Student Number:
Teacher:

St George Girls High School

Mathematics Standard 2

2023 Trial HSC Examination

General Instructions

- Reading time – 10 minutes
- Working time – 2 hours and 30 minutes
- Write using black pen.
- Calculators approved by NESA may be used.
- A reference sheet is provided at the back of this booklet
- For questions in **Section I**, use the Multiple-Choice answer sheet provided at the back of this booklet.
  For questions in **Section II:**
  - Answer the question in the spaces provided.
  - **Show relevant mathematical reasoning** and/or calculations.
  - **Extra writing space** is provided at the back of this booklet on pages 32-34. If you use this space, clearly indicate which question you are answering.
  - Marks may not be awarded for incomplete or poorly presented solutions or where multiple solutions are provided.

Total marks: 100

Section I – 15 marks (pages 3 to 9)

- Attempt Questions 1-15
- Allow about 30 minutes for this section.

Section II – 85 marks (pages 10 to 31)

- Attempt Questions 16 – 38
- Allow about 2 hours for this section.

Section I

15 marks
Attempt Questions 1 – 15
Allow about 30 **minutes** for this section
Use the **multiple-choice answer sheet** for questions 1 – 15

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1. A magpie is 12 metres above ground level, in a tree. The magpie sees an earthworm on the ground at an angle of depression of 32°. How far must the magpie fly in a straight line to catch the earthworm, assuming the earthworm does not move?

(A) 6 m

(B) 10 m

(C) 14 m

(D) 23 m

2. What is the gradient of the linear relationship below?

$$3x - 5y + 30 = 0$$

(A) $\frac{3}{5}$

(B) $-\frac{3}{5}$

(C) -3

(D) (-5)

3. Riley invests \$1600 for 3 years at 8% p.a. compounding monthly.

How much compound interest will Riley receive?

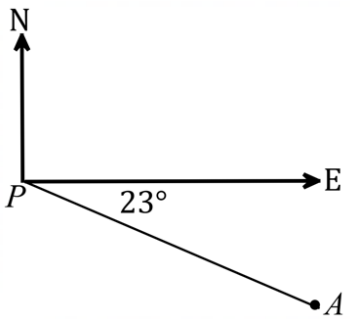
(A) \$384

(B) \$415.54

(C) \$432.38

(D) \$2032.38

4.



Not to scale

What is the true bearing of P from A?

(A) 337°

(B) 293°

(C) 113°

(D) 247°

5. What is 0.003052 expressed in standard form with two significant figures ?

(A) 2.06×10^{-2}

(B) 3.1×10^{-2}

(C) 3.1×10^{3}

(D) 3.1×10^{-3}

9. A rock is measured to be 8.25 m in length.

What is the percentage error in this measurement?

(A) $\pm 0.0006\%$

(B) $\pm 0.006\%$

(C) $\pm 0.06\%$

(D) $\pm 0.6\%$

10. If there is a positive association between two variables then:

(A) There is no relationship between the two variables.

(B) As one variable increases, the other decreases.

(C) As one variable increases, the other increases.

(D) The line of best fit comparing the variables has a negative gradient.

11. When an additional score is added to the data set below, the mean increases slightly, but the median remains the same.

Data Set: 1, 2, 3, 5, 7, 7, 7, 8

Which of the following could have been the additional score?

(A) 7

(B) 6

(C) 5

(D) 4

6. A pack of playing cards consists of four suits (Hearts, Diamonds, Clubs and Spades) containing thirteen cards each (Ace, 2 to 10, Jack, Queen and King). The pack of cards is shuffled and then a card is drawn at random. Given it is red, what is the probability that it is a queen or a diamond?

(A) $\frac{1}{2}$

(B) $\frac{7}{13}$

(C) $\frac{4}{13}$

(D) $\frac{17}{52}$

7. Which one of the following statistics is never negative?

(A) a median

(B) a mean

(C) a correlation coefficient

(D) an interquartile range

8. Cornflour is sold in four different sized packets. Which is the best buy?

(A) 1 kg for $4.00

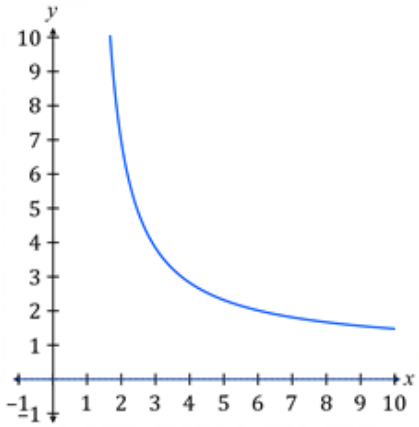
(B) 500 g for $1.95

(C) 100 g for $0.45

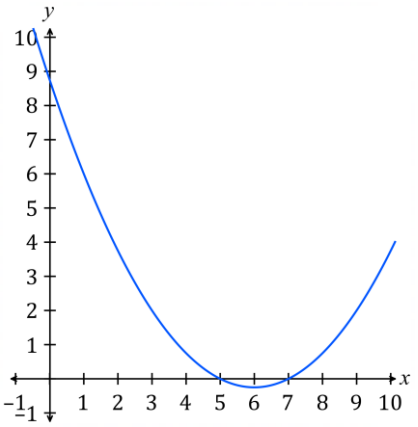
(D) 2 kg for $7.95

12. Which of the following graphs represents the equation $y = \frac{6}{x}$?

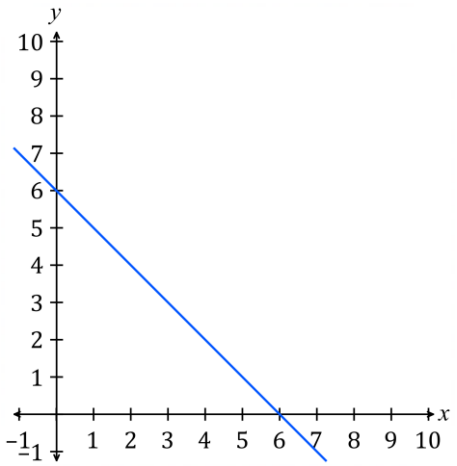
(A)



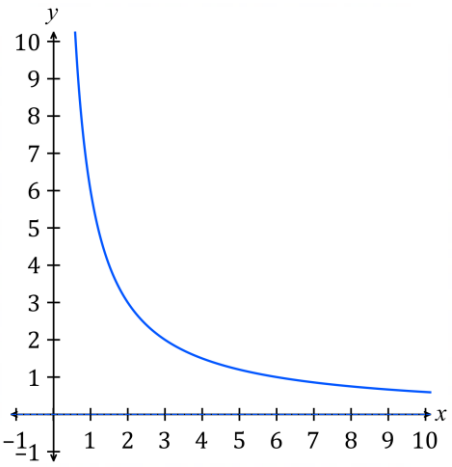
(B)



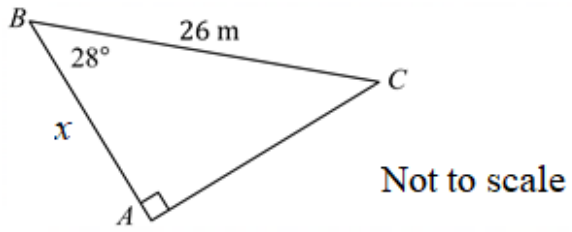
(C)



(D)



13. What is the value of x, correct to one decimal place, in the right-angled triangle shown above?



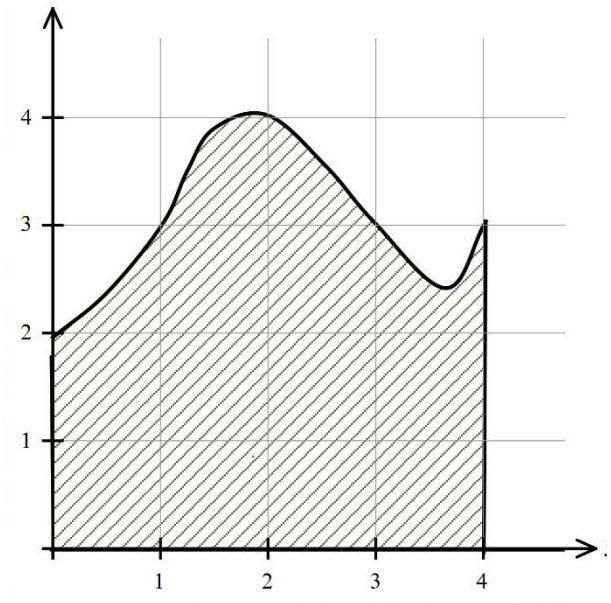
(A) 23.0 m

(B) 12.2 m

(C) 13.8 m

(D) 29.4 m

14. Using two applications of the Trapezoidal rule, Zoe estimated the area of the irregular shape shown below.



Which is the most accurate description of the correct area?

(A) More than 12 but less than 13 square units.

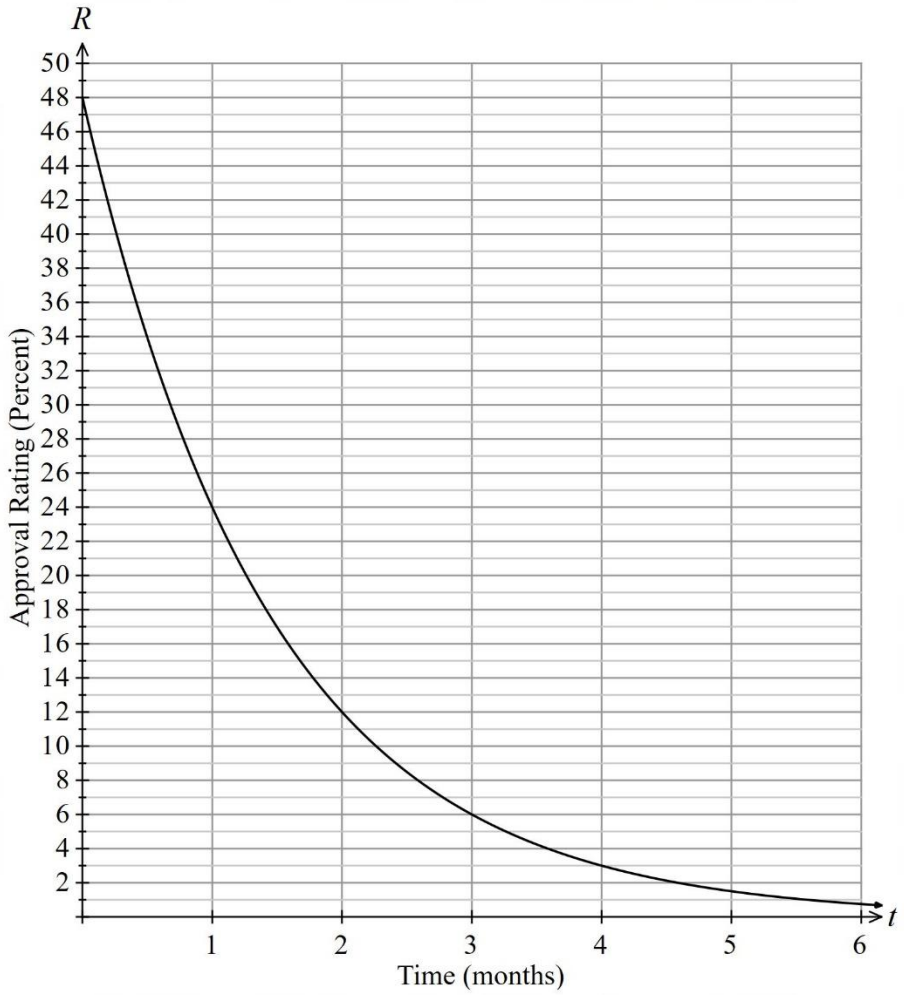
(B) More than 14 but less than 15 square units.

(C) More than 8 but less than 16 square units.

(D) More than 10 but less than 16 square units.

15. The approval rating of a politician falls dramatically after an election. The rate of decrease can be modelled by the equation: $R = a \times b^{-t}$, where R is the percentage approval rating, t is the time in months since the election and a and b are positive constants.

The graph below shows the relationship.



Which equation could be used to model the graph shown?

(A) $R = 2 \times 48^{-t}$

(B) $R = 24 \times 2^{-t}$

(C) $R = 48 \times 2^{-t}$

(D) $R = 48 \times 4^{-t}$

Section II

85 marks
Attempt questions 16 - 38
Allow about 2 hours for this section
Answer each question in the spaces provided.
Your responses should include relevant mathematical reasoning and/or calculations.

Questions 16 (2 marks) **Marks**

Songwriters are paid a royalty for each of their songs that are included on an album.

For each individual song on an album, they are paid 5. 5% of the albums retail price divided by the total number of songs on the album.

Emily wrote seven of the nine songs on her bands first album. The album retails for $15.99 as a download, CD or vinyl.

How much will she earn in song writing royalties, if the album sold 12 450 copies over all formats? **2**

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Questions 17 (2 marks) **Marks**

The formula used to calculate the height (H) of a structure is given below.

$$H = \frac{5p + k}{2} \cdot$$

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Find the value of p when $H = 12$ and $k = 9$.

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Questions 18 (2 marks)

Jessica measures the dimensions of a rectangle and finds that length is 11.5cm and width is 6.0 cm.

What could be the maximum possible length and width of the rectangle? Calculate the maximum possible area of the rectangle, to the nearest square cm? **2**

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Questions 19 (4 marks) **Marks**

On a business trip, Jacob plans to travel 1500 km on highways and 250 km in city traffic.

His car has estimated fuel consumption rates of 6.1 L/100 km on highways and 9.6 L/100 km in city traffic.

(a) Calculate the amount of fuel he could expect to use on the trip. **1**

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(b) If the average speed on highway is 90km/h and 35km/h in city traffic, how long, to the nearest hour, is Jacob expected to drive during the business trip? **2**

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(c) What is the average speed, in nearest km/h, of the car during the whole business trip? **1**

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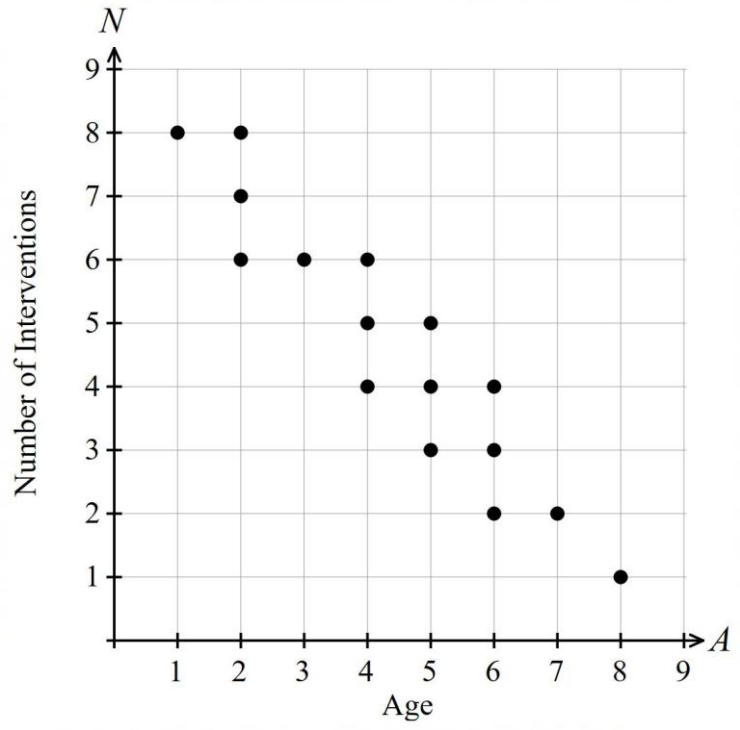
Questions 20 (4 marks) **Marks**

The scatterplot below compares the ages of rescued baby marsupials in months, with the number of veterinary interventions that were required.



(a) Draw the line of best fit on the above scatterplot. **1**

(b) What is the equation of the line of best fit that you have drawn? **2**

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(c) In your own words, and using appropriate mathematical terminologies, describe the correlation between the ages of rescued baby marsupials in months, with the number of veterinary interventions that were required. **1**

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Questions 21 (3 marks) **Marks**

An outdoor spa has a pump which is rated at 500 watts and a heater which is rated at 2.2 kW.

The table below shows the amount of usage that the pump and heater have at different times of the year.

Average Usage	Warmer Months (October – March) (182 Days)	Cooler Months (April to September) (183 Days)
Pump	Runs for 1.5 hours per day for spa usage and 1.8 hours per day filtration	Runs for 2.5 hours per day spa usage and 2.0 hours per day filtration
Heater	Heats for 5 min 12 times per day	Heats for 10 minutes 12 times per day

What is the total energy consumed for running the spa in one year? **3**

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Questions 22 (4 marks) **Marks**

Data was collected from 20 people on the number of messages they sent in the last month. The set of data collected is displayed in the stem and leaf plot.

Messages

2	0
3	0 2
4	0 0 0 2 5 5 6
5	0 0 0 1 2 2 2
6	0 2
7	0

Is 20 an outlier for this set of data? Justify your answer using suitable calculations. **4**

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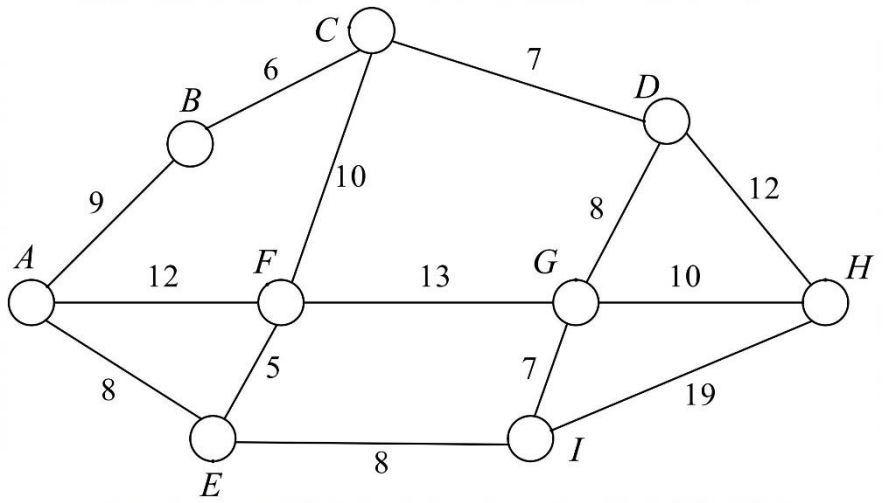
Questions 23 (5 marks) **Marks**

The network diagram below shows the location of nine towns and the connecting roads between them, along with the length of each road in kilometres.



(a) A minimum spanning tree is going to be used by the engineers to lay the cables to connect all towns by underground fibreoptic cable running on the side of the roads. Calculate the minimum length of the fibreoptic cable that needs to be laid to connect all the towns. Show all necessary working. **3**

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(b) Find the shortest path joining A and H and give its length.

Write the names of the vertices in order and calculate the length of the shortest path. **2**

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Questions 24 (5 marks) **Marks**

Tania bought a car for use with her small business for $30 000.

For taxation purposes she needed to work out a depreciated value of the car each year.

She initially decided to do this using the declining balance method at a rate of 20%.

(a) Show that the depreciation of the car in the first 3 years is nearly two times greater than the depreciation between the next 3 years (from the 4th year onwards), using the declining balance method. **3**

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(b) She decided to change to the straight-line method of depreciation, as calculations were easier, but wants the value after 6 years to be same as she calculated using the declining balance method.
By what amount should she depreciate the car each year, and what percentage is this of the cars new value? **2**

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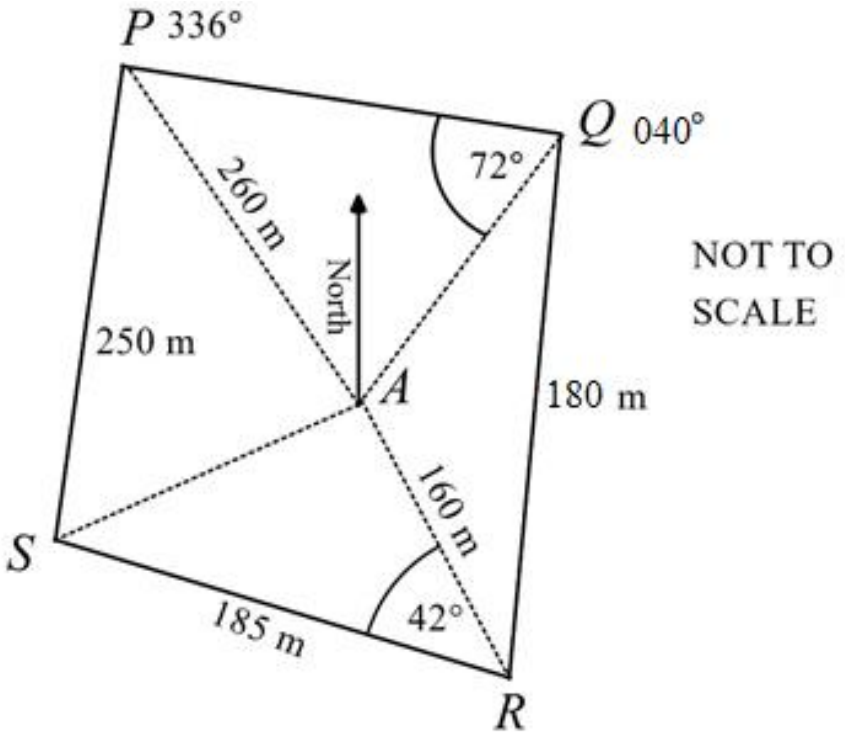
Questions 25 (4 marks)

Georgia is working as a surveyor and wishes to find the perimeter and area of a field *PQRS*.

The drawing below is completed from a survey centred at point *A*.



The bearing from *A* of *P* is 336° and of *Q* is 040°, and the distance *AP* is 260 m.

(a) What is the size of $\angle PAQ$? **1**

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(b) Calculate the length of PQ (to the nearest m). **1**

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(c) Calculate the area of the triangular region SAR, to the nearest square m. **2**

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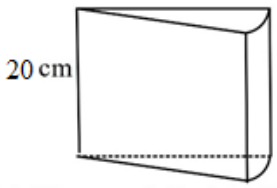
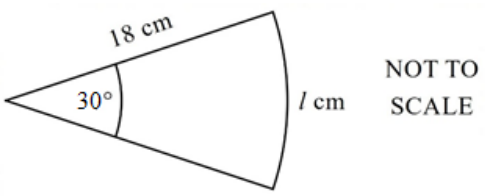
Questions 26 (2 marks) **Marks**

A cylindrical block of cheese is cut into nine identical wedges which are then wrapped for packaging for supermarkets.

One of the wedges is shown below.



The cross section of each wedge has the dimensions shown below



Calculate the value of l, and hence find the surface area of the wedge.

(a) Calculate the value of arc l, to the nearest cm. **1**

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(b) Find the area of the curved surface of the wedge, to the nearest square cm. **1**

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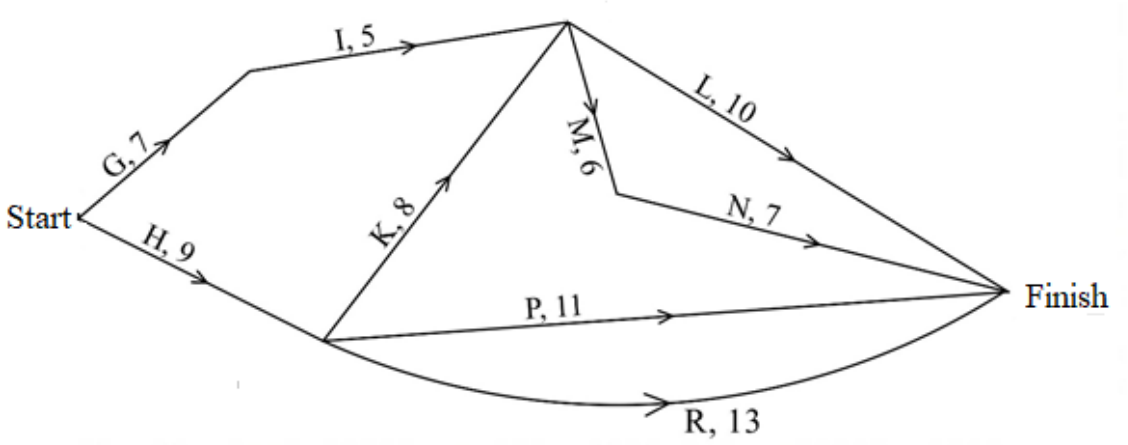
Questions 27 (5 marks) **Marks**

The network diagram shows the nine steps needed to complete a project and the time (in days) needed for each step.



(a) Complete forward and backward scans for each activity on the diagram above and find the minimum time needed to complete the project. **3**

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(b) What is the critical path for the project? **1**

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(c) What is the float time of activity I? **1**

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Questions 28 (3 marks) **Marks**

Sandy is on a holiday in Chicago (088^0W) and wants to stream a Matilda's World Cup match which is played in Sydney (151^0W) on Sunday 27th August and starts at 9:00 am.

Chicago is located at UTC –5 and Sydney at UTC +10.

Chicago is subject to daylight saving in July and August, but Sydney is not.

At what time and date in Chicago should Sandy start streaming the match? **3**

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Questions 29 (2 marks)

Olivia is a scientist who is concerned about the magpie population in her town. She collects 150 magpies and tags them. A couple of months later she collects 35 magpies and found 9 of them were tagged. What is her estimate of the magpie population, using the capture-recapture method? **2**

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Questions 30 (3 marks) **Marks**

The speed (v), in km/h, of a truck is inversely proportional to the weight (w kg) it carries. A truck carrying a weight of 2500 kg can travel at 80 km/h and the maximum speed limit for trucks on the highway is 110km/h.

What is maximum weight, to the nearest kg, that the truck can carry so that it is able to travel at the maximum allowed speed during the journey? **3**

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Questions 31 (2 marks)

A bank charges 19% per annum flat rate on the amount owing on a credit card, which has no interest free period.

What is the interest charged in three weeks on a balance of $1500? **2**

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Questions 32 (4 marks) **Marks**

An investment is modelled by the recurrence relation: $V_{n+1} = V_n(1 + r) + D$,

where V_{n+1} is the value of the investment after $(n + 1)$ payments,

V_n is the value of the investment after n payments,

r is the rate of interest, and

D is the payment per compounding period.

George makes an initial deposit of \$1500 on an investment at a rate of 5% p.a. compounding annually and an additional deposit of \$160 every year. How many years will it take for the George's investment to accumulate to more than \$2500 ? **4**

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Questions 33 (5 marks) **Marks**

The network matrix below shows the distance between each campsite in kilometres.

	C	D	E	F	G
C	–	3	–	3	6
D	3	–	4	–	–
E	–	4	–	2	5
F	3	–	2	–	7
G	6	–	5	7	–

(a) Represent the table shown above as a weighted network. **3**

(b) Using the weighted network or otherwise, find the minimum length of path in kilometres that need to be laid to connect all campsites. **2**

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Questions 34 (8 marks) **Marks**

The table below shows arm span and height of seven children in cm.

Arm span (**A**)	135	139	141	142	144	146	148
Height (**H**)	142	142	146	147	149	150	152

(a) Find Pearson's correlation coefficient. Answer correct to four decimal places. **2**

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(b) Find the value of the following, to 2 decimal places: **4**

(i) Mean of arm span = _____ cm

(ii) Mean of height = _____ cm

(iii) Standard deviation of arm span = _____

(iv) Standard deviation of height = _____

(c) $$m = r \times \frac{\text{Standard deviation of } y \text{ scores}}{\text{Standard deviation of } x \text{ scores}}$$

$$c = \text{mean of } y \text{ scores} - m \times \text{mean of } x \text{ scores}$$

Find the equation of the linear regression line using the formulae given above and information from part (b) **OR** by any other method. **2**

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Questions 35 (3 marks) **Marks**

A group of 250 people were surveyed and the results recorded in the table.

	Enjoys fishing	Does not enjoy fishing	Total
Female	65	20	85
Male	120	35	155
	185	55	240

(a) A person is selected at random from this group.

What is the probability, to the nearest percent, that the person selected is a female who does not enjoy fishing? **1**

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(b) If a male is selected at random from the group, what is the probability that he enjoys fishing? **2**

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Questions 36 (5 marks) **Marks**

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

Number of periods	***Interest rate per period as a decimal***				
	0.001	0.00125	0.0015	0.00175	0.002
300	259.0707	250.0398	241.4379	233.2418	226.3477
330	280.9577	270.2690	260.1353	250.5239	240.7211
360	302.1982	289.7541	278.0106	266.9228	258.9154
390	325.2961	309.6290	297.0981	283.6291	261.9432

(a) What would be the present value of a $1500 per month annuity at 2.4% per annum for 30 years, with interest compounding monthly? **2**

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(b) Thomas borrowed $900 000 to purchase a home, with interest charged at 1.8% per annum compounding monthly. He agrees to repay the loan by making equal monthly payments over a 25-year period.
What is the monthly payment? Answer correct to the nearest cent. **3**

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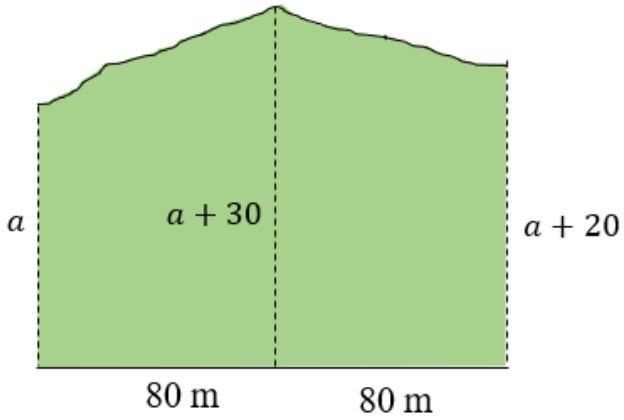
Questions 37 (4 marks) **Marks**

The diagram shows the land that Peter bought. All measurements are in metres

The area of this land, using two applications of the trapezoidal rule, is approximately 15000 m^2.



Find the value of a. **4**

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Questions 38 (4 marks) **Marks**

Rebecca weighs 65 kg. She ate 150 g of salmon and 50 g of pasta.

The labels on these products indicate that the salmon has 232 kJ of energy in a 60 g serve, and the pasta has 1050 kJ in a 100 g serve.

(a) Calculate the number of kJ in her pasta and salmon. **2**

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(b) The table below contains information indicating the number of kilocalories used each minute in a variety of exercises for different body masses.

Activity	56 kg	65 kg	74 kg
Volleyball	2.8	3.3	3.7
Dancing	7.5	9.1	10.0
Tennis	6.1	7.3	8.1

1 kilocalorie is equivalent to 4.184 kilojoules

How many minutes must Rebecca dance in order to use all the energy in the salmon can and the pasta? (Answer to the nearest minute.) **2**

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End of examination

Student Number: SOLUTIONS
Teacher:

St George Girls High School

Mathematics Standard 2

2023 Trial HSC Examination

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- Working time – 2 hours and 30 minutes
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Section I – 15 marks (pages 3 to 9)

- Attempt Questions 1-15
- Allow about 30 minutes for this section.

Section II – 85 marks (pages 10 to 31)

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Section I

15 marks
Attempt Questions 1 – 15
Allow about 30 **minutes** for this section
Use the **multiple-choice answer sheet** for questions 1 – 15

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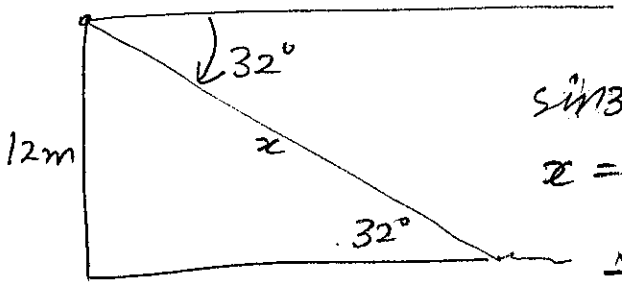
1. A magpie is 12 metres above ground level, in a tree. The magpie sees an earthworm on the ground at an angle of depression of 32°. How far must the magpie fly in a straight line to catch the earthworm, assuming the earthworm does not move?

(A) 6 m

(B) 10 m

(C) 14 m

(D) 23 m



$\sin 32° = \frac{12}{x}$

$x = \frac{12}{\sin 32°}$

$\approx 22.64...$

2. What is the gradient of the linear relationship below?

$$3x - 5y + 30 = 0$$

(A) $\frac{3}{5}$

(B) $-\frac{3}{5}$

(C) -3

(D) (-5)

$5y = 3x + 30$

$y = \frac{3}{5}x + 6$

3. Riley invests \$1600 for 3 years at 8% p.a. compounding monthly.

How much compound interest will Riley receive?

$A = 1600\left(1+\frac{8}{1200}\right)^{36}$

$= 2032.38$

-1600

$\$432.38$

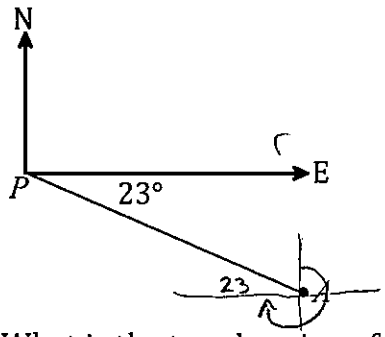
(A) \$384

(B) \$415.54

(C) \$432.38

(D) \$2032.38

4.



Not to scale

$270° + 23°$

$= 293°$

What is the true bearing of P from A?

(A) 337°

(B) 293°

(C) 113°

(D) 247°

5. What is 0.003052 expressed in standard form with two significant figures ?

3.1×10^{-3}

(A) 2.06×10^{-2}

(B) 3.1×10^{-2}

(C) 3.1×10^{3}

(D) 3.1×10^{-3}

6. A pack of playing cards consists of four suits (Hearts, Diamonds, Clubs and Spades) containing thirteen cards each (Ace, 2 to 10, Jack, Queen and King). The pack of cards is shuffled and then a card is drawn at random. Given it is red, what is the probability that it is a queen or a diamond?

(A) $\frac{1}{2}$

(B) $\frac{7}{13}$

(C) $\frac{4}{13}$

(D) $\frac{17}{52}$

Red Queen = 2
Diamond = 13
} 15 − 1 (diamond Queen counted twice)

$= \frac{14}{26}$

$= \frac{7}{13}$

7. Which one of the following statistics is never negative?

(A) a median

(B) a mean

(C) a correlation coefficient

(D) an interquartile range

8. Cornflour is sold in four different sized packets. Which is the best buy?

(A) 1 kg for \$4.00

(B) 500 g for \$1.95 — \$3.90/kg.

(C) 100 g for \$0.45 — \$4.50/kg

(D) 2 kg for \$7.95 — \$3.975/kg

9. A rock is measured to be 8.25 m in length.

What is the percentage error in this measurement?

(A) ±0.0006%

(B) ±0.006%

(C) ±0.06%

(D) ±0.6%

$\frac{0.005}{8.25} \times 100$

$= 0.0606\ldots$

10. If there is a positive association between two variables then:

(A) There is no relationship between the two variables.

(B) As one variable increases, the other decreases.

(C) As one variable increases, the other increases.

(D) The line of best fit comparing the variables has a negative gradient.

11. When an additional score is added to the data set below, the mean increases slightly, but the median remains the same.

Data Set: 1, 2, 3, 5, 7, 7, 7, 8

Which of the following could have been the additional score?

(A) 7

(B) 6

(C) 5

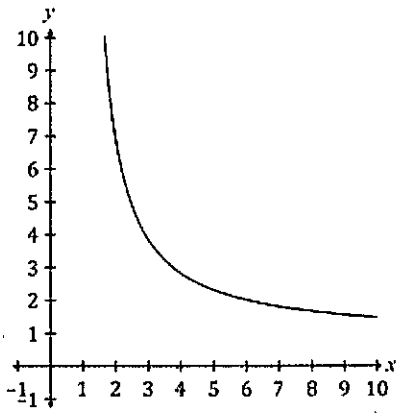
(D) 4

$\frac{40}{4} = 5$

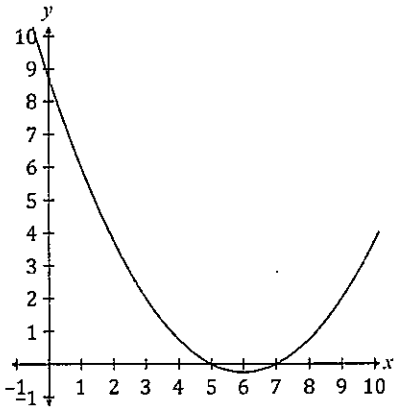
median = 6

12. Which of the following graphs represents the equation $y = \frac{6}{x}$?

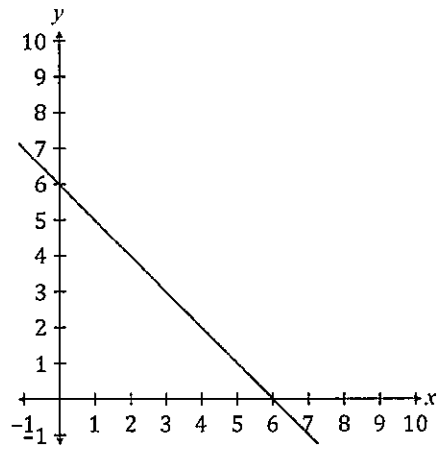
(A)



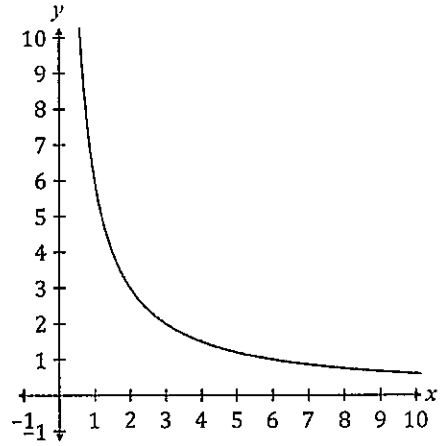
(B)



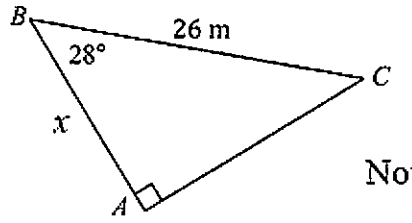
(C)



(D)



13. What is the value of x, correct to one decimal place, in the right-angled triangle shown above?



Not to scale

$\cos 28^\circ = \frac{x}{26}$

$x = 26 \times \cos 28^\circ$

$= 22.96\ldots$

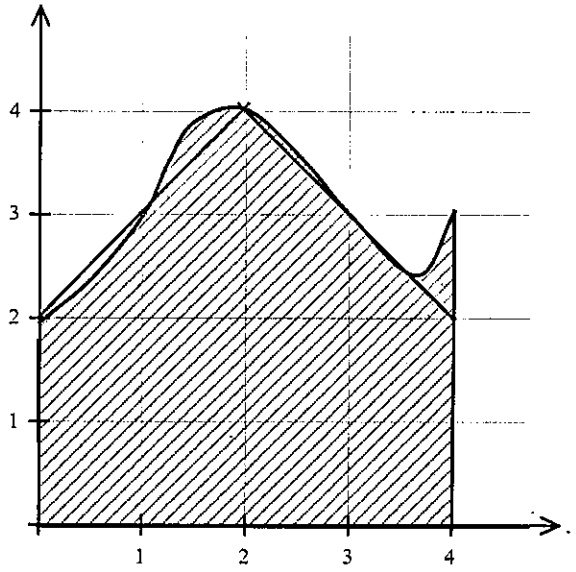
(A) 23.0 m

(B) 12.2 m

(C) 13.8 m

(D) 29.4 m

14. Using two applications of the Trapezoidal rule, Zoe estimated the area of the irregular shape shown below.



Which is the most accurate description of the correct area?

(A) More than 12 but less than 13 square units.

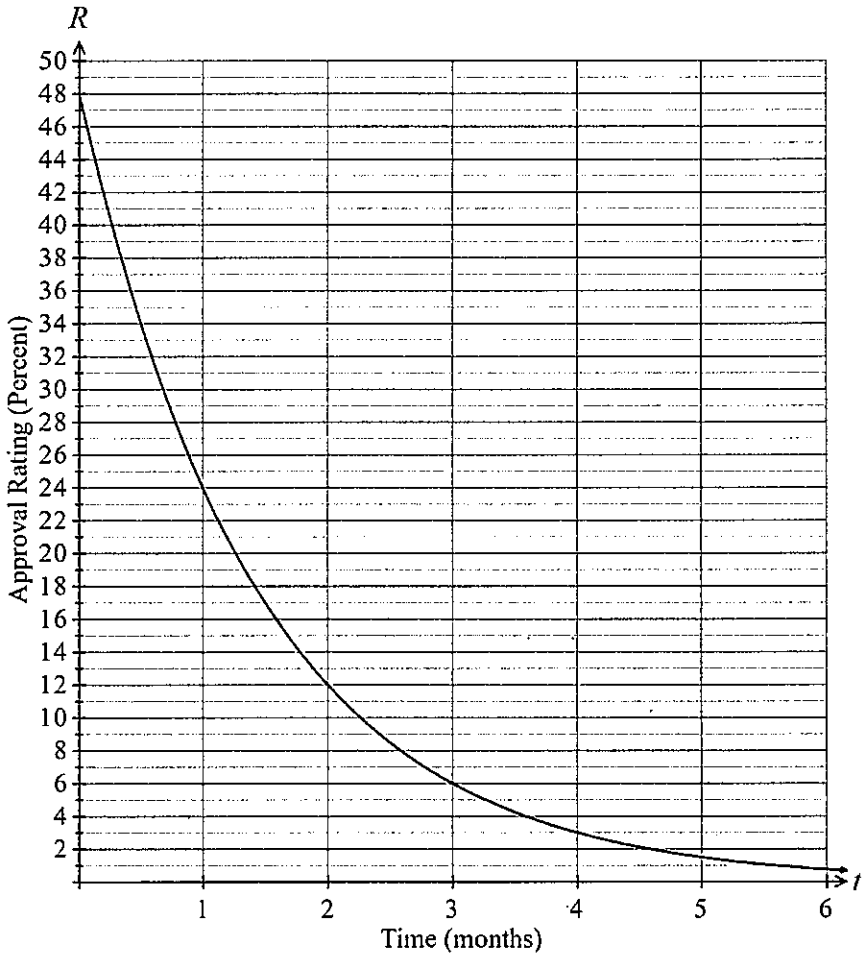
(B) More than 14 but less than 15 square units.

(C) More than 8 but less than 16 square units.

(D) More than 10 but less than 16 square units.

15. The approval rating of a politician falls dramatically after an election. The rate of decrease can be modelled by the equation: $R = a \times b^{-t}$, where R is the percentage approval rating, t is the time in months since the election and a and b are positive constants.

The graph below shows the relationship.



Which equation could be used to model the graph shown?

(A) $R = 2 \times 48^{-t}$

(B) $R = 24 \times 2^{-t}$

(C) $R = 48 \times 2^{-t}$

(D) $R = 48 \times 4^{-t}$

Section II

85 marks
Attempt questions 16 - 38
Allow about 2 hours for this section
Answer each question in the spaces provided.
Your responses should include relevant mathematical reasoning and/or calculations.

Questions 16 (2 marks) **Marks**

Songwriters are paid a royalty for each of their songs that are included on an album.

For each individual song on an album, they are paid 5. 5% of the albums retail price divided by the total number of songs on the album.

Emily wrote seven of the nine songs on her bands first album. The album retails for $15.99 as a download, CD or vinyl.

How much will she earn in song writing royalties, if the album sold 12 450 copies over all formats? **2**

$I = \frac{0.055 \times 7 \times 15.99 \times 12450}{9}$

$= \$8516.01$

Questions 17 (2 marks) **Marks**

The formula used to calculate the height (H) of a structure is given below.

$$H = \frac{5p + k}{2}.$$

2

Find the value of p when $H = 12$ and $k = 9$.

$12 = \frac{5 \times p + 9}{2}$

$24 = 5p + 9$

$5p = 15$

$p = 3$

Questions 18 (2 marks)

Jessica measures the dimensions of a rectangle and finds that length is 11.5cm and width is 6.0 cm.

What could be the maximum possible length and width of the rectangle? Calculate the maximum possible area of the rectangle, to the nearest square cm? 2

Maximum length = 11.55 cm

Maximum width = 6.05 cm

Maximum possible area = 11.55×6.05 cm^2

$= 69.8775\ cm^2$

$\doteq 70\ cm^2$

Questions 19 (4 marks) **Marks**

On a business trip, Jacob plans to travel 1500 km on highways and 250 km in city traffic.

His car has estimated fuel consumption rates of 6.1 L/100 km on highways and 9.6 L/100 km in city traffic.

(a) Calculate the amount of fuel he could expect to use on the trip. **1**

15 lots of 6.1 L + 2.5 lots of 9.6 L

$= 91.5\text{ L} + 24$

$= 115.5\text{ L}$

(b) If the average speed on highway is 90km/h and 35km/h in city traffic, how long, to the nearest hour, is Jacob expected to drive during the business trip? **2**

$\text{Total time} = \frac{1500}{90} + \frac{250}{35}$

$= 16\frac{2}{3} + 7\frac{1}{7}$

$= \frac{500}{21}$ hrs or 23 hrs 48 min 34.29 sec

$\doteqdot 24$ hrs

(c) What is the average speed, in nearest km/h, of the car during the whole business trip? **1**

$\text{Average speed} = \frac{1750}{\frac{500}{21}}$

$= \frac{147}{2}$ km/hr

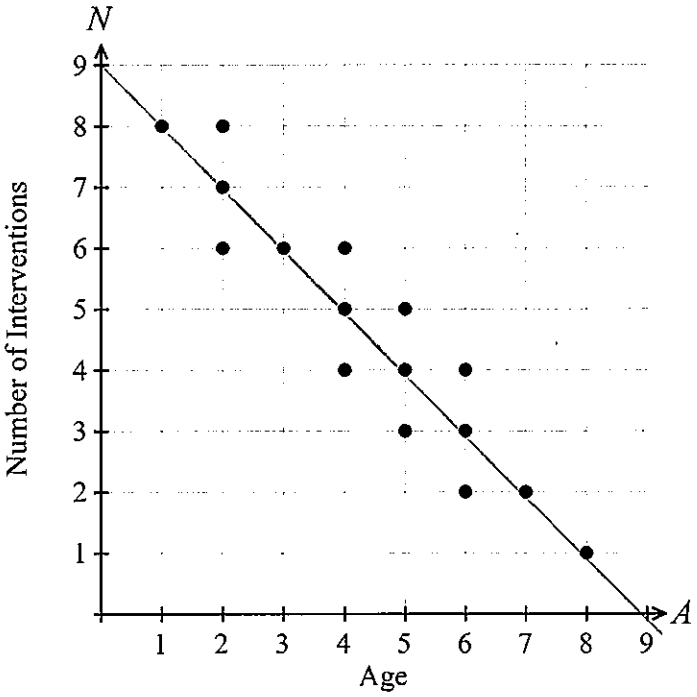
$= 73.5$ km/hr $\doteqdot 74$ km/hr

or $\frac{1750}{24}$ (using answer from (b))

$\doteqdot 72.91$ or 73 km/hr

Questions 20 (4 marks) **Marks**

The scatterplot below compares the ages of rescued baby marsupials in months, with the number of veterinary interventions that were required.



(a) Draw the line of best fit on the above scatterplot. **1**

(b) What is the equation of the line of best fit that you have drawn? **2**

$y = -x + 9$

(c) In your own words, and using appropriate mathematical terminologies, describe the correlation between the ages of rescued baby marsupials in months, with the number of veterinary interventions that were required. **1**

There is a strong negative correlation between the age of the rescued baby marsupials & the number of interventions required.

Questions 21 (3 marks) **Marks**

An outdoor spa has a pump which is rated at 500 watts and a heater which is rated at 2.2 kW.

The table below shows the amount of usage that the pump and heater have at different times of the year.

Average Usage	Warmer Months (October – March) (182 Days)	Cooler Months (April to September) (183 Days)
Pump	Runs for 1.5 hours per day for spa usage and 1.8 hours per day filtration	Runs for 2.5 hours per day spa usage and 2.0 hours per day filtration
Heater	Heats for 5 min 12 times per day	Heats for 10 minutes 12 times per day

What is the total energy consumed for running the spa in one year? **3**

$182\left[(1.5+1.8)\times 0.5 + \left(1\times 2.2\right)\right] + 183\left[4.5\times 0.5 + \frac{60\text{min}}{1\text{hr}}\times 2.2\right]$

$= 182\left[1.65 + 2.2\right] + 183\left[2.25 + 4.4\right]$

$= 182\left[3.85\right] + 183\left[6.65\right]$

$= 700.7 + 1216.95$ kWh

$= 1917.65$ kWh.

Questions 22 (4 marks) **Marks**

Data was collected from 20 people on the number of messages they sent in the last month. The set of data collected is displayed in the stem and leaf plot.

Median is between 46 & 50

$M = 48$

$Q_1 = 40$

$Q_3 = 52$

$IQR = 12$

Messages

2	0
3	0 2
4	0 0 0 2 5 5 6
5	0 0 0 1 2 2 2
6	0 2
7	0

4

Is 20 an outlier for this set of data? Justify your answer using suitable calculations.

Outlier $< Q_1 - 1.5 \times IQR$

$20 < 40 - 1.5 \times 12$

$20 < 40 - 18$

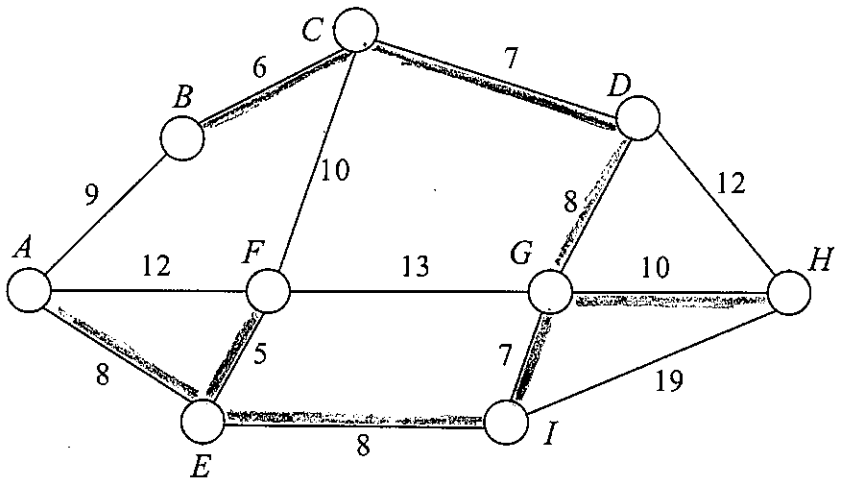
$20 < 22$

True

$\therefore$ 20 is an outlier.

Questions 23 (5 marks) **Marks**

The network diagram below shows the location of nine towns and the connecting roads between them, along with the length of each road in kilometres.



(a) A minimum spanning tree is going to be used by the engineers to lay the cables to connect all towns by underground fibreoptic cable running on the side of the roads. Calculate the minimum length of the fibreoptic cable that needs to be laid to connect all the towns. Show all necessary working. **3**

5+6+7+7+8+8+8+10

= 59 km

(b) Find the shortest path joining A and H and give its length.

Write the names of the vertices in order and calculate the length of the shortest path. **2**

AEIGH

= 8+8+7+10

= 33 km

Questions 24 (5 marks) **Marks**

Tania bought a car for use with her small business for $30 000.

For taxation purposes she needed to work out a depreciated value of the car each year.

She initially decided to do this using the declining balance method at a rate of 20%.

(a) Show that the depreciation of the car in the first 3 years is nearly two times greater than the depreciation between the next 3 years (from the 4th year onwards), using the declining balance method. **3**

Depreciation in 1st 3 years $= 30000 - 30000(0.8)^3$
$= \$14640$
Depreciation in 6 yrs $= 30000 - 30000(0.8)^6$
$= \$22135.68$.
Depreciation in last 3 years $= 7495.68$
Since 14640 is nearly twice the value of $\$7495.68$
$\therefore$ the statement is true.

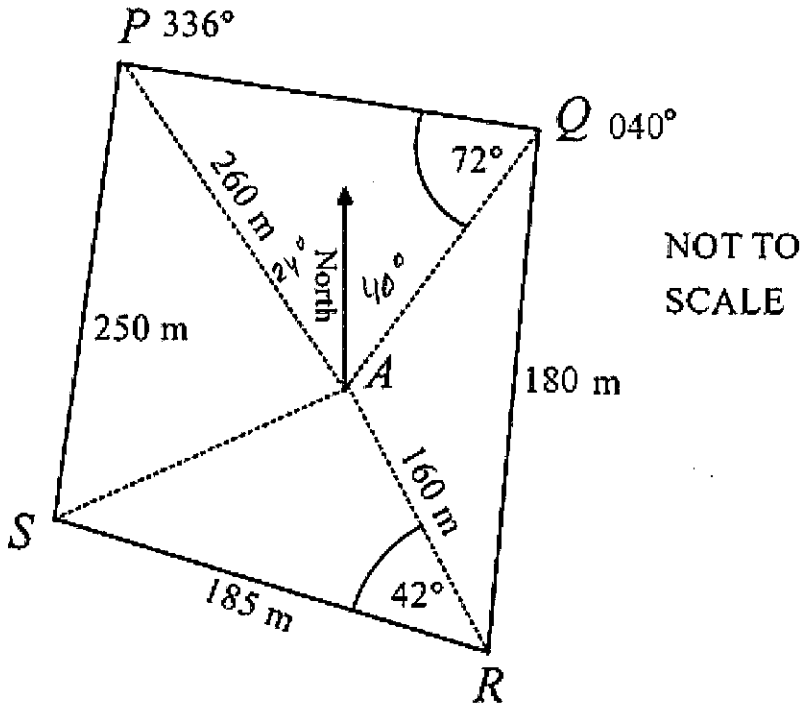
(b) She decided to change to the straight-line method of depreciation, as calculations were easier, but wants the value after 6 years to be same as she calculated using the declining balance method.
By what amount should she depreciate the car each year, and what percentage is this of the cars new value? **2**

Total depreciation in 6 years $= 22135.68$.
$\therefore$ each year depreciation by straight line method $= 22135.68 \div 6$
$= \$3689.28$ p/a.
$\frac{3689.28 \times 100}{30000}$
$= 12.30\%$ (nearest to 2 d/p)

Questions 25 (4 marks)

Georgia is working as a surveyor and wishes to find the perimeter and area of a field *PQRS*.

The drawing below is completed from a survey centred at point *A*.



The bearing from *A* of *P* is 336° and of *Q* is 040°, and the distance *AP* is 260 m.

(a) What is the size of $\angle PAQ$? **1**

$\angle PAQ = (360° - 336°) + 040°$

$= 24° + 40°$

$= 64°$

(b) Calculate the length of PQ (to the nearest m). **1**

$\frac{240}{\sin 72^\circ} = \frac{PQ}{\sin 64^\circ}$

$PQ = \frac{\sin 64^\circ \times 240}{\sin 72^\circ}$

$= 245.71\ldots \text{ m}$

$\doteq 246 \text{ m}$

(c) Calculate the area of the triangular region SAR, to the nearest square m. **2**

$\text{Area of } SAR = \frac{1}{2} \times 185 \times 160 \times \sin 42^\circ$

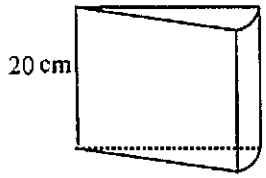
$= 9903.13\ldots \text{ m}^2$

$\doteq 9903 \text{ m}^2$

Questions 26 (2 marks) **Marks**

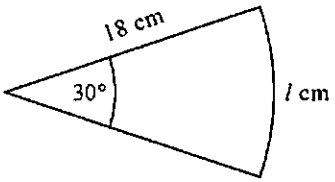
A cylindrical block of cheese is cut into nine identical wedges which are then wrapped for packaging for supermarkets.

One of the wedges is shown below.



NOT TO SCALE

The cross section of each wedge has the dimensions shown below



NOT TO SCALE

Calculate the value of l, and hence find the surface area of the wedge.

(a) Calculate the value of arc l, to the nearest cm. **1**

$l = 2\pi r \times \frac{30}{360} \quad r = 6$

$= \pi \times 18$

$= 3\pi$ cm or 9.42 cm $\doteq$ 9 cm.

(b) Find the area of the curved surface of the wedge, to the nearest square cm. **1**

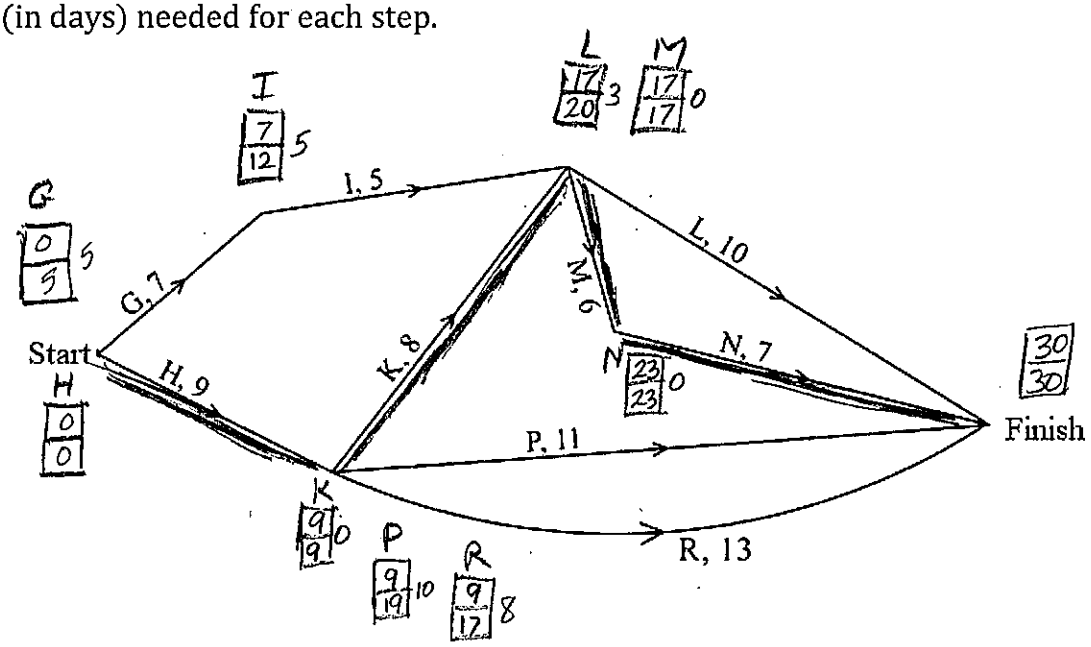
Curved surface Area $= 9.42477.. \times 20$ cm

$\doteq 188.5$ cm^2

$\doteq 189$ cm^2

Questions 27 (5 marks) **Marks**

The network diagram shows the nine steps needed to complete a project and the time (in days) needed for each step.



(a) Complete forward and backward scans for each activity on the diagram above and find the minimum time needed to complete the project. **3**

30 days

(b) What is the critical path for the project? **1**

H K M N

(c) What is the float time of activity I? **1**

5 days

Questions 28 (3 marks) **Marks**

Sandy is on a holiday in Chicago (088^0W) and wants to stream a Matilda's World Cup match which is played in Sydney (151^0W) on Sunday 27th August and starts at 9:00 am.

Chicago is located at UTC –5 and Sydney at UTC +10.

Chicago is subject to daylight saving in July and August, but Sydney is not.

At what time and date in Chicago should Sandy start streaming the match? **3**

Chicago is 15 hrs + 1 hr day light saving. behind
∴ Chicago is 16 hrs behind sydney. or Sydney is 14 hrs ahead.
9 + 5 = 14 hrs
∴ 5 hrs before Midnight of the previous day.
∴ 7pm of saturday 26th Aug = the time for starting the streaming.

Questions 29 (2 marks)

Olivia is a scientist who is concerned about the magpie population in her town. She collects 150 magpies and tags them. A couple of months later she collects 35 magpies and found 9 of them were tagged. What is her estimate of the magpie population, using the capture-recapture method? **2**

9 out of 35 magpies are tagged.
↳ .1
↳ 150 out of (?) magpies are tagged

$$\frac{35 \times 150}{9}$$

$= 583.\dot{3}$ or 584 magpies.
(always round up for life)

Questions 30 (3 marks) **Marks**

The speed (v), in km/h, of a truck is inversely proportional to the weight (w kg) it carries. A truck carrying a weight of 2500 kg can travel at 80 km/h and the maximum speed limit for trucks on the highway is 110km/h.

What is maximum weight, to the nearest kg, that the truck can carry so that it is able to travel at the maximum allowed speed during the journey? **3**

$S = \frac{k}{w}$

$80 = \frac{k}{2500}$

$\therefore k = 200000$

$\therefore S = \frac{200000}{w}$

$110 = \frac{200000}{w}$

$w = \frac{200000}{110}$

Maximum weight that the truck can carry is 1818 kg (always round down in such question)

Questions 31 (2 marks)

A bank charges 19% per annum flat rate on the amount owing on a credit card, which has no interest free period.

What is the interest charged in three weeks on a balance of $1500? **2**

$I = 1500 \times \frac{0.19}{365} \times 21$

$= \$16.40$

Questions 32 (4 marks) **Marks**

An investment is modelled by the recurrence relation: $V_{n+1} = V_n(1 + r) + D$,

where V_{n+1} is the value of the investment after $(n + 1)$ payments,

V_n is the value of the investment after n payments,

r is the rate of interest, and

D is the payment per compounding period.

George makes an initial deposit of \$1500 on an investment at a rate of 5% p.a. compounding annually and an additional deposit of \$160 every year. How many years will it take for the George's investment to accumulate to more than \$2500 ? **4**

V_1 $1500(1.05) + 160 = 1735$

V_2 $1735(1.05) + 160 = 1981.75$

V_3 $1981.75(1.05) + 160 = 2240.84$

$2240.84(1.05 + 160) = 2512.88$

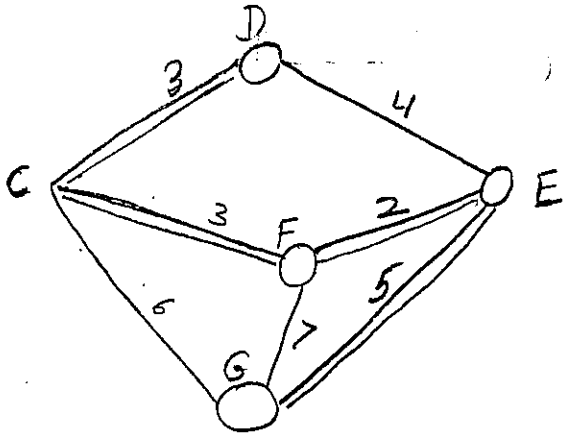
∴ it will take 4 years to accumulate more than \$2500

Questions 33 (5 marks) **Marks**

The network matrix below shows the distance between each campsite in kilometres.

	C	D	E	F	G
C	–	3	–	3	6
D	3	–	4	–	–
E	–	4	–	2	5
F	3	–	2	–	7
G	6	–	5	7	–

(a) Represent the table shown above as a weighted network. **3**



(b) Using the weighted network or otherwise, find the minimum length of path in kilometres that need to be laid to connect all campsites. **2**

Minimum length (using spanning tree)
$= 3+3+2+5$
$= 13$ km

Questions 34 (8 marks) **Marks**

The table below shows arm span and height of seven children in cm.

Arm span (A)	135	139	141	142	144	146	148
Height (H)	142	142	146	147	149	150	152

(a) Find Pearson's correlation coefficient. Answer correct to four decimal places. **2**

$r = 0.96158$

(b) Find the value of the following, to 2 decimal places: **4**

(i) Mean of arm span = 142.14 cm

(ii) Mean of height = 146.86 cm

(iii) Standard deviation of arm span = 4.05

(iv) Standard deviation of height = 3.56

(c) $$m = r \times \frac{\text{Standard deviation of } y \text{ scores}}{\text{Standard deviation of } x \text{ scores}}$$

$$c = \text{mean of } y \text{ scores} - m \times \text{mean of } x \text{ scores}$$

Find the equation of the linear regression line using the formulae given above and information from part (b) **OR** by any other method. **2**

$m = 0.96158 \times \frac{3.56}{4.05}$

$= 0.8452\ldots$ or 0.85 (2 d.p)

$c = 146.86 - 0.8452 \times 142.14$

$= 26.72$ (2 dp)

∴ equation of linear regression line:

$H = 0.85A + 26.72$

OR

$A = 26.64$ & $B = 0.85$ (2dp)

Using $A + Bx$

$H = 26.64 + 0.85A$

Questions 35 (3 marks) **Marks**

A group of 250 people were surveyed and the results recorded in the table.

	Enjoys fishing	Does not enjoy fishing	Total
Female	65	20	85
Male	120	35	155
	185	55	240

(a) A person is selected at random from this group.

What is the probability, to the nearest percent, that the person selected is a female who does not enjoy fishing? **1**

$P(F \text{ not enjoying fishing}) = \frac{20}{240}$

$= \frac{1}{12}$

(b) If a male is selected at random from the group, what is the probability that he enjoys fishing? **2**

$P(EF|M) = \frac{120}{155}$

$= \frac{24}{31}$

or

0.7742... or 77.42% (2dp)

Questions 36 (5 marks) **Marks**

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

Number of periods	*Interest rate per period as a decimal*				
	0.001	0.00125	0.0015	0.00175	0.002
300	259.0707	250.0398	241.4379	233.2418	226.3477
330	280.9577	270.2690	260.1353	250.5239	240.7211
360	302.1982	289.7541	278.0106	266.9228	258.9154
390	325.2961	309.6290	297.0981	283.6291	261.9432

(a) What would be the present value of a $1500 per month annuity at 2.4% per annum for 30 years, with interest compounding monthly? **2**

P.V. interest factor = 258.9154

∴ $1 annuity ⇒ $258.9154 lump sum deposit today.

×1500

∴ $1500 ⇒ = 258.9154 × 1500

= $388373.10

(b) Thomas borrowed $900 000 to purchase a home, with interest charged at 1.8% per annum compounding monthly. He agrees to repay the loan by making equal monthly payments over a 25-year period.
What is the monthly payment? Answer correct to the nearest cent. **3**

$241.4379 is PV interest factor.

∴ $241.4371 is equivalent to $1 annuity.

÷ 1

× 900000

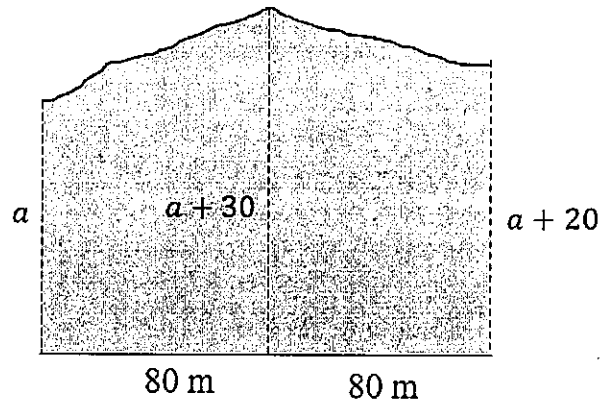
∴ $900000 is equivalent to $\frac{1 \times 900000}{241.4371}$

= $3727.67 p/m

Questions 37 (4 marks) **Marks**

The diagram shows the land that Peter bought. All measurements are in metres

The area of this land, using two applications of the trapezoidal rule, is approximately 15000 m^2.



Find the value of a. **4**

$A = \frac{(a+a+30)\times 80}{2} + \frac{(a+30+a+20)80}{2}$

$15000 = 40(2a+30) + 40(2a+50)$

$15000 = 80a + 1200 + 80a + 2000$

$160a = 15000 - 3200$

$a = \frac{11800}{160}$

$a = 73.75$

Questions 38 (4 marks) **Marks**

Rebecca weighs 65 kg. She ate 150 g of salmon and 50 g of pasta.

The labels on these products indicate that the salmon has 232 kJ of energy in a 60 g serve, and the pasta has 1050 kJ in a 100 g serve.

(a) Calculate the number of kJ in her pasta and salmon. **2**

150 ÷ 60 = 2½ serves of Salmon

50 ÷ 100g = ½ serve of pasta

∴ total energy = $2\frac{1}{2} \times 232 + \frac{1}{2} \times 1050$ kJ

= 580 + 525

= 1105 kJ

(b) The table below contains information indicating the number of kilocalories used each minute in a variety of exercises for different body masses.

Activity	56 kg	65 kg	74 kg
Volleyball	2.8	3.3	3.7
Dancing	7.5	9.1	10.0
Tennis	6.1	7.3	8.1

1 kilocalorie is equivalent to 4.184 kilojoules

How many minutes must Rebecca dance in order to use all the energy in the salmon can and the pasta? (Answer to the nearest minute.) **2**

1105 kJ = 1105 ÷ 4.184

= 264.10 kilo calories

9.1 Cal burnt in 1 min

∴ 264.10 Cal burnt in $\frac{1 \times 264.10}{9.1}$

= 29.022

Rebecca will need to run about 30 min to burn all the calories.

End of examination

Student Number: Solutions	Teacher:

Section I
Mathematics Standard 2

2023 HSC Trial Examination

Multiple-choice Answer Sheet - Questions 1 – 15

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.	A	○	B	○	C	○	D	●	𝍸 III	(8)		
2.	A	●	B	○	C	○	D	○	IIII	(4)		
3.	A	○	B	○	C	●	D	○	𝍸 II	(7)		
4.	A	○	B	●	C	○	D	○	𝍸	(5)	6	
5.	A	○	B	○	C	○	D	●	I	(1)		
6.	A	○	B	●	C	○	D	○	𝍸 I	(6)		
7.	A	○	B	○	C	○	D	●	𝍸	(5)		
8.	A	○	B	●	C	○	D	○	/	(1)		
9.	A	○	B	○	C	●	D	○	𝍸 III	(8)		
10.	A	○	B	○	C	●	D	○	I	(1)	2	
11.	A	○	B	●	C	○	D	○	𝍸	(5)		
12.	A	○	B	○	C	○	D	●	II	(2)	3	
13.	A	●	B	○	C	○	D	○	0	(0)		
14.	A	●	B	○	C	○	D	○	III	(4)		
15.	A	○	B	○	C	●	D	○	II	(2)	3	

50
65