Student's Name: _____

Student Number: | | | | | | | | | |

Teacher's Name: _____

ABBOTSLEIGH

2021
HIGHER SCHOOL CERTIFICATE
Trial Examination

Mathematics Standard 2

General Instructions

- Reading time – 10 minutes.
- Working time – 2 hours and 30 minutes
- Write using black pen.
- **NESA approved** calculators may be used.
- **NESA approved** reference sheet is provided.
- All necessary working should be shown in every question to gain full marks.
- Make sure your Student Number is on the front cover of each section.
- Answer the Multiple-Choice questions on the answer sheet provided.
- In Questions 16 - 43, show relevant mathematical reasoning and/or calculations.

Total marks – 100

- Attempt Sections I and II.

Section I Pages 3 - 10

15 marks

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

Section II Pages 11 - 42

85 marks

- Attempt Questions 16 - 43
- Allow about 2 hours and 5 minutes for this section.

Outcomes to be assessed:

Standard 2 Mathematics:

Preliminary Outcomes:

MS11-1 uses algebraic and graphical techniques to compare alternative solutions to contextual problems

MS11-2 represents information in symbolic, graphical and tabular form

MS11-3 solves problems involving quantity measurement, including accuracy and the choice of relevant units

MS11-4 performs calculations in relation to two-dimensional and three-dimensional figures

MS11-5 models relevant financial situations using appropriate tools

MS11-6 makes predictions about everyday situations based on simple mathematical models

MS11-7 develops and carries out simple statistical processes to answer questions posed

MS11-8 solves probability problems involving multistage events

MS11-9 uses appropriate technology to investigate, organise and interpret information in a range of contexts

HSC Outcomes:

MS2-12-1 uses detailed algebraic and graphical techniques to critically evaluate and construct arguments in a range of familiar and unfamiliar contexts

MS2-12-2 analyses representations of data in order to make inferences, predictions and draw conclusions

MS2-12-3 interprets the results of measurements and calculations and makes judgements about their reasonableness, including the degree of accuracy and the conversion of units where appropriate

MS2-12-4 analyses two-dimensional and three-dimensional models to solve practical problems

MS2-12-5 makes informed decisions about financial situations, including annuities and loan repayments

MS2-12-6 solves problems by representing the relationships between changing quantities in algebraic and graphical forms

MS2-12-7 solves problems requiring statistical processes, including the use of the normal distribution and the correlation of bivariate data

MS2-12-8 solves problems using networks to model decision-making in practical problems

MS2-12-9 chooses and uses appropriate technology effectively in a range of contexts, and applies critical thinking to recognise appropriate times and methods for such use

SECTION I

15 marks
Attempt Questions 1 – 15

Use the multiple-choice answer sheet

Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.
Sample 2 + 4 = (A) 2 (B) 6 (C) 8 (D) 9

(A) ○ (B) ● (C) ○ (D) ○

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

(A) ● (B) ⊗ (C) ○ (D) ○

If you change your mind and have crossed out what you consider to be the correct answer, then indicate this by writing the word *correct* and drawing an arrow as follows.

correct ←

(A) ⊗ (B) ⊗ (C) ○ (D) ○

---

1. 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

2. Electricity prices have risen by 3.4% p.a. over the past few years. If the average electricity bill in 2012 was $425, what was the average electricity bill in 2020?

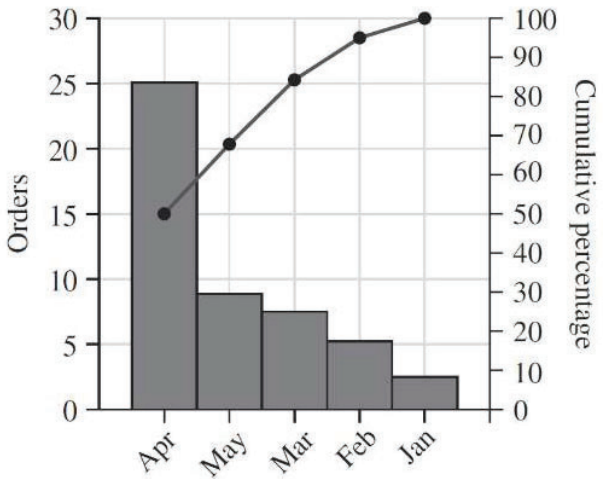
A. $437.75

B. $489.22

C. $523.67

D. $555.33

3. The Pareto chart below shows the orders received by a local computer company for 5 months.



What percentage of orders were received in May?

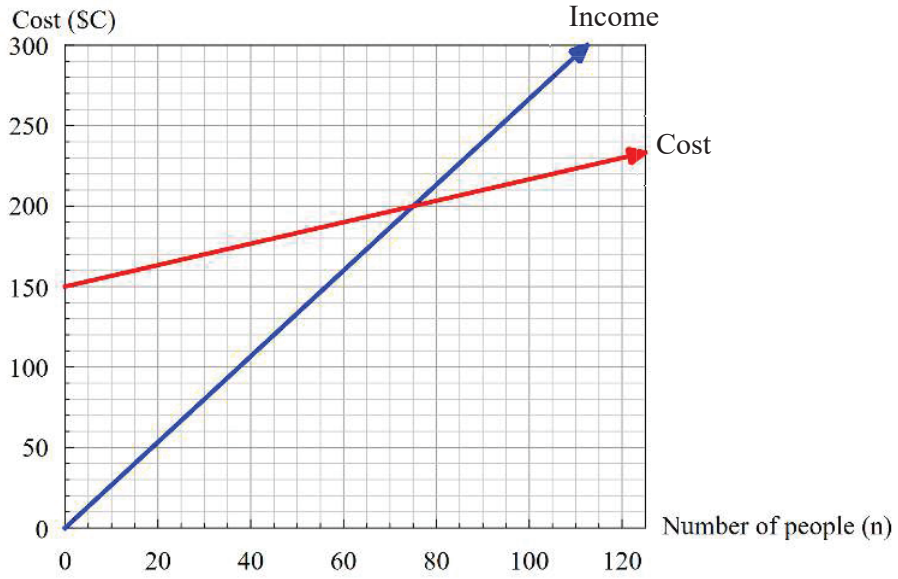
A. 8 %

B. 18%

C. 20%

D. 68%

4. The principal of SMGS has said that the fair committee need to ensure they will make a profit from the fair before she allows it to proceed.



At present 50 people have confirmed attendance, how many more need to confirm before the go ahead for the event can proceed?

A. 25

B. 50

C. 75

D. 100

5. In a 30 kg bag of fertiliser, the 3 main components of nitrogen, phosphorus and potassium have their weight in the ratio 2 :1: 3. The total weight of these 3 components represents 50% of the contents of the bag. (The remaining weight is made up of other nutrients). What amount of nitrogen is in the bag?

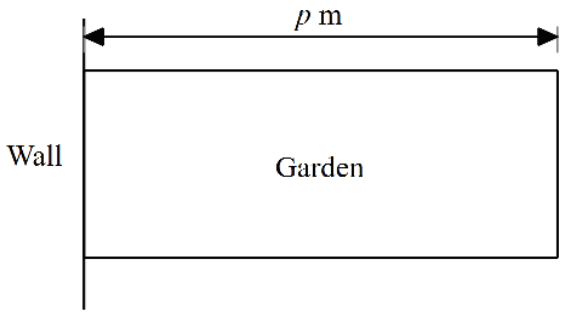
A. 2 kg

B. 2.5 kg

C. 5 kg

D. 10 kg

6. Teddy wants to build a rectangular garden bed in his backyard. He is going to use an existing wall as one side of the garden and 17 m of fencing to border the remaining 3 sides.
Which expression gives an area of the garden bed?



NOT TO SCALE

A. $17 - 2p$

B. $17p$

C. $17p^2$

D. $17p - 2p^2$

7. Amanda lives in Sydney (UTC +10) and wants to call her mum who lives in New York (UTC −5). Her mum has asked her to call her at 8:30 pm on Tuesday evening New York time.
What is the day and time in Sydney when Amanda makes the call?

A. 5:30 am Tuesday

B. 11:30 am Wednesday

C. 8:30 pm Wednesday

D. 11:30 pm Wednesday

8. Bambi owns 2700 shares in Straws. When the market value of each share was $4.55, the company declared a dividend yield of 6.2%. What is the total dividend that Bambi receives?

A. $761.67

B. $1981.45

C. $3679.12

D. $9571.07

9. How many edges are in a minimum spanning tree if a connected network has 12 vertices?

A. 11

B. 12

C. 13

D. 14

10. Which pair of variables has a strong, negative correlation with a *causal* relationship?

A. amount of road traffic and time to travel to work.

B. population of a town and number of schools.

C. number of sharks at a beach and number of people swimming.

D. the day's temperature and the number of ice-creams sold.

11. A pen is measured to be 12.1 cm long. What is the percentage error of the measurement?

A. 0.004%

B. 0.05%

C. 0.1%

D. 0.41%

12. In a supercar race the number of pit stops that occur is normally distributed.
The mean number of pit stops per car in a 24-hour race is 10 and the standard deviation is 2.
If there are 125 cars in the race, approximately how many cars make between 8 and 12 pit stops?

A. 85

B. 102

C. 108

D. 119

13. The table shows the present value interest factors for an annuity of $1 per period, for various interest rates, r, and the period, n.

Period,	**Interest rate per period**					
n	**1%**	**2%**	**3%**	**4%**	**5%**	**6%**
1	0.9901	0.9876	0.9765	0.9654	0.9432	0.9321
2	1.9704	1.8765	1.7654	1.6543	1.5432	1.4321
3	2.9410	2.7654	2.6543	2.5432	2.4321	2.4311
4	3.9020	3.8765	3.7654	3.6543	3.5432	3.4321
5	4.8534	4.5432	4.5321	4.4321	4.4123	4.2134
6	5.7966	5.4321	5.4123	5.4012	5.3211	5.2122
7	6.7543	6.4321	6.4123	6.4012	6.3211	6.2312
8	7.6523	7.5211	7.5432	7.4321	7.3212	7.2123
9	8.6780	8.5234	8.4321	8.3212	8.2312	8.1234
10	9.4713	8.9826	8.5302	8.1108	8.7212	9.1234

Gina plans to invest $10 000 every 6 months for 5 years. Her investment will earn interest at a rate of 4% p.a. compounding half-yearly. What is the present value of this annuity?

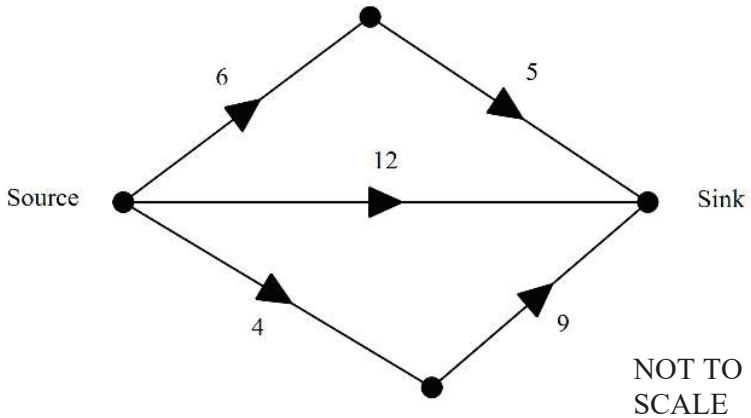
A. $44 518

B. $47 135

C. $81 109

D. $89 826

14. The network diagram shows the flow of water in a garden irrigation system connecting the source to the sink. What is the maximum flow for this system?



NOT TO SCALE

A. 12

B. 13

C. 21

D. 27

15. Twenty students sit a Geography test and the mean of their scores is 78.
Two students sit the test late and their scores are 96 and 82.
What is the new mean for the Geography test?

A. 89

B. 83

C. 80

D. 79

End of Section I

Student Number: | | | | | | | | | |

2021 TRIAL HIGHER SCHOOL CERTIFICATE EXAMINATION

Mathematics Standard 2

Section II Answer Booklet 1

Section II

85 marks

Attempt Questions 16 - 43

Allow about 2 hours and 5 minutes for this section

Booklet 1 — Attempt Questions 16–28 (39 marks)

Booklet 2 — Attempt Questions 29–43 (46 marks)

Answer the questions in the spaces provided.

These spaces provide guidance for the expected length of response.

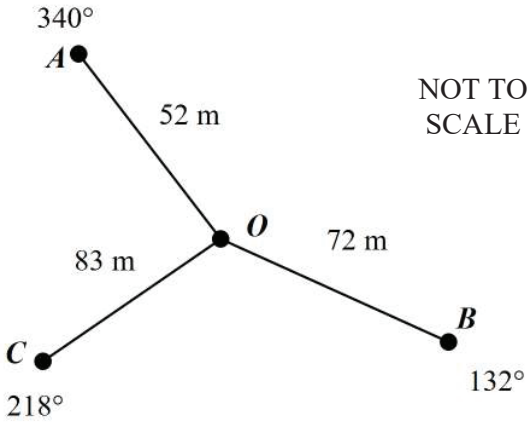
Your responses should include relevant mathematical reasoning and/or calculations.

Extra writing space is provided on pages 25, 26, 41, 42. If you use this space, clearly indicate which question you are answering.

Please Turn Over

Question 16 (4 marks)

Consider this radial survey. It shows the positions of three points on a field A, B, and C relative to point O.



(a) Find the area of this triangular field ABC, correct to 2 decimal places. **2**

……

……

……

……

……

……

(b) Calculate the distance of A to B, correct to the nearest metre. **2**

……

……

……

……

……

……

Question 17 (3 marks)

Mr Klimes has invented a new ball game, AbbBall. Points are awarded by a player throwing the ball into a net to score ONE goal (g) or place the ball over the line to score ONE behind (b). 12M9 and 12M8 have just played a trial game to see how it works.

The results of the game is given in the following table.

Team	Goals (g)	Behinds (b)	Total score
12M9	6	12	54
12M8	7	5	45

(a) Create a pair of linear equations to represent this information. **1**

……

……

……

(b) By solving the equations simultaneously, determine the number of points awarded for a 'goal' and a 'behind'. **2**

……

……

……

……

……

……

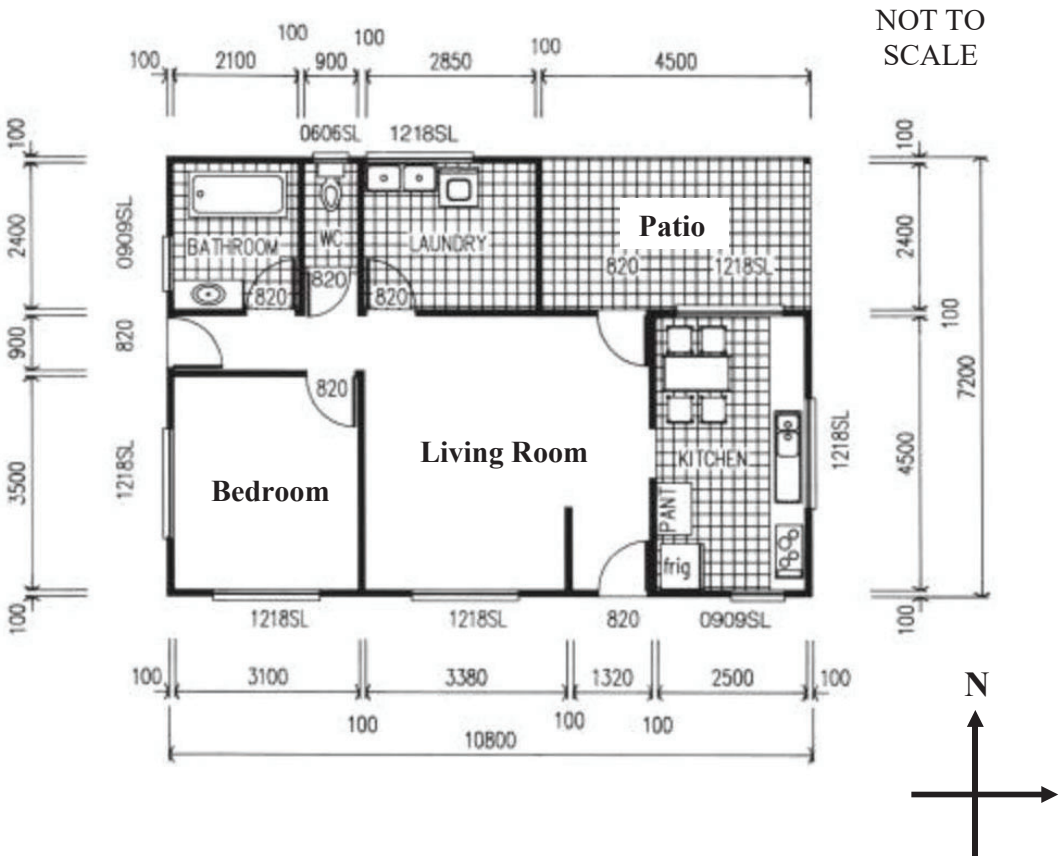
……

……

……

Question 18 (3 marks)

Rental spaces are at a premium in Jindabyne as they have all been taken over by the government for the Snowy 2.0 project. Yoda has decided to rent out his granny flat located in his back yard.



(a) Find the area of the patio in square metres. **1**

……

……

(b) The patio will be tiled to provide an entry to the rental property. The cost of the tiles is \$128 / m^2 including labour. An extra 10% for cutting and breakages must be allowed for when ordering. If Yoda buys the tiles from a company that only sells full boxes with enough tiles to cover 1 m^2, what is the total cost of tiling the patio? **2**

……

……

……

Question 19 (2 marks)

A student purchases a brand-new laptop for $6000. The value of the laptop depreciates by 20% p.a. When the salvage value of the laptop falls to at least half of its original value, the student can purchase a new laptop.

Show that she can update her computer during the fourth year. **2**

……..……..……

……..……..……

……..……..……

……..……..……

……..……..……

……..……..……

……..……..……

……..……..……

……..……..……

……..……..……

……..……..……

Question 20 (3 marks)

The table below shows the current individual tax rates.

Taxable Income	**Tax payable**
$0 to $18 200	Nil
$18 201 to $37 000	19c for each $1 over $18 200
$37 001 to $90 000	$3 572 plus 32.5c for each $1 over $37 000
$90 001 to $180 000	$20 797 plus 37c for each $1 over $90 000
$180 001 and over	$54 097 plus 45c for each $1 over $180 000

The Medicare levy to be paid is 2% of the taxable income.

Maxine calculates her tax payable as $23 979. How much will she have to pay for the Medicare levy. **3**

……

……

……

……

……

……

……

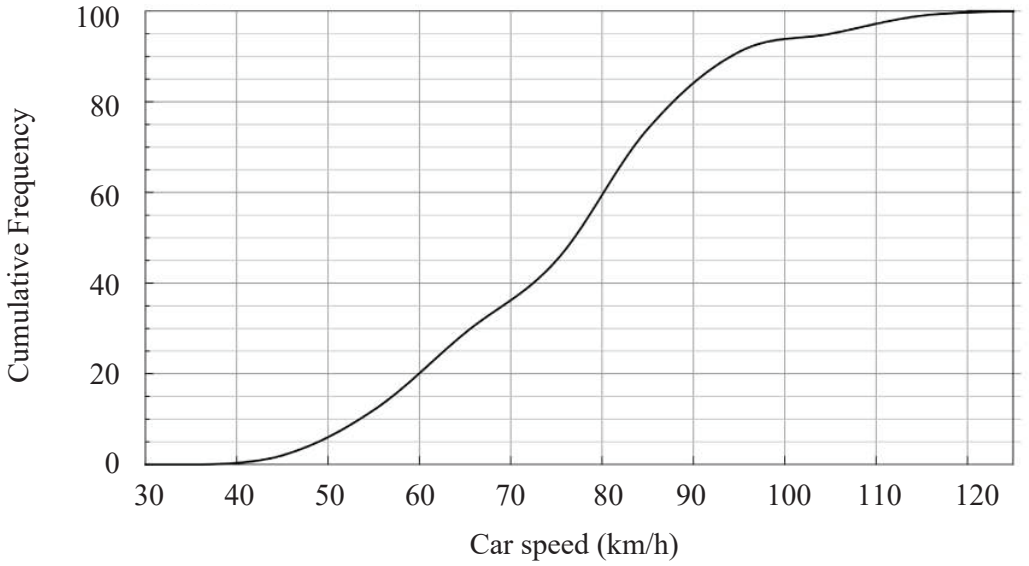
……

……

……

Question 21 (3 marks)

The cumulative frequency polygon shown below is a summary of the recorded speeds of 100 cars travelling around a bend on a country road.



Around this bend, the recommended speed is 60 km/h and the actual speed limit is 80 km/h.

(a) How many of the cars were travelling above the recommended speed? **1**

……

……

(b) The technician recording the speed of cars made the following comment:

"At least half the cars were above the speed limit."

Is the technician's comment correct? Justify your answer with appropriate calculations and mathematical reasoning. **2**

……

……

……

……

Question 22 (6 marks)

An adaptive learning tool has been designed to assist students with their studies in a course. The amount of time (t) some of the students spent using the tool and the number of tasks they completed (n) are shown in the table. There are 40 tasks to complete in the course.

Student Name	Time spent (minutes)	Number of tasks completed
Fred Flintstone	5	3
Wilma Flintstone	94	10
Barney Rubble	66	28
Betty Rubble	17	23
Pebbles Flintstone	340	32
Bamm-Bamm Rubble	223	40
Dino	38	16
Mr Slate	171	35

(a) Calculate the Pearson's coefficient for the data, correct to 4 decimal places. **1**

……..….

……..

(b) Identify the direction and the strength of the linear association between time spent and number of tasks completed. **1**

……..

(c) Write the equation of the least-squared regression line in terms of the variables correct to 3 decimal places. **1**

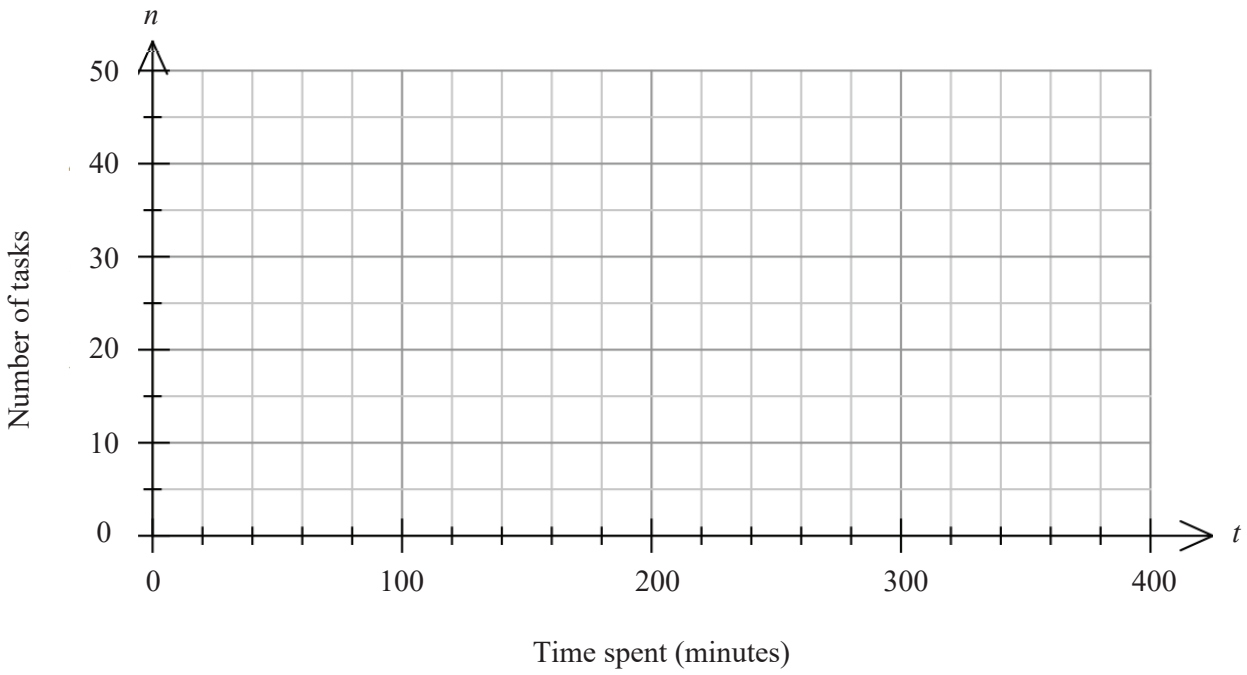
……..……

……..

Question 22 continues on page 19

Question 22 (continued)

(d) On the grid below, sketch the least-squared regression line for this data. **1**



(e) If a student completes 27 tasks, what is the time spent using the adaptive tool? **1**

……

……

……

……

(f) Is finding the time using the adaptive tool for 27 tasks an example of extrapolation or interpolation? Explain **1**

……

……

……

Question 23 (3 marks)

A certain type of Year 10 test has been used at a number of schools. The questions change but it is created in such a way that scores are normally distributed. At one school in a particular year, the test results had a mean of 52 and standard deviation of 8. Out of the 120 Year 10 students, 15 got a score of 80 or higher. Some teachers think some of those students must have cheated.

Explain why cheating may or may not have been likely with appropriate calculations. **3**

……

……

……

……

……

……

……

……

……

……

……

……

……

……

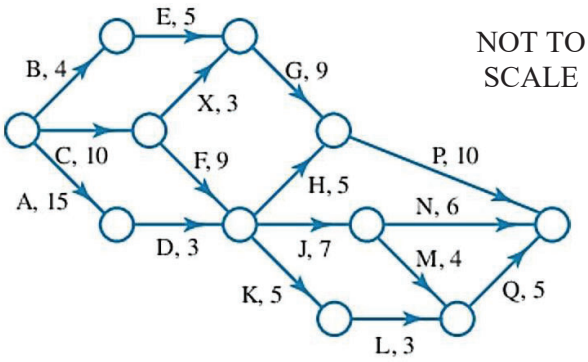
……

……

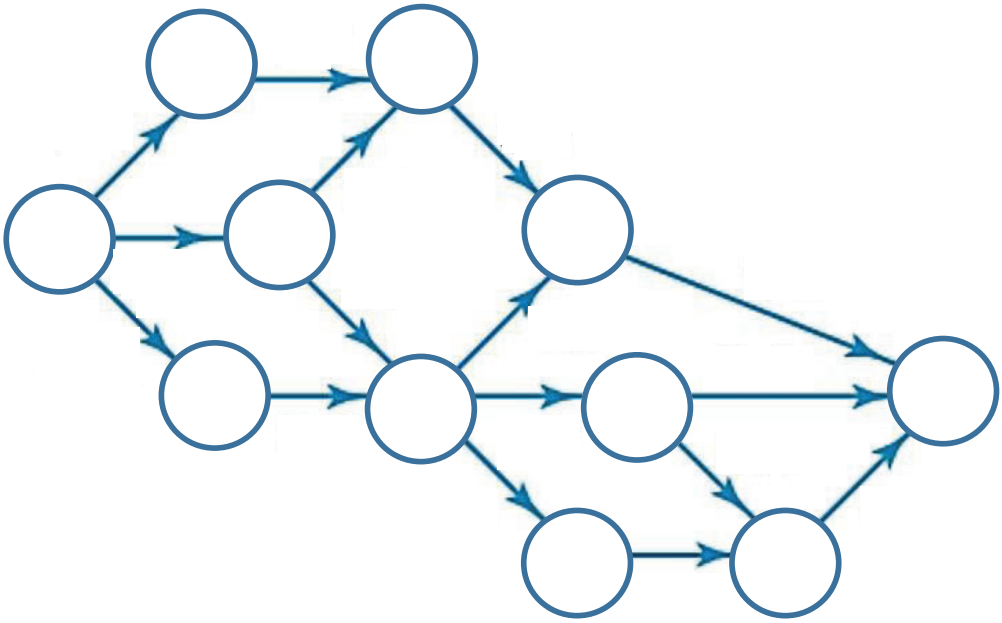
……

Question 24 (5 marks)

This network diagram shows the days needed to complete a project.



(a) Using the given information, complete a forward scan on the chart below to determine the earliest completion time. **2**



Earliest completion time = _____ days

(b) Complete a backward scan on the chart to determine the critical path. **2**

……

(c) Determine the float time for activity X. **1**

……

Question 25 (2 marks)

Amie and Georgie board a flight in Paris $(49°N, 2°E)$ at 3 pm on Wednesday.

Their flight lands in London $(52°N, 0°E)$ at 4.52 pm local time on Wednesday.

Calculate the total time taken for the flight. **2**

……

……

……

……

……

Question 26 (2 marks)

Fire-spotting towers are placed in a forest to monitor conditions. Tower *A* reports a fire on a bearing of 140°T. Tower *B* is 21.5 kilometres due east of the tower *A*, reports the fire on a bearing of 210°T.

How far is the closest tower away from the fire? **2**

……

……

……

……

……

……

……

……

Question 27 (2 marks)

Vivian is given some money from her grandparents and she wishes to invest this money to buy a car in 18 months' time when she gets her license. She chooses a savings account that pays 7.5% p.a. simple interest for 18 months . She has calculated she needs to earn $3600 in interest from her investment in order to buy her dream car.

How much did Vivian invest so that she will have enough money to purchase the car after 18 months? **2**

……

……..…….

……..……..

Question 28 (1 mark)

Hair colour in the general population is classified as the following:

red, brunette, brown, grey and blonde.

The probability of selecting a person with brunette, brown and grey is the same.

If the probability of selecting a person with red hair is 0.02, and the probability of selecting a person with blonde hair is 0.05, what is the probability of selecting a person with grey hair? **1**

……...……

……..…….

……..……..

……..……..

……..……..

……

BLANK PAGE

Section II Extra writing space

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.

Student Number: | | | | | | | | | |

2021 TRIAL HIGHER SCHOOL CERTIFICATE EXAMINATION

Mathematics Standard 2

Section II Answer Booklet 2

Booklet 2 — Attempt Questions 29–43 (46 marks)

Question 29 (3 marks)

Bill and Tom are 400 metres from the foot of a tower. From that point, they measure the angle of elevation to the top of the tower as 12°.

(a) Calculate, to the nearest metre, the height of the tower. **1**

……

……

……

(b) Bill leaves Tom and walks 100 metres towards the tower. He finds the angle of elevation has changed. Discuss how the angle of elevation has changed, giving the new angle correct to the nearest degree. **2**

……

……

……

……

……

……

Question 30 (3 marks)

This table gives the future value of an annuity with a contribution of $1 per period.

Period, n	Interest rate per period			
	1%	2%	3%	4%
1	1.0000	1.0000	1.0000	1.0000
2	2.0100	2.0200	2.0300	2.0400
3	3.0301	3.0604	3.0909	3.1216
4	4.0604	4.1216	4.1836	4.2465

A contribution of $5000 is invested at the end of each year at 4% p.a.

(a) What is the future value of the annuity after 3 years? **1**

……..…

(b) How much interest is earned? **2**

……

……

……...……

Question 31 (2 marks)

The mass of cartons of Farmer Brown's large size Free Range Eggs are found to be normally distributed with a mean of 800 grams and a standard deviation of 15 grams.

Charlotte has a carton of Farmer Brown's with a standardised mass, z =1.8.

What is the actual mass of the carton? **2**

……..……..……

……..……..……

……..……..……

Question 32 (3 marks)

Consider the following activity table.

Activity	Duration (Days)	Prerequisites
A	12	None
B	?	None
C	?	*A*
D	13	*A, B*
E	10	*D*
F	?	*C, E*
G	?	*D*

The critical path is *A*, *D*, *E*, *F*. The critical time for the project is 46 days.

(a) Draw an activity chart for this activity table. **2**

(b) Find the weight of activity *F*. **1**

……

……

Question 33 (2 marks)

The cost (C) of electricity to run a home is \$200 per month (m). For the same house, the cost of installing a solar system is \$4000, but the monthly cost of electricity decreases to \$150.

After installing the solar system, how long would it take to start saving money? **2**

……

……

……

……

……

……

Question 34 (2 marks)

The profits on an investment are divided between Sarah and Beatie in the ratio 22 : 18.

If the profits are \$235 000, calculate how much each person receives. **2**

……

……

……

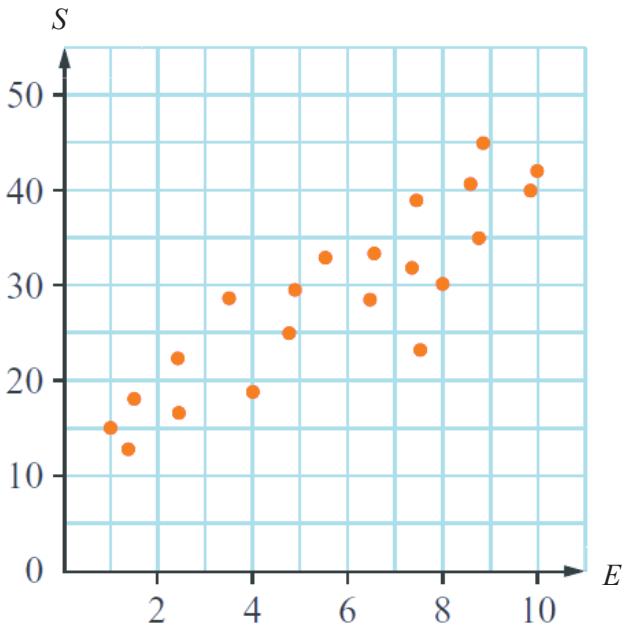
……

……

……

Question 35 (3 marks)

This scatterplot below compares the relationship between S and E.



(a) On the axes provided draw a line of best fit by eye. **1**

(b) Using your line of best fit from (a), find S when $E = 6$. **1**

……

……

(c) Give an example of an appropriate technique to find the value of E given $S = 100$. **1**

……

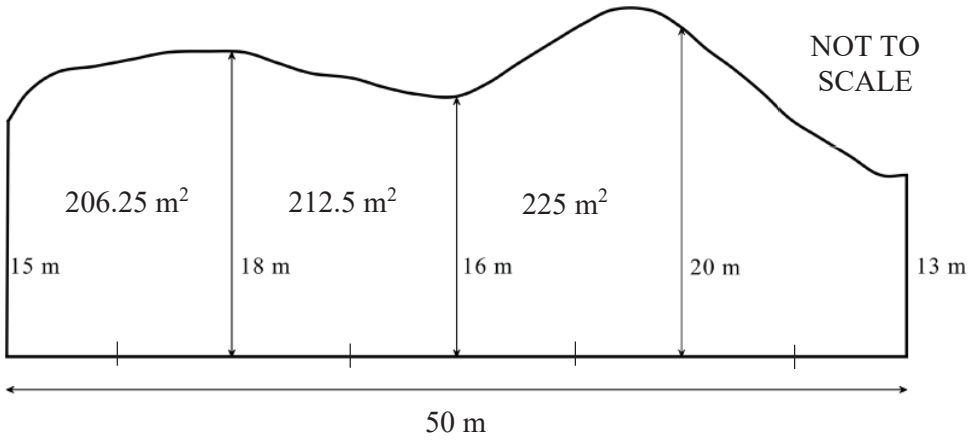
……

……

……

Question 36 (3 marks)

A landscaper is creating a new native garden. The trapezoidal rule was used to find the area of the first 3 sections. These areas are shown on the bird's eye view sketch of the garden below.



To complete the garden, soil to the depth of 15 cm, is to be added uniformly across the garden.
Find the total volume of soil needed for the garden beds. **3**

……

……

……

……

……

……

……

……

Question 37 (2 marks)

Tania buys an LCD television which is rated at 80 watts per hour when being used for viewing. Tania and her family use the TV for viewing for 8 hours a day on average and then turn it off at the power point for the remaining time.

(a) Show that the TV uses 0.64 kilowatt hours of energy on an average day. **1**

……

……

……

(b) Tania pays 32 cents per kWh for electricity. How much does it cost to the nearest dollar if Tania is to run her Television for an entire year (365 days) and continues to use it for an average of 8 hours a day? **1**

……

……

……

……

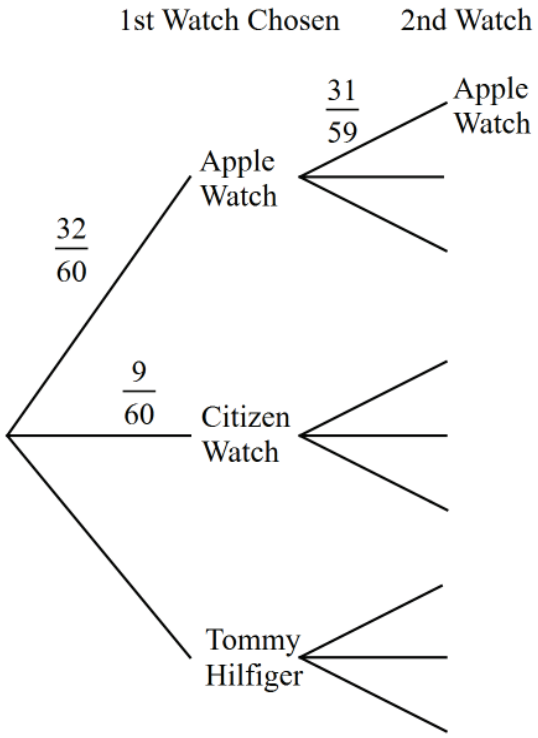
……

……

……

Question 38 (5 marks)

Before the Trial HSC examination, Mrs Selby collected any watches students wore on their wrist placing them in a box at the front of the hall. While the students completed the examination, she counted the watches and thought about the chance of randomly selecting two watches of the same type without replacing the first watch to the box.



(a) Complete the probability tree diagram to show the probabilities of each outcome. **2**

(b) What is the probability that Mrs Selby selects two Citizen watches? **1**

……..……..

(c) Calculate the probability that at least one of the two watches selected is an Apple Watch. **2**

……..……..

……..……..

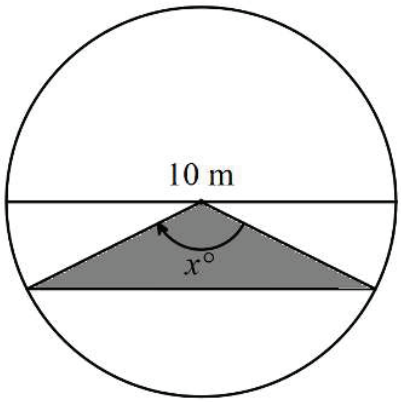
……..……..

……..……

……..……

Question 39 (3 marks)

Janine has a garden bed that is a perfect circle with a diameter of 10 metres. She wants to set up a concrete triangle inside the circle with one vertex at the centre of the circle, so that the arms make an **obtuse** angle at the centre. The rest of the garden bed will contain soil or grass.



NOT TO SCALE

The total area of the circular garden bed is 78.5 m^2.

The local council has told Janine that her planned concrete triangle must be 15% of the total garden bed. If Janine is to comply with this regulation, what is size of the angle $x°$ for the triangle? Give your answer to the nearest degree. **3**

……

……

……

……

……

……

……

……

……

Question 40 (4 marks)

Millie and Leah take out a personal loan of $15 000 to have a gap year after the HSC. They set up a spreadsheet to track the progress of their loan on a monthly basis.

Month	Principal at start of the month	Interest	Fee	Repayment	Balance at end of month
1	**A**	**B**	$10	$413	
2			$10	$413	**C**

Interest is 14.4% p.a. monthly reducible and there is a loan establishment fee of $390 plus a monthly account-keeping fee of $10 per month.

Given that their monthly repayment is $413, calculate values that would appear at **A, B** and **C.** **4**

……

……

……

……

……

……

……

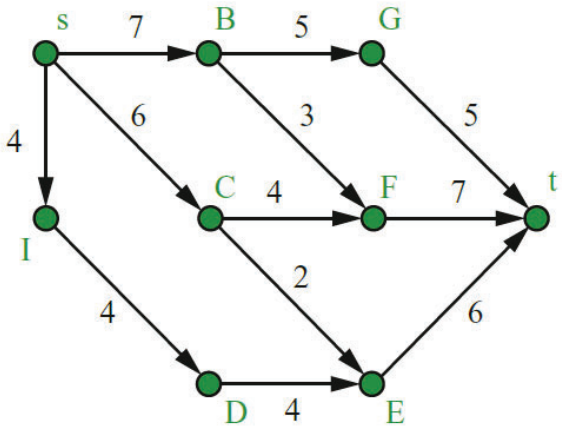
……

……

……

Question 41 (4 marks)

A shopping centre carpark (the sink) is connected to a main road (the source) by a series of one-way ramps. The direction and capacity of the ramps is shown below.



NOT TO SCALE

(a) On the diagram draw one cut that has a flow capacity of 18. **1**

(b) What is the maximum flow from the main road to the carpark? **1**

……

……

(c) What edges are NOT saturated? **1**

……...

……

(d) It is possible to increase the capacity of one edge so that every edge will become saturated. Name this edge and state its new value. **1**

……

……

Question 42 (4 marks)

Alison has a credit card with the following conditions:

- no interest free period.
- interest charged on the last day of the month.
- interest rate 19.8% per annum, compounding daily.
- interest is charged from the day of purchase until the end of the month inclusive.
- minimum payment is 5% of the closing balance.

Statement Period: 1 October to 31 October

Date	Details	Amount ($)
1 Oct	Opening balance	0
15 Oct	Car tyres	1488
15 Oct	Petrol	112
31 Oct	Interest charges	
31 Oct	Closing balance	

(a) Calculate the daily interest rate. **1**

……...

……

(b) Calculate the closing balance at the end of October. **2**

……...

……

……...

……

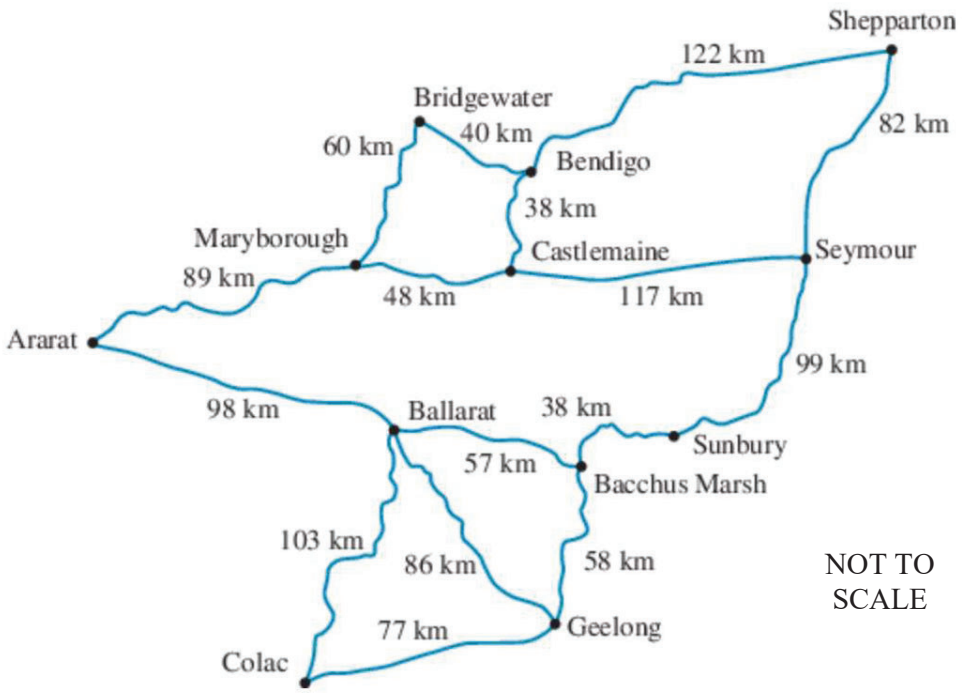
(c) Calculate the minimum payment due at the end of October. **1**

……...

……

Question 43 (3 marks)

The organisers of the 'Tour de Vic' bicycle race are using the following map to plan the event.



If they wish to start and finish in Geelong, name the shortest route and the length of the race that will pass through a total of nine other locations exactly once? **3**

……

……

……

……

……

……

……

……

End of Task

BLANK PAGE

Section II Extra writing space

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.