesday 11am

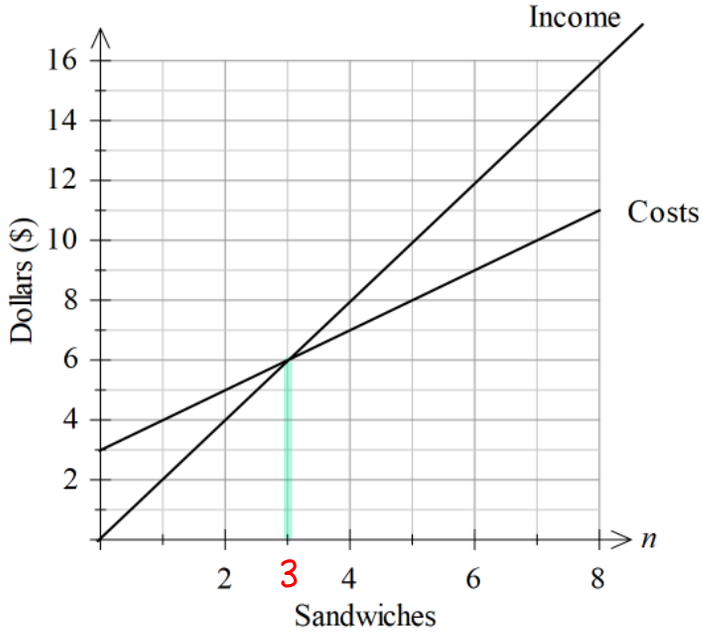
② Correct time + day

① Working towards

Marks

Question 22

The linear graphs below show the cost of making sandwiches and the income received from selling the sandwiches.



(a) Let the income received be $\$I$ and the number of sandwiches sold be n. **1**
Write a formula for the income.

$I = 2n$ correct answer

(b) Let the costs of making a sandwich be $\$C$ and the number of sandwiches sold be n.. **1**
Write a formula for the costs.

$C = n + 3$ correct answer

(c) What is the profit if 7 sandwiches are sold? **1**

Cost: $7+3 = \$10$ Income: $2 \times 7 = \$14$ correct answer

Profit: $14 - 10 = \$4$

(d) How many sandwiches are needed to be sold to break-even? **1**

3 sandwhiches correct answer

Marks

Question 23

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

Present value of $1					
Interest rate per period					
Period	**1%**	**2%**	**4%**	**6%**	**8%**
1	0.9901	0.9804	0.9615	0.9434	0.9259
2	1.9704	1.9416	1.8861	1.8334	1.7833
3	2.9410	2.8839	2.7751	2.6730	2.5771
4	3.9020	3.8077	3.6299	3.4651	3.3121
5	4.8534	4.7135	4.4518	4.2124	3.9927

(a) What would be the present value of a $9000 per year annuity at 6% per annum for 5 years, with interest compounding annually? **1**

4·2124 × 9000 = $37 911·60

Correct answer

(b) An annuity of $6000 is invested each three months at 4% per annum, compounded quarterly for 1 year. What is the present value of the annuity? **1**

Interest rate: 4% ÷ 4 = 1%

Number of periods: 1 × 4 = 4

Present value: 3·9020 × 6000 = $23 412

Correct answer

(c) What is the value of an annuity that would provide a present value of $43 230 after 3 years at 8% per annum compound interest? Answer to the nearest dollar. **1**

43 230 ÷ 2·5771 = $16 774·67

= $16 775

Correct answer / ignore to nearest cent

Marks

Question 24 **2**

A car is sold for $19 990. It will depreciate at 18% per annum.
Using the declining-balance method, what is the salvage value of the car after four years, correct to the nearest dollar?

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

$S = 19990(1-0{\cdot}18)^4$

$= 9037{\cdot}91398\ldots$ ② Correct soln

$\approx \$9037{\cdot}91$ ① Correct sub

Question 25

The mass of a car is 1800 kg, rounded to the nearest 100 kg.

(a) What is the absolute error in this measurement? **1**

$100 \div 2 = \pm 50$ kg ignore $\pm$

(b) What are the upper and lower bounds for the measurement? **1**

Lower bound: $1800 - 50 = 1750$ kg

Upper bound: $1800 + 50 = 1850$ kg Correct answer

(c) Find the percentage error, correct to one decimal place. **1**

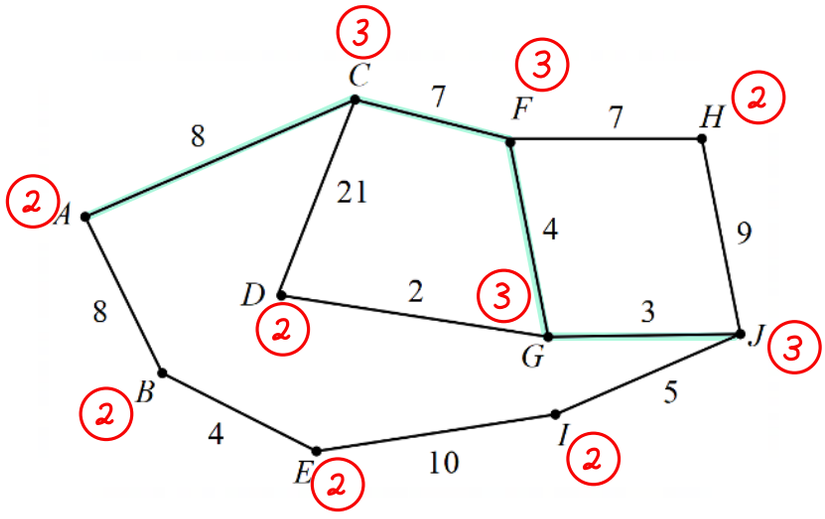
$\text{Percentage error} = \frac{50}{1800} \times 100$

$= 2{\cdot}7777\ldots$

$\approx 2{\cdot}8\%$ Correct answer

Marks

Question 26



(a) List the vertices with an odd degree. **1**

C, F, J, C

Must have at least 3

(b) What is the length of the shortest path from A to J? **1**

ACFGJ = 8+7+4+3

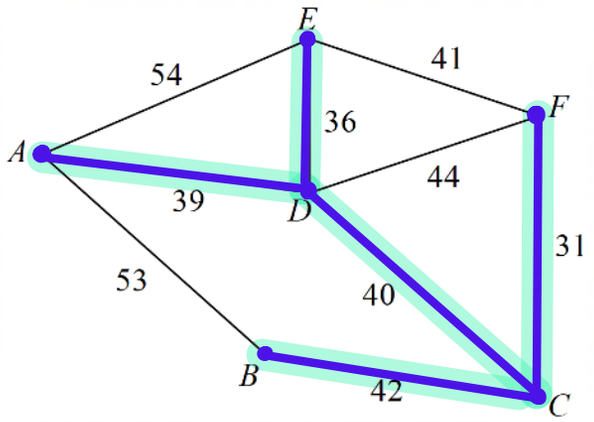
= 22

Correct answer

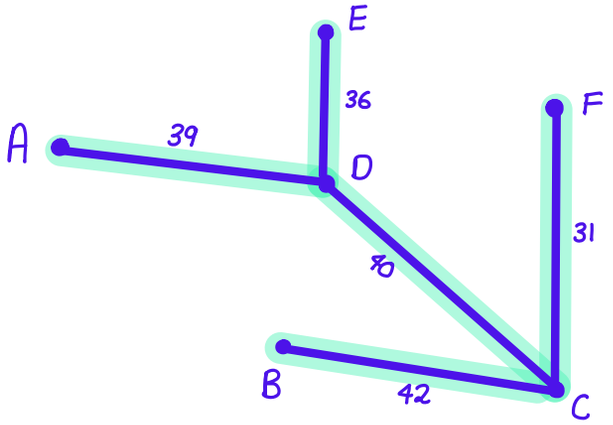
Marks

Question 27

There are 5 towns (B, C, D, E and F) that need to be linked by pipelines to a natural gas supply (A). The existing road links and the distance (in km) between the towns are shown in the network diagram below.



(a) Draw a minimum spanning tree that will ensure that all the towns are connected to the network, so as to minimise the amount of pipelines required. **2**



(b) What is the minimum length of pipeline to supply all the towns? **1**

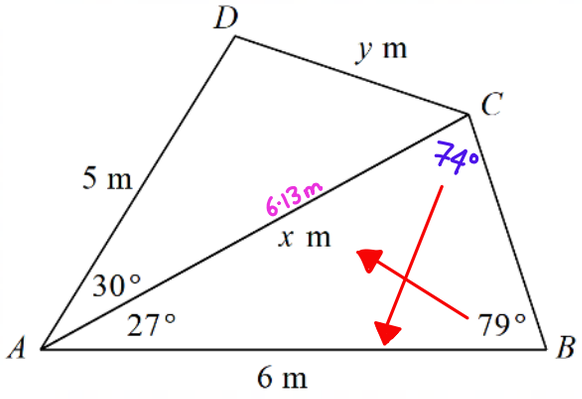
Min. length: 39+36+40+42+31 = 188 km

② Correct answer

① One error / ignore labelling

Marks

Question 28 **4**



NOT TO SCALE

Determine the values of x and y in the diagram above.
Give your answers correct to 2 decimal places.

$\angle ACB = 180° - (27° + 79°)$

$= 74°$ (1)

$\frac{x}{\sin 79°} = \frac{6}{\sin 74°}$

$x = \frac{6}{\sin 74°} \times \sin 79°$

$x = 6{\cdot}127117\ldots$

$x \approx 6{\cdot}13\text{m}$ (2dp)

$y^2 = 5^2 + 6{\cdot}13^2 - 2 \times 5 \times 6{\cdot}13 \times \cos 30°$

$y = \sqrt{5^2 + 6{\cdot}13^2 - 2 \times 5 \times 6{\cdot}13 \times \cos 30°}$

$y = 3{\cdot}0805\ldots$

$y \approx 3{\cdot}08\text{m}$ (2dp)

(4) $x = 6{\cdot}13$, $y = 3{\cdot}08$

(3) working towards with correct $x = 6{\cdot}13$

(2) $x = 6{\cdot}13$

(1) $74°$

Question 29 **1**

The number of people in a town is given by $N = 1000(2.1)^t$ where N is the number of people and t is the time in years.

What is the population of the town after five years?

$N = 1000(2{\cdot}1)^5$

$= 40841{\cdot}01$

≈ 40841

correct answer

Marks

Question 30 **2**

The volume, V, of gas varies inversely to the pressure, P, being applied to it.
The volume of gas is 400 cm^3 when pressure is 32 kg/cm^2.

What will be the volume of the gas if the pressure is increased to 40 kg/cm^2?

$V = \frac{k}{P}$ $\therefore V = \frac{12800}{P}$

$400 = \frac{k}{32}$ sub $p = 40$

$V = \frac{12800}{40}$

$32 \times 400 = k$

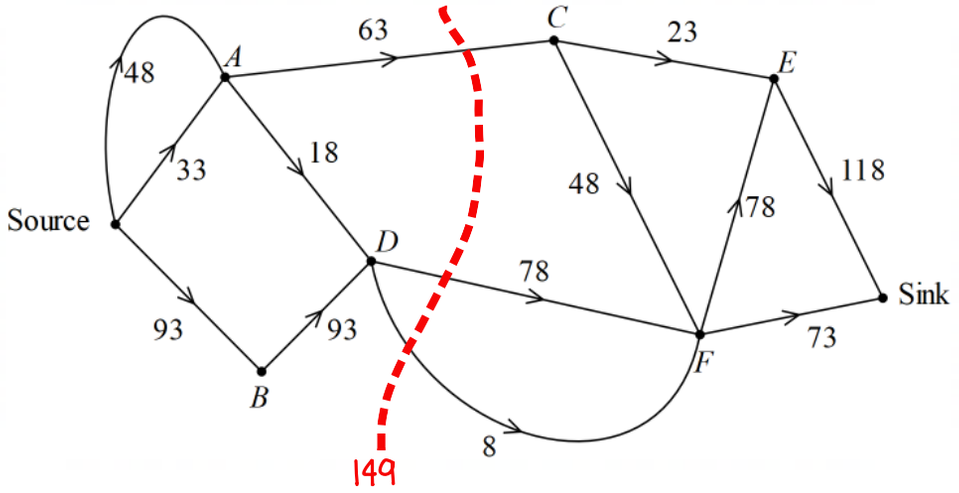
$k = 12800$ $= 320\ cm^2$

② Correct soln

① 12 800

Question 31

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



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

Inflow: $23 + 78 = 101$ $\therefore$ Max. out flow is 101

Outflow: 118 correct answer

(b) Draw the minimum cut *on the network diagram above*. correct answer **1**

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

Max flow = $63 + 78 + 8$

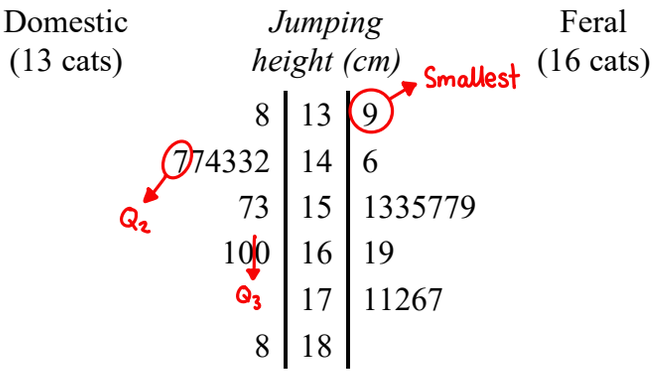
$= 149$ correct answer

Marks

Question 32

The back-to-back stem plot below displays the *jumping height*, in centimetres, of 29 cats and their *living situation* (domestic or feral).

Key **8** |**13**| **9** = 138 (domestic) and 139 (feral)



(a) One of the variables, *jumping height*, or *living situation*, is categorical. Is the categorical variable ordinal or nominal? **1**

Nominal

correct answer

(b) Use the information in the back-to-back stem plot to complete the missing values in the shaded boxes below. **2**

	Jumping height (cm)				
Living situation	minimum	Q_1	median (Q_2)	Q_3	Maximum
Domestic	138	143	147	160	188
Feral	139	143	158	171	177

(c) Can any of the domestic cats be called an outlier in terms of jumping height? Show working to justify your answer. **3**

IQR : 160 - 143 = 17 ③ Two correct + correct statement

143 - 1·5 x 17 = 117·5 ② Attempt at both with at least one correct

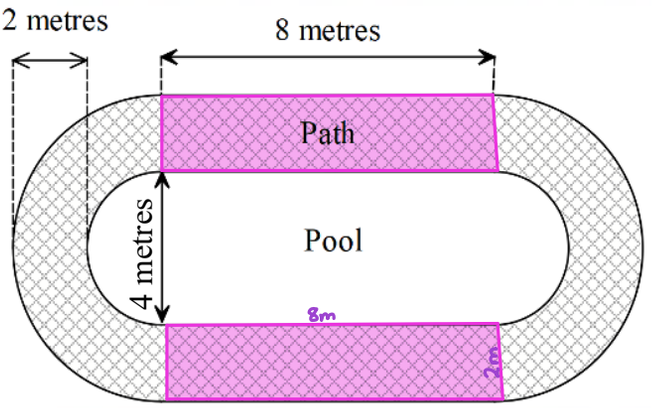
160 + 1·5 x 17 = 185·5 ① One calculation

∴ Yes, 188cm is an outlier as it is greater than 185·5

Marks

Question 33

A 2-metre-wide path is to be built around a pool as shown in the diagram below.



NOT TO SCALE

The path consists of two rectangular sections along the sides of the pool and two semi-circular sections at the ends of the pool.

(a) Calculate the area of the path, correct to one decimal place. **2**

Area of rectangles: $(2\times8)\times2 = 32m^2$

Area of curved path: $(\pi\times4^2) - (\pi\times2^2) = 37.6911184$

Total Area: $32 + 37.6911184 = 69.6991184$ ② Correct / ignore rounding

$\approx 69.7m^2$ ① working towards / need to show an attempt at area of rectangle + circle (not just one)

(b) The path is to be covered in pebble-crete that is sold in 50 kg bags. **2**
One bag will cover 15 m^2 and costs \$35.
How much will it cost to pebble-crete the path?

$69.7 \div 15 = 4.631333...$

$\therefore$ 5 bags

Cost: $5\times35 = \$175$

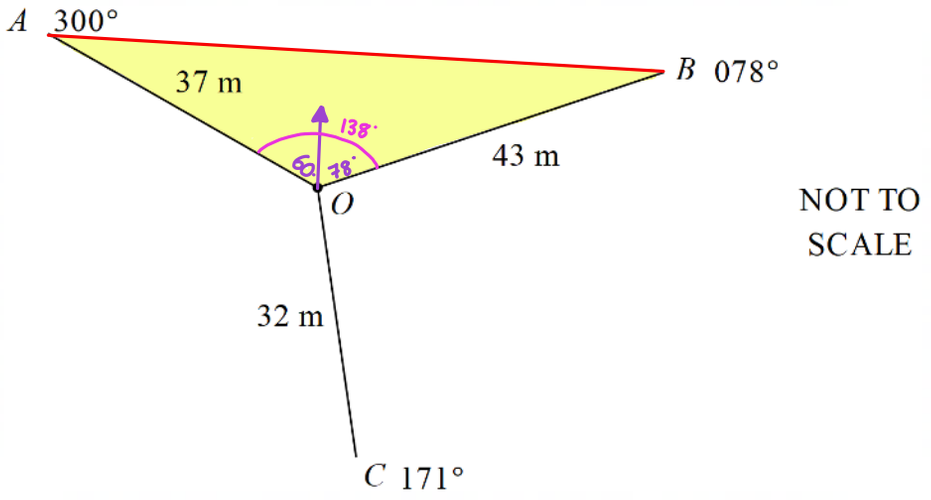
② Correct solution

① 4.6×175 answer (a) $\div 15$

Marks

Question 34

The diagram shows the results of a compass radial survey of a triangular area of land.



(a) Find the size of angle AOB. **1**

$\angle AOB = 60 + 78$

$= 138°$ correct answer

(b) Find the area of the triangle AOB to the nearest m^2. **2**

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

$A = \frac{1}{2} \times 37 \times 43 \times \sin 138°$

$= 532.29339...$

$\approx 532\ m^2$

② Correct solution / ignore rounding

① Working towards

Marks

Question 35 **3**

Winnie has $220 000 in a savings account, and uses it to pay a deposit on an investment property. The purchase price is $675 000. Winnie borrows the difference between the purchase price and the deposit.
Finance for her loan is arranged, and Winnie will make monthly repayments for 25 years at 6% p.a.

The table below shows the monthly principal and interest repayment per $1000 borrowed.

Principal and Interest per $1000 borrowed						
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

Calculate the amount of Winnie's monthly repayment.

Deposit: $220 000

Amount borrowed: 675 000 - 220 000 = $455 000

Monthly repayment: 6·44 × 455 = $2930·20

③ Correct answer

② One error

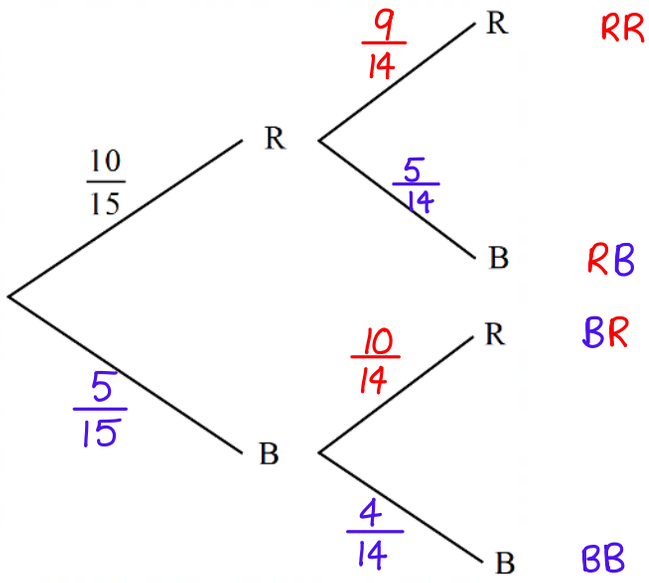
① Two error

Marks

Question 36 **3**

2+1

In a bag there are 10 red marbles (R) and 5 blue marbles (B). Two marbles are selected at random, without replacement.
A partially completed probability tree is shown below.



② Correct tree
① One error on the tree
⓪ More than one error

Complete the probability tree and calculate the probability of selecting two marbles of different colours.

$P(RB) + P(BR) = \left(\frac{10}{15} \times \frac{5}{14}\right) + \left(\frac{5}{15} \times \frac{10}{14}\right)$

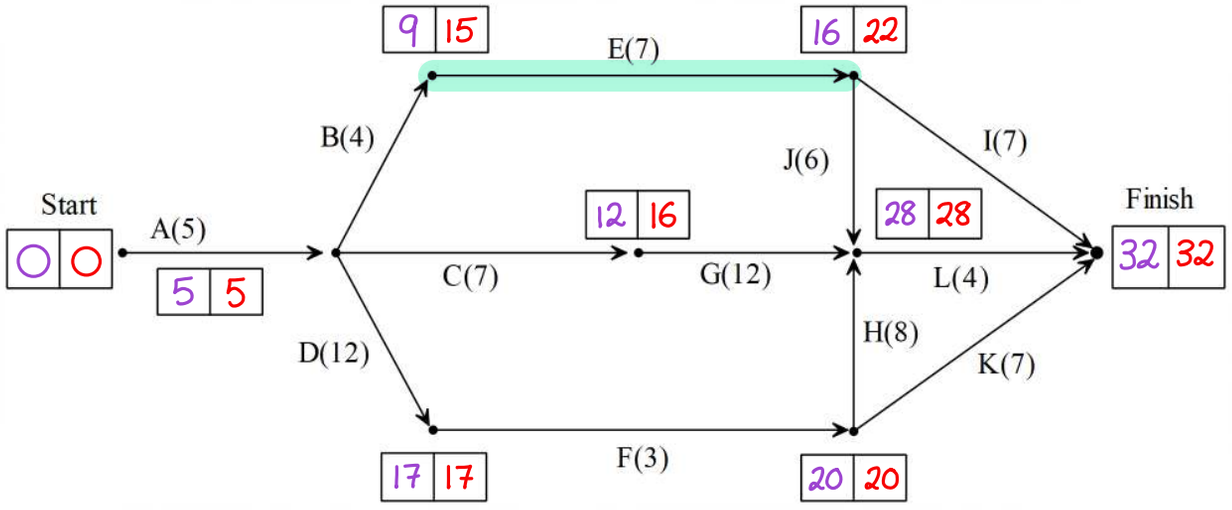
$= \frac{10}{21}$

① Correct solution

Marks

Question 37

The network diagram shows home renovation activities and their completion time in days.



~~(a) Which two activities immediately precede activity G?~~ ~~1~~

Question removed

(b) By completing the EST and LST on the diagram above, calculate the minimum time required to complete the renovation. 3

32 days

③ Correct EST, LST + 32 days

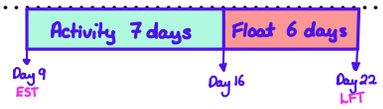
② One error

① Working towards

(c) Hence, what is the float time for activity E? 1

22 - 9 - 7 = 6 days

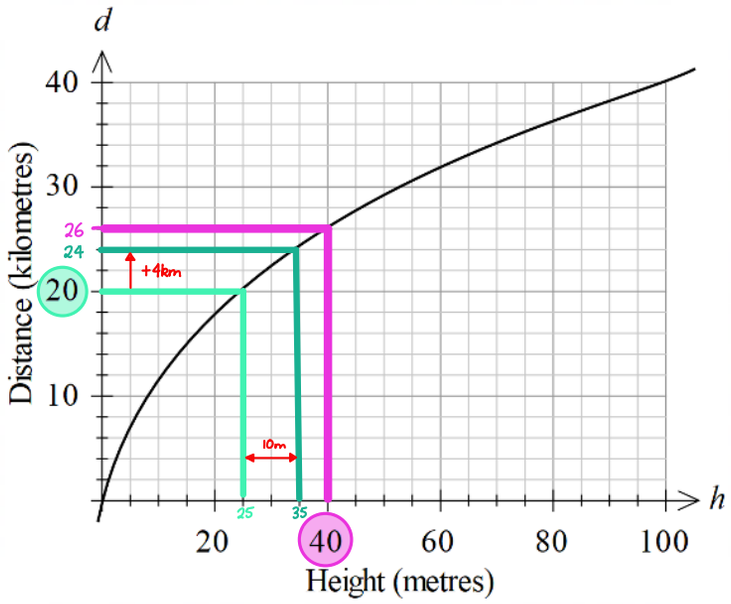
Correct answer



Marks

Question 38

The graph below shows the distance (d) in kilometres to the horizon that can be seen from different heights (h) above sea level.



(a) From the graph, what is the distance to the horizon if the height above sea level is 40 m? **1**

26 km

Correct answer

(b) Steve records a distance of 20 km to the horizon from his position at a lookout. Steve climbs to a second lookout at a higher position above sea level where he can see a further 4 kilometres. What is the difference in the height of the two vantage points? Answer to the nearest metre. **1**

when $d=20$, $h=25$ $\therefore 35-25=10$m

when $d=24$, $h=35$ Correct answer

(c) The formula $d=8\sqrt{\frac{h}{4}}$ can be used to calculate the distance (d) to the horizon from a height (h) above sea level. Using this formula, calculate the distance to the horizon when the height above sea level is 75 metres. Answer to the nearest kilometre. **1**

$d=8\sqrt{\frac{35}{4}}$

$=34.64101\ldots$ Correct answer

≈ 35 km

Marks

Question 39 **3**

In 2018 a researcher used the following method to estimate a population of frogs.

- 40 frogs were caught, tagged and released.
- Later, 160 frogs were caught at random.
- 20 of these 160 frogs had been tagged.

The estimated population of frogs in 2018 was 20% less than the estimated population for 2014.
What was the estimated population for 2014?

2018 2014 ∴ 400 frogs in 2018

$\frac{40}{P} = \frac{20}{120}$

$120 \times 40 = 20 \times P$

$320 = P$

320 = 80%

÷80 ↓ 4 = 1% ↓ ÷80

×100 ↓ 400 = 100% ↓ ×100

③ 400

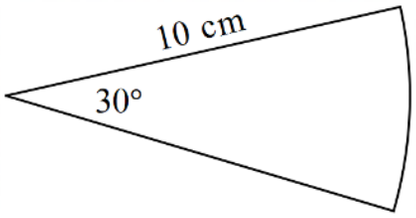
② 320 + attempt at %

① 320

Marks

Question 40 **3**

Jenny has a flat piece of metal in the shape of a sector of a circle as shown below.



As part of a metalwork class, Jenny has been asked to melt the sector and reshape it into a flat circular disc, assuming the same thickness.
Jenny would like the disc to have a diameter of 6 cm. Is this possible?

Area of sector $= \frac{30°}{360°} \times \pi \times 10^2$

$= 26.1799...$

$\approx 26.18\ cm^2$ (2dp.) (1)

Area of circle $= \pi \times 3^2$

$= 28.2743...$

$\approx 28.27\ cm^2$ (1)

$\therefore$ No, Jenny will not have enough (1) Statement

Marks

Question 41

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

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

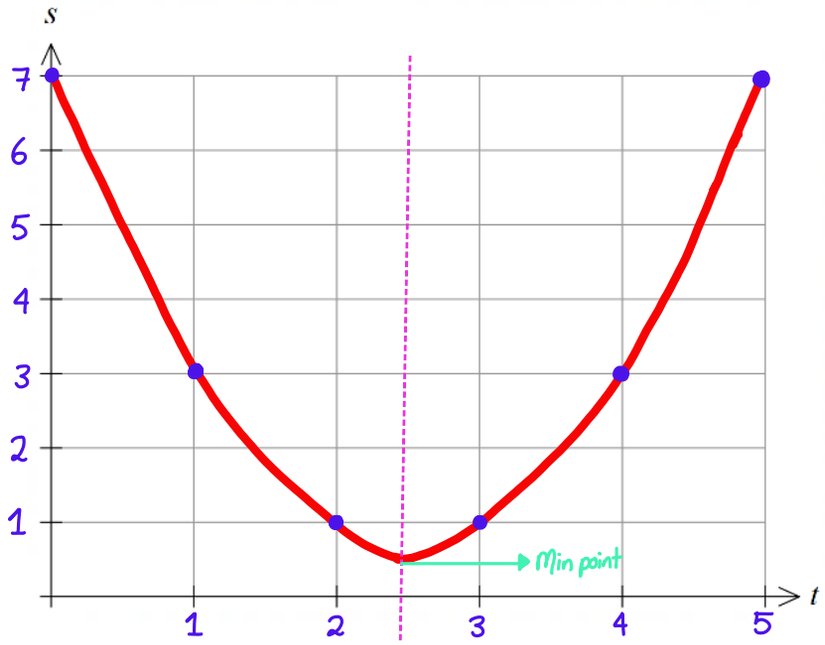
Time (t)	0	1	2	3	4	5
Speed (s)	7	3	1	1	3	7

.....

.....

.....Correct answer

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



Correct answer / no straight lines

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

2·5 seconds.....

.....

.....Correct answer

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

Sub $t = 2{\cdot}5$ $s = (2{\cdot}5)^2 - 5(2{\cdot}5) + 7$

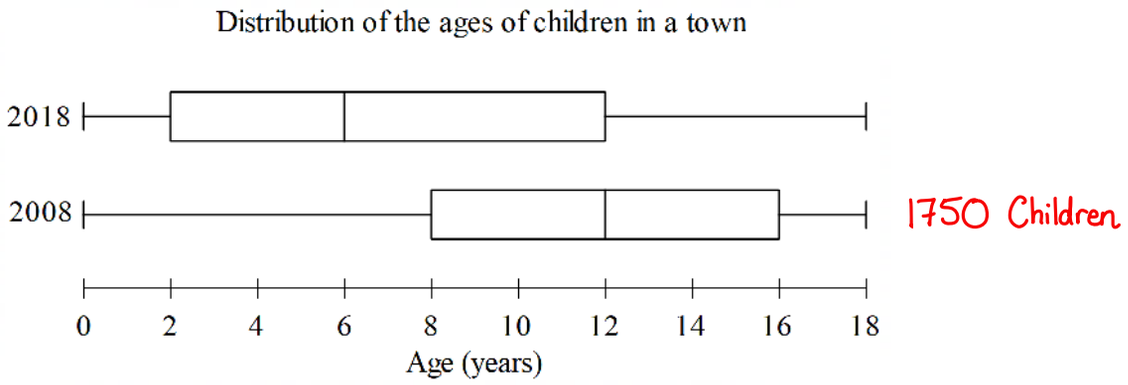
$= 0{\cdot}75$

.....Correct answer

Marks

Question 42 **2**

The diagram shows the distribution of the ages of children in a town in 2008 and 2018.



In 2008 there were 1750 children aged 0-18 years.

The number of children aged 12-18 years was the same in both 2008 and 2018.

How many children aged 0-18 years were there in 2018?

2008 : 12-18 year olds = 50% ..... 50% × 1750 = 875 children .....

2018 : 12-18 year olds = 25%

∴ 875 × 4 = 3500 children ..... ② Correct answer

① 875

Marks

Question 43 **4**

The table shows the tax payable for different taxable incomes.

Taxable income	Tax payable on this income
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 01 – $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

Leslie has a gross annual salary of $92 000, and tax deductions of $1200 for work-related travel and $350 for stationery. The Medicare levy to be paid is 2% of the taxable income.
Leslie has already paid $22 400 in tax.

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

Taxable income: $92000 - 1200 - 350 = \$90\,450$ (1)

Medicare levy: $2\% \times 90\,450 = \$1809$ (1)

Tax payable: $19\,822 + 0.37 \times (90\,450 - 87\,000) = \$21\,098.50$ (1)

Tax payable + medicare levy = $21098.50 + 1809 = \$22\,907.50$

Tax paid − (tax payable + medicare) = $22\,400 - 22\,907.50 = -\$507.50$

∴ Leslie owes $507.50 (1)

Marks

Question 44 **4**

Mia wants to invest $42 000 for a total of 5 years. She has three investment options.

Option A – simple interest is paid at the rate of 6% per annum.

Option B – compound interest is paid at a rate of 5.5% per annum, compounded annually.

Option C – compound interest is paid at a rate of 4.8% per annum, compounded quarterly. $n = 4 \times 5 = 20$

$\frac{4.8\%}{4}$

Determine Mia's best investment option. Support your answer with calculations.

Option A: Interest = $42\,000 \times 0.06 \times 5$

$= \$12\,600$ (1)

Option B: $FV = 42000(1+0.055)^5$

$= \$54892.32$

Interest = $54892.32 - 42000$

$= \$12892.32$ (1)

Option C: $FV = 42000\left(1+\frac{0.048}{4}\right)^{20}$

$= \$53316.24$

Interest = $53316.24 - 42000$

$= \$11316.24$ (1)

$\therefore$ Option B would be the best. (1)

END OF PAPER