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CANDIDATE NUMBER

SYDNEY GRAMMAR SCHOOL



2016 Trial Examination

FORM VI

GENERAL MATHEMATICS

Tuesday 9th August 2016

General Instructions

- Reading time — 5 minutes
- Writing time — $2\frac{1}{2}$ hours
- Write using black pen.
- Board-approved calculators and templates may be used.

Total — 100 Marks

- All questions may be attempted.

Section I – 25 Marks

- Questions 1–25 are of equal value.
- Record your answers to the multiple choice on the sheet provided.

Section II – 75 Marks

- Questions 26–30 are of equal value.
- All necessary working should be shown.
- Write all solutions on this paper in the spaces provided.

Collection

- Write your candidate number on this paper and on your multiple choice answer sheet.
- Place everything inside the question paper.

Checklist

- Multiple choice answer sheet
- Formulae sheet
- Candidature — 17 boys

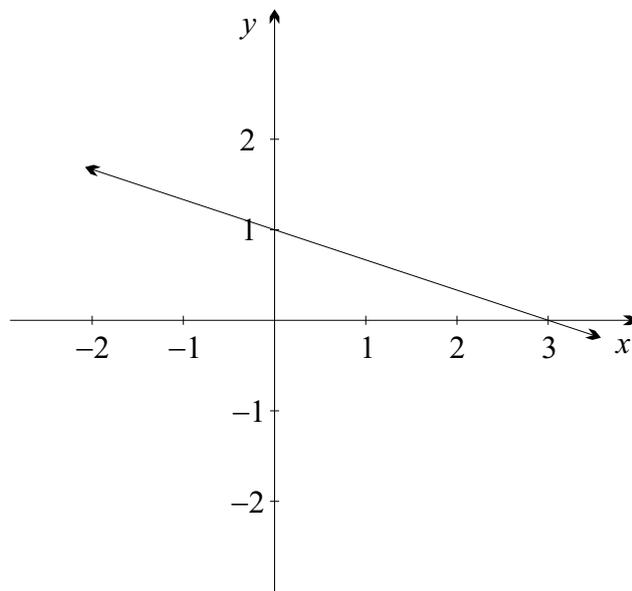
Examiner

BR

SECTION I - Multiple Choice

Answers for this section should be recorded on the separate answer sheet handed out with this examination paper.

QUESTION ONE



What is the correct equation of the line shown above?

- (A) $y = -3x + 1$
- (B) $y = -\frac{1}{3}x + 1$
- (C) $y = \frac{1}{3}x + 1$
- (D) $y = 3x + 1$

QUESTION TWO

Expand and simplify $6x^2(x^2 - 1) - 2x^2$.

- (A) $6x^4 - 2x^2 - 1$
- (B) $6x^4 - 4x^2$
- (C) $6x^4 - 8x^2$
- (D) $-12x^6 + 12x^4$

QUESTION THREE

When rounded to 2 significant figures, 3950.628 becomes:

- (A) 39
- (B) 3900
- (C) 3950.63
- (D) 4000

QUESTION FOUR

A 2400-watt heater is run for six hours each day. If electricity is charged at 26.3 c/kWh, what is the cost of running the heater for eight days?

- (A) \$3.03
- (B) \$30.30
- (C) \$302.98
- (D) \$3029.76

QUESTION FIVE

Esteban asked 30 students about their method of travel to school. The results of the survey are displayed in the table below.

Method of travel	Frequency
Walk	3
Cycle	6
Bus	12
Car	5
Train	4

He decides to construct a sector graph to display the information in the table. What is the angle of the sector representing 'Bus'?

- (A) 12°
- (B) 30°
- (C) 40°
- (D) 144°

QUESTION SIX

Alicia just received her water bill for July. It shows the following charges. Use the table below to calculate the total amount due.

Water service	\$45.15
Wastewater (sewerage)	\$151.08
Water usage 24.2 kL @ \$2.248 per kL	
Amount due	

- (A) \$198.48
- (B) \$212.50
- (C) \$244.48
- (D) \$250.63

QUESTION SEVEN

A car travels 480 km on 60 L of petrol. Its fuel consumption is:

- (A) 0.125 L/100 km
- (B) 8 L/100 km
- (C) 12.5 L/100 km
- (D) 28.8 L/100 km

QUESTION EIGHT

Amy, Brett and Coen invested \$30 000, \$25 000 and \$15 000 respectively in a new business. At the end of the first year the business made a total profit of \$42 000. The profit was divided in the same ratio as the amounts they had invested. How much of the profit did Amy receive?

- (A) \$9000
- (B) \$14 000
- (C) \$18 000
- (D) \$30 000

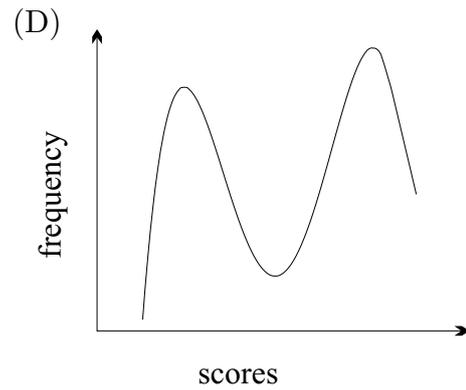
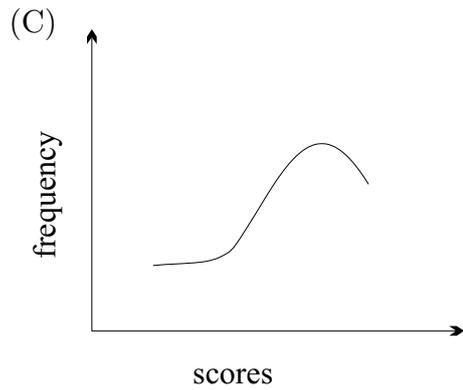
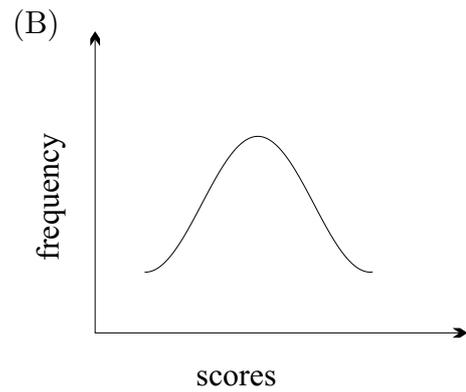
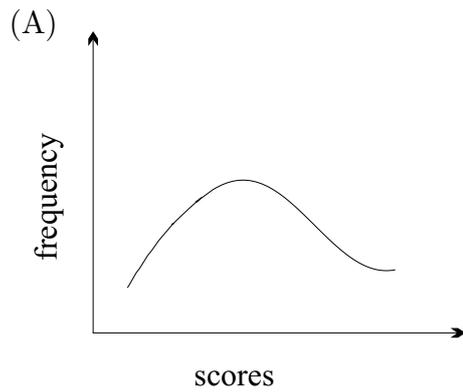
QUESTION NINE

Karl claims \$96 per year depreciation on the brick-cutter he uses in his work as a bricklayer. The brick-cutter originally cost \$1200. What straight line rate of depreciation did Karl use to calculate \$96 depreciation?

- (A) 0.08% p.a.
- (B) 0.125% p.a.
- (C) 8.0% p.a.
- (D) 12.5% p.a.

QUESTION TEN

Which graph below indicates the data was positively skewed?

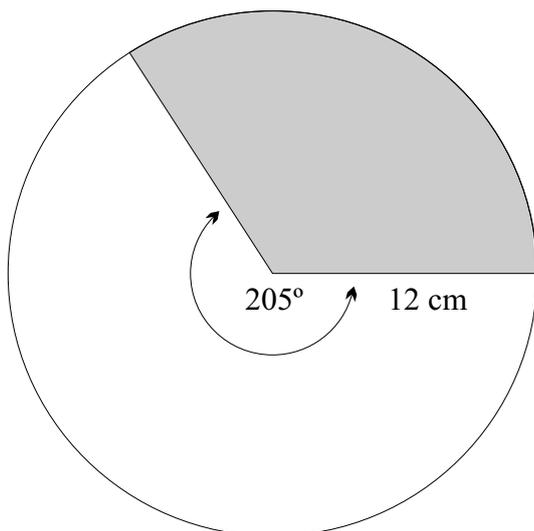


QUESTION ELEVEN

A set of scores are normally distributed. The scores have a mean of 70 and a standard deviation of 8. What z -score corresponds to a mark of 66?

- (A) -1
- (B) $-\frac{1}{2}$
- (C) $\frac{1}{2}$
- (D) 1

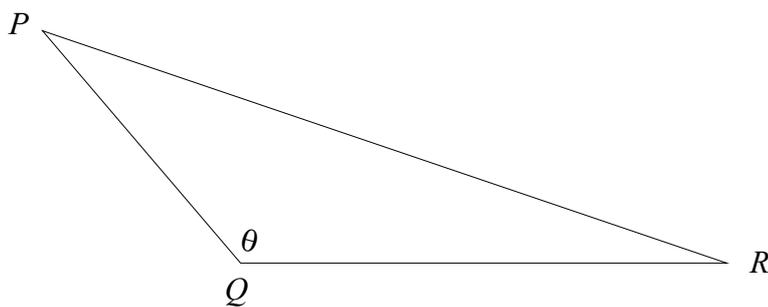
QUESTION TWELVE



Calculate the area of the shaded sector of radius 12 cm shown above.

- (A) 32.5 cm^2
- (B) 42.9 cm^2
- (C) 195 cm^2
- (D) 258 cm^2

QUESTION THIRTEEN



In $\triangle PQR$ shown above, angle θ is obtuse. Which of these could be the value of $\cos \theta$?

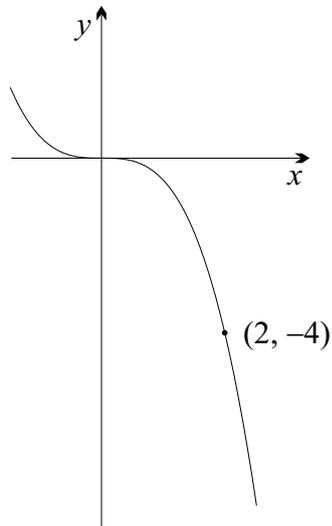
- (A) -1.5
- (B) -0.5
- (C) 0.5
- (D) 1.5

QUESTION FOURTEEN

Angela is going to choose 3 names from 8 out of a hat and arrange them in order from left to right. How many different arrangements can she make?

- (A) $3!$
- (B) $\frac{8!}{3!5!}$
- (C) $\frac{8!}{5!}$
- (D) $8!$

QUESTION FIFTEEN



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

- (A) -2
- (B) $-\frac{1}{2}$
- (C) $\frac{1}{2}$
- (D) 2

QUESTION SIXTEEN

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

- (A) $\frac{4022 - 3340}{3340 \times 11} \times 100\%$
- (B) $\frac{3340}{4022 \times 11} \times 100\%$
- (C) $\frac{12 \times (4022 - 3340)}{3340 \times 11} \times 100\%$
- (D) $\frac{12 \times 3340}{4022 \times 11} \times 100\%$

QUESTION SEVENTEEN

The daily cost of running a sandwich shop that makes n sandwiches is given by the equation $C = 3n + 150$. The 150 could represent the:

- (A) number of sandwiches sold
- (B) cost per sandwich
- (C) fixed daily cost
- (D) number of sandwiches made

QUESTION EIGHTEEN

The weights in kilograms of eight women at birth and at the age of 21 are given in the table below:

Birth weight	1.9	2.4	2.6	2.7	2.9	3.2	3.4	3.6
Weight at 21	47.6	53.1	52.2	56.2	57.6	59.9	55.3	56.7

What is the value of the correlation coefficient r ?

- (A) 0.5360
- (B) 0.6182
- (C) 0.7863
- (D) 0.8232

QUESTION NINETEEN

When you cross the International Date Line from east to west, you should:

- (A) put the clock forward one day
- (B) put the clock back one day
- (C) put the clock forward 12 hours
- (D) put the clock back 12 hours

QUESTION TWENTY

If an event E is certain to happen, then:

- (A) $P(E) = 0$
- (B) $P(E) = \frac{1}{2}$
- (C) $P(E) = 1$
- (D) $0 < P(E) < 1$

QUESTION TWENTY ONE

The capacity of a cubic tank with side length 8 m is:

- (A) 64 kL
- (B) 512 kL
- (C) 640 kL
- (D) 512 000 kL

QUESTION TWENTY TWO

A machine produces 6000 items in a week. To obtain a systematic sample of 200, we could start with the 10th item and then select item numbers:

- (A) 40, 70, 100, 130, ...
- (B) 200, 400, 600, 800, ...
- (C) 100, 190, 280, 370, ...
- (D) 210, 410, 610, 810, ...

QUESTION TWENTY THREE

A phone plan charges 28 cents per MB for excess data usage in blocks of 1 MB. What is the cost of 27.8 MB of excess data?

- (A) 28 cents
- (B) \$7.56
- (C) \$7.78
- (D) \$7.84

QUESTION TWENTY FOUR

On Tuesday Andre worked 8 hours at normal time and 2 hours at time-and-a-half. His normal rate of pay is \$23.80 per hour. Which expression calculates Andre's pay on Tuesday in dollars?

- (A) $8 \times 23.8 + 2 \times 0.5 \times 23.8$
- (B) $8 \times 23.8 + 2 \times 23.8$
- (C) 11×23.8
- (D) $8 \times 23.8 \times 2 \times 1.5 \times 23.8$

QUESTION TWENTY FIVE

Chloe holds a provisional license. Her allowable Blood Alcohol Content (BAC) to drive is zero. She knows that the liver breaks down alcohol at an average rate of 0.75 standard drinks per hour. If she consumed 10 standard drinks from 10pm to 2am, what is the earliest time that she could legally drive to work?

- (A) 11:20 am
- (B) 11:33 am
- (C) 3:20 pm
- (D) 3:33 pm

_____ End of Section I _____

SECTION II - Written Response

Answers for this section should be recorded in the space provided in this paper.
Show all necessary working.

QUESTION TWENTY SIX (15 marks)

Marks

(a) Simplify $6x - 7x$.

1

Solution

(b) A cube has a side length of 4 cm. What is the surface area of the cube?

1

Solution

(c) A square pyramid has a base with side lengths of 9 cm and a perpendicular height of 4 cm. Calculate the volume of the pyramid.

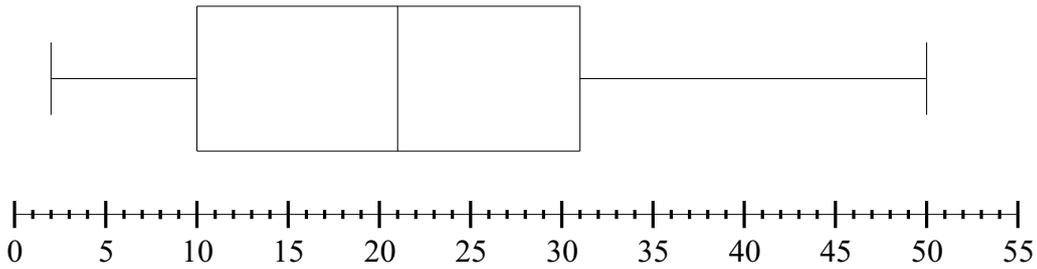
2

Solution

QUESTION TWENTY SIX (Continued)

1

(d)



What is the interquartile range of the data shown in the box plot above?

Solution

(e) Constantine borrows \$8000 to buy a car. The flat interest rate is 8.6% p.a. and he repays the loan in equal monthly instalments over five years.

(i) Find the amount of interest charged.

1

Solution

(ii) Find the total amount to be repaid.

1

Solution

QUESTION TWENTY SIX (Continued)

(iii) Find the monthly repayment.

1

Solution

(f) Make x the subject of the formula $y = k - mx$.

2

Solution

QUESTION TWENTY SIX (Continued)

- (g) The radius of the Earth is approximately 6370 km to the nearest 10 km. Assuming that the Earth is a sphere, what are the largest and smallest possible surface areas? Give you answers correct to the nearest km^2 . 2

Solution

- (h) Deniliquin is 1° south of Hay. If Hay's coordinates are (34°S , 145°E), what are Deniliquin's coordinates? 1

Solution

- (i) A flagpole 5.6 m high casts a shadow 7.5 m long. What is the angle of elevation of the sun? Give your answer correct to the nearest minute. 2

Solution

QUESTION TWENTY SEVEN (15 marks)

Marks

(a) Calculate the number of Kb in 5.9 MB. Give your answer correct to the nearest Kb. 1

Solution

(b) The ratio of heads to tails when a biased coin is tossed is 5 : 7. The coin is tossed twice. Determine the probability of getting at least one head. 2

Solution

(c) Calculate the dividend on 3500 shares with a market price of \$1.00 per share if the dividend yield is 4.6%. 1

Solution

QUESTION TWENTY SEVEN (Continued)

(d) Rohit washes his car twice a month. Washing by hose uses 180 L/wash and washing by bucket uses 100 L/wash.

(i) How much does the water cost each year if he uses a hose and water costs 2 \$2.18/kL?

Solution

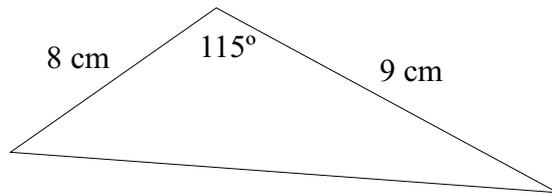
(ii) How much would he save each year if he used a bucket instead of a hose? 2

Solution

QUESTION TWENTY SEVEN (Continued)

2

(e)



Find the area of the triangle shown above. Give your answer correct to the nearest square centimetre.

Solution

(f) A bag contains one red, one black and one white marble. Two marbles are selected from the bag. The first marble is selected and not replaced before the second marble is selected. What is the probability of getting one red and one white marble?

2

Solution

QUESTION TWENTY SEVEN (Continued)

- (g) Susan and Jim join a Get Slim program. The weights of participants in each program are normally distributed and the statistics for male and female groups are shown in the table below. **3**

	Mean weight (kg)	Standard deviation (kg)
Male group	93	7.5
Female group	83	6

If Susan weighs 86.4 kg and Jim weighs 97.2 kg, who is more overweight compared to the people in their group? Justify your answer.

Solution

QUESTION TWENTY EIGHT (15 marks)

Marks

(a) The formula $D = \frac{2A}{15}$ is used to calculate the dosage of a medicine to be given to a child where D is the dosage in millilitres and A is the age of the child in months. Give your answer correct to the nearest millilitre.

(i) If Sam is 8 months old, what dosage of the medicine should he be given?

1

Solution

(ii) The correct dosage of the medicine for Luke is 5 mL. What is Luke's age in months?

2

Solution

QUESTION TWENTY EIGHT (Continued)

(b) A ship sails 85 km from A to B on a bearing of 060°T . It then turns and sails 120 km to C on a bearing of 130°T .

(i) Find the size of $\angle ABC$.

1

Solution

(ii) How far is the ship from its starting point? Give your answer correct to the nearest kilometre.

2

Solution

QUESTION TWENTY EIGHT (Continued)

- (iii) What is the bearing of the ship from its starting point? Give your answer to the nearest degree. **2**

Solution

- (c) A plane flies along the meridian from $(45^\circ\text{S}, 115^\circ\text{W})$ to $(8^\circ\text{N}, 115^\circ\text{W})$. Assuming the radius of the earth is 6400 km, what distance does the plane fly? Give your answer correct to the nearest 100 kilometres. **3**

Solution

QUESTION TWENTY EIGHT (Continued)

(d) During pregnancy, the period from conception to delivery of a baby is called the gestation period. The gestation period for humans is normally distributed with a mean of 266 days and a standard deviation of 16 days.

(i) Between which two values will 95% of gestation periods lie?

2

Solution

(ii) What percentage of pregnancies will last more than 282 days?

1

Solution

(iii) Is it possible to have a gestation period of 320 days? Justify your answer.

1

Solution

QUESTION TWENTY NINE (15 marks)

Marks

- (a) What is the value in dollars of the 10% GST on a Blu-Ray player that sells for \$458?
Give your answer correct to the nearest cent.

1

Solution

- (b) The surface area of a lake is $785\,000\text{ m}^2$. If an average of 4 mm of rain falls on the lake, what will be the increase in volume of water in the lake? Ignore any runoff from the surrounding area.

1

Solution

- (c) When it is noon Thursday, local time, in Chicago (42°N , 88°W), what is the local time in Tokyo (36°N , 140°E)?

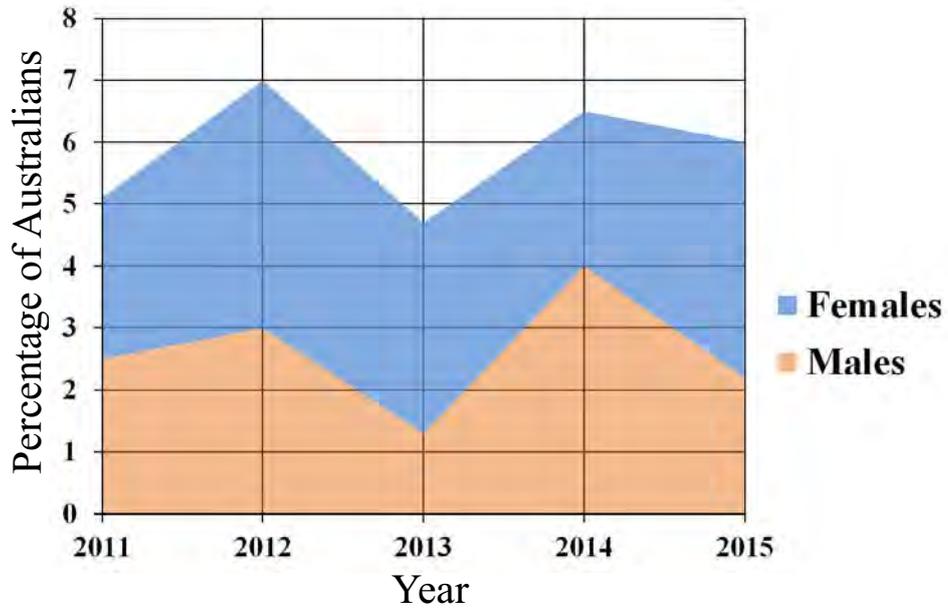
2

Solution

QUESTION TWENTY NINE (Continued)

(d)

Australian Unemployment by Gender



The stacked area chart above illustrates the mean percentage of Australians that were unemployed each year from 2011 to 2015, divided into male and female bands.

(i) What was the combined unemployment rate in 2015?

1

Solution

(ii) For the year 2012, find the percentage of unemployed females.

1

Solution

QUESTION TWENTY NINE (Continued)

- (iii) The difference between the unemployment rate for males and females fluctuates. 1
In which year was this difference the smallest?

Solution

- (e) Borris decided to test the accuracy of Simpson’s rule to approximate the area of a semi-circle.

- (i) Use one application of Simpson’s rule to approximate the area of a semi-circle with radius 5 cm. 2

Solution

- (ii) Borris noticed that the approximate area he calculated was less than the actual area. What percentage is the approximate area of the actual area? Give your answer correct to the nearest percent. 1

Solution

QUESTION TWENTY NINE (Continued)

(f) John is applying for a place at the Design College. He will be accepted if he passes the theory exam OR the practical exam. He has a probability of 0.6 of passing the theory exam and a probability of 0.7 of passing the practical exam. They are independent events.

(i) Draw a probability tree diagram showing all of the possible outcomes.

2

Solution

(ii) Find the probability that he passes both exams.

1

Solution

QUESTION TWENTY NINE (Continued)

(iii) Find the probability that he is accepted into the College.

2

Solution

QUESTION THIRTY (15 marks)

Marks

(a) The population of an island is increasing exponentially. The population of the island is modelled using the formula $P = 40\,000(1.03)^t$, where P is the population and t is the time in years.

(i) What was the initial population of the island?

1

Solution

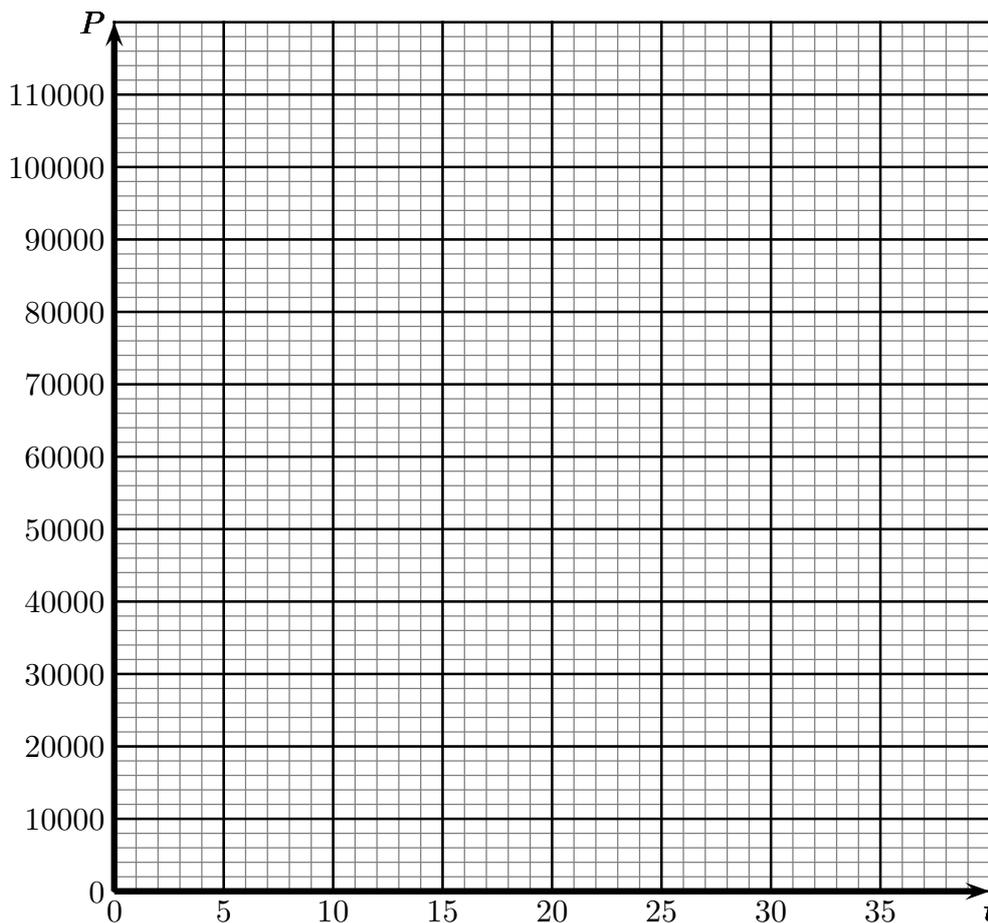
(ii) Complete the table of values below using $P = 40\,000(1.03)^t$.

1

t	0	5	10	15	20	25
P						

(iii) Draw the population graph with t on the horizontal axis and P on the vertical axis.

2



QUESTION THIRTY (Continued)

(iv) Use the graph to estimate the population at 18 years.

1

Solution

(v) Estimate the time taken for the population to reach 59 000.

1

Solution

(vi) Extrapolate your graph to obtain an estimate of the time taken for the population to reach 100 000.

1

Solution

(b) The distance, d km, travelled by a train is directly proportional to the time t , in hours, it has travelled and is given by the relationship $d = mt + b$. In five hours the train travelled 400 km. What is the value of b ?

1

Solution

(c) A and B are antipodal points. If A has position $(37^\circ\text{S}, 145^\circ\text{W})$, find the position coordinates of B .

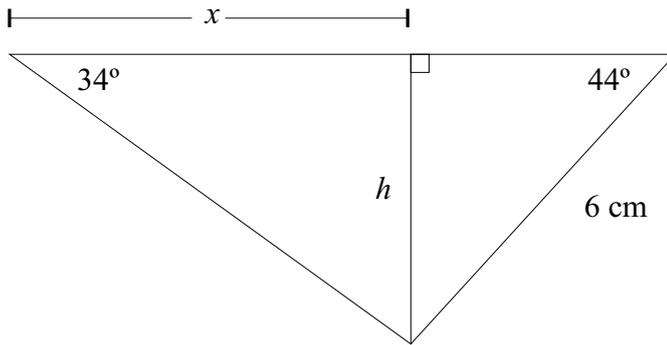
1

Solution

QUESTION THIRTY (Continued)

3

(d)



Determine the value of x in the diagram above. Give your answer correct to two decimal places.

Solution

QUESTION THIRTY (Continued)

3

(e) Nigel knows that the cost of electricity to run his home is presently \$200 per month.

The fuse box in Nigel’s home was damaged during an electrical storm. He has been told that it will cost \$290 to fix. Rather than spending the money to fix it, Nigel investigates the cost of installing a solar system.

The cost of the solar system and installation will be \$4000 and his monthly electricity cost will decrease by 40%. Also, the government is offering an incentive of \$10 cash back per month for using green energy for which Nigel will be eligible. Unfortunately, there is a \$240 a year maintenance cost, charged monthly, on the solar panels.

He decides to install the solar system. How long will it take for Nigel to recoup the cost of the solar system and start saving money?

Solution

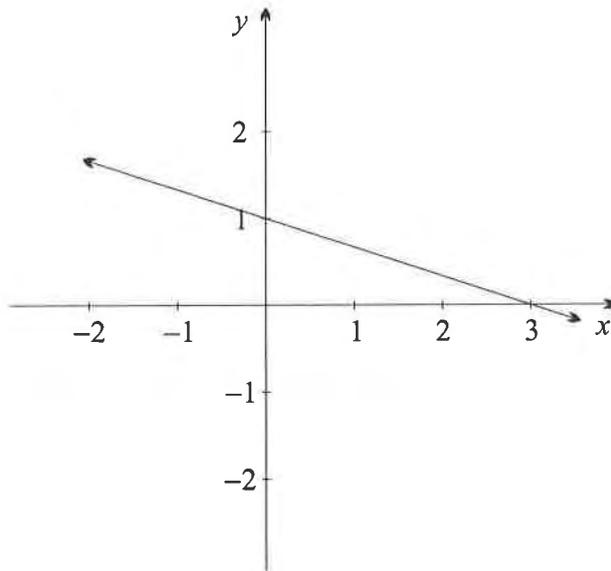
————— End of Section II —————

END OF EXAMINATION

SECTION I - Multiple Choice

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QUESTION ONE



What is the correct equation of the line shown above?

- (A) $y = -3x + 1$
- (B) $y = -\frac{1}{3}x + 1$
- (C) $y = \frac{1}{3}x + 1$
- (D) $y = 3x + 1$

$m = -\frac{1}{3}$
 $b = 1$

QUESTION TWO

Expand and simplify $6x^2(x^2 - 1) - 2x^2$.

- (A) $6x^4 - 2x^2 - 1$
- (B) $6x^4 - 4x^2$
- (C) $6x^4 - 8x^2$
- (D) $-12x^6 + 12x^4$

$6x^4 - 6x^2 - 2x^2$
 $= 6x^4 - 8x^2$

QUESTION THREE

When rounded to 2 significant figures, 3950.628 becomes:

- (A) 39
- (B) 3900
- (C) 3950.63
- (D) 4000

QUESTION FOUR

A 2400-watt heater is run for six hours each day. If electricity is charged at 26.3c/kWh, what is the cost of running the heater for eight days?

- (A) \$3.03
- (B) \$30.30
- (C) \$302.98
- (D) \$3029.76

$$\frac{2400 \times 6}{1000} = 14.4 \text{ kWh}$$

$$14.4 \times 26.3 = 378.72 \text{ 1 day}$$

$$3029.76 \text{ 8 days}$$

QUESTION FIVE

Esteban asked 30 students about their method of travel to school. The results of the survey are displayed in the table below.

Method of travel	Frequency
Walk	3
Cycle	6
Bus	12
Car	5
Train	4

He decides to construct a sector graph to display the information in the table. What is the angle of the sector representing 'Bus'?

- (A) 12°
- (B) 30°
- (C) 40°
- (D) 144°

$$\frac{12}{30} \times 360$$

QUESTION SIX

Alicia just received her water bill for July. It shows the following charges. Use the table below to calculate the total amount due.

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Wastewater (sewerage)	\$151.08
Water usage 24.2 kL @ \$2.248 per kL	54.40
Amount due	

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QUESTION SEVEN

A car travels 480 km on 60 L of petrol. Its fuel consumption is:

- (A) 0.125 L/100 km
- (B) 8 L/100 km
- (C) 12.5 L/100 km
- (D) 28.8 L/100 km

60 L per 480 km

$$\frac{60}{480} \times 100 \text{ L per } 100 \text{ km}$$

QUESTION EIGHT

Amy, Brett and Coen invested \$30 000, \$25 000 and \$15 000 respectively in a new business. At the end of the first year the business made a total profit of \$42 000. The profit was divided in the same ratio as the amounts they had invested. How much of the profit did Amy receive?

- (A) \$9000
- (B) \$14 000
- (C) \$18 000
- (D) \$30 000

$$\frac{30\,000}{(30\,000 + 25\,000 + 15\,000)} \times 42\,000$$

QUESTION NINE

Karl claims \$96 per year depreciation on the brick-cutter he uses in his work as a bricklayer. The brick-cutter originally cost \$1200. What straight line rate of depreciation did Karl use to calculate \$96 depreciation?

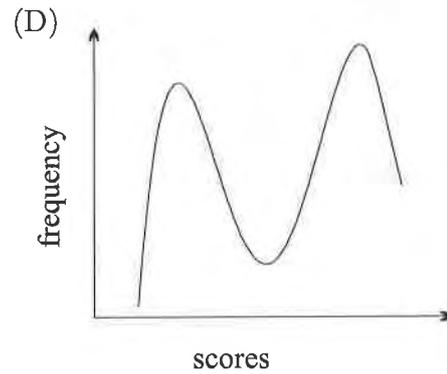
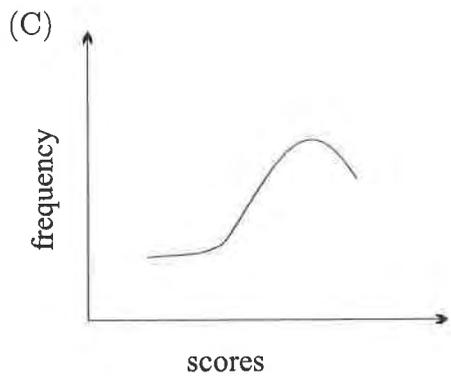
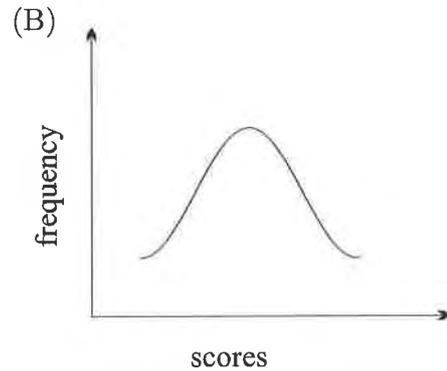
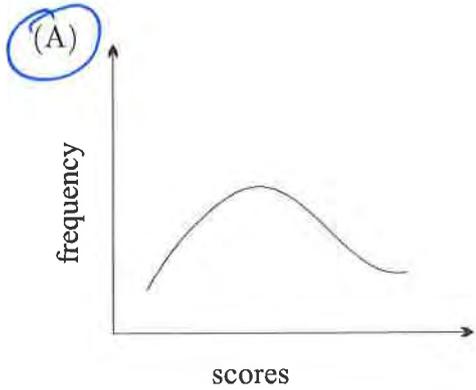
- (A) 0.08% p.a.
- (B) 0.125% p.a.
- (C) 8.0% p.a.
- (D) 12.5% p.a.

$$96 = 1200R(1)$$

$$R = \frac{96}{1200}$$

QUESTION TEN

Which graph below indicates the data was positively skewed?



QUESTION ELEVEN

A set of scores are normally distributed. The scores have a mean of 70 and a standard deviation of 8. What z-score corresponds to a mark of 66?

(A) -1

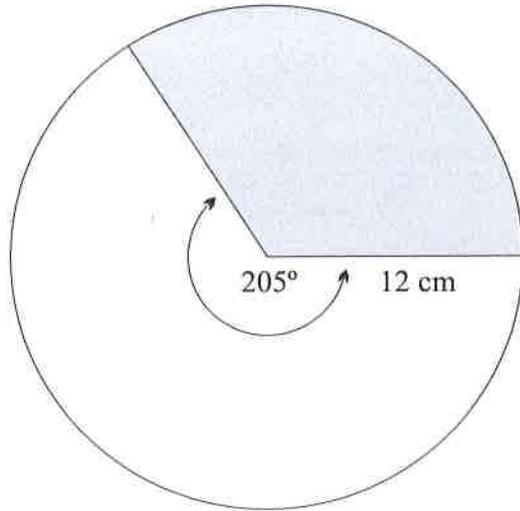
(B) $-\frac{1}{2}$

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

(D) 1

$$\frac{66 - 70}{8}$$

QUESTION TWELVE

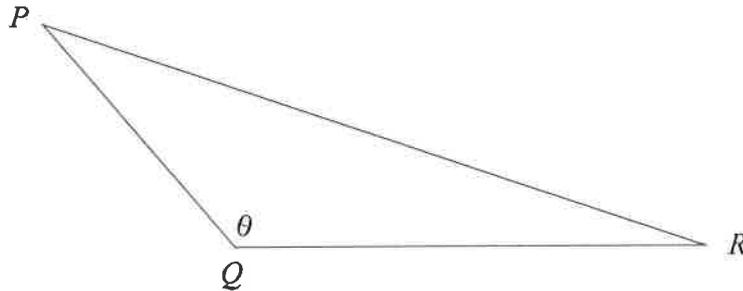


Calculate the area of the shaded sector of radius 12 cm shown above.

- (A) 32.5 cm^2
- (B) 42.9 cm^2
- (C) 195 cm^2
- (D) 258 cm^2

$$\frac{155}{360} \pi (12)^2$$

QUESTION THIRTEEN



In $\triangle PQR$ shown above, angle θ is obtuse. Which of these could be the value of $\cos \theta$?

- (A) -1.5
- (B) -0.5
- (C) 0.5
- (D) 1.5

$$-1 \leq \cos \theta \leq 1$$

θ obtuse, $-1 < \cos \theta < 0$

QUESTION FOURTEEN

Angela is going to choose 3 names from 8 out of a hat and arrange them in order from left to right. How many different arrangements can she make?

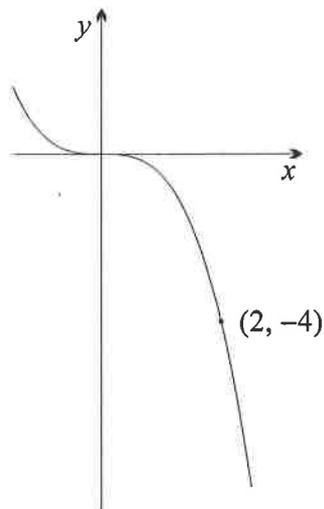
(A) $3!$

(B) $\frac{8!}{3!5!}$

(C) $\frac{8!}{5!}$

(D) $8!$

QUESTION FIFTEEN



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

(A) -2

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

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

(D) 2

$$-4 = k(2)^3$$

$$-4 = 8k$$

$$k = -\frac{4}{8}$$

QUESTION SIXTEEN

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

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

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

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

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

$$4022 - 3340 = 3340 R \left(\frac{11}{12}\right)$$

$$12(4022 - 3340) = (11)(3340)R$$

$$R = \frac{12(4022 - 3340)}{11(3340)}$$

QUESTION SEVENTEEN

The daily cost of running a sandwich shop that makes n sandwiches is given by the equation $C = 3n + 150$. The 150 could represent the:

- (A) number of sandwiches sold
- (B) cost per sandwich
- (C) fixed daily cost
- (D) number of sandwiches made

QUESTION EIGHTEEN

The weights in kilograms of eight women at birth and at the age of 21 are given in the table below:

Birth weight	1.9	2.4	2.6	2.7	2.9	3.2	3.4	3.6
Weight at 21	47.6	53.1	52.2	56.2	57.6	59.9	55.3	56.7

What is the value of the correlation coefficient r ?

- (A) 0.5360
- (B) 0.6182
- (C) 0.7863
- (D) 0.8232

QUESTION NINETEEN

When you cross the International Date Line from east to west, you should:

- (A) put the clock forward one day
- (B) put the clock back one day
- (C) put the clock forward 12 hours
- (D) put the clock back 12 hours

QUESTION TWENTY

If an event E is certain to happen, then:

(A) $P(E) = 0$

(B) $P(E) = \frac{1}{2}$

(C) $P(E) = 1$

(D) $0 < P(E) < 1$

QUESTION TWENTY ONE

The capacity of a cubic tank with side length 8 m is:

(A) 64 kL

(B) 512 kL

(C) 640 kL

(D) 512 000 kL

$$\begin{aligned} V &= 8^3 \\ &= 512 \text{ m}^3 \\ &= 512 000 \text{ L} \end{aligned}$$

QUESTION TWENTY TWO

A machine produces 6000 items in a week. To obtain a systematic sample of 200, we could start with the 10th item and then select item numbers:

(A) 40, 70, 100, 130, ...

(B) 200, 400, 600, 800, ...

(C) 100, 190, 280, 370, ...

(D) 210, 410, 610, 810, ...

QUESTION TWENTY THREE

A phone plan charges 28 cents per MB for excess data usage in blocks of 1 MB. What is the cost of 27.8 MB of excess data?

(A) 28 cents

(B) \$7.56

(C) \$7.78

(D) \$7.84

$$28 \times 28$$

QUESTION TWENTY FOUR

On Tuesday Andre worked 8 hours at normal time and 2 hours at time-and-a-half. His normal rate of pay is \$23.80 per hour. Which expression calculates Andre's pay on Tuesday in dollars?

(A) $8 \times 23.8 + 2 \times 0.5 \times 23.8$

(B) $8 \times 23.8 + 2 \times 23.8$

(C) 11×23.8

(D) $8 \times 23.8 \times 2 \times 1.5 \times 23.8$

QUESTION TWENTY FIVE

Chloe holds a provisional license. Her allowable Blood Alcohol Content (BAC) to drive is zero. She knows that the liver breaks down alcohol at an average rate of 0.75 standard drinks per hour. If she consumed 10 standard drinks from 10 pm to 2 am, what is the earliest time that she could legally drive to work?

(A) 11:20 am

(B) 11:33 am

(C) 3:20 pm

(D) 3:33 pm

————— End of Section I —————

Examination continues next page ...

SECTION II - Written Response

Answers for this section should be recorded in the space provided in this paper.
Show all necessary working.

QUESTION TWENTY SIX (15 marks)

Marks

(a) Simplify $6x - 7x$.

1

Solution

$$-x \quad \checkmark$$

(b) A cube has a side length of 4 cm. What is the surface area of the cube?

1

Solution

$$6 \times 4^2 = 96 \text{ cm}^2 \quad \checkmark$$

(c) A square pyramid has a base with side lengths of 9 cm and a perpendicular height of 4 cm. Calculate the volume of the pyramid.

2

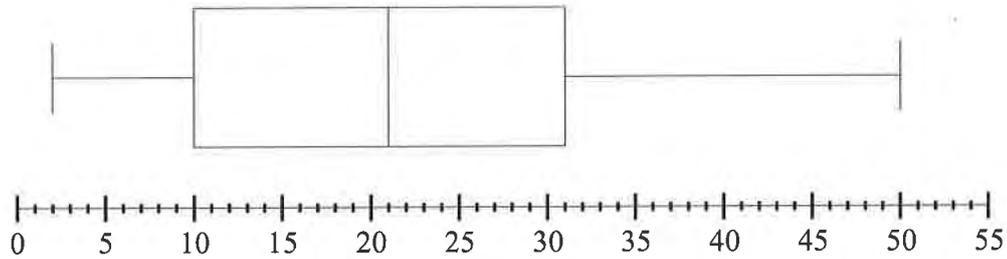
Solution

$$\begin{aligned} V &= \frac{1}{3} (9)^2 (4) \quad \checkmark \\ &= 108 \text{ cm}^3 \quad \checkmark \end{aligned}$$

QUESTION TWENTY SIX (Continued)

(d)

1



What is the interquartile range of the data shown in the box plot above?

Solution

$$31 - 10 = 21 \quad \checkmark$$

(e) Constantine borrows \$8000 to buy a car. The flat interest rate is 8.6% p.a. and he repays the loan in equal monthly instalments over five years.

(i) Find the amount of interest charged.

1

Solution

$$\begin{aligned} I &= (8000)(0.086)(5) \\ &= \$3440 \quad \checkmark \end{aligned}$$

(ii) Find the total amount to be repaid.

1

Solution

$$3440 + 8000 = \$11440 \quad \checkmark$$

QUESTION TWENTY SIX (Continued)

(iii) Find the monthly repayment.

1

Solution

$$\frac{11\,440}{(12)(5)} = \$190.67 \quad \checkmark$$

(f) Make x the subject of the formula $y = k - mx$.

2

Solution

$$y = k - mx$$

$$y - k = -mx \quad \checkmark$$

$$k - y = mx$$

$$x = \frac{k - y}{m} \quad \checkmark$$

QUESTION TWENTY SIX (Continued)

- (g) The radius of the Earth is approximately 6370 km to the nearest 10 km. Assuming that the Earth is a sphere, what are the largest and smallest possible surface areas? Give your answers correct to the nearest km^2 . 2

Solution

$$r_{\text{small}} = 6365 \text{ km}$$

$$r_{\text{large}} = 6374 \text{ km}$$

$$SA_{\text{small}} = 509\,104\,200 \text{ km}^2$$

$$SA_{\text{large}} = 510\,544\,947 \text{ km}^2$$

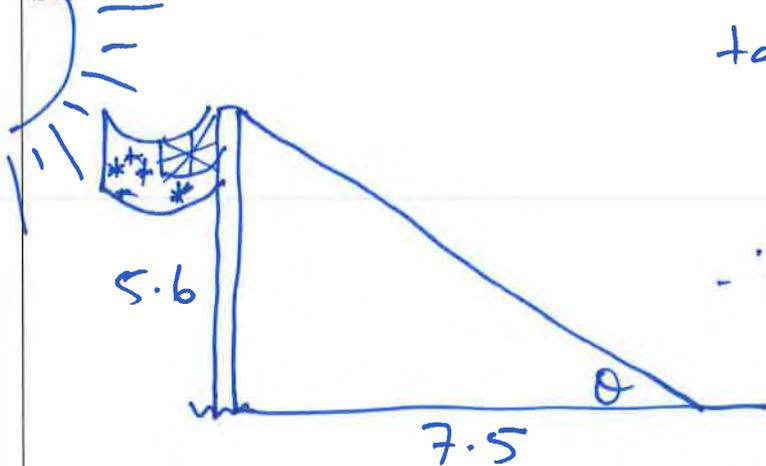
- (h) Deniliquin is 1° south of Hay. If Hay's coordinates are $(34^\circ\text{S}, 145^\circ\text{E})$, what are Deniliquin's coordinates? 1

Solution

$$(35^\circ\text{S}, 145^\circ\text{E})$$

- (i) A flagpole 5.6 m high casts a shadow 7.5 m long. What is the angle of elevation of the sun? Give your answer correct to the nearest minute. 2

Solution



$$\tan \theta = \frac{5.6}{7.5}$$

$$\theta = 36^\circ 45'$$

\therefore The angle of elevation is $36^\circ 45'$.

QUESTION TWENTY SEVEN (15 marks)

Marks

- (a) Calculate the number of Kb in 5.9 MB. Give your answer correct to the nearest Kb. 1

Solution

$$\begin{aligned}
 5.9 \text{ MB} &= 5.9 \times 2^{20} \text{ bytes} \\
 &= 5.9 \times 2^{20} \times 8 \text{ bits} \\
 &= \frac{5.9 \times 2^{20} \times 8}{1000} \text{ Kb} \\
 &= 49\,493 \text{ Kb} \quad \checkmark
 \end{aligned}$$

- (b) The ratio of heads to tails when a biased coin is tossed is 5 : 7. The coin is tossed twice. Determine the probability of getting at least one head. 2

Solution

$$\begin{aligned}
 P(\text{at least 1 head}) &= 1 - P(\text{no head}) \\
 &= 1 - \frac{7}{12} \cdot \frac{7}{12} \quad \checkmark \\
 &= \frac{95}{144} \quad \checkmark
 \end{aligned}$$

- (c) Calculate the dividend on 3500 shares with a market price of \$1.00 per share if the dividend yield is 4.6%. 1

Solution

$$\begin{aligned}
 \text{dividend} &= (0.046)(3500)(1) \\
 &= \$161 \quad \checkmark
 \end{aligned}$$

QUESTION TWENTY SEVEN (Continued)

(d) Rohit washes his car twice a month. Washing by hose uses 180 L/wash and washing by bucket uses 100 L/wash.

(i) How much does the water cost each year if he uses a hose and water costs \$2.18/kL? 2

Solution

$$\text{Water} = \frac{180 \times 2 \times 12}{1000} \text{ kL}$$

$$= 4.32 \text{ kL} \quad \checkmark$$

$$\therefore \text{Cost} = 4.32 \times 2.18$$

$$= \$9.42 \quad \checkmark$$

(ii) How much would he save each year if he used a bucket instead of a hose? 2

Solution

$$\text{Water}_{\text{bucket}} = \frac{100 \times 2 \times 12}{1000} \text{ kL}$$

$$= 2.4 \text{ kL} \quad \checkmark$$

$$\text{Cost}_{\text{bucket}} = 2.4 \times 2.18$$

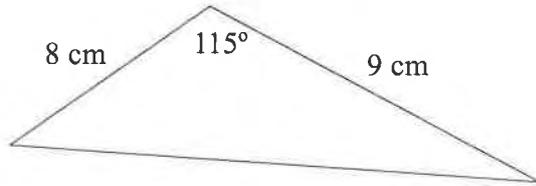
$$= \$5.23$$

$$\therefore \text{Money saved is } \$4.19 \quad \checkmark$$

QUESTION TWENTY SEVEN (Continued)

(e)

2



Find the area of the triangle shown above. Give your answer correct to the nearest square centimetre.

Solution

$$\begin{aligned} \text{Area} &= \frac{1}{2}(8)(9)\sin 115^\circ \checkmark \\ &\doteq 33 \text{ cm}^2 \checkmark \end{aligned}$$

(f) A bag contains one red, one black and one white marble. Two marbles are selected from the bag. The first marble is selected and not replaced before the second marble is selected. What is the probability of getting one red and one white marble?

2

Solution

$$\begin{aligned} P(\text{Red and white}) &= P(RW) + P(WR) \checkmark \\ &= \frac{1}{3} \cdot \frac{1}{2} + \frac{1}{3} \cdot \frac{1}{2} \\ &= \frac{1}{3} \checkmark \end{aligned}$$

QUESTION TWENTY SEVEN (Continued)

- (g) Susan and Jim join a Get Slim program. The weights of participants in each program are normally distributed and the statistics for male and female groups are shown in the table below. 3

	Mean weight (kg)	Standard deviation (kg)
Male group	93	7.5
Female group	83	6

If Susan weighs 86.4 kg and Jim weighs 97.2 kg, who is more overweight compared to the people in their group? Justify your answer.

Solution

$$z_{\text{susan}} = \frac{86.4 - 83}{6} \\ \doteq 0.567 \quad \checkmark$$

$$z_{\text{jim}} = \frac{97.2 - 93}{7.5} \\ = 0.56 \quad \checkmark$$

\therefore Susan is more overweight as her z-score is higher which means she is further from the mean. \checkmark

QUESTION TWENTY EIGHT (15 marks)

Marks

- (a) The formula $D = \frac{2A}{15}$ is used to calculate the dosage of a medicine to be given to a child where D is the dosage in millilitres and A is the age of the child in months. Give your answer correct to the nearest millilitre.

(i) If Sam is 8 months old, what dosage of the medicine should he be given?

1

Solution

$$D = \frac{2(8)}{15}$$

$$\doteq 1\text{mL} \quad \checkmark$$

- (ii) The correct dosage of the medicine for Luke is 5 mL. What is Luke's age in months?

2

Solution

$$5 = \frac{2A}{15} \quad \checkmark$$

$$2A = 75$$

$$A = 37.5 \quad \checkmark$$

Luke is $37\frac{1}{2}$ months old.

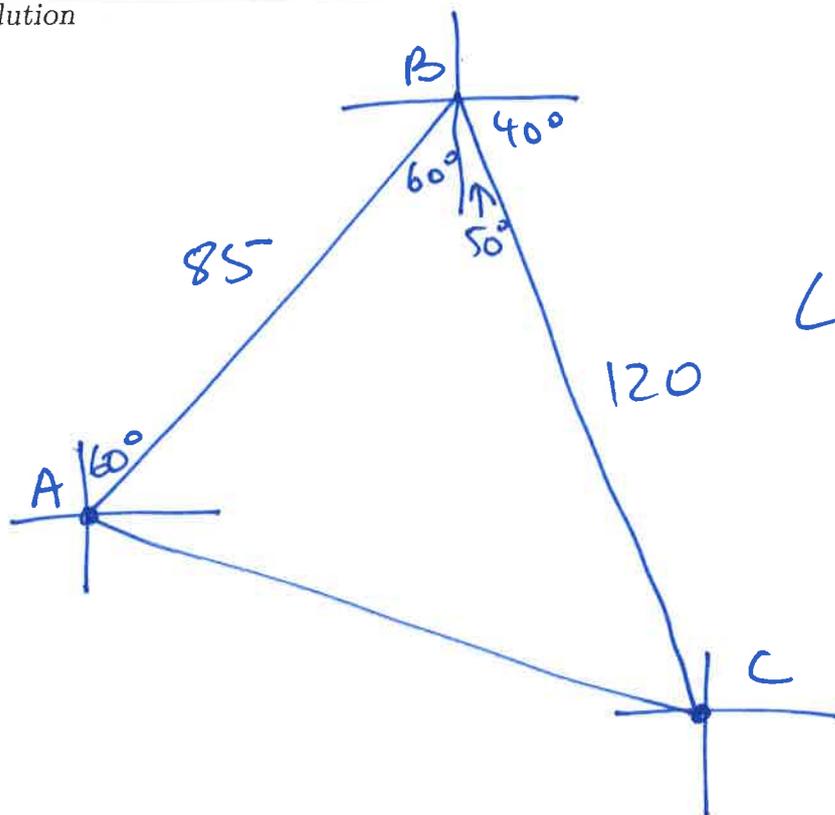
QUESTION TWENTY EIGHT (Continued)

(b) A ship sails 85 km from A to B on a bearing of 060°T . It then turns and sails 120 km to C on a bearing of 130°T .

(i) Find the size of $\angle ABC$.

1

Solution



$\angle ABC = 110^\circ$ ✓

(ii) How far is the ship from its starting point? Give your answer correct to the nearest kilometre.

2

Solution

$$AC^2 = 85^2 + 120^2 - 2(85)(120)\cos 110^\circ$$

$$AC \doteq 169 \text{ km}$$

QUESTION TWENTY EIGHT (Continued)

- (iii) What is the bearing of the ship from its starting point? Give your answer to the nearest degree. 2

Solution

$$\frac{\sin \theta}{120} = \frac{\sin 110^\circ}{169}$$

$$\theta \doteq 42^\circ \checkmark$$

\therefore Bearing is 102°T \checkmark

- (c) A plane flies along the meridian from $(45^\circ\text{S}, 115^\circ\text{W})$ to $(8^\circ\text{N}, 115^\circ\text{W})$. Assuming the radius of the earth is 6400 km, what distance does the plane fly? Give your answer correct to the nearest 100 kilometres. 3

Solution

$$\begin{aligned} \theta &= 45^\circ + 8^\circ \\ &= 53^\circ \end{aligned} \checkmark$$

$$d = \frac{53}{360} \times 2 \times \pi \times 6400 \checkmark$$

$$\doteq 5900 \text{ km} \checkmark$$

(must be rounded correctly)

QUESTION TWENTY EIGHT (Continued)

(d) During pregnancy, the period from conception to delivery of a baby is called the gestation period. The gestation period for humans is normally distributed with a mean of 266 days and a standard deviation of 16 days.

(i) Between which two values will 95% of gestation periods lie?

2

Solution

$$266 - 2 \times 16 \longleftrightarrow 266 + 2 \times 16$$

$$234 \text{ days} \longleftrightarrow 298 \text{ days}$$

(ii) What percentage of pregnancies will last more than 282 days?

1

Solution

$$z = \frac{282 - 266}{16} = 1$$

$$\frac{100 - 68}{2} = 16$$

16% will last more than 282 days

(iii) Is it possible to have a gestation period of 320 days? Justify your answer.

1

Solution

Yes. It is possible to have 1000 days, but it is unlikely.

QUESTION TWENTY NINE (15 marks)

Marks

- (a) What is the value in dollars of the 10% GST on a Blu-Ray player that sells for \$458? 1
Give your answer correct to the nearest cent.

Solution

$$\frac{458}{11} = \$41.64 \checkmark$$

- (b) The surface area of a lake is 785 000 m². If an average of 4 mm of rain falls on the lake, what will be the increase in volume of water in the lake? Ignore any runoff from the surrounding area. 1

Solution

$$\begin{aligned} V &= 785\,000 \times \frac{4}{(10 \times 100)} \\ &= 3140 \text{ m}^3 \checkmark \\ \text{OR } &3140 \text{ kL} \end{aligned}$$

- (c) When it is noon Thursday, local time, in Chicago (42°N, 88°W), what is the local time in Tokyo (36°N, 140°E)? 2

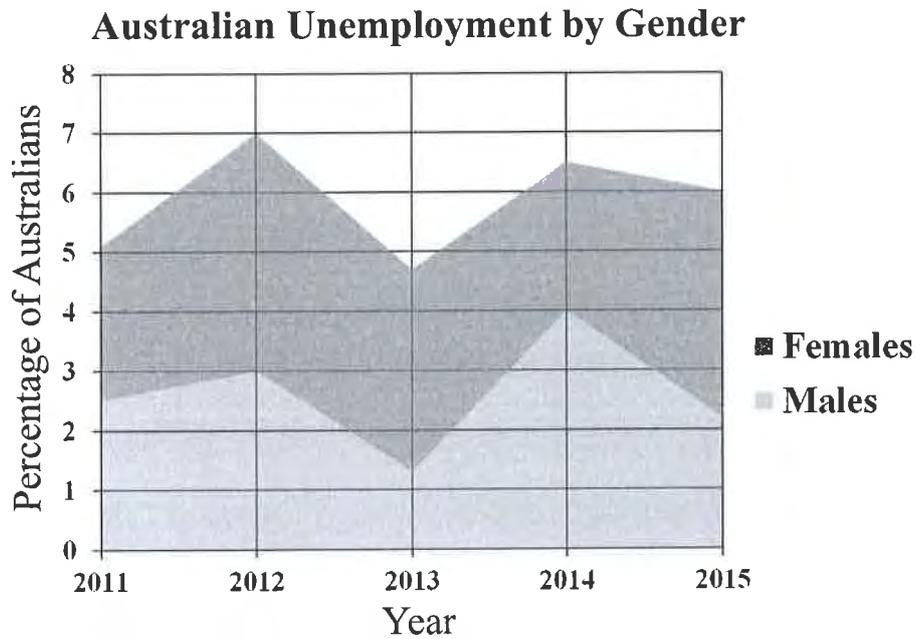
Solution

$$\begin{aligned} 88^\circ + 140^\circ &= 228^\circ \checkmark \\ \frac{228}{15} &= 15.2 \end{aligned}$$

It is 3:12 am Friday in Tokyo. ✓

QUESTION TWENTY NINE (Continued)

(d)



The stacked area chart above illustrates the mean percentage of Australians that were unemployed each year from 2011 to 2015, divided into male and female bands.

(i) What was the combined unemployment rate in 2015?

1

Solution

6% ✓

(ii) For the year 2012, find the percentage of unemployed females.

1

Solution

4% ✓

QUESTION TWENTY NINE (Continued)

- (iii) The difference between the unemployment rate for males and females fluctuates. 1
 In which year was this difference the smallest?

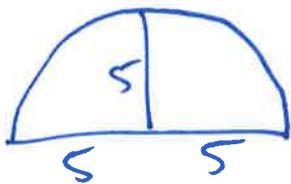
Solution

2011 ✓

- (e) Borris decided to test the accuracy of Simpson's rule to approximate the area of a semi-circle.

- (i) Use one application of Simpson's rule to approximate the area of a semi-circle with radius 5 cm. 2

Solution



$$A \doteq \frac{5}{3} (0 + 4(5) + 0) \checkmark$$

$$= 33 \frac{1}{3} \text{ cm}^2 \checkmark$$

- (ii) Borris noticed that the approximate area he calculated was less than the actual area. What percentage is the approximate area of the actual area? Give your answer correct to the nearest percent. 1

Solution

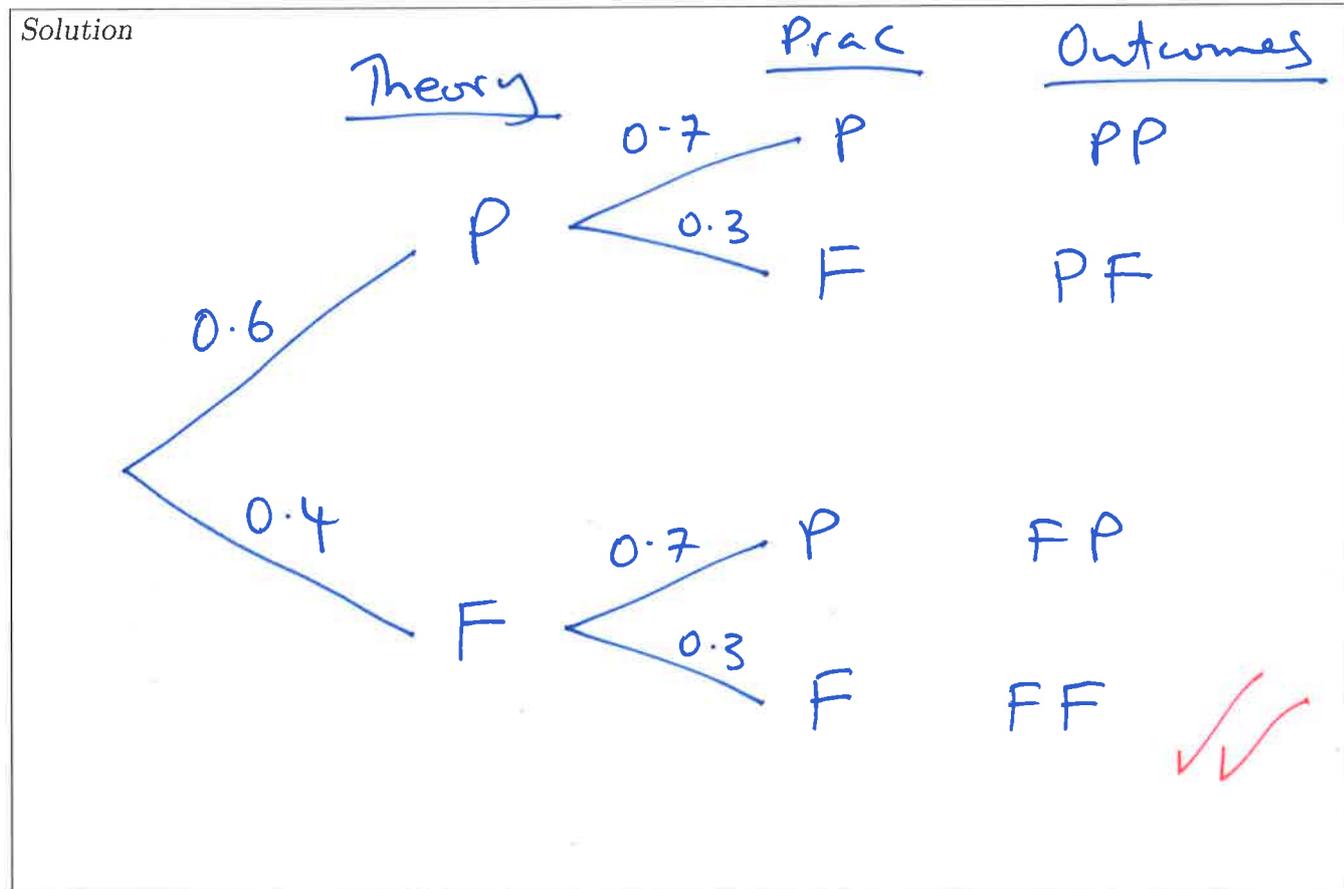
$$\frac{33 \frac{1}{3}}{\frac{1}{2} \pi (5)^2} \times 100\% \doteq 85\% \checkmark$$

QUESTION TWENTY NINE (Continued)

(f) John is applying for a place at the Design College. He will be accepted if he passes the theory exam OR the practical exam. He has a probability of 0.6 of passing the theory exam and a probability of 0.7 of passing the practical exam. They are independent events.

(i) Draw a probability tree diagram showing all of the possible outcomes.

2



(ii) Find the probability that he passes both exams.

1

Solution

$$P(PP) = 0.6 \times 0.7$$

$$= 0.42 \quad \checkmark$$

QUESTION TWENTY NINE (Continued)

(iii) Find the probability that he is accepted into the College.

2

Solution

$$\begin{aligned} P(\text{College}) &= 1 - P(\text{FF}) \checkmark \\ &= 1 - 0.4 \times 0.3 \\ &= 0.88 \checkmark \end{aligned}$$

QUESTION THIRTY (15 marks)

Marks

(a) The population of an island is increasing exponentially. The population of the island is modelled using the formula $P = 40\,000(1.03)^t$, where P is the population and t is the time in years.

(i) What was the initial population of the island?

1

Solution

40 000 / i.e. $t = 0$

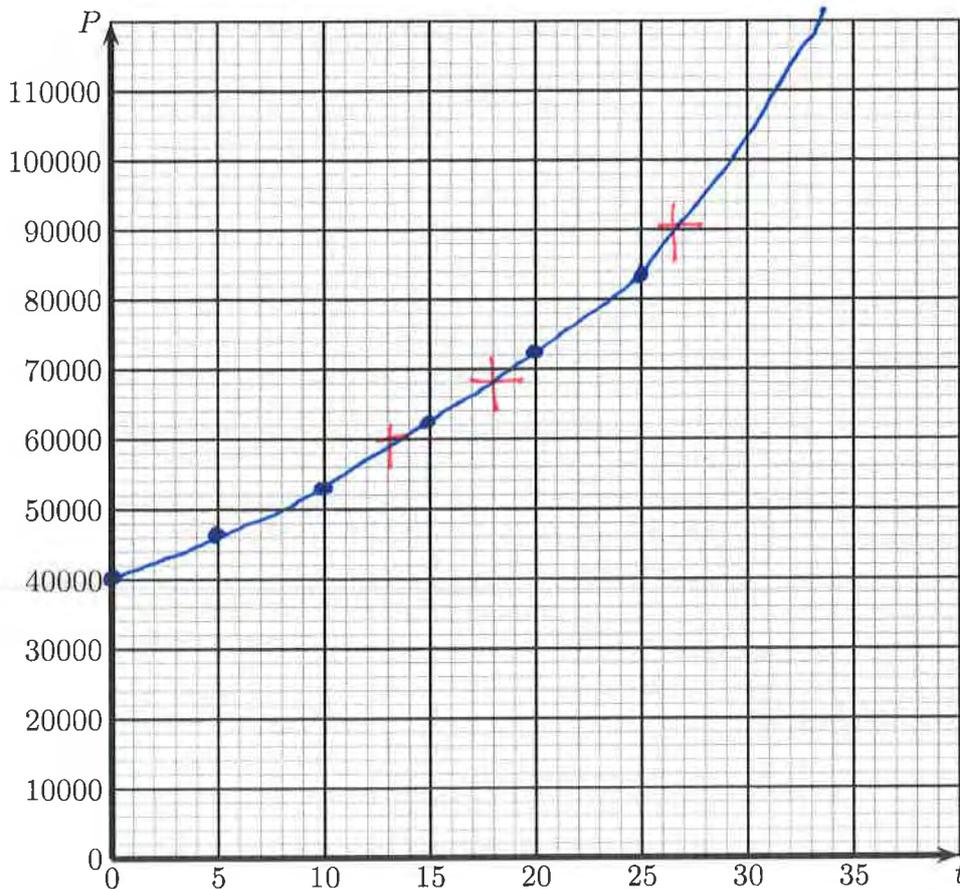
(ii) Complete the table of values below using $P = 40\,000(1.03)^t$.

1

t	0	5	10	15	20	25
P	40 000	46 371	53 757	62 319	72 244	83 751

(iii) Draw the population graph with t on the horizontal axis and P on the vertical axis.

2



QUESTION THIRTY (Continued)

(iv) Use the graph to estimate the population at 18 years. 1

Solution

68 000 ✓

(v) Estimate the time taken for the population to reach 59 000. 1

Solution

13.5 years ✓

(vi) Extrapolate your graph to obtain an estimate of the time taken for the population to reach 100 000. 1

Solution

31 years ✓

(b) The distance, d km, travelled by a train is directly proportional to the time t , in hours, it has travelled and is given by the relationship $d = mt + b$. In five hours the train travelled 400 km. What is the value of b ? 1

Solution

0 ✓

(c) A and B are antipodal points. If A has position $(37^\circ\text{S}, 145^\circ\text{W})$, find the position coordinates of B . 1

Solution

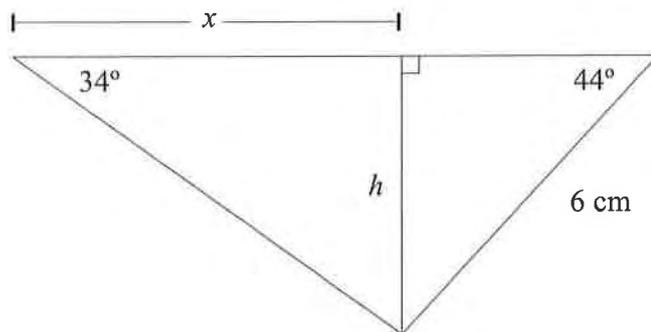
$(37^\circ\text{N } 35^\circ\text{E})$ ✓

Marked off graph -

QUESTION THIRTY (Continued)

(d)

3



Determine the value of x in the diagram above. Give your answer correct to two decimal places.

Solution

$$\sin 44^\circ = \frac{h}{6} \quad \checkmark$$

$$h = 6 \sin 44^\circ$$

$$\tan 34^\circ = \frac{h}{x} \quad \checkmark$$

$$x = \frac{h}{\tan 34^\circ}$$

$$= \frac{6 \sin 44^\circ}{\tan 34^\circ}$$

$$\hat{=} 6.18 \text{ cm} \quad \checkmark$$

QUESTION THIRTY (Continued)

- (e) Nigel knows that the cost of electricity to run his home is presently \$200 per month. 3

The fuse box in Nigel's home was damaged during an electrical storm. He has been told that it will cost \$290 to fix. Rather than spending the money to fix it, Nigel investigates the cost of installing a solar system.

The cost of the solar system and installation will be \$4000 and his monthly electricity cost will decrease by 40%. Also, the government is offering an incentive of \$10 cash back per month for using green energy for which Nigel will be eligible. Unfortunately, there is a \$240 a year maintenance cost, charged monthly, on the solar panels.

He decides to install the solar system. How long will it take for Nigel to recoup the cost of the solar system and start saving money?

Solution

$$C = 290 + 200m \dots \textcircled{1}$$

$$C = 4000 + (0.6)(200)m - 10m + \frac{240}{12}m$$

$$C = 4000 + 130m \dots \textcircled{2}$$

sub $\textcircled{1}$ into $\textcircled{2} \Rightarrow$

$$290 + 200m = 4000 + 130m$$

$$70m = 3710$$

$$m = 53$$

\therefore It will take Nigel 53 months (4 years 5 months) to start saving money.