Blacktown Boys' High School

2024 Year 12

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 - All diagrams are NOT drawn to scale - A reference sheet is provided for this paper - In Questions in Section II, show all relevant mathematical reasoning and/or calculations
Total marks: **100**	**Section I – 15 marks** (pages 3 - 8) - Attempt Questions 1 – 15 - Allow about 25 minutes for this section. **Section II – 85 marks** (pages 9 - 31) - Attempt Questions 16 – 39 - Allow about 2 hours and 5 minutes for this section.

Assessor: Mr P Govender

Students are advised that this is a trial examination only and cannot in any way guarantee the content or format of the 2024 Higher School Certificate Examination.
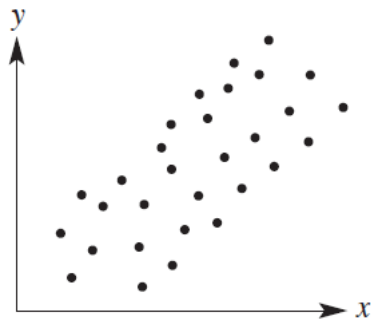
Section I

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

Use the multiple choice answer sheet for Questions 1–15.

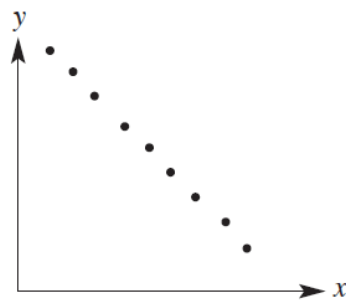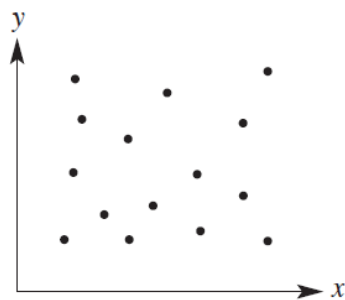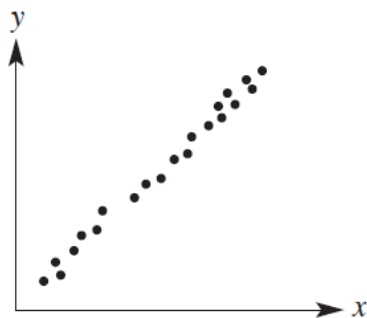**1**   Which of the data sets graphed below has the largest positive correlation coefficient value?
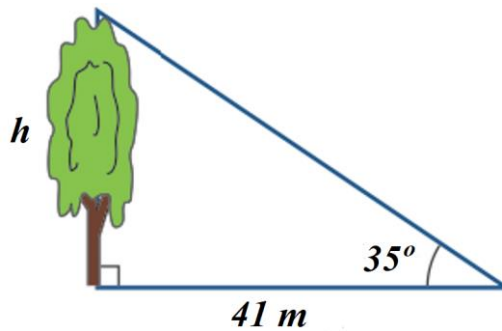
A.

B.

C.

D.

2   Which of the following expressions would give the height (h), of the tree in the diagram?

A. $41 \times tan35°$

B. $\dfrac{41}{cos35°}$

C. $41 \times cos35°$

D. $\dfrac{41}{cos35°}$

3   The length of a flat screen television is measured to be 1.61 metres correct to the nearest centimetre.
What is the absolute error of the length of the flat screen television?

A. $0.01\ m$

B. $0.05\ m$

C. $0.001\ m$

D. $0.005\ m$

4   The female and male smoking rates, expressed as percentage are shown below.

			Female						Male							
		9	8	8	7	6	1	8	9							
8	8	6	5	5	3	2	0	2	2	3	3	4	5	5	6	7
							3	0	1	1	6	7	8			

What is the lowest female smoking rate?

A.   6%

B.   18%

C.   16%

D.   19%

5   In a survey of 250 randomly selected Year 12 students it was found that 65 use a bicycle to travel to school. Based on this survey, approximately how many of 72 000 Year 12 students would be expected to use a bicycle to school?

    A.   72000

    B.   64800

    C.   18720

    D.   71815

6   The network shows the distances, in kilometres, along roads that connect Town A and Town B.
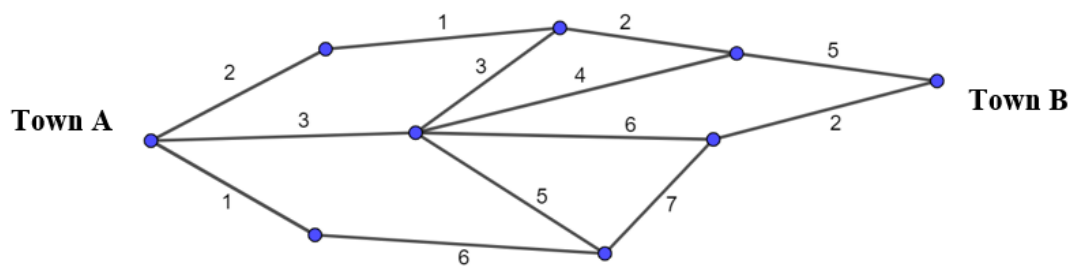
The shortest distance, in kilometres, from Town A to Town B is:

    A.   7

    B.   10

    C.   11

    D.   12

7   Terrence boards a plane in London at 8 pm on Thursday 12th September and flies for 22 hours before arriving in Sydney. Given that Sydney's time zone is ten hours ahead of London's, what is the local time when he arrives in Sydney?

    A.   6:00 pm Friday 13th September

    B.   6:00 am Friday 13th September

    C.   4:00 am Saturday 14th September

    D   6:00 am Saturday 14th September

8 A group of students sat two different exams, namely Mathematics and Science and their scores are given in the table below. Use your calculator to find the equation of the least squares regression line for the scores. (Answers have been rounded).
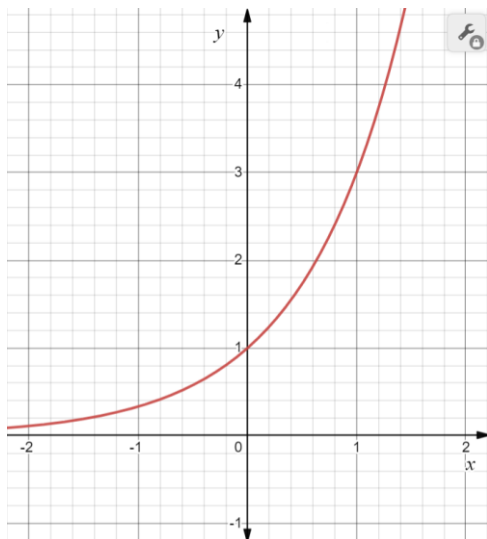
Student	A	B	C	D	E	F	G	H
Maths (x)	68	70	45	51	86	61	72	78
Science (y)	80	85	63	71	93	79	86	92

    A. $y = 0.739x + 32.05$

    B. $y = 32.05x + 0.739$

    C. $y = 1.298x - 3.890$

    D. $y = 3.890x - 1.298$

9 An asset depreciates to half its original value after 5 years using the declining balance method. What is the approximate annual rate of depreciation?

    A.   10.5%

    B.   12.9%

    C.   15.5%

    D.   9.5%

10 Amanda received her natural gas account. She is charged 3.892 cents per MJ for the first 5000 MJ and 2.354 cents per MJ for any other usage. What is the cost if she used 8450 MJ of natural gas?

    A. $338.87
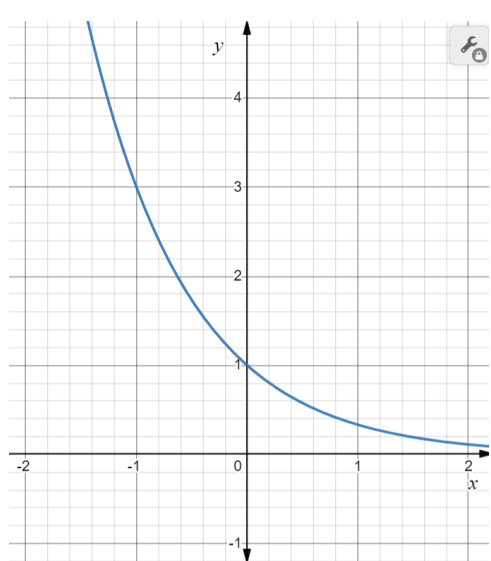
    B. $198.91

    C. $117.70

    D. $275.81

11 Which is the correct expression to make t the subject of the formula
$x = ab + yt^2$?

A. $t = \sqrt{\dfrac{x - ab}{y}}$

B. $t = \pm\sqrt{\dfrac{x - ab}{y}}$

C. $t = \sqrt{\dfrac{y}{x - ab}}$

D. $t = \pm\sqrt{\dfrac{x + ab}{y}}$

12 Peter has completed four Geography tests. His mean mark is 72%. What percentage mark does he have to get in his next test to increase the mean to 73% ?

A. 75%

B. 76%

C. 77%

D. 78%

13 Ravi owns 1782 shares with a market value of $8.25 per share. The dividend received for these shares is $1372.50. The percentage dividend yield is:

A. 9.3%

B. 0.1%

C. 77%

D. 0.8%

14 In 2008 the population in a Country ABC was 15.5 million people. The number of people in the same country increased at a rate of 2.5% per year.
Which expression represents the number (in millions) of people in Country ABC, if y represents the number of years after 2008?

A. $15.5 \times (1.025)^y$

B. $15.5 \times (0.025)^y$

C. $15.5 \times 1.025 \times y$

D. $15.5 \times 0.025 \times y$

15 Which of the following graphs represents $y = -3^{-x}$

A.

B.

C.

D.

End of Section I

Mathematics Standard 2

Section II Answer Booklet

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

Instructions

- Answer the Questions in the spaces provided. These spaces provide guidance for the expected length of response.
- Your response should include relevant mathematical reasoning and/or calculations
- Extra writing space is provided at the back of this booklet. If you use this space, clearly indicate which question you are answering.

Question 16 (2 marks)

In a raffle, the total prize money is shared among the first two tickets drawn in the ratio **2**
7 : 3. The prize for the first ticket drawn is $560.

What is the total prize money?

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Question 17 (2 marks)

Roger purchases a car to travel to work and back home. The fuel consumption of the car is **2**
8.1 L/ 100km and the fuel tank capacity of the car is 50 L. If Roger drives 850 km in total
each week, how many full tanks of petrol will he need to reach his destination?

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Question 18 (3 marks)

In 2017, Jasmine bought a home for $625 000. The house appreciated by 6.3% p.a. over the
next 5 years.

Determine how much the value of the house had increased by over the 5 years, correct to
the nearest $1000.

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Question 19 (3 marks)

A rocket is launched into the air. The height of the rocket can be modelled using the quadratic equation $h = -40t^2 + 800t$ where h is the height in metres and t is the time in seconds. The graph of this model is shown below.
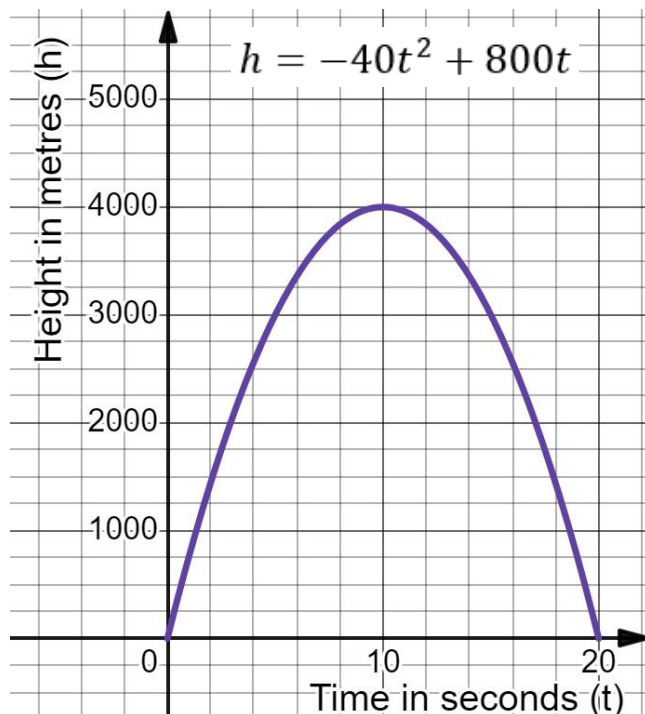
a) State the maximum height that the rocket reaches. **1**

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b) Explain why there two times, namely 5 seconds and 15 seconds, when the rocket is 3000 metres above the ground? **1**

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c) When does the rocket return back to the ground? **1**

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Question 20 (4 marks)

The network diagram shows the travel times in minutes along roads connecting a number of different towns, namely Towns *A, B, C, D, E, F, G* and *H*.
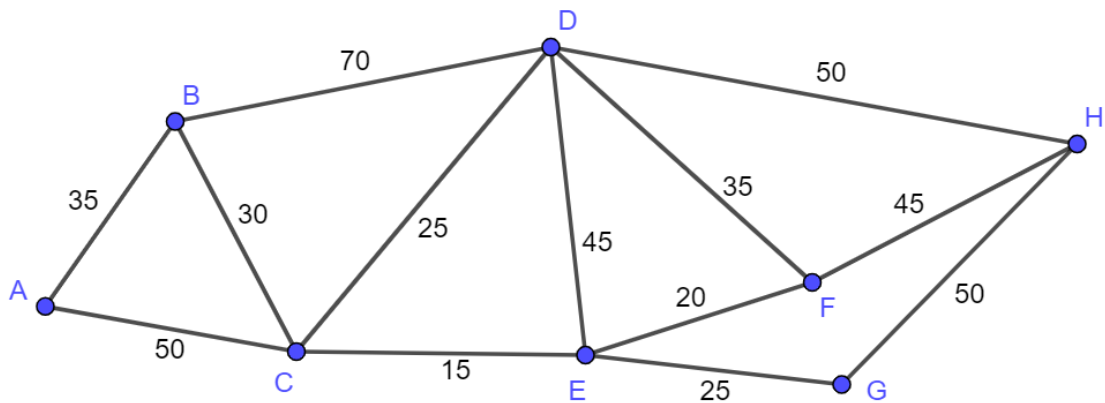
a)   Draw a minimum spanning tree for this network and determine its length.   **3**

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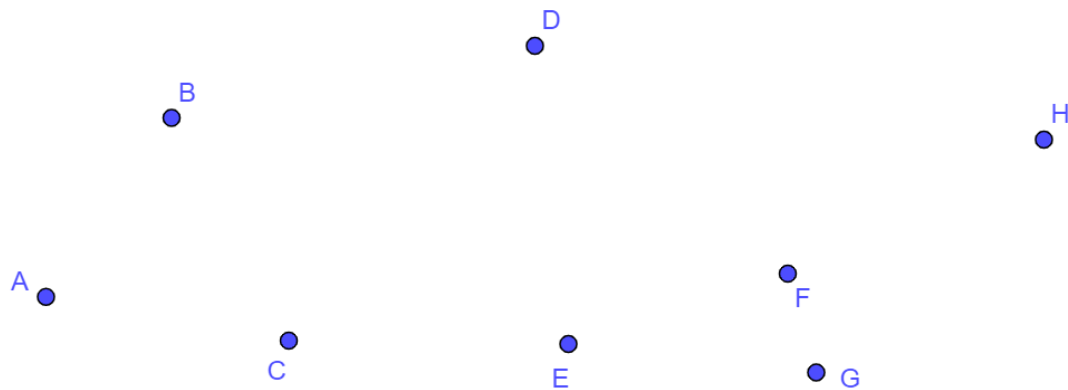
b)   How long does it take to travel from Town *A* to Town *F* using the fastest route?   **1**

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Question 21 (6 marks)

This table shows the tax rates for the 2023-2024 financial year.

Taxable income	Tax on this income
0 – $18,200	Nil
$18,201 – $45,000	19c for each $1 over $18,200
$45,001 – $120,000	$5,092 plus 32.5c for each $1 over $45,000
$120,001 – $180,000	$29,467 plus 37c for each $1 over $120,000
$180,001 and over	$51,667 plus 45c for each $1 over $180,000

Jonathan is an electrician and receives a yearly salary of $92500. He also receives an income of $750 per month from his part-time work at the local gym. Jonathan purchased an electrician's toolbox for $2075 which is an allowed tax deduction. He made a PAYG contribution from both sources of income of $2140 per month. He must also pay the Medicare levy, which is 2% of his taxable income.

a) Find Jonathan's taxable income. **1**

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b) Using the tax table given above, find the income tax payable. **2**

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c) Calculate the Medicare levy that Jonathan needs to pay. **1**

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d) Will he have a tax liability or a tax refund? Justify your answer with calculations. **2**

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Question 22 (3 marks)

The following table shows the future value of $1 invested at the end of each time period at the rate indicated.

Future value of $1 invested

Period	Interest rate per period									
	2%	2.5%	3%	3.5%	4%	4.5%	5%	5.5%	6%	8%
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	2.0200	2.0250	2.0300	2.0350	2.0400	2.0450	2.0500	2.0550	2.0600	2.0800
3	3.0604	3.0756	3.0909	3.1062	3.1216	3.1370	3.1525	3.1680	3.1836	3.2464
4	4.1216	4.1525	4.1836	4.2149	4.2465	4.2782	4.3101	4.3423	4.3746	4.5061
5	5.2040	5.2563	5.3091	5.3625	5.4163	5.4707	5.5256	5.5811	5.6371	5.8666
6	6.3081	6.3877	6.4684	6.5502	6.6330	6.7169	6.8019	6.8881	6.9753	7.3359
7	7.4343	7.5474	7.6625	7.7794	7.8983	8.0192	8.1420	8.2669	8.3938	8.9228
8	8.5830	8.7361	8.8923	9.0517	9.2142	9.3800	9.5491	9.7216	9.8975	10.6366
9	9.7546	9.9545	10.1591	10.3685	10.5828	10.8021	11.0266	11.2563	11.4913	12.4876
10	10.9497	11.2034	11.4639	11.7314	12.0061	12.2882	12.5779	12.8754	13.1808	14.4866
11	12.1687	12.4835	12.8078	13.1420	13.4864	13.8412	14.2068	14.5835	14.9716	16.6455
12	13.4121	13.7956	14.1920	14.6020	15.0258	15.4640	15.9171	16.3856	16.8699	18.9771
15	17.2934	17.9319	18.5989	19.2957	20.0236	20.7841	21.5786	22.4087	23.2760	27.1521

a) Use the table of future values to find the future value of an annuity of $900   **1**
    invested at the end of each year for 11 years at an interest rate of 4.5% p.a.

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b) Calculate the amount of interest earned on the investment.   **2**

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Question 23 (2 mark)

The table below shows the present value of an annuity of $1 invested at the end of each time period at the rate indicated.   **2**

Present value of an annuity of $1

Period	Interest rate per period									
	2%	2.5%	3%	3.5%	4%	4.5%	5%	5.5%	6%	8%
2	1.9416	1.9274	1.9135	1.8997	1.8861	1.8727	1.8594	1.8463	1.8334	1.7833
3	2.8839	2.8560	2.8286	2.8016	2.7751	2.7490	2.7232	2.6979	2.6730	2.5771
4	3.8077	3.7620	3.7171	3.6731	3.6299	3.5875	3.5460	3.5052	3.4651	3.3121
5	4.7135	4.6458	4.5797	4.5151	4.4518	4.3900	4.3295	4.2703	4.2124	3.9927
6	5.6014	5.5081	5.4172	5.3286	5.2421	5.1579	5.0757	4.9955	4.9173	4.6229
7	6.4720	6.3494	6.2303	6.1145	6.0021	5.8927	5.7864	5.6830	5.5824	5.2064
8	7.3255	7.1701	7.0197	6.8740	6.7327	6.5959	6.4632	6.3346	6.2098	5.7466

$3500 is deposited at the end of each year for 5 years into an annuity account. The interest rate is 5.5% p.a. Find the present value of the annuity.

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Question 24 (3 marks)

The formula below is used to calculate an estimate for blood alcohol content (*BAC*) for males.

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

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

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

The number of standard drinks in a glass of wine and a glass of spirits is shown.

Wine
1.2 standard drinks

Spirits
1 standard drink
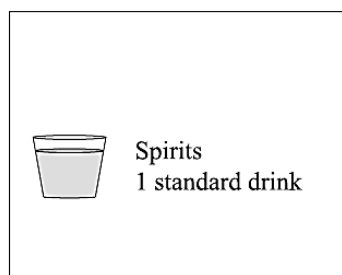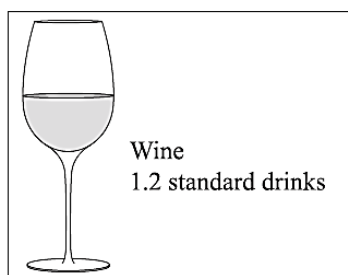
John weighs 69.54 kg. He consumed 4 glasses of wine and 3 glasses of spirits between 7:00 pm and 12:45 am the following day. He then stopped drinking alcohol.

Using the given formulae, calculate the time in the morning when John's *BAC* should reach zero. Give your answer correct to the nearest minute.

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Question 25 (5 marks)

Rita would like to save $35000 for her first home deposit in 5 years' time and she is considering her investment options.

a)   Option 1: Rita wants to have $35 000 in 5 years' time to pay for her first home   **2**
      deposit. She invests in an annuity that pays 14% p.a. compounding quarterly.
      Using the table below, how much does she need to deposit at the end of each
      quarter to achieve this result?

Future value of $1 invested

Period	Interest rate per period									
	2%	2.5%	3%	3.5%	4%	4.5%	5%	5.5%	6%	8%
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	2.0200	2.0250	2.0300	2.0350	2.0400	2.0450	2.0500	2.0550	2.0600	2.0800
3	3.0604	3.0756	3.0909	3.1062	3.1216	3.1370	3.1525	3.1680	3.1836	3.2464
4	4.1216	4.1525	4.1836	4.2149	4.2465	4.2782	4.3101	4.3423	4.3746	4.5061
5	5.2040	5.2563	5.3091	5.3625	5.4163	5.4707	5.5256	5.5811	5.6371	5.8666
6	6.3081	6.3877	6.4684	6.5502	6.6330	6.7169	6.8019	6.8881	6.9753	7.3359
7	7.4343	7.5474	7.6625	7.7794	7.8983	8.0192	8.1420	8.2669	8.3938	8.9228
8	8.5830	8.7361	8.8923	9.0517	9.2142	9.3800	9.5491	9.7216	9.8975	10.6366
9	9.7546	9.9545	10.1591	10.3685	10.5828	10.8021	11.0266	11.2563	11.4913	12.4876
10	10.9497	11.2034	11.4639	11.7314	12.0061	12.2882	12.5779	12.8754	13.1808	14.4866
11	12.1687	12.4835	12.8078	13.1420	13.4864	13.8412	14.2068	14.5835	14.9716	16.6455
12	13.4121	13.7956	14.1920	14.6020	15.0258	15.4640	15.9171	16.3856	16.8699	18.9771
15	17.2934	17.9319	18.5989	19.2957	20.0236	20.7841	21.5786	22.4087	23.2760	27.1521
18	21.4123	22.3863	23.4144	24.4997	25.6454	26.8551	28.1324	29.4812	30.9057	37.4502
20	24.2974	25.5447	26.8704	28.2797	29.7781	31.3714	33.0660	34.8683	36.7856	45.7620
21	25.7833	27.1833	28.6765	30.2695	31.9692	33.7831	35.7193	37.7861	39.9927	50.4229
24	30.4219	32.3490	34.4265	36.6665	39.0826	41.6892	44.5020	47.5380	50.8156	66.7648
25	32.0303	34.1578	36.4593	38.9499	41.6459	44.5652	47.7271	51.1526	54.8645	73.1059

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b) <u>Option 2</u>: Rita's friend advises her that it is better for her to invest $21 000 at **2**
9% p.a. interest, compounding monthly, for 5 years.

How much will Rita save at the end of 5 years if she follows her friend's advice?

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c) Which option will result in her saving enough for her first home deposit? Justify **1**
your answer with mathematical calculations by determining how much more or
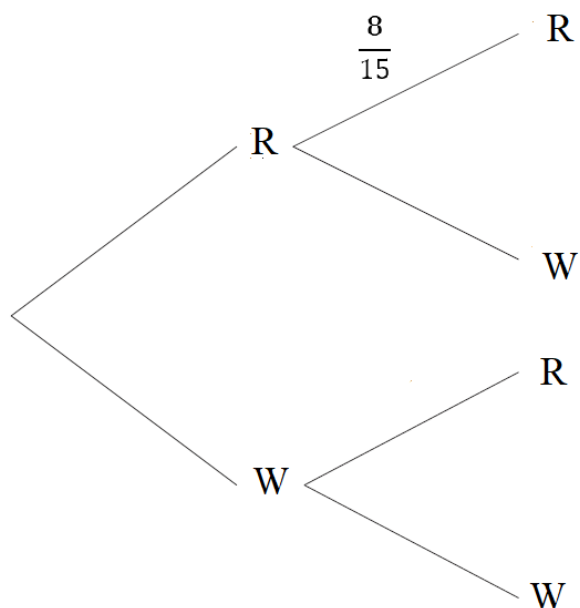how much less than the required amount she will have with each option.

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Question 26 (4 marks)

A bag contains 9 red balls and 7 white balls. Two balls are selected at random without replacement. A partially completed tree diagram is shown below.

a) Complete the tree diagram given above.   **2**

b) Calculate the probability of selecting two balls of different colours.   **1**

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c) Calculate the probability of picking at least one red ball.   **1**

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Question 27 (5 marks)

This scatterplot shows the age and value for a sample of cars of a particular model. A scatter plot of the data was then created and a line of best fit constructed, to model the relationship between value (V) and age (A). Aline of best-fit has been drawn for these points.

Value versus age of cars
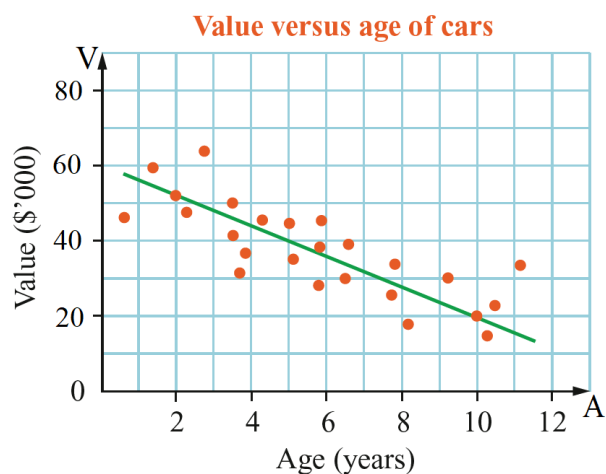
a)   Determine the gradient of the line of best fit.   **1**

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b)   Determine the equation of the line of best fit shown on the graph.   **1**

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c)   Use the equation to predict the value of a car of this model of age of 5 years.   **1**

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d)   Use the equation to predict the age of a car of this model with a value of   **1**
      $ *48 000*.

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(e)   Would this model be good to predict the value of a car that is 16 years old?   **1**
      Justify with reason.

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Question 28 (3 marks)

Solve $\dfrac{x+5}{5} - \dfrac{2x-2}{3} = -3$ **3**

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Question 29 (3 marks)

A student believes that the time it takes for an ice cube to melt (M minutes) varies inversely with the room temperature (T °C). The student observes that at a room temperature of 9°C it takes 20 minutes for an ice cube to melt.

a) Write an equation relating M and T to model this situation. **2**

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b) How many minutes would it take for an ice cube to melt when the room temperature is 30°C? **1**

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Question 30 (3 marks)

Consider the following dataset.

$$3, 7, 11, 12, 17$$

3

Suppose a new value, x, is added to this dataset, giving the following.

$$3, 7, 11, 12, 17, x$$

It is known that x is greater than 17. It is also known that the difference between the means of the two datasets is equal to ten times the difference between the medians of the two datasets.

Calculate the value of x.

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Question 31 (4 marks)

A tunnel is excavated with a cross-section as shown, during the construction of a new train route.
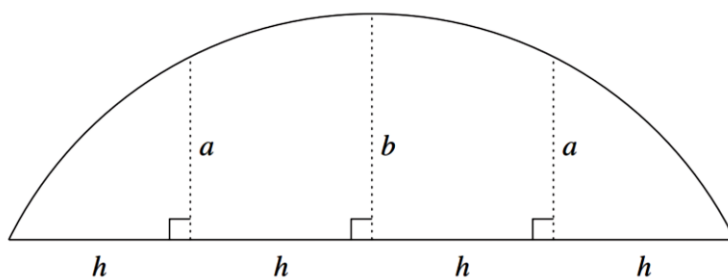
a) Find an expression in the simplest form for the area of the cross-section using the Trapezoidal rule.   **2**

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b) The area of the cross-section must be $810\ m^2$. The tunnel is $108\ m$ wide. If the value of b increases by 4 metres, by how much will a change?   **2**

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Question 32 (4 marks)

Calculate the balance on this credit card at the end of April given that the annual percentage rate is 19.8%. Assume that there is no interest-free period on these purchases.

4

April Statement		
Date	Details	Amount ($)
1 April	Opening balance	37
7 April	Purchase (Kettle)	65
16 April	Purchase (Toaster)	43
23 April	Payment	−80

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Question 33 (3 marks)

Linda is driving her car on the motorway where the legal speed limit is 110 km/h. She **3** notices that an animal is suddenly attempting to cross the road. In response to the danger she immediately reacts to apply the brakes in order to avoid a collision. If Linda's reaction time is 1.7 seconds and she travels 65 metres in that time, was she travelling within the legal speed limit? Justify your answer using appropriate mathematical calculations.

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Question 34 (6 marks)

Xian produces small toys at his business. He spent $100 on equipment and ascertain that it will cost $2 to manufacture each toy. Xian is planning to sell each toy for $4.

a) If C is the total cost and R is the total revenue, in dollars, set up the cost and revenue equations for the sale of x items. **2**

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b) Plot the graph of the two equations below and determine the break-even point. **2**
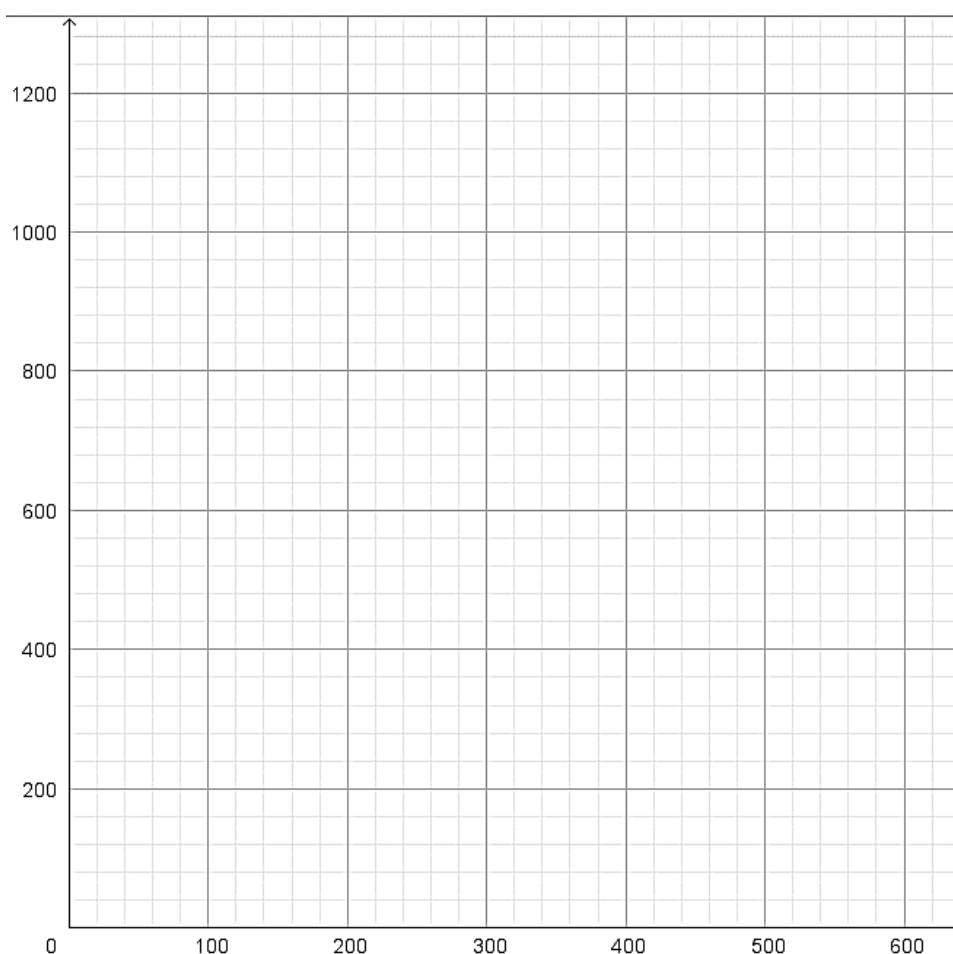
c) Will Xian make a profit or loss if he produces and sells 100 shirts? Determine the **2** amount of the profit or loss that he will make at 100 shirts.

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Question 35 (2 marks)

Thomas will travel from Melbourne (38°S, 145°E) to Tokyo (36° N, 140°E) on
Thursday, 21 December. The flight will leave Melbourne at 6.20 pm, and will take 10
hours and 30 minutes to reach Tokyo. The time difference between Melbourne and
Tokyo is two hours at that time of year. On what day and at what time will Thomas
arrive in Tokyo?

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Question 36 (2 marks)

Shaun travelled by train to his school. He walked from the train station to his school. The school is located 196 m north and 60 m west of the train station.

a) What distance will Shaun have to walk if he were to walk in a straight line from   **1**
    the train station his school? Round your answer to two decimal places.

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b) What is the three-figure bearing of the school from the train station? Round your   **1**
    answer to the nearest degree?

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Question 37 (5 marks)

Tennis balls are packaged in cylindrical containers. Tim purchases a container of tennis balls that holds three standard tennis balls, stacked one on top of the other. This container has a radius of 3.6 cm and a height of 21.6 cm, as shown in the diagram below.

a) What is the total outside surface area of this container, including both ends? Write your answer in square centimetres, rounded to one decimal place? **2**

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b) A standard tennis ball is spherical in shape with a radius of 3.6 cm.

   i) Write a calculation that shows that the volume, rounded to one decimal place, of one standard tennis ball is 195.4 cm^3. **1**

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   ii) Calculate the volume, rounded to one decimal place, of three standard tennis balls. **1**

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   iii) How much unused volume, in cubic centimetres, surrounds the tennis balls in this container? Round your answer to 1 decimal place. **1**

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Question 38 (4 marks)

The diagram shows two triangles ABC and ABD, where $AC = 37cm$, $BD = 95cm$, $\angle ACB = 41°$ and $\angle ADB = \theta$.
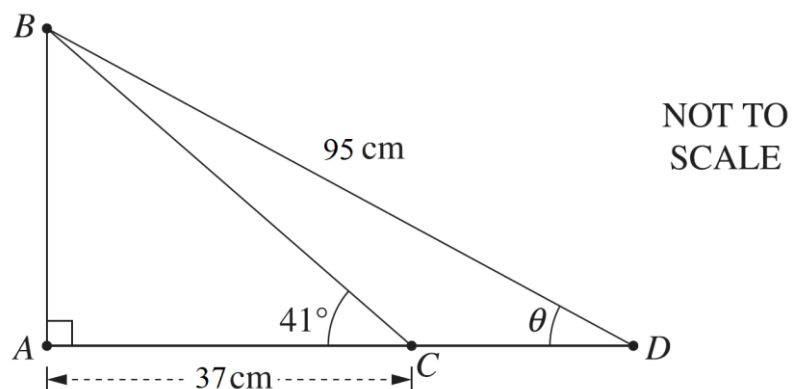
4

Calculate the size of angle θ, to the nearest minute.

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Question 39 (4 marks)

The information from a compass radial survey of a field is shown in the diagram below.

NOT TO SCALE
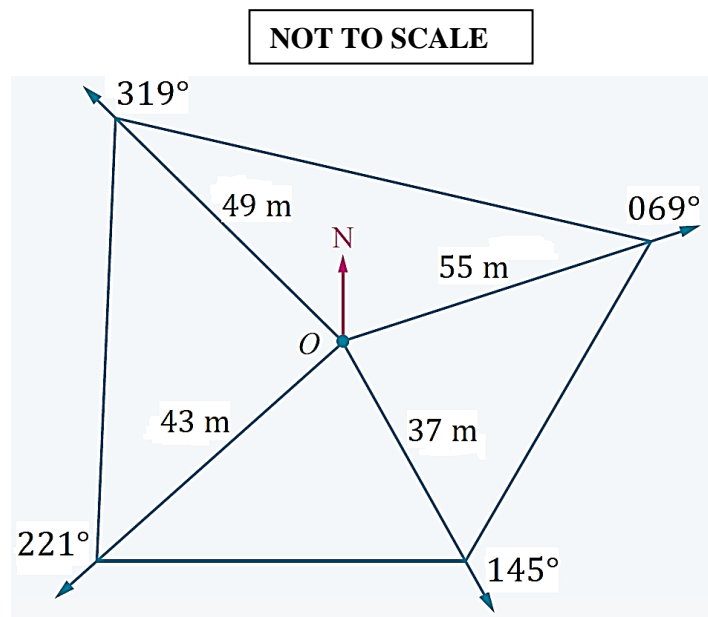
a) Find the perimeter of the field, to the nearest metre. **2**

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b) Find the area of the field, to the nearest square metre. **2**

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End of paper

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   Which of the data sets graphed below has the largest positive correlation
     coefficient value?

A.

B.

C.

D.
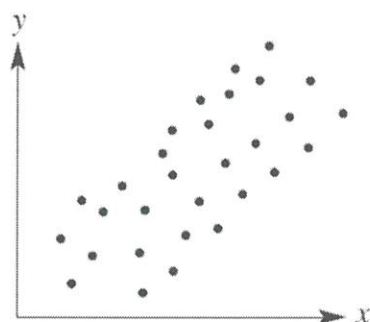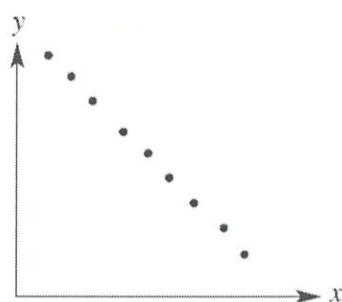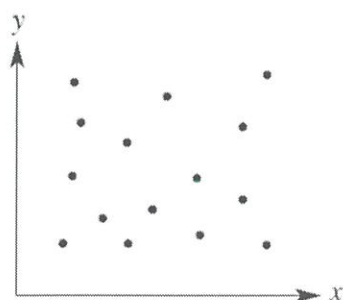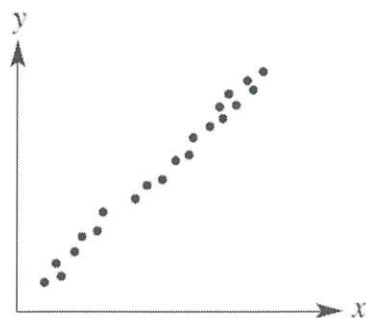
2 Which of the following expressions would give the height (h), of the tree in the diagram?

$$\tan 35° = \frac{h}{41}$$
$$h = 41 \times \tan 35°$$

- **A.** 41 × tan35° ✓ (circled)

- **B.** $\dfrac{41}{cos35°}$

- **C.** 41 × cos35°

- **D.** $\dfrac{41}{cos35°}$

3 The length of a flat screen television is measured to be 1.61 metres correct to the nearest centimetre.
What is the absolute error of the length of the flat screen television?

- **A.** 0.01 m

- **B.** 0.05 m

- **C.** 0.001 m

- **D.** 0.005 m ✓ (circled)
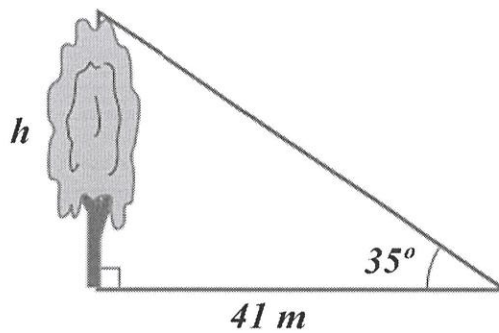
Absolute Error = ½ × Precision
= ½ × 1cm
= ½ × 0.001
= 0.005

4 The female and male smoking rates, expressed as percentage are shown below.

							Female		Male								
			9	8	8	7	⑥	1	8	9						
8	8	6	5	5	3	2	0	2	2	3	3	4	5	5	6	7
								3	0	1	1	6	7	8		

What is the lowest female smoking rate? 16%

- **A.** 6%

- **B.** 18%

- **C.** 16% ✓ (circled)

- **D.** 19%

5 In a survey of 250 randomly selected Year 12 students it was found that 65 use a bicycle to travel to school. Based on this survey, approximately how many of 72 000 Year 12 students would be expected to use a bicycle to school?

A. 72000

B. 64800

C. 18720

D. 71815

$$\frac{65}{250} \times 72000$$

$$= 18720$$

6 The network shows the distances, in kilometres, along roads that connect Town A and Town B.
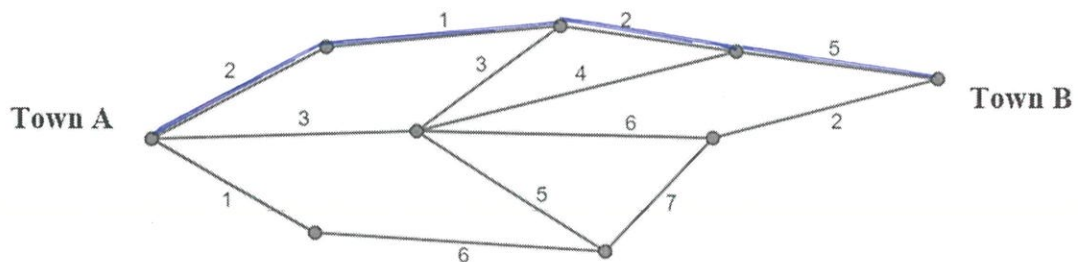
The shortest distance, in kilometres, from Town A to Town B is:

A. 7

B. 10

C. 11

D. 12

$$Shortest\ path = 2 + 1 + 2 + 5$$
$$= 10$$

7 Terrence boards a plane in London at 8 pm on Thursday 12th September and flies for 22 hours before arriving in Sydney. Given that Sydney's time zone is ten hours ahead of London's, what is the local time when he arrives in Sydney?

A. 6:00 pm Friday 13th September

B. 6:00 am Friday 13th September

C. 4:00 am Saturday 14th September

D 6:00 am Saturday 14th September

London $\xrightarrow{22h}$ Arrive in Sydney $\xrightarrow{+10h}$ Arrive in Sydney
6 pm Friday   04:00 am,
13 Sep (London   Sat 14 Sep.
time)   (Sydney time)

-5-

8 A group of students sat two different exams, namely Mathematics and Science and their scores are given in the table below. Use your calculator to find the equation of the least squares regression line for the scores. (Answers have been rounded).

Student	A	B	C	D	E	F	G	H
Maths (x)	68	70	45	51	86	61	72	78
Science (y)	80	85	63	71	93	79	86	92

A. $y = 0.739x + 32.05$

$y = 0.73931....x + 32.05291....$

B. $y = 32.05x + 0.739$

C. $y = 1.298x - 3.890$

D. $y = 3.890x - 1.298$

9 An asset depreciates to half its original value after 5 years using the declining balance method. What is the approximate annual rate of depreciation?

A. 10.5%

$S = V_0(1-r)^n$
$\frac{1}{2}V_0 = V_0(1-r)^5$
$0.5 = (1-r)^5$

B. 12.9%

Trial and Error :
When $r = 0.125$: $(1-0.125)^5 = 0.5129$

C. 15.5%
When $r = 0.130$: $(1-0.130)^5 = 0.4984$

D. 9.5%
When $r = 0.129$: $(1-0.129)^5 = 0.5013$

10 Amanda received her natural gas account. She is charged 3.892 cents per MJ for the first 5000 MJ and 2.354 cents per MJ for any other usage. What is the cost if she used 8450 MJ of natural gas?

A. $338.87

Cost $= 5000(0.03892) + (8450 - 5000)(0.02354)$
$= 275.813$
≈ 275.81

B. $198.91

C. $117.70

D. $275.81

11 Which is the correct expression to make t the subject of the formula
$x = ab + yt^2$?

A. $t = \sqrt{\dfrac{x - ab}{y}}$

B. $t = \pm\sqrt{\dfrac{x - ab}{y}}$

C. $t = \sqrt{\dfrac{y}{x - ab}}$

D. $t = \pm\sqrt{\dfrac{x + ab}{y}}$

(handwritten working:)
$x = ab + yt^2$
$x - ab = yt^2$
$\dfrac{x - ab}{y} = t^2$
$t^2 = \dfrac{x - ab}{y}$
$t = \pm\sqrt{\dfrac{x - ab}{y}}$

12 Peter has completed four Geography tests. His mean mark is 72%. What percentage mark does he have to get in his next test to increase the mean to 73% ?

A. 75%

B. 76%

C. 77%

D. 78%

(handwritten working:)
Sum of scores for T_1 to T_4 = 72×4 = 288
New mean = $\dfrac{288 + x}{5}$
$73 = \dfrac{288 + x}{5}$
$288 + x = 73 \times 5$
$x = (73 \times 5) - 288$
$= 77$

13 Ravi owns 1782 shares with a market value of $8.25 per share. The dividend received for these shares is $1372.50. The percentage dividend yield is:

A. 9.3%

B. 0.1%

C. 77%

D. 0.8%

(handwritten working:)
% Dividend yield = $\dfrac{1372.50}{1782 \times 8.25} \times 100\%$
$= 9.3\%$

14 In 2008 the population in a Country ABC was 15.5 million people. The number of people in the same country increased at a rate of 2.5% per year.
Which expression represents the number (in millions) of people in Country ABC, if y represents the number of years after 2008?

A. $15.5 \times (1.025)^y$

B. $15.5 \times (0.025)^y$

C. $15.5 \times 1.025 \times y$

D. $15.5 \times 0.025 \times y$

15 Which of the following graphs represents $y = -3^{-x}$

A.

B.

C.

D.

End of Section I

Mathematics Standard 2

Section II Answer Booklet

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

Instructions
- Answer the Questions in the spaces provided. These spaces provide guidance for the expected length of response.
- Your response should include relevant mathematical reasoning and/or calculations
- Extra writing space is provided at the back of this booklet. If you use this space, clearly indicate which question you are answering.

Question 16 (2 marks)

In a raffle, the total prize money is shared among the first two tickets drawn in the ratio **2**
7 : 3. The prize for the first ticket drawn is $560.

What is the total prize money?

$$\frac{7}{10} \times Total = \$560 \quad \checkmark \quad 1\,mark$$

$$Total = 560 \times \frac{10}{7}$$

$$Total = \$800 \quad \checkmark \quad 1\,mark$$

∴ The total prize money was $800.

Question 17 (2 marks)

Roger purchases a car to travel to work and back home. The fuel consumption of the car is **2**
8.1 L/ 100km and the fuel tank capacity of the car is 50 L. If Roger drives 850 km in total
each week, how many full tanks of petrol will he need to reach his destination?

$$Fuel\ use = \frac{850}{100} \times 8.1$$

$$= 68.85\,L \quad \checkmark \quad 1\,mark$$

$$Number\ of\ tanks\ needed = \frac{68.85}{50} = 1.377$$

∴ Roger needs 2 full tanks of fuel. ✓ *1 mark for 2 full tanks*
Deduct 1 mark for
incorrect rounding.

Question 18 (3 marks)

In 2017, Jasmine bought a home for $625 000. The house appreciated by 6.3% p.a. over the
next 5 years.

Determine how much the value of the house had increased by over the 5 years, correct to
the nearest $1000. **3**

$$FV = 625000\left(1 + \frac{6.3}{100}\right)^5 \quad \checkmark \quad 1\,mark\ for\ correct\ substitution$$

$$FV = \$848293.892 \quad \checkmark \quad 1\,mark$$

$$Increase\ in\ value = \$848293.892 - \$625\,000$$

$$= \$223293.89$$

Increase in value = $223000 (to the nearest $1000)
✓ *1 mark*

Question 19 (3 marks)

A rocket is launched into the air. The height of the rocket can be modelled using the quadratic equation $h = -40t^2 + 800t$ where h is the height in metres and t is the time in seconds. The graph of this model is shown below.
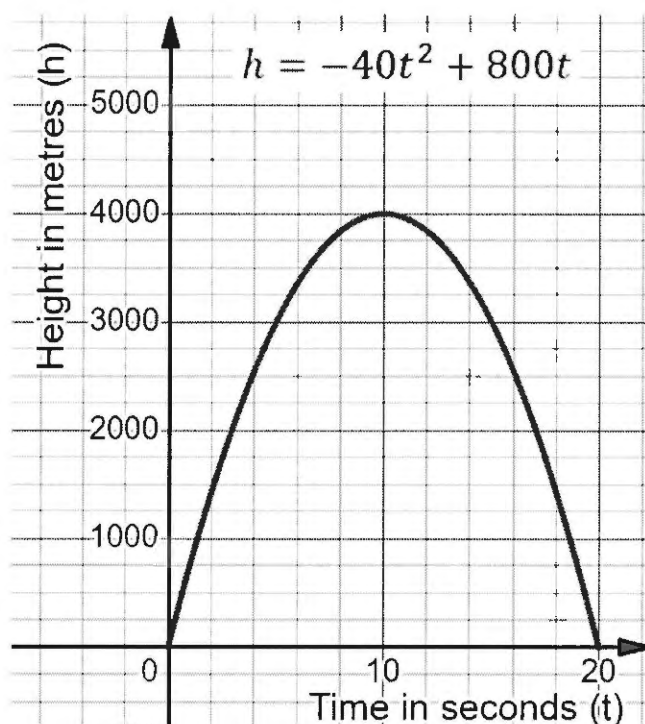
a) State the maximum height that the rocket reaches.   1

   4000 m ✓

b) Explain why there two times, namely 5 seconds and 15 seconds, when the rocket   1
   is 3000 metres above the ground?

   The rocket is on it's upward journey at $t = 5$ seconds
   and on it's return / downward journey at
   $t = 15$ seconds. ✓

c) When does the rocket return back to the ground?   1

   At $t = 20$ seconds ✓

Question 20 (4 marks)

The network diagram shows the travel times in minutes along roads connecting a number of different towns, namely Towns A, B, C, D, E, F, G and H.
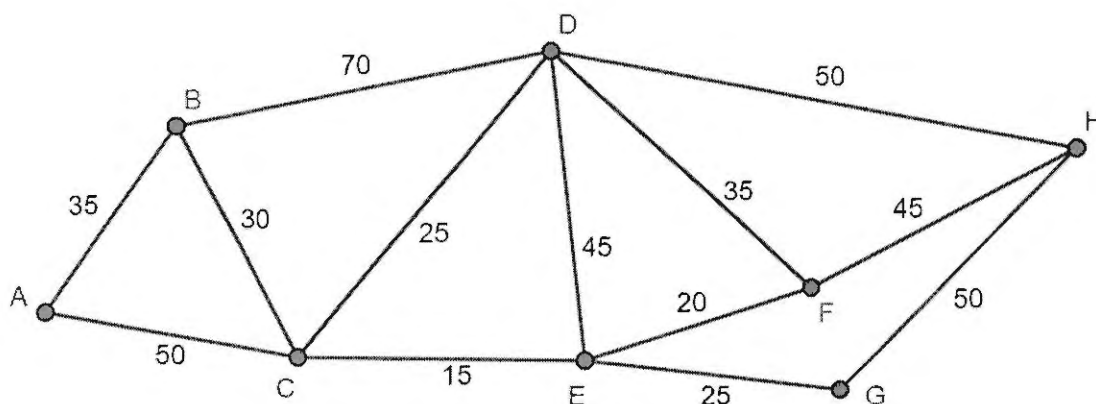
a) Draw a minimum spanning tree for this network and determine its length. **3**
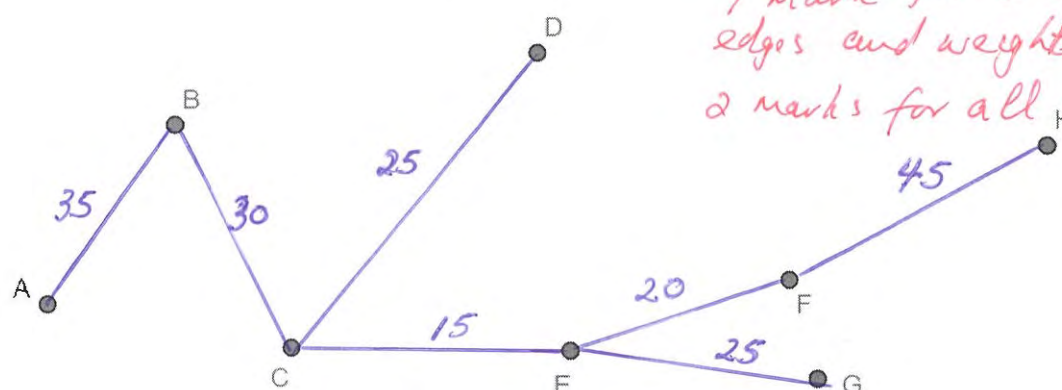
1 mark for 5 correct edges and weights.
2 marks for all correct.

Length of Minimum Spanning tree
$= 35 + 30 + 25 + 15 + 20 + 25 + 45$
$= 195$ minutes .   ✓ 1 mark

b) How long does it take to travel from Town A to Town F using the fastest route? **1**

$A \to F$: $ABDF = 35 + 70 + 35 = 140$

$ABDEF = 35 + 70 + 45 + 20 = 170$

$ABCDF = 35 + 30 + 25 + 35 = 125$

$ACEF = 50 + 15 + 20 = 85$ *

∴ fastest route is $ACEF = 85$ minutes ✓ 1 mark

Question 21 (6 marks)

This table shows the tax rates for the 2023-2024 financial year.

Taxable income	Tax on this income
0 – $18,200	Nil
$18,201 – $45,000	19c for each $1 over $18,200
$45,001 – $120,000	$5,092 plus 32.5c for each $1 over $45,000
$120,001 – $180,000	$29,467 plus 37c for each $1 over $120,000
$180,001 and over	$51,667 plus 45c for each $1 over $180,000

$99425 ✳

Jonathan is an electrician and receives a yearly salary of $92500. He also receives an income of $750 per month from his part-time work at the local gym. Jonathan purchased an electrician's toolbox for $2075 which is an allowed tax deduction. He made a PAYG contribution from both sources of income of $2140 per month. He must also pay the Medicare levy, which is 2% of his taxable income.

a) Find Jonathan's taxable income. **1**

$$\text{Taxable Income} = 92500 + (750 \times 12) - 2075$$
$$= 99425 \checkmark$$

b) Using the tax table given above, find the income tax payable. **2**

1 mark for correct substitution

$$\text{Tax payable} = 5092 + 0.325(99425 - 45000)$$
$$= \$22780.13 \quad \checkmark \text{ 1 mark}$$

c) Calculate the Medicare levy that Jonathan needs to pay. **1**

$$\text{Medicare Levy} = \frac{2}{100} \times \$99425$$
$$= \$1988.50 \checkmark$$

d) Will he have a tax liability or a tax refund? Justify your answer with calculations. **2**

$$\text{Total tax payable} = \$22780.13 + \$1988.50$$
$$= \$24768.63 \quad \checkmark \text{ 1 mark}$$

$$\text{PAYG} = \$2140 \times 12 = \$25680$$

∴ He will receive a tax refund of $25680 - $24768.63 = \$911.37$

✓ 1 mark

Question 22 (3 marks)

The following table shows the future value of $1 invested at the end of each time period at the rate indicated.

Future value of $1 invested

Period	Interest rate per period									
	2%	2.5%	3%	3.5%	4%	4.5%	5%	5.5%	6%	8%
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	2.0200	2.0250	2.0300	2.0350	2.0400	2.0450	2.0500	2.0550	2.0600	2.0800
3	3.0604	3.0756	3.0909	3.1062	3.1216	3.1370	3.1525	3.1680	3.1836	3.2464
4	4.1216	4.1525	4.1836	4.2149	4.2465	4.2782	4.3101	4.3423	4.3746	4.5061
5	5.2040	5.2563	5.3091	5.3625	5.4163	5.4707	5.5256	5.5811	5.6371	5.8666
6	6.3081	6.3877	6.4684	6.5502	6.6330	6.7169	6.8019	6.8881	6.9753	7.3359
7	7.4343	7.5474	7.6625	7.7794	7.8983	8.0192	8.1420	8.2669	8.3938	8.9228
8	8.5830	8.7361	8.8923	9.0517	9.2142	9.3800	9.5491	9.7216	9.8975	10.6366
9	9.7546	9.9545	10.1591	10.3685	10.5828	10.8021	11.0266	11.2563	11.4913	12.4876
10	10.9497	11.2034	11.4639	11.7314	12.0061	12.2882	12.5779	12.8754	13.1808	14.4866
11	12.1687	12.4835	12.8078	13.1420	13.4864	13.8412	14.2068	14.5835	14.9716	16.6455
12	13.4121	13.7956	14.1920	14.6020	15.0258	15.4640	15.9171	16.3856	16.8699	18.9771
15	17.2934	17.9319	18.5989	19.2957	20.0236	20.7841	21.5786	22.4087	23.2760	27.1521

a) Use the table of future values to find the future value of an annuity of $900 invested at the end of each year for 11 years at an interest rate of 4.5% p.a. **1**

4.5% and 11 years → Interest factor = 13.8412

FV = 13.8412 × 900

= $12 457.08   ✓ 1 mark

b) Calculate the amount of interest earned on the investment.   ✓ 1 mark **2**

Interest earned = $12457.08 − (11 × 900)

= $2557.08   ✓ 1 mark

-14-

Question 23 (2 mark)

The table below shows the present value of an annuity of $1 invested at the end of each   **2**
time period at the rate indicated.

Present value of an annuity of $1

Period	Interest rate per period									
	2%	2.5%	3%	3.5%	4%	4.5%	5%	5.5%	6%	8%
2	1.9416	1.9274	1.9135	1.8997	1.8861	1.8727	1.8594	1.8463	1.8334	1.7833
3	2.8839	2.8560	2.8286	2.8016	2.7751	2.7490	2.7232	2.6979	2.6730	2.5771
4	3.8077	3.7620	3.7171	3.6731	3.6299	3.5875	3.5460	3.5052	3.4651	3.3121
5	4.7135	4.6458	4.5797	4.5151	4.4518	4.3900	4.3295	4.2703	4.2124	3.9927
6	5.6014	5.5081	5.4172	5.3286	5.2421	5.1579	5.0757	4.9955	4.9173	4.6229
7	6.4720	6.3494	6.2303	6.1145	6.0021	5.8927	5.7864	5.6830	5.5824	5.2064
8	7.3255	7.1701	7.0197	6.8740	6.7327	6.5959	6.4632	6.3346	6.2098	5.7466

$3500 is deposited at the end of each year for 5 years into an annuity account. The
interest rate is 5.5% p.a. Find the present value of the annuity.

✓ 1 mark

5.5 % and 5 years : Interest Factor = 4.2703

PV = 3500 × 4.2703

= $14946.05   ✓ 1 mark

Question 24 (3 marks)

The formula below is used to calculate an estimate for blood alcohol content (*BAC*) for males.

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

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

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

The number of standard drinks in a glass of wine and a glass of spirits is shown.

Wine
1.2 standard drinks

Spirits
1 standard drink
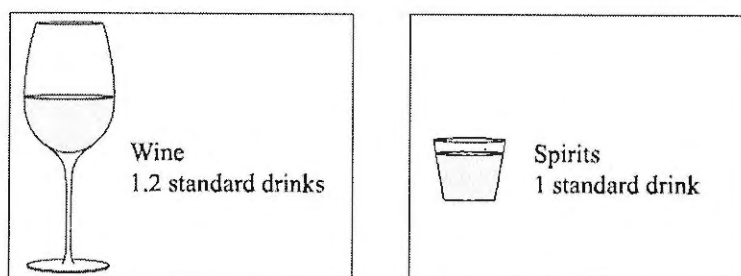
John weighs 69.54 kg. He consumed 4 glasses of wine and 3 glasses of spirits between 7:00 pm and 12:45 am the following day. He then stopped drinking alcohol.

Using the given formulae, calculate the time in the morning when John's *BAC* should reach zero. Give your answer correct to the nearest minute.

Number of standard drinks consumed $= (4 \times 1.2) + (3 \times 1)$

$N = 7.8$

Number of hours drinking $(H) = 5h\ 45min = 5.75h$.

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

$= \frac{10 \times 7.8 - 7.5 \times 5.75}{6.8 \times 69.54}$

$= 0.07375145917$ ✓ 1 mark

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

$= \frac{0.07375145917}{0.015}$

$= 4.917$

$= 4h\ 55'$ ✓ 1 mark

∴ John should reach zero BAC at $12:45 + 4h55' = 5:40am$ ✓ 1 mark

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Question 25 (5 marks)

Rita would like to save $35000 for her first home deposit in 5 years' time and she is considering her investment options.

a)   Option 1: Rita wants to have $35 000 in 5 years' time to pay for her first home   **2**
     deposit. She invests in an annuity that pays 14% p.a. compounding quarterly.
     Using the table below, how much does she need to deposit at the end of each
     quarter to achieve this result?

Future value of $1 invested

Period	Interest rate per period									
	2%	2.5%	3%	3.5%	4%	4.5%	5%	5.5%	6%	8%
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	2.0200	2.0250	2.0300	2.0350	2.0400	2.0450	2.0500	2.0550	2.0600	2.0800
3	3.0604	3.0756	3.0909	3.1062	3.1216	3.1370	3.1525	3.1680	3.1836	3.2464
4	4.1216	4.1525	4.1836	4.2149	4.2465	4.2782	4.3101	4.3423	4.3746	4.5061
5	5.2040	5.2563	5.3091	5.3625	5.4163	5.4707	5.5256	5.5811	5.6371	5.8666
6	6.3081	6.3877	6.4684	6.5502	6.6330	6.7169	6.8019	6.8881	6.9753	7.3359
7	7.4343	7.5474	7.6625	7.7794	7.8983	8.0192	8.1420	8.2669	8.3938	8.9228
8	8.5830	8.7361	8.8923	9.0517	9.2142	9.3800	9.5491	9.7216	9.8975	10.6366
9	9.7546	9.9545	10.1591	10.3685	10.5828	10.8021	11.0266	11.2563	11.4913	12.4876
10	10.9497	11.2034	11.4639	11.7314	12.0061	12.2882	12.5779	12.8754	13.1808	14.4866
11	12.1687	12.4835	12.8078	13.1420	13.4864	13.8412	14.2068	14.5835	14.9716	16.6455
12	13.4121	13.7956	14.1920	14.6020	15.0258	15.4640	15.9171	16.3856	16.8699	18.9771
15	17.2934	17.9319	18.5989	19.2957	20.0236	20.7841	21.5786	22.4087	23.2760	27.1521
18	21.4123	22.3863	23.4144	24.4997	25.6454	26.8551	28.1324	29.4812	30.9057	37.4502
20	24.2974	25.5447	26.8704	28.2797	29.7781	31.3714	33.0660	34.8683	36.7856	45.7620
21	25.7833	27.1833	28.6765	30.2695	31.9692	33.7831	35.7193	37.7861	39.9927	50.4229
24	30.4219	32.3490	34.4265	36.6665	39.0826	41.6892	44.5020	47.5380	50.8156	66.7648
25	32.0303	34.1578	36.4593	38.9499	41.6459	44.5652	47.7271	51.1526	54.8645	73.1059

Period = 5 × 4 = 20

$I = \dfrac{14\%}{4} = 3.5\%$

$FV = PV \times 28.2797$ ✓ 1 mark for correct factor

$35000 = PV \times 28.2797$

$PV = \dfrac{35000}{28.2797}$

$= \$1237.64$ per quarter ✓ 1 mark

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b) Option 2: Rita's friend advises her that it is better for her to invest \$21 000 at 9% p.a. interest, compounding monthly, for 5 years. **2**

How much will Rita save at the end of 5 years if she follows her friend's advice?

$$FV = Pv(1+r)^n \qquad \checkmark \text{ 1 mark}$$

$$FV = 21000\left(1+\frac{9\%}{12}\right)^{5\times12}$$

$$= 21000(1+0.0075)^{60}$$

$$= \$32\,879.30 \qquad \checkmark \text{ 1 mark}$$

c) Which option will result in her saving enough for her first home deposit? Justify your answer with mathematical calculations by determining how much more or how much less than the required amount she will have with each option. **1**

She should choose Option 1. With Option 1, she will have $35000.

With Option 2, she will have $32879.30 which is $2120.70 less than the amount she needs for her first home deposit. $\checkmark$ 1 mark

Question 26 (4 marks)

A bag contains 9 red balls and 7 white balls. Two balls are selected at random without replacement. A partially completed tree diagram is shown below.

I mark for 3 or more correct fractions.

2 marks for all correct.
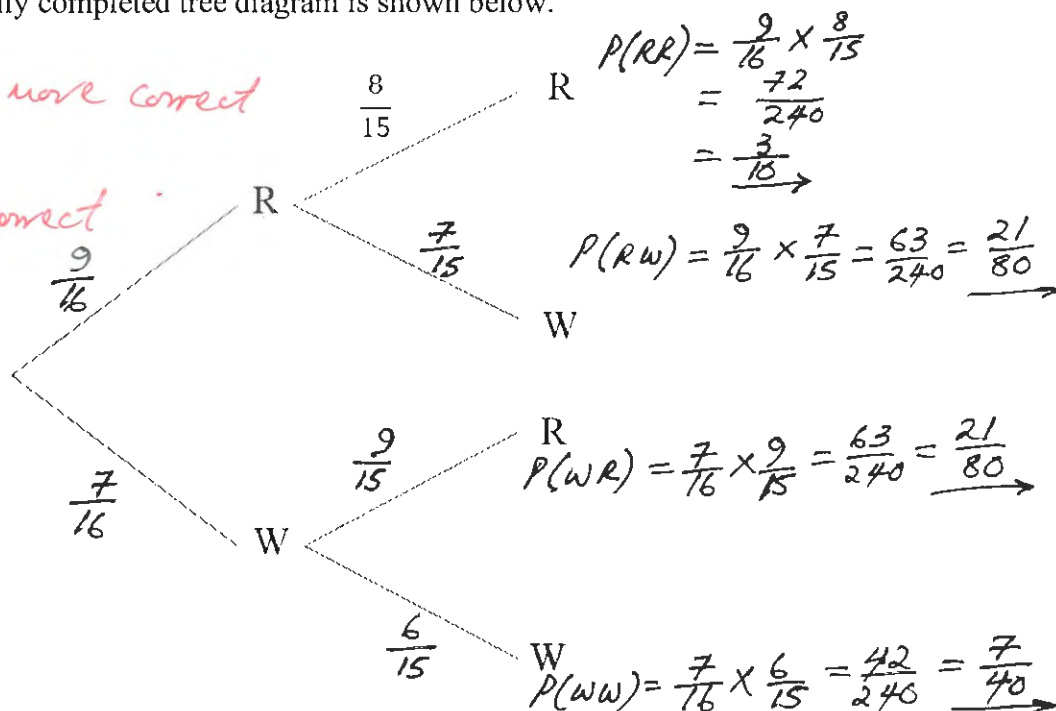
$\frac{9}{16}$ R

$\frac{8}{15}$ R $\quad$ $P(RR) = \frac{9}{16} \times \frac{8}{15}$

$= \frac{72}{240}$

$= \frac{3}{10}$

$\frac{7}{15}$ W $\quad$ $P(RW) = \frac{9}{16} \times \frac{7}{15} = \frac{63}{240} = \frac{21}{80}$

$\frac{7}{16}$ W

$\frac{9}{15}$ R $\quad$ $P(WR) = \frac{7}{16} \times \frac{9}{15} = \frac{63}{240} = \frac{21}{80}$

$\frac{6}{15}$ W $\quad$ $P(WW) = \frac{7}{16} \times \frac{6}{15} = \frac{42}{240} = \frac{7}{40}$

a) Complete the tree diagram given above. $\qquad$ **2**

b) Calculate the probability of selecting two balls of different colours. $\qquad$ **1**

$P(RW) + P(WR)$

$= \frac{21}{80} + \frac{21}{80}$

$= \frac{21}{40}$ $\quad$ ✓ *I mark*

c) Calculate the probability of picking at least one red ball. $\qquad$ **1**

$P(WR) + P(RW) + P(RR)$

$= \frac{21}{80} + \frac{21}{80} + \frac{3}{10}$

$= \frac{33}{40}$ $\quad$ ✓ *I mark*

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Question 27 (5 marks)

This scatterplot shows the age and value for a sample of cars of a particular model. A scatter plot of the data was then created and a line of best fit constructed, to model the relationship between value (V) and age (A). Aline of best-fit has been drawn for these points.

Value versus age of cars

$x_1 \quad y_1 \qquad x_2 \quad y_2$
$(5, 40000) \text{ & } (10, 20000)$
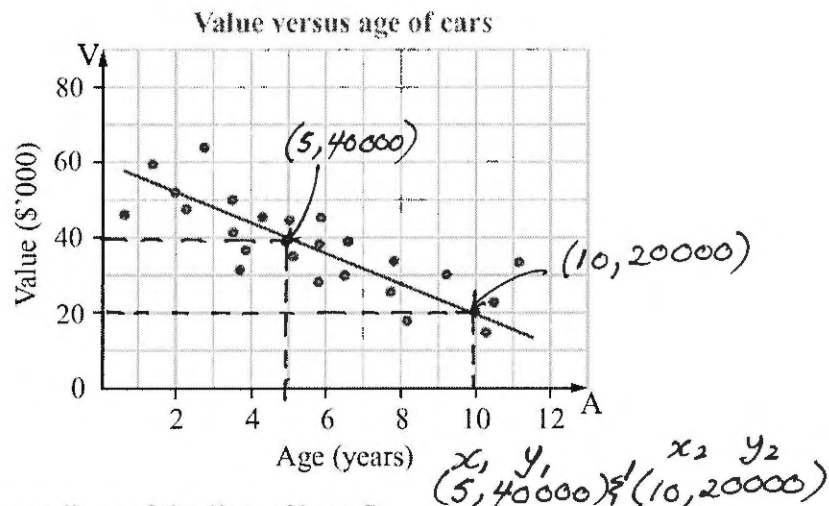
a) Determine the gradient of the line of best fit.   **1**

$$m = \frac{20\,000 - 40\,000}{10 - 5} = \frac{-20\,000}{5} = -4000 \checkmark$$

b) Determine the equation of the line of best fit shown on the graph.   **1**

$$V = -4000 A + c$$
$(5, 40000): \quad 40\,000 = -4000 \times 5 + c$
$$c = 60\,000$$
$$\therefore V = -4000 A + 60\,000 \checkmark$$

c) Use the equation to predict the value of a car of this model of age of 5 years.   **1**

$$V = -4000 \times 5 + 60\,000$$
$$V = \$40\,000 \checkmark$$

d) Use the equation to predict the age of a car of this model with a value of $48\,000.   **1**

$$48\,000 = -4000A + 60\,000$$
$$4000A = 12\,000$$
$$A = \frac{12\,000}{4000}$$
$$\therefore A = 3 \text{ years} \checkmark$$

(e) Would this model be good to predict the value of a car that is 16 years old? Justify with reason.   **1**

When A = 16 years : $V = -4000 \times 16 + 60000 = -\$4000$.
∴ No, not a good model to predict the value of a car $(-\$4000)$ since the car is worth a negative value at 16 years which is not realistic. $\checkmark$

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Question 28 (3 marks)

Solve $\dfrac{x+5}{5} - \dfrac{2x-2}{3} = -3$ **3**

$$\frac{x+5}{5} - \frac{2x-2}{3} = -3$$

$\times 15: \quad 3(x+5) - 5(2x-2) = -45$

$3x + 15 - 10x + 10 = -45 \quad \checkmark \text{ 1 Mark}$

$-7x + 25 = -45$

$-7x = -70 \qquad \checkmark \text{ 1 Mark}$

$x = 10 \qquad \checkmark \text{ 1 Mark}$

Check $LHS = \dfrac{10+5}{5} - \dfrac{2\times10-2}{3}$

$= -3$

$= RHS$

Question 29 (3 marks)

A student believes that the time it takes for an ice cube to melt (M minutes) varies inversely with the room temperature (T °C). The student observes that at a room temperature of 9°C it takes 20 minutes for an ice cube to melt.

a) Write an equation relating M and T to model this situation.   **2**

$M = \dfrac{k}{T}$. When $T = 9°C$, $M = 20$

$20 = \dfrac{k}{9} \qquad$ 1 mark for Correct Substitution

$k = 180$

$\therefore M = \dfrac{180}{T} \qquad \checkmark \text{ 1 mark}$

b) How many minutes would it take for an ice cube to melt when the room temperature is 30°C?   **1**

When $T = 30°C$, $M = \dfrac{180°}{30°}$

$= 6 \text{ hours} \qquad \checkmark \text{ 1 mark}$

Question 30 (3 marks)

Consider the following dataset.

$$3, 7, 11, 12, 17$$

Suppose a new value, x, is added to this dataset, giving the following.

$$3, 7, 11, 12, 17, x$$

It is known that x is greater than 17. It is also known that the difference between the means of the two datasets is equal to ten times the difference between the medians of the two datasets.

Calculate the value of x.

$$3, 7, \textcircled{11}, 12, 17$$

$$M_1 = 11$$

✓ 1 mark for correct M_1 and M_2.

$$3, 7, \boxed{11, 12}, 17, x$$

$$M_2 = \frac{11+12}{2} = \frac{23}{2} = 11.5$$

$$\bar{x_1} = \frac{3+7+11+12+17}{5}$$

$$\bar{x_2} = \frac{50+x}{6}$$

$$= \frac{50}{5}$$

✓ 1 mark for correct $\bar{x_1}$ and $\bar{x_2}$.

$$= 10$$

$$\frac{50+x}{6} - 10 = 10(11.5-11)$$

$$\frac{50+x}{6} = 15$$

$$50+x = 90$$

$$x = 40$$ ✓ 1 mark

Question 31 (4 marks)

A tunnel is excavated with a cross-section as shown, during the construction of a new train route.
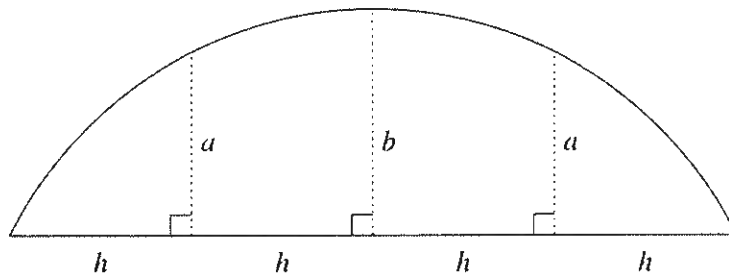
a) Find an expression in the simplest form for the area of the cross-section using the Trapezoidal rule. **2**

$$A = \frac{h}{2}\left[(0+a)+(a+b)+(b+a)+(a+0)\right] \checkmark \text{ /mark}$$

$$= \frac{h}{2}\left[4a+2b\right]$$

$$A = h(2a+b) \checkmark \text{ /mark}$$

b) The area of the cross-section must be $810\ m^2$. The tunnel is $108\ m$ wide. If the value of b increases by 4 metres, by how much will a change? **2**

$$108 = 4h$$
$$\Rightarrow h = 108/4 = 27m$$
$$A = h(2a+b)$$
$$810 = 27(2a+b) \qquad \checkmark \text{ /mark}$$
$$2a+b = 30$$
$$a = \frac{1}{2}(30-b)$$
$$a = 15 - \frac{b}{2}$$

If b increases by 4, then: $a = 15 - \dfrac{(b+4)}{2}$

$$a = 15 - \frac{b}{2} - 2$$

$\Rightarrow a$ must decrease by 2 metres. $\checkmark$ /mark

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Question 32 (4 marks)

Calculate the balance on this credit card at the end of April given that the annual percentage rate is 19.8%. Assume that there is no interest-free period on these purchases.

4

April Statement		
Date	Details	Amount ($)
1 April	Opening balance	37
7 April	Purchase (Kettle)	65
16 April	Purchase (Toaster)	43
23 April	Payment	−80

$$r = \frac{19.8\%}{365} = \frac{0.198}{365}$$

1-6 Apr (6 days): $FV = 37\left(1 + \frac{0.198}{365}\right)^6 = 37.12059083$ ✓ 1 mark

7-15 Apr (9 days): $PV = (37.12059083 + 65) = 102.12059083$

$$FV = 102.12059083\left(1 + \frac{0.198}{365}\right)^9$$

$$FV = 102.62002463$$ ✓ 1 mark

6-22 Apr (7 days): $PV = (102.6202463 + 43) = 145.62002463$

$$FV = 145.62002463\left(1 + \frac{0.198}{365}\right)^7$$

$$FV = 146.174015$$ ✓ 1 mark

23-30 Apr. (8 days): $PV = (146.174015 - 80) = 66.17410502$

$$FV = 66.17410502\left(1 + \frac{0.198}{365}\right)^8$$

$$FV = 66.46182834$$ ✓ 1 mark

Therefore the balance at the end of April is $66.46.

Question 33 (3 marks)

Linda is driving her car on the motorway where the legal speed limit is 110 km/h. She **3** notices that an animal is suddenly attempting to cross the road. In response to the danger she immediately reacts to apply the brakes in order to avoid a collision. If Linda's reaction time is 1.7 seconds and she travels 65 metres in that time, was she travelling within the legal speed limit? Justify your answer using appropriate mathematical calculations.

$$S = \frac{d}{t} = \frac{65}{1.7} = 38.235 \text{ m/s} \quad \checkmark \text{ 1 mark}$$

$$S = \frac{\frac{65}{1000} \text{ km}}{\frac{1.7}{3600} \text{ h}}$$

$$S = \frac{65}{1000} \times \frac{3600}{1.7} \text{ km/h}$$

$$S = 137.65 \text{ km/h} \quad \checkmark \text{ 1 mark}$$

No, Linda was not travelling within the speed limit. She was over the speed limit by 137.65 km/h – 110 km/h

$= 27.65 \text{ km/h}$ $\checkmark$ 1 mark

Question 34 (6 marks)

Xian produces small toys at his business. He spent $100 on equipment and ascertain that it will cost $2 to manufacture each toy. Xian is planning to sell each toy for $4.

a)   If C is the total cost and R is the total revenue, in dollars, set up the cost and   **2**
revenue equations for the sale of x items.

$$C = 2x + 100 \qquad (1) \qquad \checkmark \text{ 1 mark}$$

$$R = 4x \qquad (2) \qquad \checkmark \text{ 1 mark}$$

b)   Plot the graph of the two equations below and determine the break-even point.   **2**

x	0	100	200	300
C	100	300	500	700
R	0	400	800	1200
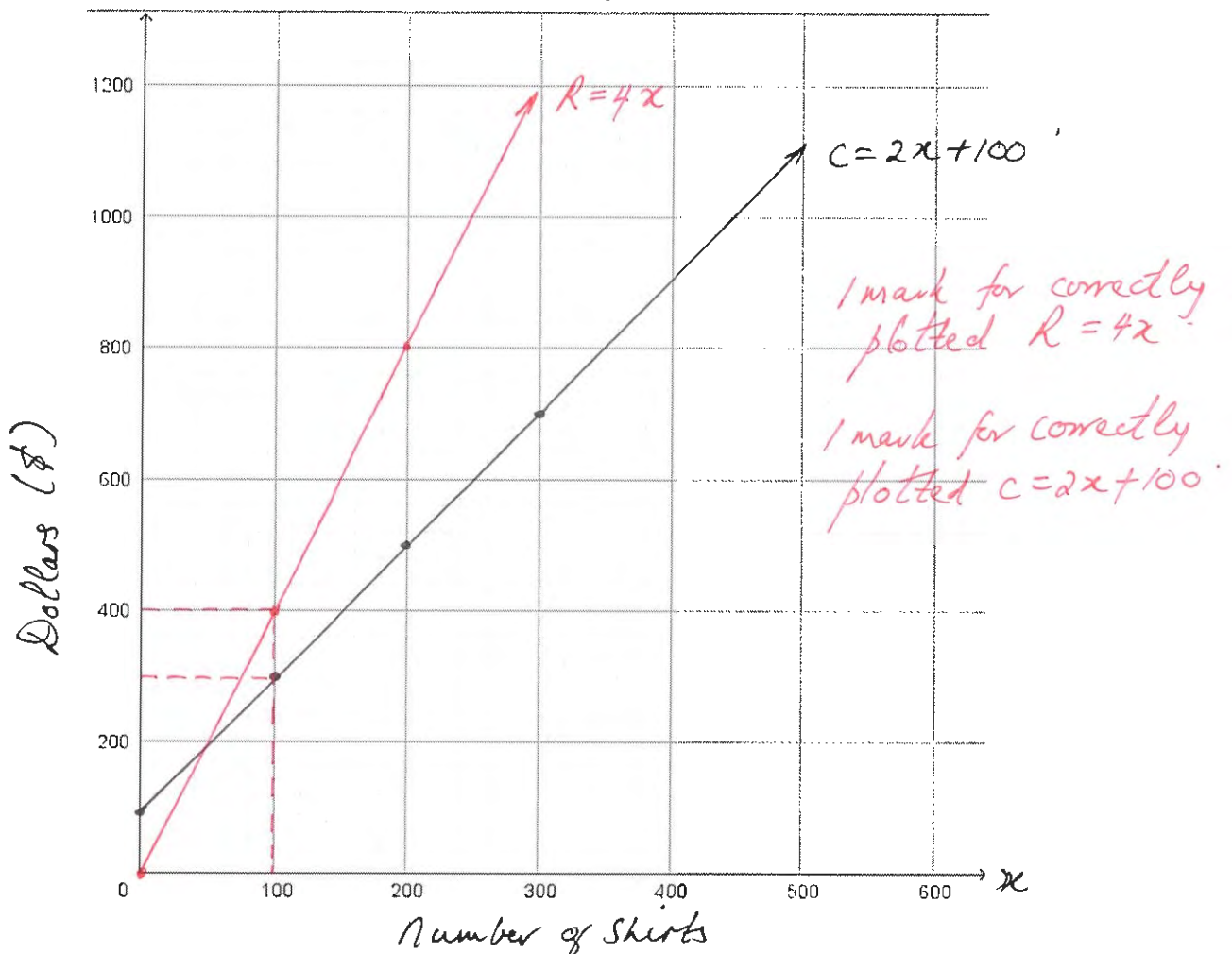
$R = 4x$

$C = 2x + 100$

1 mark for correctly plotted $R = 4x$

1 mark for correctly plotted $C = 2x + 100$

Dollars ($)

Number of Shirts

c)   Will Xian make a profit or loss if he produces and sells 100 shirts? Determine the   **2**
amount of the profit or loss that he will make at 100 shirts.

From the Graph: When $x = 100$, Cost $= \$300$ and Total Income $= \$400$.

Xian will make a profit as his Total Income exceeds $\checkmark$ 1 mark
his cost. Profit $= \$400 - \$300$

$= \$100$ $\checkmark$ 1 mark

Question 35 (2 marks)

Thomas will travel from Melbourne (38°S, 145°E) to Tokyo (36° N, 140°E) on
Thursday, 21 December. The flight will leave Melbourne at 6.20 pm, and will take 10
hours and 30 minutes to reach Tokyo. The time difference between Melbourne and
Tokyo is two hours at that time of year. On what day and at what time will Thomas
arrive in Tokyo?

2

Tokyo

4:50am
Fri. 22 Dec
(Melbourne Time)

Melbourne

6:20 pm
Thurs. 21 Dec.

(Flight : 10h30min)

Less 2hrs time difference .

∴ Arrival time of 2:50am Friday 22 December
(Tokyo time) .

1 mark for correct time .

1 mark for correct Day and date

Question 36 (2 marks)

Shaun travelled by train to his school. He walked from the train station to his school. The school is located 196 m north and 60 m west of the train station.

a) What distance will Shaun have to walk if he were to walk in a straight line from **1** the train station his school? Round your answer to two decimal places.

Let x be the straight line from the train station to the school,

$$x^2 = 60^2 + 196^2 \ldots \text{Pythagoras}$$

$$x = \sqrt{60^2 + 196^2}$$

$$x = 204.98 \text{ m} \quad (\text{to } 2 \text{ d.p.}) \qquad \checkmark \text{ /mark}$$

$$\boxed{OR} \quad \theta = \tan^{-1}\left(\frac{60}{196}\right)$$

$$\sin\theta = \frac{60}{x}$$

$$x = \frac{60}{\sin[\tan^{-1}(\frac{60}{196})]}$$

$$= 204.98 \text{ m} \quad (\text{to } 2 \text{ d.p.})$$

b) What is the three-figure bearing of the school from the train station? Round your **1** answer to the nearest degree?

Bearing of school from Train Station

$$= 360° - \theta$$

$$= 343° \, T \quad (\text{to the nearest degree}) $$

$$\checkmark \text{ /mark}$$

Question 37 (5 marks)

Tennis balls are packaged in cylindrical containers. Tim purchases a container of tennis balls that holds three standard tennis balls, stacked one on top of the other. This container has a radius of 3.6 cm and a height of 21.6 cm, as shown in the diagram below.

$r = 3.6$ cm

$h = 21.6$ cm
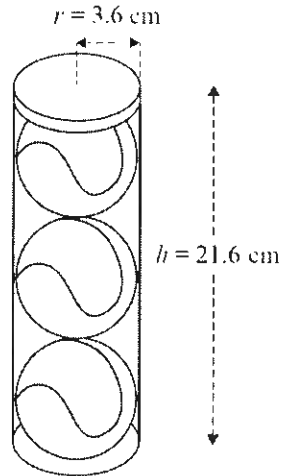
a)   What is the total outside surface area of this container, including both ends?   **2**
     Write your answer in square centimetres, rounded to one decimal place?

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

✓ 1 mark for correct $2\pi r^2$ or $2\pi rh$ correctly substituted

$$= [2\times\pi\times 3.6^2] + [2\times\pi\times 3.6\times 21.6]$$

$$= 570.0 \ cm^2 \quad (\text{to } 1 \ d.p.)$$

✓ 1 mark

b)   A standard tennis ball is spherical in shape with a radius of 3.6 cm.

i)   Write a calculation that shows that the volume, rounded to one decimal   **1**
     place, of one standard tennis ball is 195.4 cm^3.

$$Volume \ of \ Tennis \ Ball = \frac{4}{3}\pi r^3$$

$$= \frac{4}{3}\times\pi\times(3.6)^3$$ ✓ 1 mark

$$= 195.4 \ cm^3 \ (\text{to } 1 d.p.) \ as \ required$$

ii)   Calculate the volume, rounded to one decimal place, of three standard   **1**
     tennis balls.

$$3\times 195.4 = 586.2 \ cm^3$$ ✓ 1 mark.

iii) Volume of Container $= \pi\times(3.6)^2\times 21.6 = 879.4 \ cm^3 \ (\text{to } 1 d.p.)$

iii) How much unused volume, in cubic centimetres, surrounds the tennis balls   **1**
     in this container? Round your answer to 1 decimal place.

$$Unused \ Volume = 879.4 \ cm^3 - 3\times 195.4 \ cm^3$$

$$= 293.2 \ cm^3 \ (\text{to } 1 d.p.)$$ ✓ 1 mark.

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Question 38 (4 marks)

The diagram shows two triangles ABC and ABD, where $AC = 37cm$, $BD = 95cm$,   **4**
$\angle ACB = 41°$ and $\angle ADB = \theta$.

NOT TO SCALE

95 cm

41° θ

B A C D 37cm
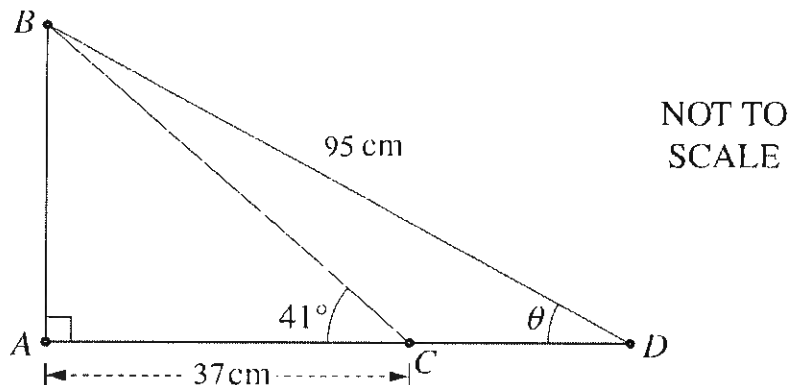
Calculate the size of angle θ, to the nearest minute.

In $\triangle BCA$: $\tan 41° = \dfrac{AB}{37}$ ✓ 1 mark

$AB = 37 \tan 41°$

$= 32.1636093 \, m$ ✓ 1 mark

In $\triangle BDA$: $\sin \theta = \dfrac{AB}{95}$

$\theta = \sin^{-1}\left[\dfrac{32.1636093}{95}\right]$ ✓ 1 mark

$= 19.7894...$

$= 19°47'$ (to the nearest minute)   ✓ 1 mark

(OR) $\angle BCD = 180° - 41°$ ..... Straight angle

$= 139°$

In $\triangle BCA$: $\cos 41° = \dfrac{37}{BC} \Rightarrow BC = \dfrac{37}{\cos 41°}$

$= 49.02548... \, m$

In $\triangle BCD$: $\dfrac{\sin\theta}{BC} = \dfrac{\sin 139°}{95}$

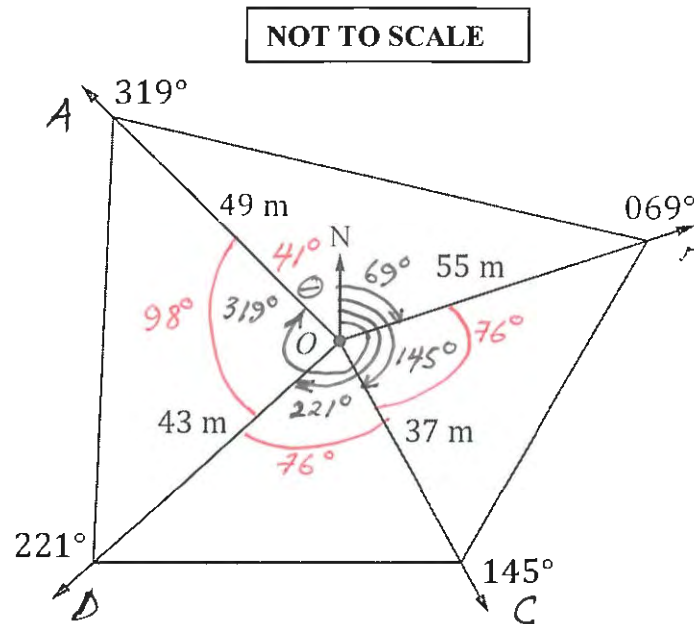$\sin\theta = \left(\dfrac{37}{\cos 41°}\right) \times \dfrac{\sin 139°}{95}$

$\theta = \sin^{-1}\left[\dfrac{37}{\cos 41°} \times \dfrac{\sin 139°}{95}\right]$

$\theta = 19.7894...$

$\theta = 19°47'$ (to the nearest minute)

Question 39 (4 marks)

The information from a compass radial survey of a field is shown in the diagram below.

NOT TO SCALE

a)   Find the perimeter of the field, to the nearest metre.   2

$\theta = 360° - 319° = \underline{41°}$

$\angle AOB = 41° + 69° = \underline{110°}$ ✓ 1 mark

Perimeter $= AB + BC + DC + DA$

$= \sqrt{49^2 + 55^2 - 2 \times 49 \times 55 \cos 110°} + \sqrt{55^2 + 37^2 - 2 \times 55 \times 37 \cos 76°} + \sqrt{37^2 + 43^2 - 2 \times 37 \times 43 \cos 76°}$

$+ \sqrt{43^2 + 49^2 - 2 \times 43 \times 49 \cos 98°}$ ✓ 1 mark

$= 262.6753 \, m \qquad \simeq 263 \, m \text{ (to the nearest metre)}$

b)   Find the area of the field, to the nearest square metre.   2

$A = \left[\frac{1}{2} AO \times BO \times \sin 110°\right] + \left[\frac{1}{2} \times BO \times CO \times \sin 76°\right] + \left[\frac{1}{2} CO \times DO \times \sin 76°\right] + \left[\frac{1}{2} DO \times AO \times \sin 98°\right]$

$= \left[\frac{1}{2} \times 49 \times 55 \times \sin 110°\right] + \left[\frac{1}{2} \times 55 \times 37 \times \sin 76°\right] + \left[\frac{1}{2} \times 37 \times 43 \times \sin 76°\right] + \left[\frac{1}{2} \times 43 \times 49 \times \sin 98°\right]$

✓ 1 mark for 2 sides
correctly substituted.

$= 4068.629369$

$= 4069 \, m^2 \quad \text{(to the nearest } m^2\text{)}$

✓ 2 marks for correct
final answer.

End of paper

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