SYDNEY GRAMMAR SCHOOL

CANDIDATE NUMBER

2021 Trial HSC Examination

Form VI Mathematics Standard 2

Friday 20th August 2021
8:40am

General Instructions

- Reading time — 10 minutes
- Working time — 2 hours 30 minutes
- Attempt all questions.
- Write using black pen.
- Calculators approved by NESA may be used.
- A loose reference sheet is provided separate to this paper.

Total Marks: 100

Section I (15 marks) Questions 1 – 15

- This section is multiple-choice. Each question is worth 1 mark.
- Record your answers on the provided answer sheet.
- Write your candidate number on each page.

Section II (85 marks) Questions 16 – 37

- Because of the nature of this task, greater weight than normal will be placed on working. Clear reasoning and full calculations are required.
- Answer the questions in this paper in the spaces provided.
- Write your candidate number on each page.

Your sheets must be ORDERED
then scanned and uploaded in a
SINGLE PDF FILE
to the Schoology page of your mathematics class

Checklist

- Reference sheet
- Multiple-choice answer sheet
- Candidature: 10 pupils

Writer: AEA

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 following is the solution to the equation below?

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

(A) $x = 2$

(B) $x = 3$

(C) $x = 6$

(D) $x = 8$

2. Which is the correct expansion of $3x - \left(x^2 - x\right) + 2x\left(x - 2\right)$?

(A) $x^2 - 2x$

(B) $-3x^3 + 5x^2 - 4x$

(C) $x^2 + 8x$

(D) x^2

3. The probability of an event occurring is 0·25. What is the probability that this event will NOT occur?

(A) 0·25

(B) 0·65

(C) 0·75

(D) 85%

4. Seb runs a 2400-watt heater for 6 hours each day. Electricity is charged at 26.3 c/kWh. What is the cost of running the heater for 8 days?

(A) \$3.03

(B) \$30.30

(C) \$302.98

(D) \$3029.76

5. The surface area of a spherical basketball is $2828\,\text{cm}^2$. What is the approximate radius of the basketball?

   (A) 15 cm

   (B) 27 cm

   (C) 47 cm

   (D) 225 cm

6. Max travels from Prague (50°N, 15°E) to the Congo (4°S, 15°E). What is the approximate distance from Prague to the Congo, given the radius of Earth is 6400 km?

   (A) 2569 km

   (B) 3016 km

   (C) 5138 km

   (D) 6032 km

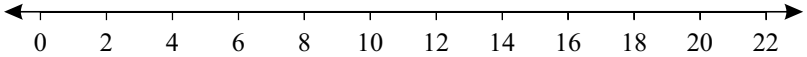
7. Which of the data sets displayed in the following box-and-whisker plots has the largest interquartile range?

   (A)

   (B)

   (C)

   (D)



8. Ari borrowed $3340 for a period of 11 months. In total he repaid $4022. The simple interest rate per annum is:

   (A) $\dfrac{4022 - 3340}{3340 \times 11} \times 100\%$

   (B) $\dfrac{3340}{4022 \times 11} \times 100\%$

   (C) $\dfrac{12 \times (4022 - 3340)}{3340 \times 11} \times 100\%$

   (D) $\dfrac{12 \times 3340}{4022 \times 11} \times 100\%$

9. Amy has 1000 shares with a market value of \$3.00 per share. The shares paid a dividend of 15 c per share. What was the dividend yield for these shares?

   (A) 5%

   (B) 15%

   (C) 20%

   (D) 67%

10. Rob works in a factory that produces bags of cashews. The weights of the bags are normally distributed, with a mean of 900 g and a standard deviation of 50 g. What is the best approximation for the percentage of bags that weigh more than 1000 g?

    (A) 0%

    (B) 2·5%

    (C) 5%

    (D) 16%

11. James is driving along the highway at 80 km/h. He notices a kangaroo on the road and applies the brakes 1·8 seconds after noticing the kangaroo. His braking distance is 35 metres. What is his approximate total stopping distance?

    (A) 40 m

    (B) 75 m

    (C) 92 m

    (D) 180 m

12. The formula below is used to estimate the blood alcohol content (BAC) for males.

$$BAC_{Male} = \frac{10N - 7{\cdot}5H}{6{\cdot}8M}$$

    where N is the number of standard drinks consumed
    H is the number of hours drinking
    M is the person's weight in kilograms

    Mitch weighs 72 kilograms. He starts drinking at 6:30pm and stops at 9:00pm. During this time, he consumes 3 standard drinks. What is his approximate BAC at 9:00pm?

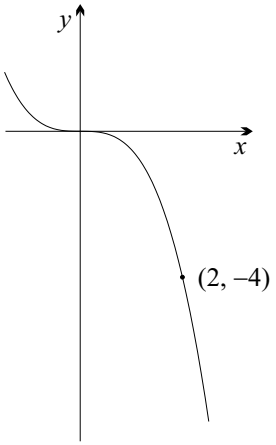
    (A) 0·005

    (B) 0·007

    (C) 0·023

    (D) 0·026

13.



The diagram above shows the graph of $y = kx^3$. What is the value of k?

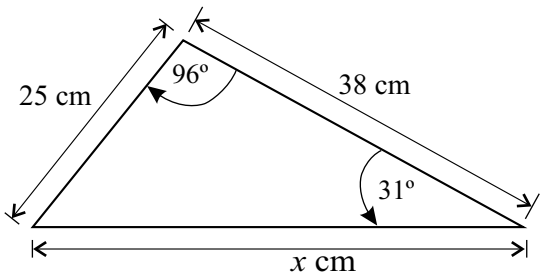
(A) -2

(B) $-\dfrac{1}{2}$

(C) $\dfrac{1}{2}$

(D) 2

14.



Which of the following would correctly calculate x in the above triangle?

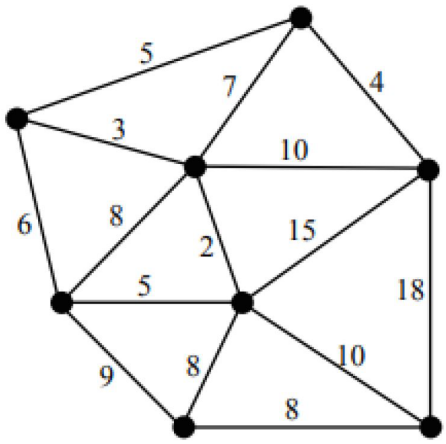
(A) $x = \dfrac{\sin 96^\circ}{25 \times \sin 31^\circ}$

(B) $x = \dfrac{25 \times \sin 31^\circ}{\sin 96^\circ}$

(C) $x = 25^2 + 38^2 - 2 \times 25 \times 38 \times \cos 96^\circ$

(D) $x = \sqrt{25^2 + 38^2 - 2 \times 25 \times 38 \times \cos 96^\circ}$

15.



What is the length of the minimum spanning tree in the network above?

(A) 30

(B) 31

(C) 35

(D) 39

End of Section I

The paper continues in the next section

Section II

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

QUESTION SIXTEEN (2 marks) **Marks**

Conor has a taxable income of \$97 000. Using the tax table below, calculate the tax payable on this amount. [2]

Taxable income	Tax on this income
0 – \$18 200	Nil
\$18 201 – \$37 000	19c for each \$1 over \$18 200
\$37 001 – \$90 000	\$3 572 plus 32·5c for each \$1 over \$37 000
\$90 001 – \$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

.....

.....

.....

.....

.....

.....

QUESTION SEVENTEEN (2 marks) **Marks**

Solve $\dfrac{16-x}{2} = 3x + 1$. [2]

.....

.....

.....

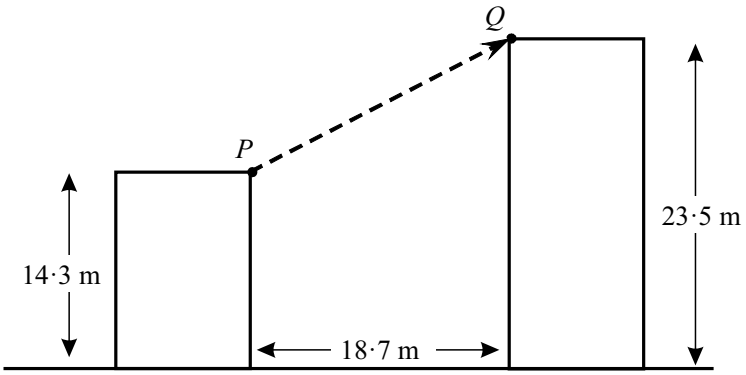
.....

.....

.....

QUESTION EIGHTEEN (2 marks) **Marks**

The following diagram shows two people standing on the edges of the roofs of two buildings. Peter is standing at P and Quentin is standing at Q. 2



Find the angle of elevation from Peter to Quentin. Give your answer to the nearest degree.

.....

.....

.....

.....

.....

.....

QUESTION NINETEEN (2 marks) **Marks**

Three water pipes are used to fill a swimming pool. The first pipe alone takes 8 hours to fill the pool, the second pipe alone takes 12 hours to fill the pool and the third pipe alone takes 24 hours to fill the pool. If all three pipes are opened at the same time, how long will it take to fill the pool? 2

.....

.....

.....

.....

.....

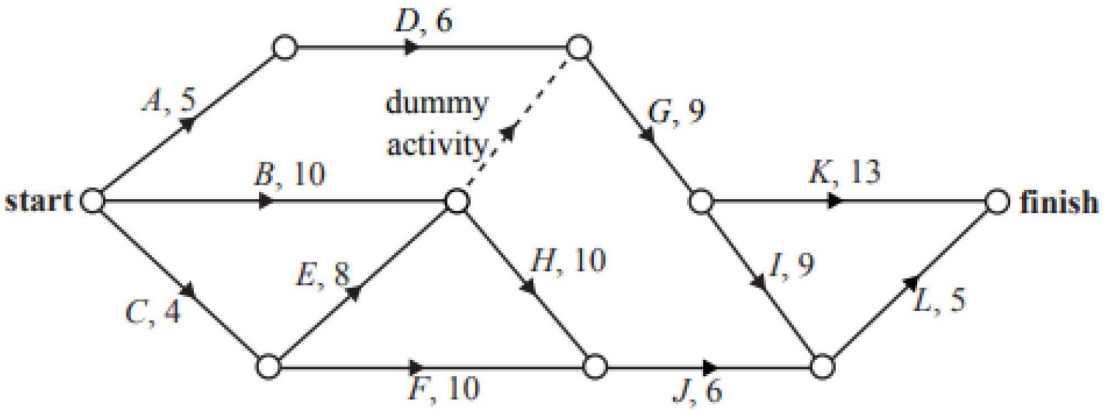
.....

.....

.....

QUESTION TWENTY (2 marks) **Marks**

2



A project has 12 activities. The network above gives the time (in hours) that it takes to complete each activity. Find the critical path for this project.

.....

.....

.....

.....

.....

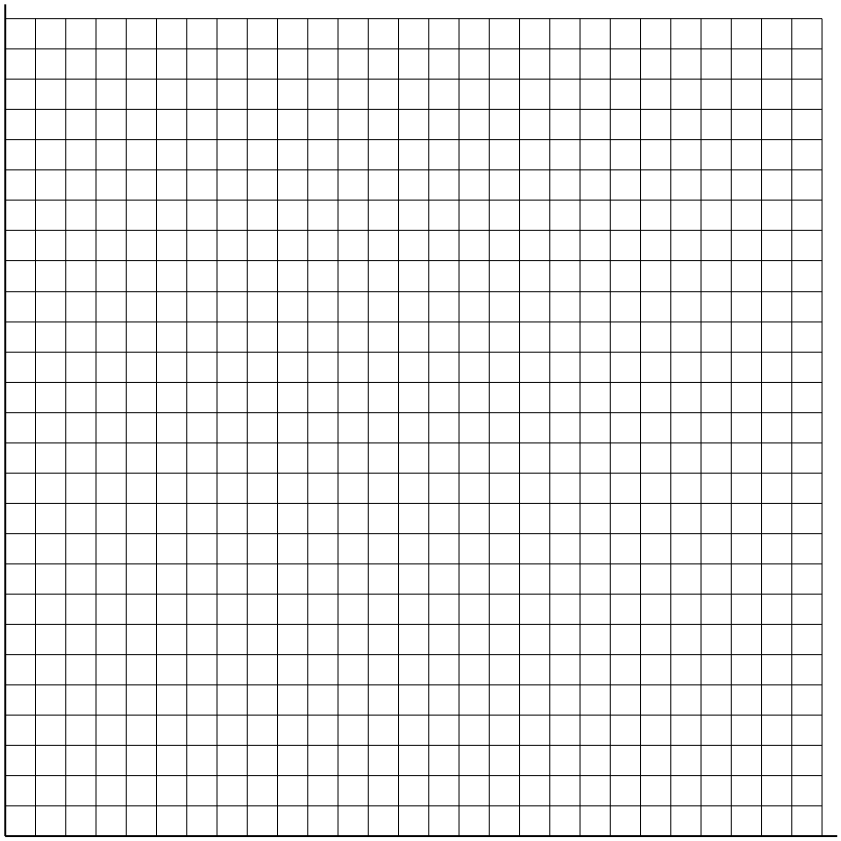
.....

QUESTION TWENTY-ONE (4 marks) **Marks**

The table below shows the height (cm) and mass (kg) of ten Olympic "Plunge for Distance" competitors.

Height (h)	157	158	160	163	164	168	173	180	184	190
Mass (m)	65	60	64	70	72	82	85	93	97	101

(a) Construct a scatter plot using the table above. 1



(b) On your scatter plot above, draw a line of best fit. 1

(c) Find the equation of your line of best fit. 2

.....

.....

.....

.....

QUESTION TWENTY-TWO (2 marks) **Marks**

Henry buys a new car which costs \$40 000 and depreciates at the rate of 12·5% p.a.

(a) Use the declining balance formula for depreciation to write an equation to find the value of the car (V) after n years. 1

.....

.....

(b) After how many years will the value of the car first fall below \$15 000? 1

.....

.....

.....

QUESTION TWENTY-THREE (6 marks) **Marks**

On level ground, A is 35 km due east of O, the bearing of B from O is 030°T and the distance of B from O is 50 km.

(a) Draw a clearly labelled diagram of the situation in the space below. 1

(b) Find the distance from A to B. Give your answer to the nearest kilometre. 2

.....

.....

.....

.....

.....

(c) Find the bearing of B from A. Give your answer to the nearest degree. 3

.....

.....

.....

.....

.....

QUESTION TWENTY-FOUR (3 marks) **Marks**

The weekly rental on a house is shared by a number of people. The rent per person R varies inversely with the number of people living in the house N. If there are four people living in the house, each person pays \$72.

(a) If $R = \dfrac{k}{N}$, where k is the constant of variation, find the value of k. 1

.....

.....

.....

(b) How much would each person pay if there were 3 people living in the house? 1

.....

.....

.....

(c) How many people would need to live in the house if each person were only to pay \$48 per week? 1

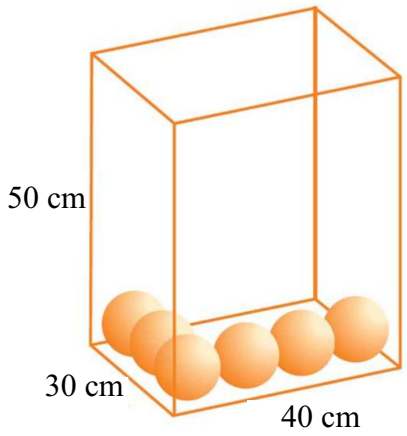
.....

.....

.....

QUESTION TWENTY-FIVE (4 marks) **Marks**

Spherical balls of diameter 10 cm are stacked inside a box as shown below. The box is in the shape of a rectangular prism such that 12 balls will fit snuggly in each layer.



(a) If the balls are stacked in the same manner as in the bottom layer until the box is full, calculate the volume of the space occupied by the balls. Give your answer correct to the nearest cubic centimetre. 2

.....

.....

.....

.....

.....

.....

.....

.....

(b) What percentage of the box is empty space? Give your answer correct to the nearest percentage. 2

.....

.....

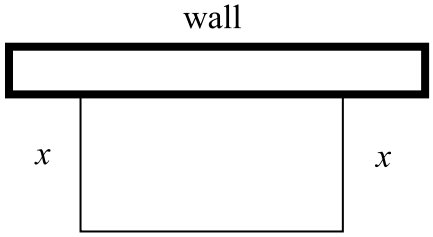
.....

.....

.....

QUESTION TWENTY-SIX (8 marks) **Marks**

Archie is planning to make a rectangular puppy pen using an existing wall as one side. He uses 24 metres of fencing.



(a) If the width of the puppy pen is x metres, find an expression for the length in terms of x and show that the area of the pen is given by 2

$$A = 24x - 2x^2.$$

.....

.....

.....

.....

.....

.....

.....

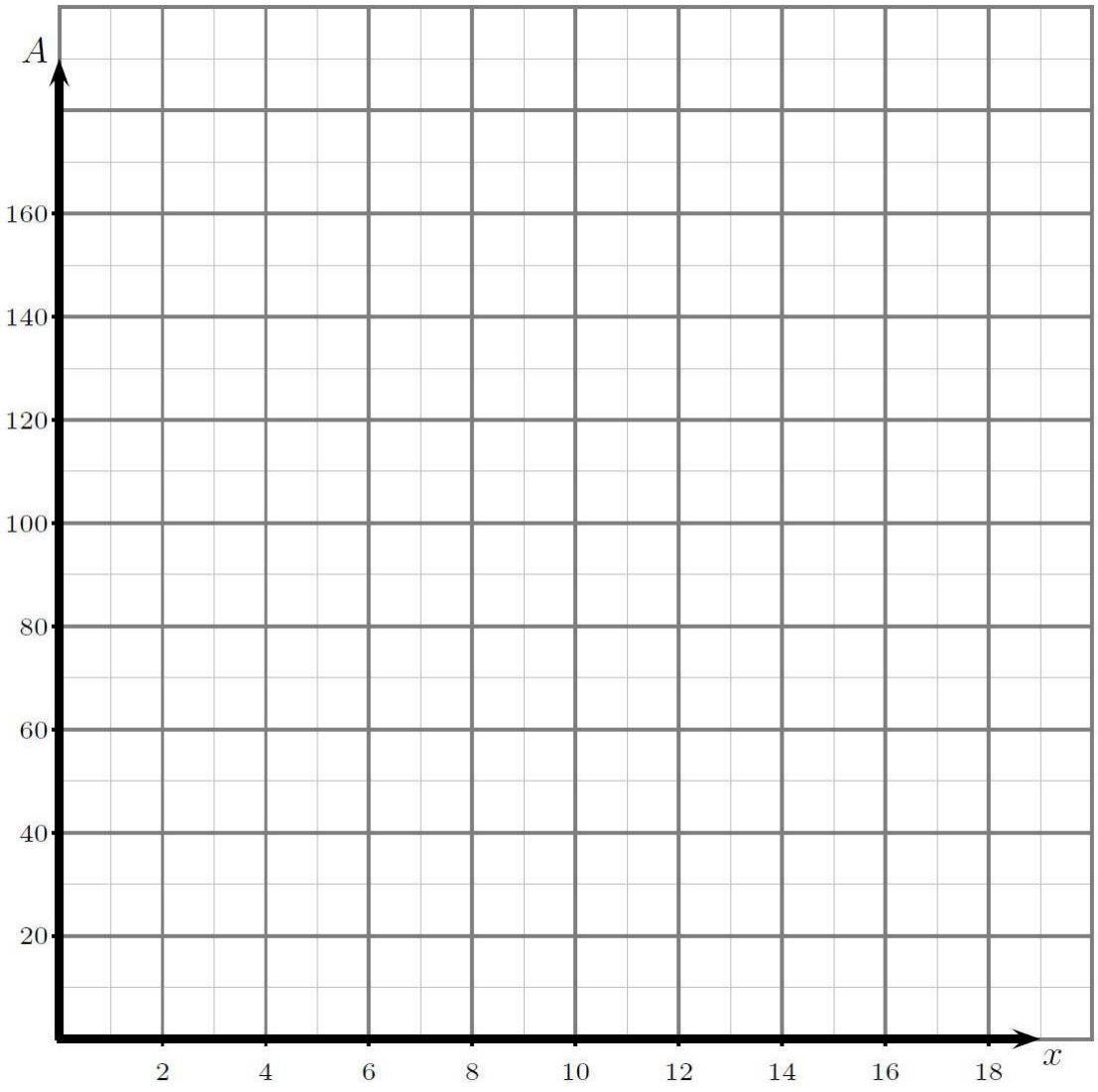
.....

(b) Complete the table below. 2

x	0	2	4	6	8	10	12
A							

QUESTION TWENTY-SIX (Continued)

(c) Draw the graph of the equation. 2



(d) What are the dimensions that give the maximum area? 2

.....

.....

.....

.....

QUESTION TWENTY-SEVEN (4 marks) **Marks**

A project requires activities A to G. The activity chart shows the immediate predecessors and duration of each activity.

Activity	Immediate Predecessor(s)	Duration in hours
A	-	3
B	A	6
C	B	7
D	B	11
E	C	6
F	D, E	3
G	F	8

(a) By drawing a network diagram, determine the minimum time for the project to be completed. 3

Minimum time = ...

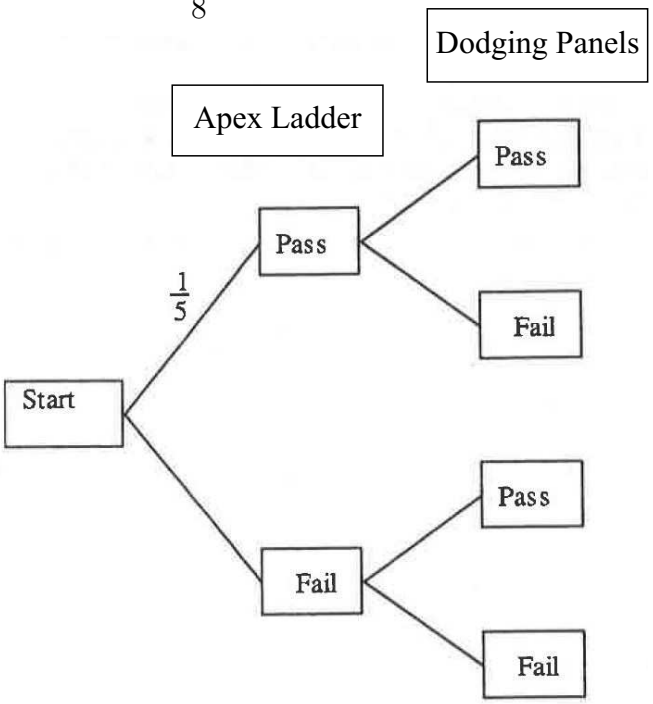
(b) Determine the float time for the non-critical activity. 1

.....

QUESTION TWENTY-EIGHT (4 marks) **Marks**

On an obstacle course for Army Cadets, two obstacles are particularly challenging. The first obstacle, an Apex Ladder, trains balancing and confidence at a height. The second obstacle, Dodging Panels, trains lateral dodging in confined spaces.

The probability of a Cadet successfully negotiating the first of these is $\frac{1}{5}$ and the probability of success at the second is $\frac{3}{8}$.



(a) Complete the above tree diagram by writing in the five missing probabilities. 2

(b) What is the probability that a cadet will fail the Apex Ladder but succeed with the Dodging Panels? 1

.....

.....

.....

(c) Calculate the probability that a cadet will successfully negotiate only one of the obstacles. 1

.....

.....

.....

QUESTION TWENTY-NINE (4 marks) **Marks**

Raff borrows \$15 000 from the bank. The interest rate is 6·5% per annum, compounded monthly. He agrees to pay \$360 per month and pays it off in exactly four years.
The loan balance shows the interest charged and the balance owing for the first two months.

Month	Principal at the start of the month	Interest charged	Monthly repayment	Balance at the end of the month
1	\$15 000	\$81.25	\$360	\$14 721.25
2	\$14 721.25	A	\$360	B

(a) How much in total will Raff repay after the 4 years? 1

.....

.....

(b) Show how the interest of \$81.25 was calculated for the first month. 1

.....

.....

.....

.....

(c) Find the values of A and B in the table above. 2

.....

.....

.....

.....

QUESTION THIRTY (7 marks) **Marks**

After the recent drought, the rain gauge at the Asquith Farm registered 62·2 mm of rain during a storm. The machinery shed has a flat roof that measures 25 metres by 10 metres.

(a) How many litres of water was collected from the roof during the storm, assuming there is no wastage? 2

.....

.....

.....

.....

(b) The rain that falls on the roof of the machinery shed is collected in a cylindrical tank with a diameter of 6 metres. What depth of water was in the cylindrical tank after the storm? Assume the tank was empty before the storm. Give your answer to the nearest centimetre. 2

.....

.....

.....

.....

(c) If the cylindrical tank has a height of 2·5 metres, how many more litres of rain can be collected before the tank begins to overflow? Give your answer to the nearest litre. 3

.....

.....

.....

.....

.....

.....

QUESTION THIRTY-ONE (6 marks) **Marks**

A class is going on an overnight excursion by bus. The students were asked to each pack one bag for the trip. The bags were weighed, and the mass of the bags in kilograms are listed as follows:

9 10 11 11 16 19 23 26 27 28 30 42.

(a) A bag is selected at random. What is the probability that the chosen bag has a mass of more than 15 kg? 1

.....

.....

(b) Determine the median mass of the bags. 1

.....

.....

(c) Determine the interquartile range of the bags' masses. 1

.....

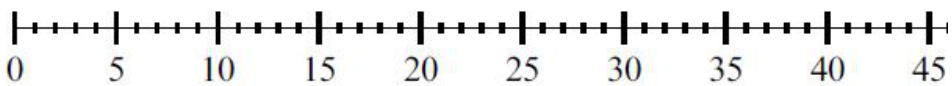
.....

(d) Determine if this data set contains any outliers. 1

.....

.....

(e) Construct an accurate box-and-whisker plot below to represent this data. 2



QUESTION THIRTY-TWO (7 marks) **Marks**

The net mass of pasta in packets sold by Amalfi Producers has a normal distribution with a mean of 1017 grams and a standard deviation of 9 grams.

(a) The following table displays the z–score that various masses represent. 2

Net Mass (g)	999	U	1017	1026	1035
z–score	-2	-1	0	V	2

Find the missing values U and V in the table above.

.....

.....

.....

.....

(b) A packet of pasta was taken at random and is found to contain 1022 grams of pasta. What is the z–score that this mass represents? Give your answer correct to 2 decimal places. 2

.....

.....

.....

.....

(c) The advertising promises that "Over 99% of our packets contain more than 1 kilogram of pasta." 3
Explain whether this is supported by the above statistics.

.....

.....

.....

.....

.....

QUESTION THIRTY-THREE (3 marks) **Marks**

A single bacterium divides into two every second, so one cell becomes 2 in the first second and in the next second two cells become 4 and so on. By writing a rule for the number of bacteria N after t seconds, find how long it will take for the population to exceed 100 000. Give your answer to the nearest second. [3]

.....

.....

.....

.....

.....

.....

.....

.....

QUESTION THIRTY-FOUR (4 marks) **Marks**

Alice intends to invest \$820 every month for 18 months, earning interest which will compound monthly at a rate of 7·3% per annum. Alice calculates that \$15 680.75 will be the final value of this investment. Victoria intends to invest a single lump sum starting at the same time and at the same compounding rate. How much does Victoria need to invest to achieve the same final value as Alice? [4]

.....

.....

.....

.....

.....

.....

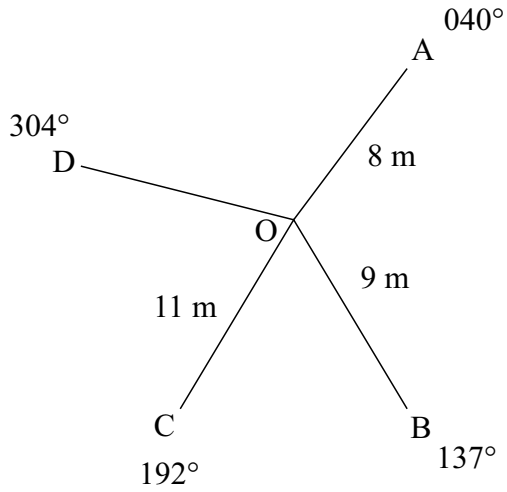
.....

.....

.....

QUESTION THIRTY-FIVE (3 marks) **Marks**

Zayne has taken a compass radial survey of a park shown below.



(a) Find the size of $\angle DOA$. 1

.....

.....

.....

(b) Zayne was unable to measure the distance OD, but was able to locate the area of the park sections. If the area of $\triangle DOA$ is $24\,\text{m}^2$, what is the length OD? Give your answer correct to the nearest metre. 2

.....

.....

.....

.....

.....

.....

.....

.....

QUESTION THIRTY-SIX (2 marks) **Marks**

Two cities lie on the same meridian of longitude and are 4804 km apart. One city is located on the parallel of latitude 45°N. What is the latitude of the second city if it is directly south of the first city? Use the Earth's radius as 6400 km. Give your answer to the nearest degree. [2]

.....

.....

.....

.....

.....

.....

QUESTION THIRTY-SEVEN (4 marks) **Marks**

Jack and Josh are neighbours who enjoy racing each other to school in their new cars. Both travel at constant speeds, with the ratio of their speeds being 3 : 2 respectively. Josh leaves home at exactly 8:00 am and arrives at school at 8:24 am. Since Jack drives a Bugatti Chiron Super Sport, he knows that he is faster so he leaves at 8:03 am and still arrives first. At what time will Jack overtake Josh? [4]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

END OF PAPER

SYDNEY GRAMMAR SCHOOL

Solutions.

CANDIDATE NUMBER

2021 Trial HSC Examination

Form VI Mathematics Standard 2

Friday 20th August 2021

8:40am

General Instructions

- Reading time — 10 minutes
- Working time — 2 hours 30 minutes
- Attempt all questions.
- Write using black pen.
- Calculators approved by NESA may be used.
- A loose reference sheet is provided separate to this paper.

Total Marks: 100

Section I (15 marks) Questions 1 – 15

- This section is multiple-choice. Each question is worth 1 mark.
- Record your answers on the provided answer sheet.
- Write your candidate number on each page.

Section II (85 marks) Questions 16 – 37

- Because of the nature of this task, greater weight than normal will be placed on working. Clear reasoning and full calculations are required.
- Answer the questions in this paper in the spaces provided.
- Write your candidate number on each page.

Your sheets must be ORDERED
then scanned and uploaded in a
SINGLE PDF FILE
to the Schoology page of your mathematics class

Checklist

- Reference sheet
- Multiple-choice answer sheet
- Candidature: 10 pupils

Writer: AEA

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 following is the solution to the equation below?

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

(A) $x = 2$

(B) $x = 3$

(C) $x = 6$

(D) $x = 8$

2. Which is the correct expansion of $3x - \left(x^2 - x\right) + 2x\left(x - 2\right)$?

(A) $x^2 - 2x$

(B) $-3x^3 + 5x^2 - 4x$

(C) $x^2 + 8x$

(D) x^2

3. The probability of an event occurring is 0·25. What is the probability that this event will NOT occur?

(A) 0·25

(B) 0·65

(C) 0·75

(D) 85%

4. Seb runs a 2400-watt heater for 6 hours each day. Electricity is charged at 26.3 c/kWh. What is the cost of running the heater for 8 days?

(A) \$3.03

(B) \$30.30

(C) \$302.98

(D) \$3029.76

5. The surface area of a spherical basketball is $2828\,\text{cm}^2$. What is the approximate radius of the basketball?

   (A) 15 cm

   (B) 27 cm

   (C) 47 cm

   (D) 225 cm

6. Max travels from Prague (50°N, 15°E) to the Congo (4°S, 15°E). What is the approximate distance from Prague to the Congo, given the radius of Earth is 6400 km?

   (A) 2569 km

   (B) 3016 km

   (C) 5138 km

   (D) 6032 km

$\frac{54}{360} \times 2\pi \times 6400$

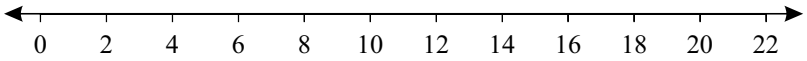
7. Which of the data sets displayed in the following box-and-whisker plots has the largest interquartile range?

   (A)

   (B)

   (C)

   (D)



8. Ari borrowed $3340 for a period of 11 months. In total he repaid $4022. The simple interest rate per annum is:

   (A) $\dfrac{4022 - 3340}{3340 \times 11} \times 100\%$

   (B) $\dfrac{3340}{4022 \times 11} \times 100\%$

   (C) $\dfrac{12 \times (4022 - 3340)}{3340 \times 11} \times 100\%$

   (D) $\dfrac{12 \times 3340}{4022 \times 11} \times 100\%$

9. Amy has 1000 shares with a market value of \$3.00 per share. The shares paid a dividend of 15 c per share. What was the dividend yield for these shares?

   (A) 5%

   (B) 15%

   (C) 20%

   (D) 67%

10. Rob works in a factory that produces bags of cashews. The weights of the bags are normally distributed, with a mean of 900 g and a standard deviation of 50 g. What is the best approximation for the percentage of bags that weigh more than 1000 g?

   (A) 0%

   (B) 2·5%

   (C) 5%

   (D) 16%

11. James is driving along the highway at 80 km/h. He notices a kangaroo on the road and applies the brakes 1·8 seconds after noticing the kangaroo. His braking distance is 35 metres. What is his approximate total stopping distance?

   (A) 40 m

   (B) 75 m

   (C) 92 m

   (D) 180 m

12. The formula below is used to estimate the blood alcohol content (BAC) for males.

$$BAC_{Male} = \frac{10N - 7{\cdot}5H}{6{\cdot}8M}$$

   where N is the number of standard drinks consumed
   H is the number of hours drinking
   M is the person's weight in kilograms

   Mitch weighs 72 kilograms. He starts drinking at 6:30pm and stops at 9:00pm. During this time, he consumes 3 standard drinks. What is his approximate BAC at 9:00pm?

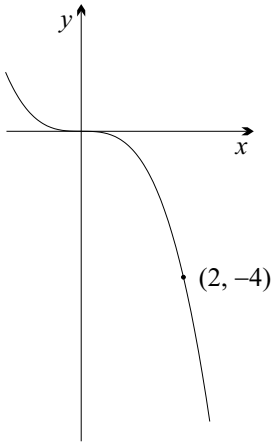
   (A) 0·005

   (B) 0·007

   (C) 0·023

   (D) 0·026

13.



The diagram above shows the graph of $y = kx^3$. What is the value of k?

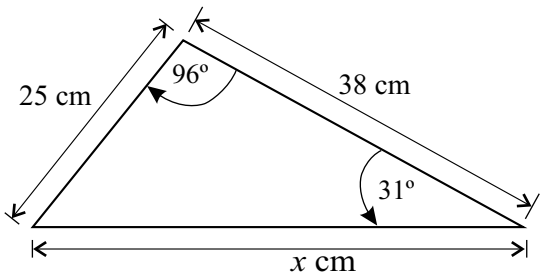
(A) -2

(B) $-\dfrac{1}{2}$

(C) $\dfrac{1}{2}$

(D) 2

14.



Which of the following would correctly calculate x in the above triangle?

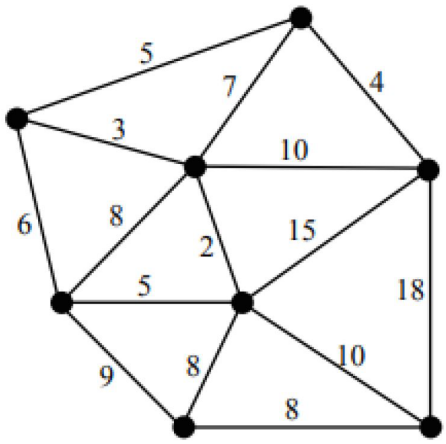
(A) $x = \dfrac{\sin 96^\circ}{25 \times \sin 31^\circ}$

(B) $x = \dfrac{25 \times \sin 31^\circ}{\sin 96^\circ}$

(C) $x = 25^2 + 38^2 - 2 \times 25 \times 38 \times \cos 96^\circ$

(D) $x = \sqrt{25^2 + 38^2 - 2 \times 25 \times 38 \times \cos 96^\circ}$

15.



What is the length of the minimum spanning tree in the network above?

(A) 30

(B) 31

(C) 35

(D) 39

End of Section I

The paper continues in the next section

Section II

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

QUESTION SIXTEEN (2 marks) **Marks**

Conor has a taxable income of \$97 000. Using the tax table below, calculate the tax payable on this amount. [2]

Taxable income	Tax on this income
0 – \$18 200	Nil
\$18 201 – \$37 000	19c for each \$1 over \$18 200
\$37 001 – \$90 000	\$3 572 plus 32·5c for each \$1 over \$37 000
\$90 001 – \$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

$20797 + 0.37(97000 - 90000)$

$= \$23\ 387$

QUESTION SEVENTEEN (2 marks) **Marks**

Solve $\frac{16-x}{2} = 3x + 1$. [2]

$16 - x = 2(3x + 1)$

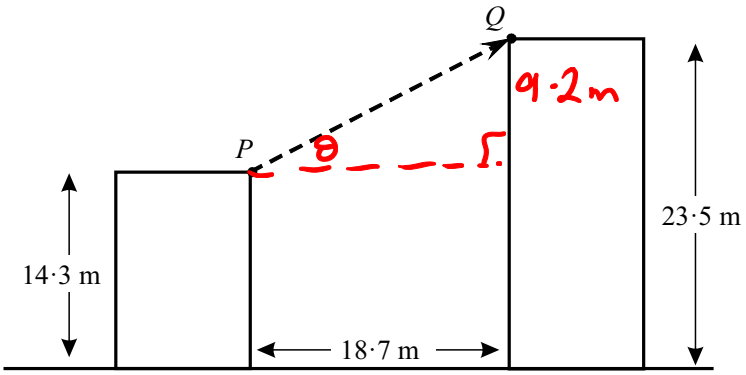
$16 - x = 6x + 2$

$7x = 14$

$x = 2$

QUESTION EIGHTEEN (2 marks) **Marks** 2

The following diagram shows two people standing on the edges of the roofs of two buildings. Peter is standing at P and Quentin is standing at Q.



Find the angle of elevation from Peter to Quentin. Give your answer to the nearest degree.

$\tan\theta = \frac{9.2}{18.7}$

$\theta = \tan^{-1}\left(\frac{9.2}{18.7}\right) = 26^\circ$

QUESTION NINETEEN (2 marks) **Marks** 2

Three water pipes are used to fill a swimming pool. The first pipe alone takes 8 hours to fill the pool, the second pipe alone takes 12 hours to fill the pool and the third pipe alone takes 24 hours to fill the pool. If all three pipes are opened at the same time, how long will it take to fill the pool?

$\frac{1}{t} = \frac{1}{8} + \frac{1}{12} + \frac{1}{24}$

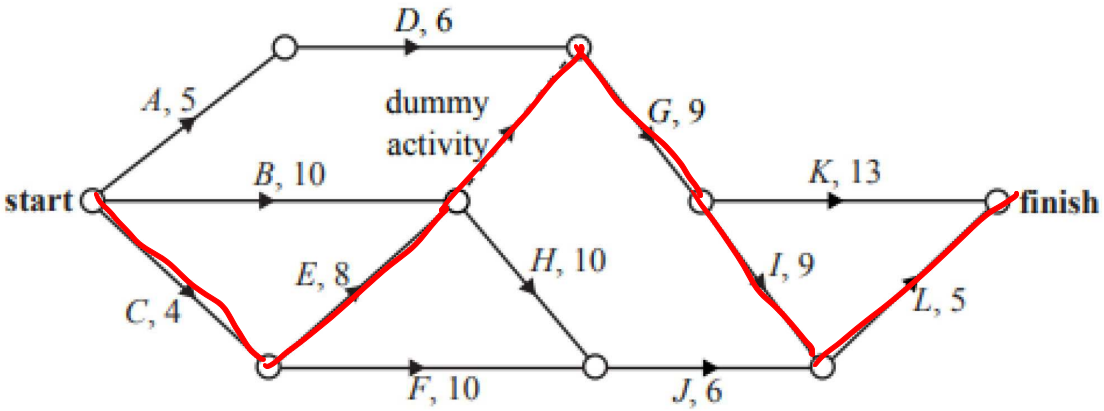
$= \frac{3+2+1}{24}$

$= \frac{6}{24} = \frac{1}{4}$ $\therefore$ 4 hrs.

QUESTION TWENTY (2 marks)

Marks

2



A project has 12 activities. The network above gives the time (in hours) that it takes to complete each activity. Find the critical path for this project.

.....

C E G I L = 35 hrs.

.....

.....

.....

.....

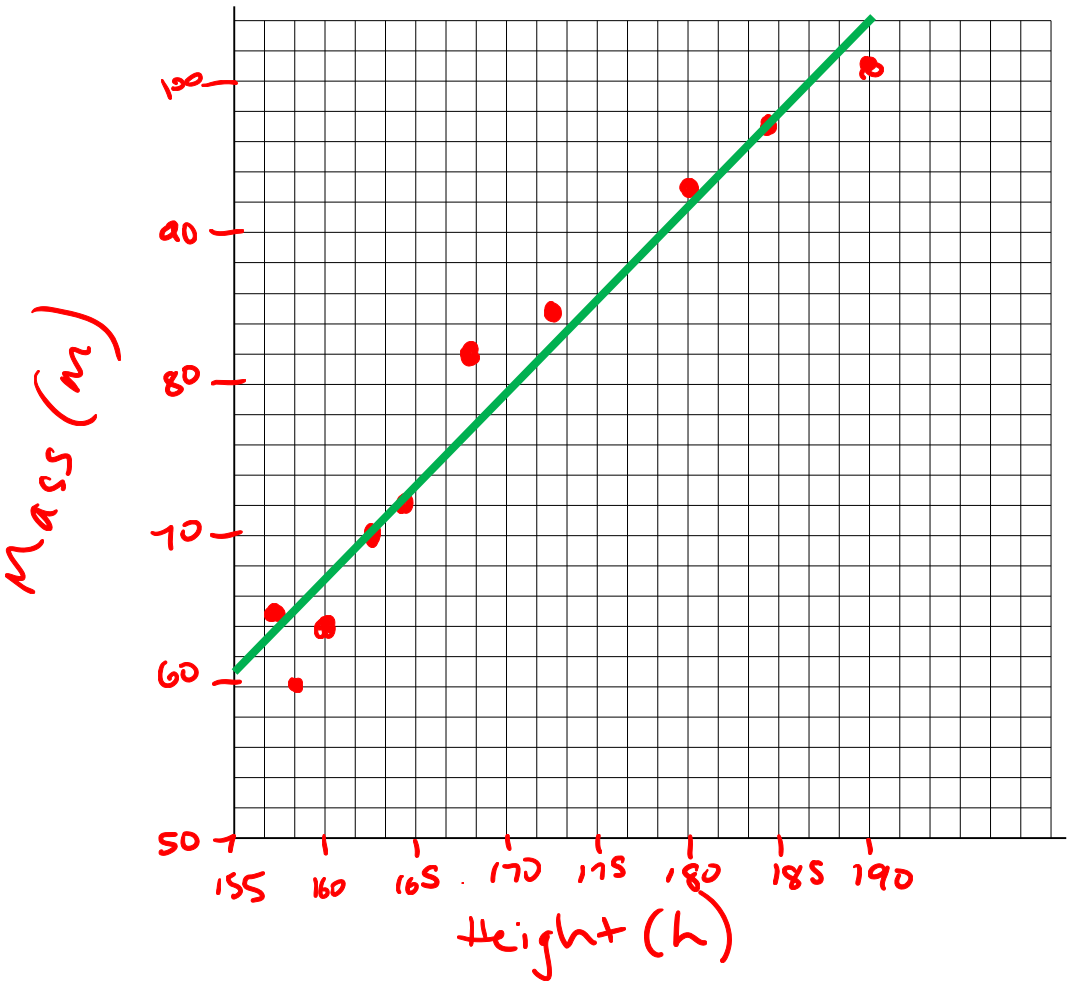
.....

QUESTION TWENTY-ONE (4 marks) **Marks**

The table below shows the height (cm) and mass (kg) of ten Olympic "Plunge for Distance" competitors.

Height (h)	157	158	160	163	164	168	173	180	184	190
Mass (m)	65	60	64	70	72	82	85	93	97	101

(a) Construct a scatter plot using the table above. 1



(b) On your scatter plot above, draw a line of best fit. 1

(c) Find the equation of your line of best fit. 2

$m = \frac{97-70}{184-163}$

$= \frac{9}{7}$

$m - 70 = \frac{9}{7}(h - 163)$

$m = \frac{9}{7}h - 139.6$

QUESTION TWENTY-TWO (2 marks) **Marks**

Henry buys a new car which costs \$40 000 and depreciates at the rate of 12·5% p.a.

(a) Use the declining balance formula for depreciation to write an equation to find the value of the car (V) after n years. [1]

$V = 40000(1-0.125)^n$

(b) After how many years will the value of the car first fall below \$15 000? [1]

$15000 = 40000(1-0.125)^n$

$0.375 = (0.875)^n$

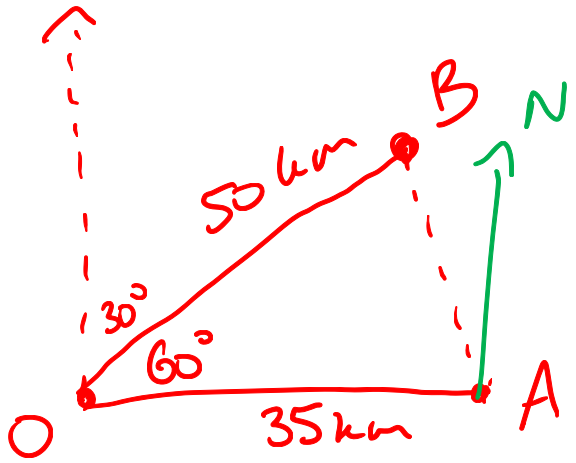
$n=7 \rightsquigarrow 0.393$ } After 8 yrs.

$n=8 \rightsquigarrow 0.344$ }

QUESTION TWENTY-THREE (6 marks) **Marks**

On level ground, A is 35 km due east of O, the bearing of B from O is 030°T and the distance of B from O is 50 km.

(a) Draw a clearly labelled diagram of the situation in the space below. [1]



(b) Find the distance from A to B. Give your answer to the nearest kilometre. [2]

$AB^2 = 50^2 + 35^2 - 2 \times 50 \times 35 \times \cos 60$

$AB^2 = 1975$

$AB = 44.44\ldots$

$= 44$ km

(c) Find the bearing of B from A. Give your answer to the nearest degree. [3]

$\cos A = \dfrac{35^2 + 44^2 - 50^2}{2 \times 35 \times 44}$

$A = 77.6^\circ = 78^\circ$

$\therefore$ Bearing from A to B is $270 + 78 = 348^\circ$

QUESTION TWENTY-FOUR (3 marks) **Marks**

The weekly rental on a house is shared by a number of people. The rent per person R varies inversely with the number of people living in the house N. If there are four people living in the house, each person pays \$72.

(a) If $R = \dfrac{k}{N}$, where k is the constant of variation, find the value of k. [1]

$72 = \dfrac{k}{4}$

$\therefore k = 288$

(b) How much would each person pay if there were 3 people living in the house? [1]

$R = \dfrac{288}{3} = \$96$

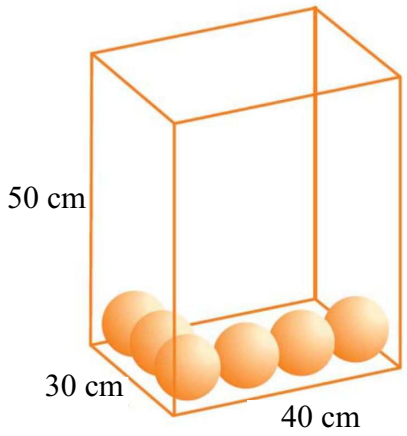
(c) How many people would need to live in the house if each person were only to pay \$48 per week? [1]

$48 = \dfrac{288}{N}$

$N = \dfrac{288}{48} = 6$

QUESTION TWENTY-FIVE (4 marks) **Marks**

Spherical balls of diameter 10 cm are stacked inside a box as shown below. The box is in the shape of a rectangular prism such that 12 balls will fit snuggly in each layer.



(a) If the balls are stacked in the same manner as in the bottom layer until the box is full, calculate the volume of the space occupied by the balls. Give your answer correct to the nearest cubic centimetre. 2

$V_B = \frac{4}{3}\pi r^3$

$= \frac{4}{3}\pi \times 5^3$

$= 523.598...$

Volume (60 balls) $= 523.598... \times 60$

$= 31415.926...$

$= 31416 \text{ cm}^3$

(b) What percentage of the box is empty space? Give your answer correct to the nearest percentage. 2

$V_{box} = 50 \times 30 \times 40 = 60000$

Empty Volume $= 60000 - 31416$

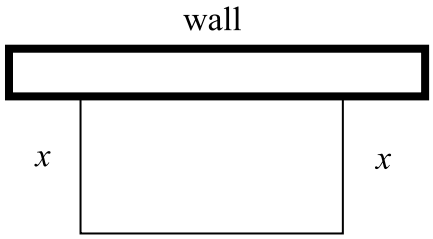
$= 28584$

% empty $= \frac{28584}{60000} \times 100\% = 47.64$

$= 48\%$

QUESTION TWENTY-SIX (8 marks) **Marks**

Archie is planning to make a rectangular puppy pen using an existing wall as one side. He uses 24 metres of fencing.



(a) If the width of the puppy pen is x metres, find an expression for the length in terms of x and show that the area of the pen is given by 2

$$A = 24x - 2x^2.$$

length = $24 - 2x$

Area = $x \times (24 - 2x)$

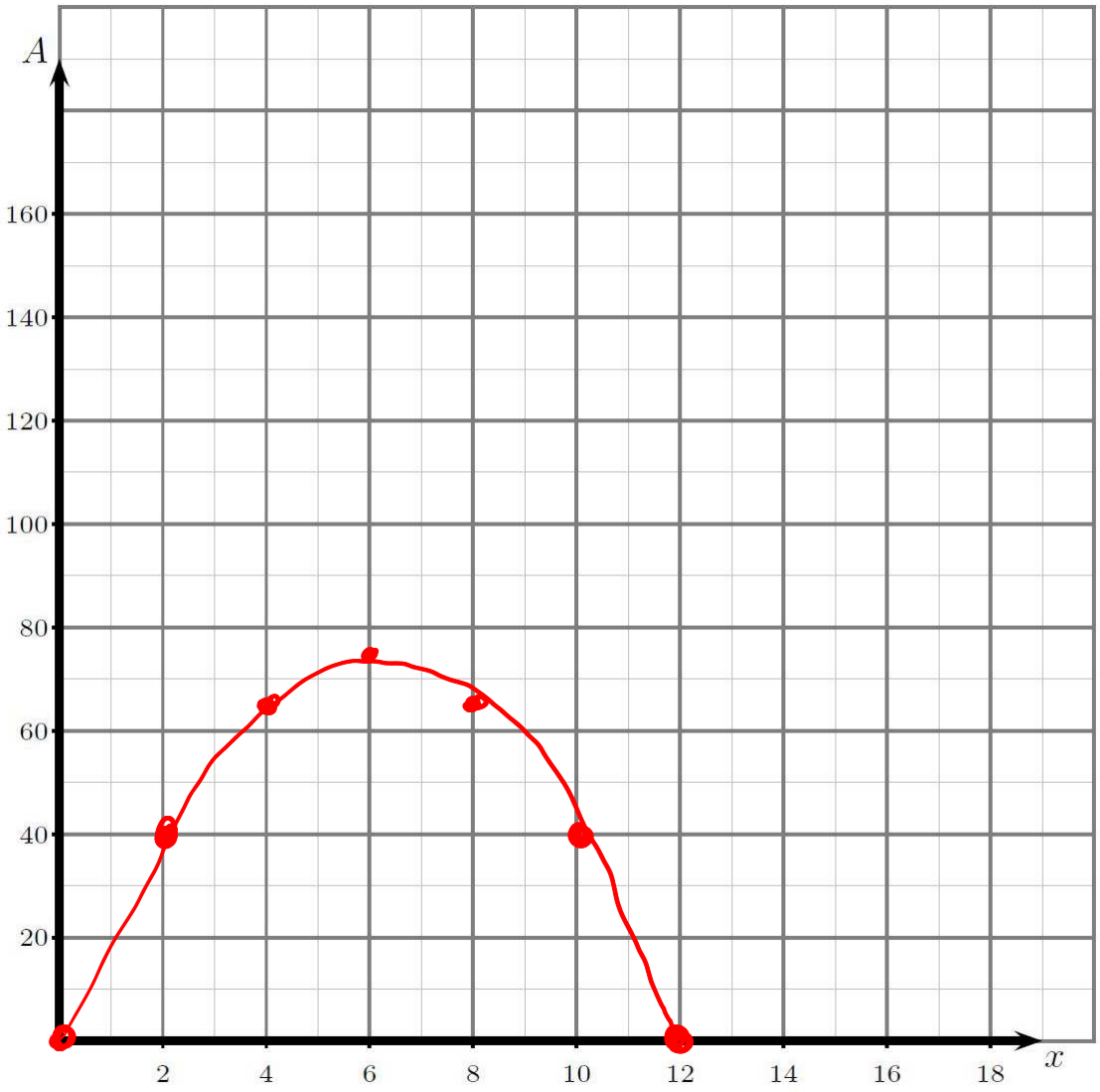
$\therefore A = 24x - 2x^2$

(b) Complete the table below. 2

x	0	2	4	6	8	10	12
A	0	40	64	72	64	40	0

QUESTION TWENTY-SIX (Continued)

(c) Draw the graph of the equation. 2



(d) What are the dimensions that give the maximum area? 2

max when $x = 6$

$\therefore$ Dimensions are $w = 6$

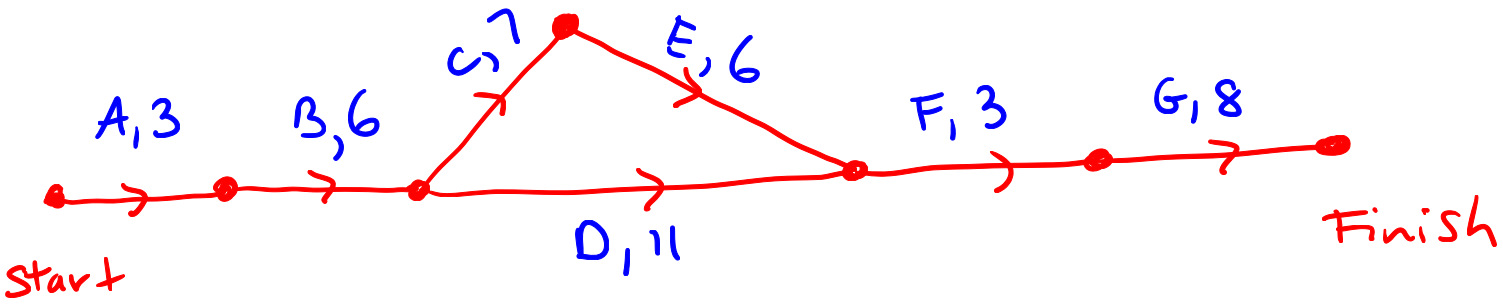
length $= 24 - 2(6) = 12$

QUESTION TWENTY-SEVEN (4 marks) **Marks**

A project requires activities A to G. The activity chart shows the immediate predecessors and duration of each activity.

Activity	Immediate Predecessor(s)	Duration in hours
A	-	3
B	A	6
C	B	7
D	B	11
E	C	6
F	D, E	3
G	F	8

(a) By drawing a network diagram, determine the minimum time for the project to be completed. 3



Minimum time = 33 (longest route).

(b) Determine the float time for the non-critical activity. 1

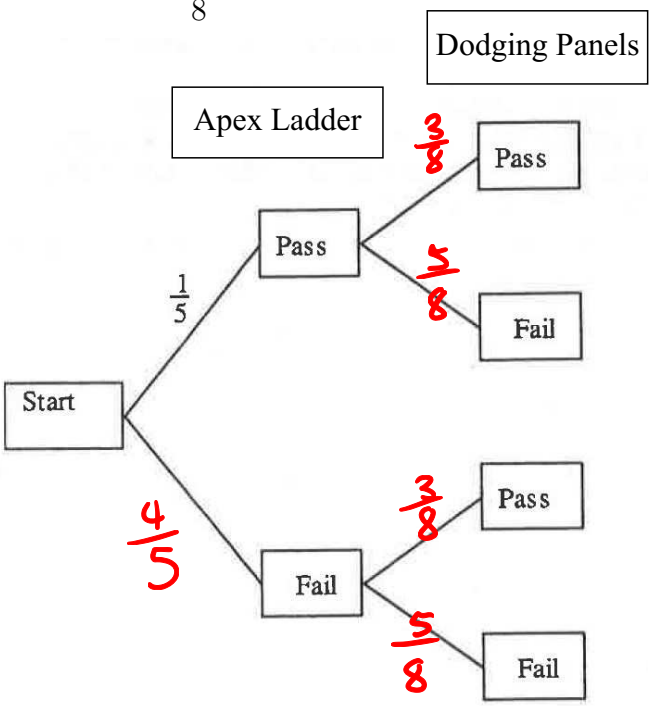
Non-critical activity is D

Float time = 13 − 11 = 2 hours.

QUESTION TWENTY-EIGHT (4 marks) **Marks**

On an obstacle course for Army Cadets, two obstacles are particularly challenging. The first obstacle, an Apex Ladder, trains balancing and confidence at a height. The second obstacle, Dodging Panels, trains lateral dodging in confined spaces.

The probability of a Cadet successfully negotiating the first of these is $\frac{1}{5}$ and the probability of success at the second is $\frac{3}{8}$.



(a) Complete the above tree diagram by writing in the five missing probabilities. 2

(b) What is the probability that a cadet will fail the Apex Ladder but succeed with the Dodging Panels? 1

$P(FP) = \frac{4}{5} \times \frac{3}{8} = \frac{3}{10}$

(c) Calculate the probability that a cadet will successfully negotiate only one of the obstacles. 1

$P(PF) + P(FP) = \frac{1}{5} \times \frac{5}{8} + \frac{3}{10}$

$= \frac{1}{8} + \frac{3}{10}$

$= \frac{17}{40}$

QUESTION TWENTY-NINE (4 marks) **Marks**

Raff borrows \$15 000 from the bank. The interest rate is 6·5% per annum, compounded monthly. He agrees to pay \$360 per month and pays it off in exactly four years.
The loan balance shows the interest charged and the balance owing for the first two months.

Month	Principal at the start of the month	Interest charged	Monthly repayment	Balance at the end of the month
1	\$15 000	\$81.25	\$360	\$14 721.25
2	\$14 721.25	A	\$360	B

(a) How much in total will Raff repay after the 4 years? 1

$360 \times 4 \times 12 = \$17\,280$

(b) Show how the interest of \$81.25 was calculated for the first month. 1

$15000 \times 0.065 \div 12 \times 1$

$= \$81.25$

(c) Find the values of A and B in the table above. 2

$A = 14\,721.25 \times 0.065 \div 12$

$= \$79.74$

$B = 14\,721.25 + 79.74 - 360$

$= \$14\,440.99$

QUESTION THIRTY (7 marks) **Marks**

After the recent drought, the rain gauge at the Asquith Farm registered 62·2 mm of rain during a storm. The machinery shed has a flat roof that measures 25 metres by 10 metres.

(a) How many litres of water was collected from the roof during the storm, assuming there is no wastage? 2

$V = 25 \times 10 \times 0.0622$

$= 15.55 \text{ m}^3$

$= 15.55 \text{ kL}$

$= 15\,550 \text{ L}$

(b) The rain that falls on the roof of the machinery shed is collected in a cylindrical tank with a diameter of 6 metres. What depth of water was in the cylindrical tank after the storm? Assume the tank was empty before the storm. Give your answer to the nearest centimetre. 2

$r = 3$

$V = \pi r^2 h$

$15.55 = \pi \times 3^2 \times h$

$h = 0.5499...$

$= 0.55 \text{ m}$

$= 55 \text{ cm}$.

(c) If the cylindrical tank has a height of 2·5 metres, how many more litres of rain can be collected before the tank begins to overflow? Give your answer to the nearest litre. 3

Remaining height $= 2.5 - 0.55 = 1.95$

$V = \pi r^2 h$

$= \pi \times 3^2 \times 1.95$

$= 55.1349... \text{ m}^3$

$= 55.1349... \text{ kL}$

$= 55\,135 \text{ L}$

QUESTION THIRTY-ONE (6 marks) **Marks**

A class is going on an overnight excursion by bus. The students were asked to each pack one bag for the trip. The bags were weighed, and the mass of the bags in kilograms are listed as follows:

9 10 11 11 16 19 23 26 27 28 30 42.

(a) A bag is selected at random. What is the probability that the chosen bag has a mass of more than 15 kg? [1]

$\frac{8}{12} = \frac{2}{3}$

(b) Determine the median mass of the bags. [1]

$\frac{19+23}{2} = 21$

(c) Determine the interquartile range of the bags' masses. [1]

$Q_1 = 11$

$Q_3 = 27.5$

$IQR = 27.5 - 11$

$= 16.5$

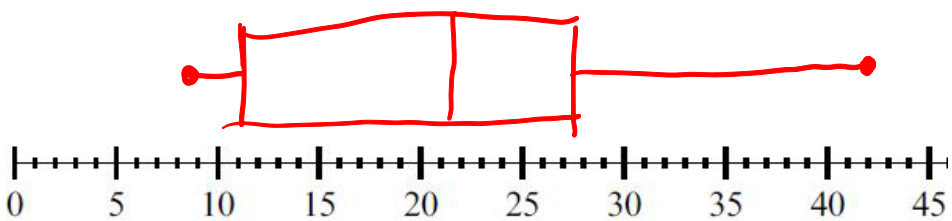
(d) Determine if this data set contains any outliers. [1]

$1.5 \times IQR = 1.5 \times 16.5$

$= 24.75$

no.

(e) Construct an accurate box-and-whisker plot below to represent this data. [2]



QUESTION THIRTY-TWO (7 marks) **Marks**

The net mass of pasta in packets sold by Amalfi Producers has a normal distribution with a mean of 1017 grams and a standard deviation of 9 grams.

(a) The following table displays the z–score that various masses represent. 2

Net Mass (g)	999	U	1017	1026	1035
z–score	-2	-1	0	V	2

Find the missing values U and V in the table above.

$U = 999 + 9$ $V = 1$

$= 1008$

(b) A packet of pasta was taken at random and is found to contain 1022 grams of pasta. What is the z–score that this mass represents? Give your answer correct to 2 decimal places. 2

$z = \frac{1022 - 1017}{9} = \frac{5}{9} = 0.56$

(c) The advertising promises that "Over 99% of our packets contain more than 1 kilogram of pasta."
Explain whether this is supported by the above statistics. 3

A mass of 999 g has a z-score of -2.
95% of scores lie within 2 S.D. of the mean
Hence, 2.5% lie beyond $z=2$ and $z=-2$
$\therefore$ 97.5% of packets contain more than 999 g of pasta.

So this does not support their claim.

QUESTION THIRTY-THREE (3 marks) **Marks**

A single bacterium divides into two every second, so one cell becomes 2 in the first second and in the next second two cells become 4 and so on. By writing a rule for the number of bacteria N after t seconds, find how long it will take for the population to exceed 100 000. Give your answer to the nearest second. [3]

$N = 2^t$

$100\,000 = 2^t$

when $t = 16 \rightsquigarrow 65536$

$t = 17 \rightsquigarrow 131072$

$\therefore$ nearest second is 17.

QUESTION THIRTY-FOUR (4 marks) **Marks**

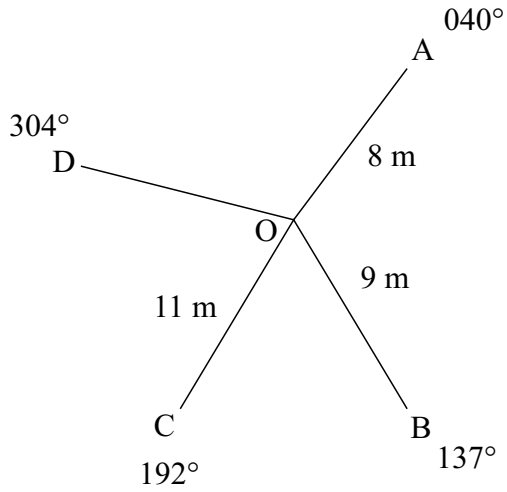
Alice intends to invest \$820 every month for 18 months, earning interest which will compound monthly at a rate of 7·3% per annum. Alice calculates that \$15 680.75 will be the final value of this investment. Victoria intends to invest a single lump sum starting at the same time and at the same compounding rate. How much does Victoria need to invest to achieve the same final value as Alice? [4]

$15\,680.75 = P\left(1 + \frac{0.073}{12}\right)^{18}$

$P = 14059.04$

QUESTION THIRTY-FIVE (3 marks) **Marks**

Zayne has taken a compass radial survey of a park shown below.



(a) Find the size of $\angle DOA$. 1

$360 - 304 = 56$

$56 + 40 = 96°$

(b) Zayne was unable to measure the distance OD, but was able to locate the area of the park sections. If the area of $\triangle DOA$ is $24\,\text{m}^2$, what is the length OD? Give your answer correct to the nearest metre. 2

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

$24 = \frac{1}{2} \times a \times 8 \times \sin 96°$

$24 = 4 \times a \times \sin 96$

$6 = a \times \sin 96$

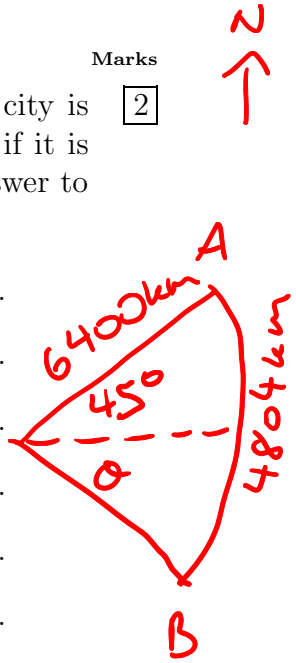
$a = 6.033\ldots$

$\therefore a = 6\text{m}$

/

QUESTION THIRTY-SIX (2 marks) **Marks**

Two cities lie on the same meridian of longitude and are 4804 km apart. One city is located on the parallel of latitude 45°N. What is the latitude of the second city if it is directly south of the first city? Use the Earth's radius as 6400 km. Give your answer to the nearest degree. [2]



$\frac{45+\theta}{360} \times 2\pi \times 6400 = 4804$

$45+\theta = \frac{4804 \times 360}{2\pi \times 6400}$

$= 43.007...$

$\therefore$ second city is $2°$ N

Lat $= 45°N - 43°$

QUESTION THIRTY-SEVEN (4 marks) **Marks**

Jack and Josh are neighbours who enjoy racing each other to school in their new cars. Both travel at constant speeds, with the ratio of their speeds being 3 : 2 respectively. Josh leaves home at exactly 8:00 am and arrives at school at 8:24 am. Since Jack drives a Bugatti Chiron Super Sport, he knows that he is faster so he leaves at 8:03 am and still arrives first. At what time will Jack overtake Josh? [4]

$s = \frac{d}{t}$

Jack: $3 = \frac{d}{t-3}$ Josh: $2 = \frac{d}{t}$

$3(t-3) = d$ $2t = d$

$\therefore \quad 3(t-3) = 2t$

$3t - 9 = 2t$

$t = 9$ minutes

Hence Jack overtakes Josh at 8:09 am.

END OF PAPER