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CANDIDATE NUMBER

SYDNEY GRAMMAR SCHOOL



2014 Assessment Examination

FORM VI

GENERAL MATHEMATICS

Friday 1st August 2014

General Instructions

- Reading time — 5 minutes
- Writing time — 2 hours 30 minutes
- Write using black or blue 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 solutions 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.
- Place your multiple choice answer sheet inside the question paper

Checklist

- Multiple choice answer sheet
- Formulae sheet
- Candidature — 9 boys

Examiner

REJ

SECTION I - Multiple Choice

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

QUESTION ONE

The probability of an event occurring is 0.1. What is the probability that this event will NOT occur?

- (A) 0.1
- (B) 10%
- (C) 0.9
- (D) 0.09

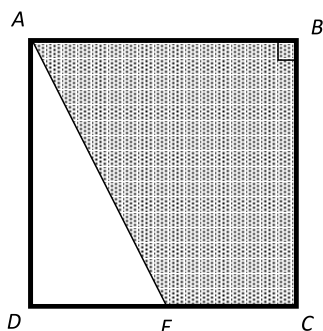
QUESTION TWO

The length of the wingspan for a number of rare birds was recorded. What type of data has been recorded?

- (A) Continuous
- (B) Discrete
- (C) Categorical
- (D) Systematic

QUESTION THREE

The square $ABCD$ has a perimeter of 36 cm.



The point E is the the midpoint of the edge DC of the square. What is the perimeter, in centimetres, of the shaded trapezium?

- (A) 21.7 cm
- (B) 22.5 cm
- (C) 31.5 cm
- (D) 32.6 cm

QUESTION FOUR

On Monday at 2:00 pm local time in Sydney (150°E), an email is sent to Rio de Janeiro (45°W). At what local time in Rio de Janeiro should the email arrive? You may assume that the email arrives instantly.

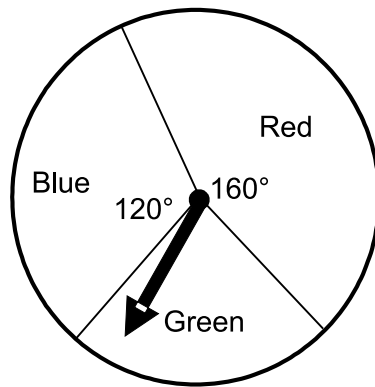
- (A) 1:00 am Monday
- (B) 1:00 pm Monday
- (C) 7:00 am Monday
- (D) 3:00 pm Tuesday

QUESTION FIVE

Which of the following data sets demonstrates a range of 23 and an interquartile range of 15?

- (A) 4, 10, 15, 18, 27
- (B) 4, 10, 10, 18, 25, 31
- (C) 4, 6, 10, 12, 14, 19
- (D) 4, 10, 10, 18, 25, 27

QUESTION SIX



Each time the arrow is spun on this spinner, what is the probability that it will land in the Green sector?

- (A) $\frac{1}{3}$
- (B) $\frac{1}{9}$
- (C) $\frac{2}{9}$
- (D) $\frac{1}{6}$

QUESTION SEVEN

A 2400-watt heater is run for 6 hours each day. If electricity is charged at 26.3c/kWh, what is the cost of running the heater for 8 days, to the nearest cent?

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

QUESTION EIGHT

The hiring charge \$ C for a large crane at a building site is determined by the formula:

$$C = 850 + 1385d$$

where d is the number of days the crane is on site. What is the total cost of hiring a crane for 18 days?

- (A) \$23 545
- (B) \$24 395
- (C) \$25 364.50
- (D) \$25 780

QUESTION NINE

The scale on an aerial photograph is given as $1 \text{ mm} = 200 \text{ m}$. If the distance between two landmarks A and B is 350 m, what is the distance between A and B on the map.

- (A) 0.25 mm
- (B) 0.57 mm
- (C) 1.75 mm
- (D) 2 cm

QUESTION TEN

Nathan works the number of hours shown in the table below.

Employee	Normal hours	Hours at time-and-a-half	Gross wage
Nathan B	28	6	\$592

According to the information in the table, what was the hourly rate at which Nathan was paid?

- (A) \$16.00
- (B) \$17.41
- (C) \$18.50
- (D) \$20.82

QUESTION ELEVEN

Jess buys a packet of cashews weighing 375 grams measured correct to the nearest gram. Calculate the percentage error.

- (A) 0.7%
- (B) 0.13%
- (C) 2.5%
- (D) 5.0%

QUESTION TWELVE

The surface area of a spherical basketball is 2828 cm^2 . What is the radius of the basketball, to the nearest cm?

- (A) 15 cm
- (B) 27 cm
- (C) 47 cm
- (D) 225 cm

QUESTION THIRTEEN

Samantha invested \$4500 in an account for 3 years at an annual flat rate of interest. At the end of the 3 years, the original investment had grown to \$5310. What was the annual flat rate of interest?

- (A) 2.7%
- (B) 5.08%
- (C) 6%
- (D) 18%

QUESTION FOURTEEN

The formula $M = \frac{Dt}{TB}$ can be used to change a time margin to a margin in “boat lengths” in a boat race, where:

M = the margin in boat lengths

D = the length of the race in metres

t = the margin in seconds

T = the time in seconds of the slower boat for the whole race

B = the length of the boat in metres.

In a boat race over 1000 metres, the margin between 1st and 2nd was 4.2 seconds. The time for the 2nd crew was 3 minutes and 35.2 seconds. If the length of a boat is 13 metres, what was the margin in boat lengths between 1st and 2nd?

- (A) 1
- (B) 1.5
- (C) 1.8
- (D) 96

QUESTION FIFTEEN

NOT TO SCALE

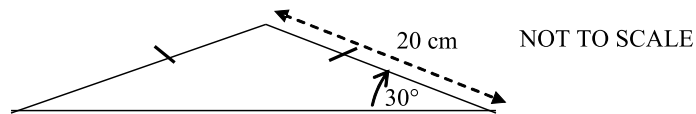


These two similar conical flasks have their heights in the ratio 2:3.
Which of the following statements is correct?

- (A) The areas of the base of the flasks is are the ratio 1:3.
- (B) The surface areas of the flasks is are the ratio 4:9.
- (C) The surface areas of the flasks is are the ratio 2:3.
- (D) The areas of the base of the flasks is are the ratio 1:9.

QUESTION SIXTEEN

What is the area of this triangle to the nearest square centimetre?



- (A) 87 cm²
- (B) 173 cm²
- (C) 200 cm²
- (D) 300 cm²

QUESTION SEVENTEEN

Alex borrows \$20 000 to purchase a motorcycle. Her repayments are set at \$195 per fortnight. The total interest charged over the period of the loan will be \$10 420. Over how many years will Alex repay her loan?

- (A) 2
- (B) 4
- (C) 5.5
- (D) 6

QUESTION EIGHTEEN

Ivy travels from Prague (50°N , 15°E) to the Congo (4°S , 15°E). What is the distance from Prague to the Congo? Answer to the nearest kilometre.

- (A) 2569 km
- (B) 3016 km
- (C) 5138 km
- (D) 6032 km

QUESTION NINETEEN

Vera 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%

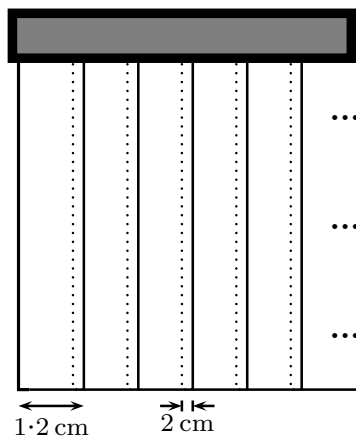
QUESTION TWENTY

Tyson's water usage in one day was 60 L for the shower, 39 L for the toilet, 33 L for the tap and 8 L for the washing machine. What percentage of his water usage is for the washing machine?

- (A) 5.7%
- (B) 8.0%
- (C) 42.9%
- (D) 140%

QUESTION TWENTY ONE

Vertical blinds 12 cm wide overlap by 2 cm when they are closed.



Which of the following expressions represents the width in centimetres, covered by n blinds when they are closed?

- (A) $10n + 2$
- (B) $10n - 2$
- (C) $12n$
- (D) $12n - 2$

QUESTION TWENTY TWO

A factory 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%

QUESTION TWENTY THREE

Madeline has a credit card with a compound interest rate of 0.05% per day and no interest-free period. She used the credit card to pay for a bag costing \$120. Madeline paid the credit card account 16 days later. What is the total amount (including interest) that she paid for the bag?

- (A) \$120.06
- (B) \$120.96
- (C) \$126.00
- (D) \$129.97

QUESTION TWENTY FOUR

Addison is a hospital patient who is given 1.5 litres of fluid over 8 hours. What is the required drip rate in mL/h?

- (A) 0.2
- (B) 5.3
- (C) 12
- (D) 187.5

QUESTION TWENTY FIVE

An object is thrown from the top of a building. The height of the object is given by:

$$h = 16 + 6t - t^2$$

where h is the height in metres that the object is above the ground and t is the time in seconds that the object is in the air.

If the object reaches its maximum height above the ground after 3 seconds, what is the vertical distance in metres that the object reaches above the building?

- (A) 4
- (B) 9
- (C) 16
- (D) 25

————— 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) Expand and simplify the expression $7x(8 + x) + 4x$.

1

Solution

(b) Given the formula $S = \frac{n}{2}(a + l)$:

(i) Find the value of S when $n = 60$, $a = 42$ and $l = 6$.

1

Solution

(ii) Find the value of a when $S = -45$, $n = 36$ and $l = 3.5$.

2

Solution

QUESTION TWENTY SIX (Continued)

(c) Serena borrows \$15 000 from a credit union and is charged an annual flat interest rate of 7.5%. Serena agrees to repay the loan in equal monthly payments over a period of 8 years.

(i) Calculate the interest Serena is charged.

1

Solution

(ii) What is the total amount to be repaid on the loan?

1

Solution

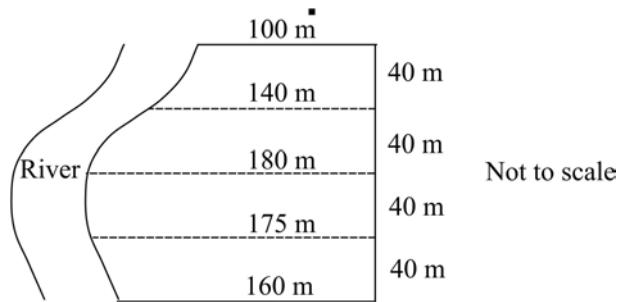
(iii) Calculate the amount of each monthly repayment.

1

Solution

QUESTION TWENTY SIX (Continued)

(d) A riverside campsite is shown below.



Use two applications of Simpson's rule to approximate the area of the campsite.
Answer correct to the nearest square metre.

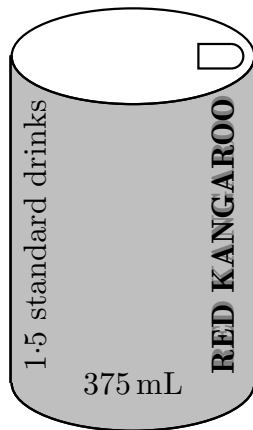
2

Solution

QUESTION TWENTY SIX (Continued)

(e) The diagram shows a can of ‘Red Kangaroo’, a drink containing alcohol.

3



Felicity, who weighs 55 kg, is at a party and consumes two cans of this drink. She commences the first can at 8 pm and finishes the second at 11 pm.

To roughly estimate how long it will take for a person’s blood alcohol content (BAC) to reach zero after they stop drinking, this formula can be used:

$$\text{Number of hours for BAC to reach zero} = \frac{\text{BAC}}{0.015}$$

How long will it take for Felicity’s BAC to reach zero? Give your answer correct to the nearest 10 minutes.

Solution

QUESTION TWENTY SIX (Continued)

(f) The table below shows the present value of an annuity with a contribution of \$1 at the end of each period.

	Interest Rate Per Period				
Period	1%	2%	4%	6%	8%
1	0.9901	0.9804	0.9615	0.9434	0.9259
2	1.9704	1.9416	1.8861	1.8334	1.7833
3	2.9410	2.8839	2.7751	2.6730	2.5771
4	3.9020	3.8077	3.6299	3.4651	3.3121
5	4.8534	4.7135	4.4518	4.2124	3.9927

(i) What would be the present value of an annuity with a contribution of \$9000 per year at 6% per annum for 5 years, with interest compounding annually? 1

Solution

(ii) An annuity pays \$6000 every three months for one year. What is the present value of the annuity given an interest rate of 4% per annum, compounding quarterly. 1

Solution

(iii) What is the value of an annuity that would provide a present value of \$43 230 after 3 years at 8% per annum compound interest? Answer to the nearest dollar. 1

Solution

QUESTION TWENTY SEVEN (15 marks)

Marks

- (a) During a fitness test, the number of sit-ups, s , and the number of push-ups, p , performed by ten pupils are recorded. The results are in the table below.

Sit-ups (s)	0	5	15	20	25	30	35	40	45	50
Push-ups (p)	10	15	25	25	33	48	45	50	50	60

- (i) Calculate the value of the correlation coefficient, r . Give your answer correct to two decimal places. 1

Solution

- (ii) Use the formulas to find the gradient and y -intercept of the least-squares line of best fit for this data. Round your answers to one decimal place. 2

Solution

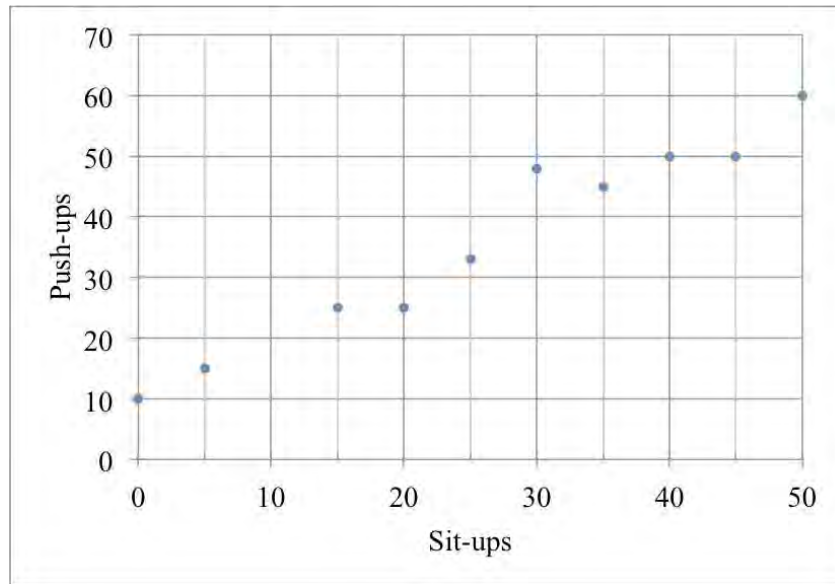
- (iii) Hence, write the equation of the least-squares line of best fit. 1

Solution

QUESTION TWENTY SEVEN (Continued)

(iv) Draw the least-squares line of best fit on the scatterplot below.

1



(b) The two-way table shows the gender of drivers and whether their headlights are on or off at sunset.

	Headlights on	Headlights off	Total
Female drivers	15	A	80
Male drivers	12	93	105
	B	158	

(i) What are the values of A and B?

1

Solution

QUESTION TWENTY SEVEN (Continued)

(ii) What fraction of the cars had male drivers?

1

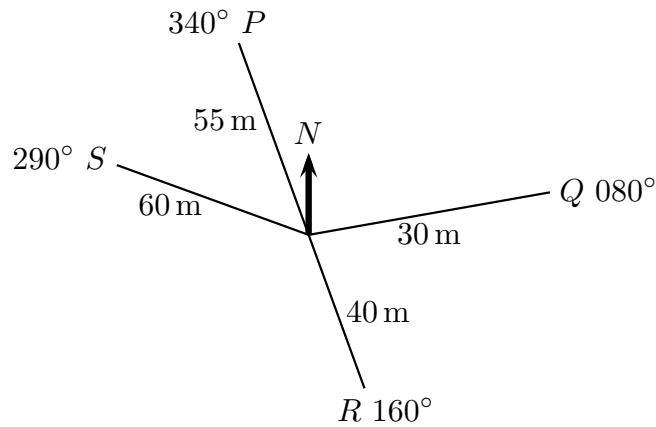
Solution

(iii) What percentage of the cars driven by males had their headlights on? Round your answer to the nearest percent.

1

Solution

(c) A radial survey of a field is shown below.



(i) What is the size of $\angle POQ$?

1

Solution

QUESTION TWENTY SEVEN (Continued)

(ii) Calculate the length of PQ , correct to the nearest metre.

2

Solution

(iii) The triangular area ROQ is going to be planted with barley. What is the size of this area? Answer correct to 2 significant figures.

2

Solution

QUESTION TWENTY SEVEN (Continued)

(d) Young’s rule is used to prescribe medicine for children. Young’s rule states:

$$D = \frac{yA}{y + 12}$$

where y is the child’s age in years and A is the adult dosage and D is the child dosage, both in milligrams.

Owen buys a prescription for 1200 mg of medicine. The adult dose is 50 mg and the recommended dosage for Owen’s child, calculated by Young’s rule, is 10 mg.

(i) How old is Owen’s child?

1

Solution

(ii) It is recommended that the medicine be taken at most 4 times a day. What is the minimum number of days the prescription will last for Owen’s child?

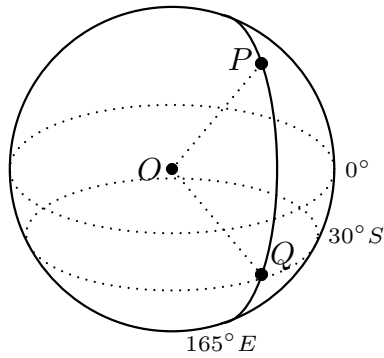
1

Solution

QUESTION TWENTY EIGHT (15 marks)

Marks

- (a) Two cities, P and Q , lie on the 165°E longitude of the Earth's spherical surface. City Q lies at a latitude of 30°S . In the diagram below, O is the centre of the Earth.



- (i) Given that $\angle POQ = 55^\circ$, what are the coordinates of city P ?

2

Solution

- (ii) Calculate the distance between P and Q . Give your answer to the nearest 10 km.

3

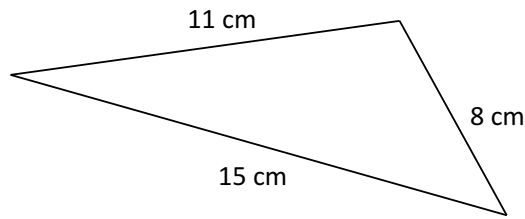
Solution

QUESTION TWENTY EIGHT (Continued)

- (iii) A plane leaves P and flies nonstop directly towards Q at a constant speed of 875 km/h. Determine the time it would take to fly from city P to city Q . Give your answer correct to the nearest minute. 2

Solution

- (b) Use the cosine rule to calculate the largest angle in the triangle. Give your answer to the nearest degree. 2



Solution

QUESTION TWENTY EIGHT (Continued)

(c) At the final stage of manufacture, new cars undergo two independent tests: a mechanical test and a paint test. The probability that a car will pass the mechanical test is 0.9 and the probability that a car will pass the paint test is 0.95.

Determine the probability that a car selected at random will:

(i) Pass both tests.

2

Solution

(ii) Pass only one of the tests.

2

Solution

(iii) Pass at least one of the tests.

2

Solution

QUESTION TWENTY NINE (15 marks)

Marks

- (a) The table below gives the future value in dollars of an annuity with a contribution of \$1 per period. The values are rounded to 4 decimal places.

Future Value Interest Factors
(Future value of an annuity with a contribution of \$1 at the end of each period)

Period	Interest Rate Per Period											
	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	2.0100	2.0200	2.0300	2.0400	2.0500	2.0600	2.0700	2.0800	2.0900	2.1000	2.1100	2.1200
3	3.0301	3.0604	3.0909	3.1216	3.1525	3.1836	3.2149	3.2464	3.2781	3.3100	3.3421	3.3744
4	4.0604	4.1216	4.1836	4.2465	4.3101	4.3746	4.4399	4.5061	4.5731	4.6410	4.7097	4.7793
5	5.1010	5.2040	5.3091	5.4163	5.5256	5.6371	5.7507	5.8666	5.9847	6.1051	6.2278	6.3528
6	6.1520	6.3081	6.4684	6.6330	6.8019	6.9753	7.1533	7.3359	7.5233	7.7156	7.9129	8.1152
7	7.2135	7.4343	7.6625	7.8983	8.1420	8.3938	8.6540	8.9228	9.2004	9.4872	9.7833	10.0890
8	8.2857	8.5830	8.8923	9.2142	9.5491	9.8975	10.2598	10.6366	11.0285	11.4359	11.8594	12.2997
9	9.3685	9.7546	10.1591	10.5828	11.0266	11.4913	11.9780	12.4876	13.0210	13.5795	14.1640	14.7757
10	10.4622	10.9497	11.4639	12.0061	12.5779	13.1808	13.8164	14.4866	15.1929	15.9374	16.7220	17.5487
11	11.5668	12.1687	12.8078	13.4864	14.2068	14.9716	15.7836	16.6455	17.5603	18.5312	19.5614	20.6546
12	12.6825	13.4121	14.1920	15.0258	15.9171	16.8699	17.8885	18.9771	20.1407	21.3843	22.7132	24.1331

Mahalia wants to save for a European vacation that she is planning to take in three years. She has decided to deposit \$1000 on 31st March, 30th June, 30th September and 31st December each year. The annual rate of interest is 4% per annum, compounding quarterly.

- (i) Use the table above to calculate the amount of money Mahalia will have in her bank account at the end of the three years. 3

Solution

- (ii) Calculate the total interest that Mahalia has received over the three years. 2

Solution

QUESTION TWENTY NINE (Continued)

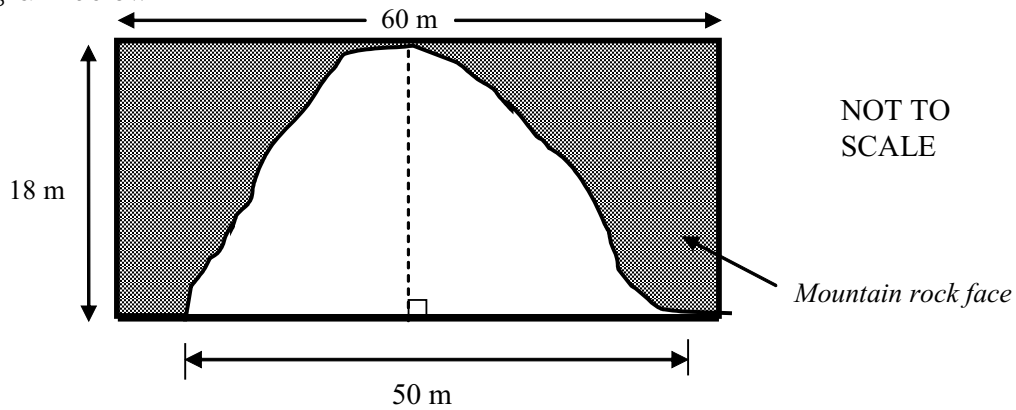
- (iii) After visiting the travel agent, Mahalia realises she will need \$14 000 and that depositing \$1000 per quarter would not be enough. Using the table, calculate the amount that she will need to deposit each quarter, so that she has enough money for this trip at the end of the three years. Give your answer to the nearest cent.

2

Solution

QUESTION TWENTY NINE (Continued)

(b) Construction work begins on a tunnel, which is to be drilled through a rectangular section of a mountain rock face. The tunnel is to have an opening that is 50 metres wide and 18 metres high. The tunnel has a constant cross-section, shown in the diagram below.



(i) Use one application of Simpson’s rule to calculate the approximate area of the tunnel opening that will be cut out from the rock face. Give your answer to the nearest square metre. 2

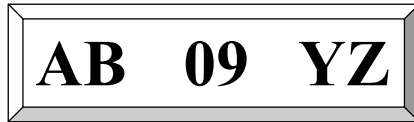
Solution

(ii) The tunnel will be 2.5 km long and will cost \$57 million to excavate. What is the cost to excavate each cubic metre of rock from the tunnel? 2

Solution

QUESTION TWENTY NINE (Continued)

- (c) Car registration plates consist of two letters, followed by two numbers, followed by two letters. One example of a registration plate is shown below.
All 26 letters and 10 digits may be repeated in any particular plate.



- (i) How many different registration plates can be made?

1

Solution

QUESTION TWENTY NINE (Continued)

- (ii) Jacob and Mandy both drive their family car and want the first two letters of their registration plate to be: 1

J M

How many different registration plates would have these letters in the first two places?

<i>Solution</i>

- (iii) Jacob and Mandy buy their car in 2014 and want to have their registration plate to have the first two letters and the middle digits as: 2

J M 14

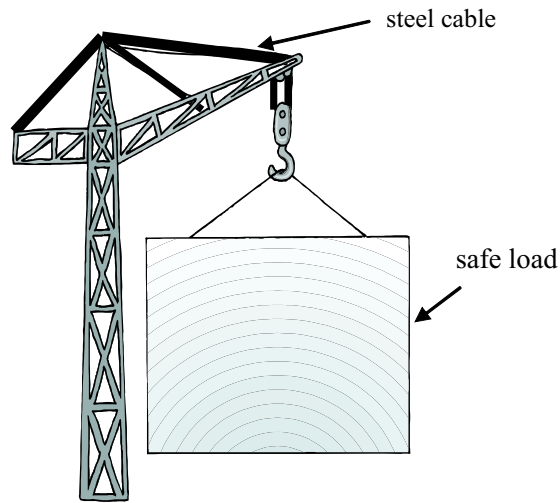
(They do not mind what letters are used for the last two places.)
If Jacob and Mandy are randomly assigned a registration plate, what is the probability that they will get the registration plate they want? Leave your answer as a simplified fraction.

<i>Solution</i>

QUESTION THIRTY (15 marks)

Marks

- (a) The maximum safe load, L , measured in tonnes, that can be suspended from a steel cable is directly related to the square of the diameter of the cable, d , in millimetres.



A cable with a diameter of 25 mm can safely support a maximum load of 4.375 tonnes.

- (i) Show that $L = 0.007d^2$.

2

Solution

- (ii) What is the maximum safe load that can be supported by a cable with diameter 30 mm?

1

Solution

QUESTION THIRTY (Continued)

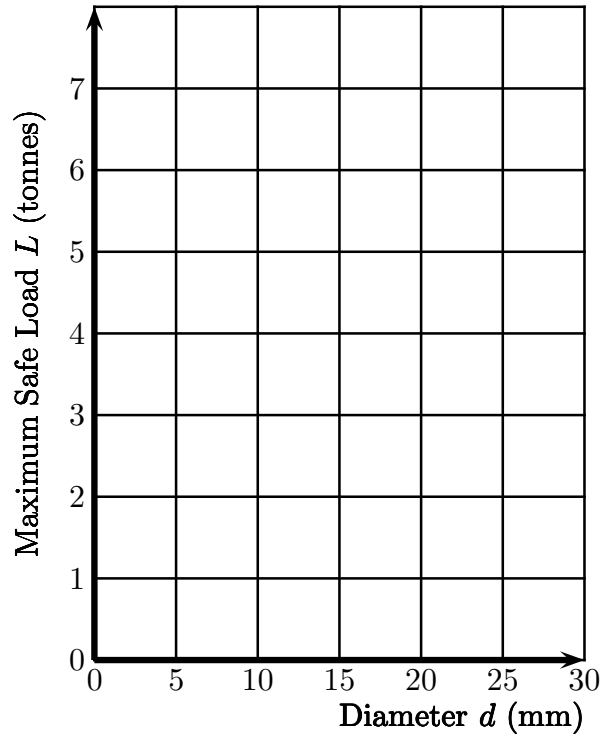
- (iii) Suppose a cable of diameter d supports a weight L . Find the percentage increase of the diameter, if a new cable of diameter D supports twice the weight, that is, $2L$.

3

Solution

QUESTION THIRTY (Continued)

- (iv) Sketch a graph on the grid below, relating the weight of the safe load, L , to the diameter, d , of the cable for diameters from 0 mm to 30 mm. Use diameter increments of 5 mm. 2



QUESTION THIRTY (Continued)

(b) A large group of people undertook a survey regarding the number of hours of sleep they had in a certain week. The results of the survey were normally distributed with 95% of the people indicating that they had between 42 and 54 hours of sleep per week.

(i) Determine the mean number of hours of sleep per week of the group.

2

Solution

(ii) What was the standard deviation?

1

Solution

(iii) A person from the group has a z -score of -2.5 . How many hours of sleep per week do they have?

2

Solution

- (iv) A person is selected randomly from the group. Determine the probability as a percentage that they had between 51 and 57 hours of sleep per week. 2

Solution

————— End of Section II —————

END OF EXAMINATION

B L A N K P A G E



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CANDIDATE NUMBER

2014
Assessment Examination
FORM VI
GENERAL MATHEMATICS
Friday 1st August 2014

- Record your multiple choice answers by filling in the circle corresponding to your choice for each question.
- Fill in the circle completely.
- Each question has only one correct answer.

THIS SHEET HAS TWO SIDES

Question One

A B C D

Question Two

A B C D

Question Three

A B C D

Question Four

A B C D

Question Five

A B C D

Question Six

A B C D

Question Seven

A B C D

Question Eight

A B C D

Question Nine

A B C D

Question Ten

A B C D

Question Eleven

A B C D

Question Twelve

A B C D

Question Thirteen

A B C D

Question Fourteen

A B C D

Question Fifteen

A B C D

Question Sixteen

A B C D

Question Seventeen

A B C D

Question Eighteen

A B C D

Question Nineteen

A B C D

Question Twenty

A B C D

Question Twenty One

A B C D

Question Twenty Two

A B C D

Question Twenty Three

A B C D

Question Twenty Four

A B C D

Question Twenty Five

A B C D



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GENERAL MATHEMATICS
Friday 1st August 2014

- Record your multiple choice answers by filling in the circle corresponding to your choice for each question.
- Fill in the circle completely.
- Each question has only one correct answer.

THIS SHEET HAS TWO SIDES

CANDIDATE NUMBER:

Question One

A B C D

Question Two

A B C D

Question Three

A B C D

Question Four

A B C D

Question Five

A B C D

Question Six

A B C D

Question Seven

A B C D

Question Eight

A B C D

Question Nine

A B C D

Question Ten

A B C D

Question Eleven

A B C D

Question Twelve

A B C D

Question Thirteen

A B C D

Question Fourteen

A B C D

Question Fifteen

A B C D

Question Sixteen

A B C D

Question Seventeen

A B C D

Question Eighteen

A B C D

Question Nineteen

A B C D

Question Twenty

A B C D

Question Twenty One

A B C D

Question Twenty Two

A B C D

Question Twenty Three

A B C D

Question Twenty Four

A B C D

Question Twenty Five

A B C D

Q1

$$P(\text{not}) = 1 - P(\text{will})$$

$$= 1 - 0.1$$

$$= 0.9$$

(C)

Q2 A

Q3. $P = 36$
 $S = 9$
 $EC = 4.5 \text{ cm}$

$$AE^2 = 9^2 + 4.5^2 \text{ (pythagoras theorem)}$$

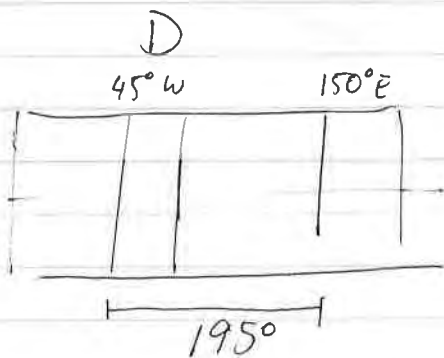
$$= 101.25$$

$$AE = 10.0623 \dots$$

$$\text{Perimeter} = 9 + 9 + 4.5 + 10.0623 \dots$$

$$= 32.5623053 \dots$$

Q4



$$195 \div 15 = 13$$

13 hours behind.

$$1400 - 13 = 0100$$

I am on Monday A

A range 23 $1QR = 22.5 - 7 = 15.5$

B 27 X

C 15 X

D 23 $25 - 10 = 15 \checkmark$

(D)

Q6: angle = 80°

$$\frac{80}{360} = \frac{2}{9}$$

(C)

Q7/

$$2400 \times 6 \times 8$$

$$= 115200 \text{ Watts}$$

$$= 115.2 \text{ kW}$$

$$*26.3 = 3029.76 \text{ ¢}$$

$$= 30.2976 \dots$$

$$= \text{\$}30.30$$

(B)

Answer \$30.30.

Q8: $C = 850 + 1385 \times 18$

$$= 25780$$

(D)

Q9. $1 \text{ mm} = 200 \text{ m}$
 $1.75 \text{ mm} = 350 \text{ m}$

(C)

$$\begin{aligned} \text{Q10: } 28x + 6 \times 1.5x &= 592 \\ 37x &= 592 \\ x &= 16 \end{aligned}$$

(A)

Q11 precision = 1g.

$$\text{absolute error} = 0.5g$$

$$\% \text{ error} = \frac{0.5}{3.75} \times 100$$

$$= 0.13\% \quad (B)$$

Q12

$$\begin{aligned} 4\pi r^2 &= 2828 \\ \pi r^2 &= 225.045 \dots \end{aligned}$$

$$r = 15.001 \dots$$

(A)

Q13

$$I = PTR$$

$$\begin{aligned} I &= 5310 - 4500 \\ &= 810 \end{aligned}$$

$$810 = 4500 \times R$$

$$R = 0.06$$

$$= 6\% \text{ p.a.}$$

(C)

Q14

$$t = 4.2$$

$$T = 215.2$$

$$B = 13$$

$$D = 1000$$

$$M = \frac{Dt}{TB}$$

$$= \frac{1000 \times 4.2}{215.2 \times 13}$$

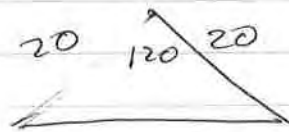
$$= 1.5012 \dots$$

$$\approx 1.5 \quad (B)$$

Q15

(B)

Q16



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

$$= \frac{1}{2} \times 20 \times 20 \sin 120$$

$$= 173.205 \dots$$

$$\approx 173m \quad (B)$$

Q17

$$\begin{aligned} \text{Total repaid} &= 20000 + \\ &\quad 10420 \\ &= 30420 \end{aligned}$$

$$\begin{aligned} &\div 195 \\ &= 156 \text{ payments} \end{aligned}$$

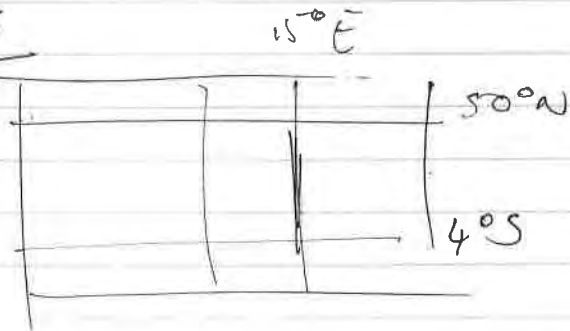
$$\div 26 \text{ fortnights per year}$$

6

6 years

(D)

Q18



$$\begin{aligned} \text{Angular distance} &= 50 + 4 \\ &= 54^\circ \end{aligned}$$

$$l = \frac{\theta}{360} \times 2\pi r$$

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

$$= 6031.85 \dots$$

$$\approx 6032 \text{ km} \quad (D)$$

Q19 Dividend yield

$$= \frac{\text{dividend}}{\text{market price}} \times 100$$

$$= \frac{0.15}{3} \times 100$$

$$= 5\% \quad A$$

Q20

$$\text{Total} = 60 + 39 + 33 + 8$$

$$= 140$$

$$\text{WM} = \frac{8}{140} \times 100$$

$$\approx 5.7142 \dots \%$$

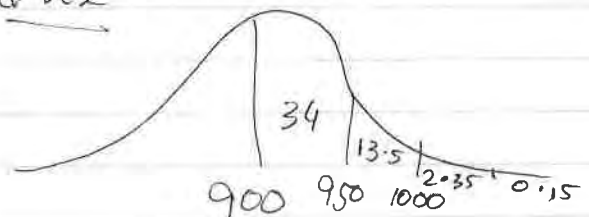
$$\approx 5.7\% \quad A$$

Q21

Blinds	1	2	3	4	5
length	12	22	32	42	52

$$10n + 2 \quad (A)$$

Q22



$$\text{Ans } 2.35 + 0.15 =$$

$$2.5\% \quad (B)$$

23

$$\begin{aligned} I &= PTR \\ &= 120 \times 16 \times \frac{0.05}{100} \\ &= 0.96 \end{aligned}$$

$$\begin{aligned} \text{total repaid} &= \$120.96 \\ &= B \end{aligned}$$

24

$$\begin{aligned} 1500 &\text{ in } 8 \text{ h} \\ \div 8 &\qquad \div 8 \\ = 187.5 \text{ mL/h} \end{aligned}$$

D

Q25

$$h = 16 + 6t - t^2$$

$$t = 0 \quad h = 16$$

$$t = 3 \quad h = 25$$

$$\begin{aligned} d &= 25 - 16 \\ &= 9 \end{aligned}$$

B

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) Expand and simplify the expression $7x(8 + x) + 4x$.

1

Solution

$$56x + 7x^2 + 4x$$

$$60x + 7x^2$$

(b) Given the formula $S = \frac{n}{2}(a + l)$:

(i) Find the value of S when $n = 60$, $a = 42$ and $l = 6$.

1

Solution

$$S = \frac{60}{2}(42 + 6)$$

$$= 1440$$

(ii) Find the value of a when $S = -45$, $n = 36$ and $l = 3.5$.

2

Solution

$$-45 = \frac{36}{2}(a + 3.5)$$

$$-2.5 = a + 3.5$$

$$a = -6$$

QUESTION TWENTY SIX (Continued)

(c) Serena borrows \$15 000 from a credit union and is charged an annual flat interest rate of 7.5%. Serena agrees to repay the loan in equal monthly payments over a period of 8 years.

(i) Calculate the interest Serena is charged.

1

Solution

$$\begin{aligned}
 I &= Prn \\
 &= 15000 \times 0.075 \times 8 \\
 &= 9000
 \end{aligned}$$

She pays \$9000 interest.

(ii) What is the total amount to be repaid on the loan?

1

Solution

$$\begin{aligned}
 \text{Total} &= 9000 + 15000 \\
 &= 24000
 \end{aligned}$$

She must repay \$24 000

(iii) Calculate the amount of each monthly repayment.

1

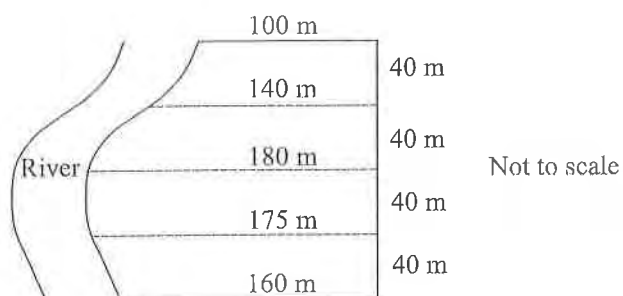
Solution

$$\begin{aligned}
 \text{monthly repayment} &= 24000 \div (8 \times 12) \\
 &= 250
 \end{aligned}$$

Her monthly repayments are \$250.

QUESTION TWENTY SIX (Continued)

(d) A riverside campsite is shown below.



Use two applications of Simpson's rule to approximate the area of the campsite.
 Answer correct to the nearest square metre.

2

Solution

$$\begin{aligned}
 A &\approx \frac{h}{3} [d_f + 4d_m + d_u] \\
 &\approx \frac{40}{3} [160 + 4 \times 175 + 180] + \frac{40}{3} [180 + 4 \times 140 + 100] \\
 &\approx 25066.66 \dots \\
 &\approx 25067 \text{ m}^2 \text{ (nearest metre)}
 \end{aligned}$$

The area is approximately 25067 m^2 .

QUESTION TWENTY SIX (Continued)

(e) The diagram shows a can of 'Red Kangaroo', a drink containing alcohol.

3



Felicity, who weighs 55 kg, is at a party and consumes two cans of this drink. She commences the first can at 8 pm and finishes the second at 11 pm.

To roughly estimate how long it will take for a person's blood alcohol content (BAC) to reach zero after they stop drinking, this formula can be used:

$$\text{Number of hours for BAC to reach zero} = \frac{\text{BAC}}{0.015}$$

How long will it take for Felicity's BAC to reach zero? Give your answer correct to the nearest 10 minutes.

Solution

$$\begin{aligned} \text{BAC}_{\text{female}} &= \frac{10N - 7.5H}{5.5M} \\ &= \frac{10 \times 3 - 7.5 \times 3}{5.5 \times 55} \\ &= \frac{3}{121} \end{aligned}$$

$$\begin{aligned} \text{Number of hours to reach zero} &= \frac{3}{121} \div 0.015 \\ &= 1 \text{ hour } 39' 10.41'' \\ &= 1 \text{ hour } 40 \text{ min (nearest } 10 \text{ min)} \end{aligned}$$

QUESTION TWENTY SIX (Continued)

(f) The table below shows the present value of an annuity with a contribution of \$1 at the end of each period.

Period	Interest Rate Per Period				
	1%	2%	4%	6%	8%
1	0.9901	0.9804	0.9615	0.9434	0.9259
2	1.9704	1.9416	1.8861	1.8334	1.7833
3	2.9410	2.8839	2.7751	2.6730	2.5771
4	3.9020	3.8077	3.6299	3.4651	3.3121
5	4.8534	4.7135	4.4518	4.2124	3.9927

(i) What would be the present value of an annuity with a contribution of \$9000 per year at 6% per annum for 5 years, with interest compounding annually? 1

Solution

$$4.2124 \times 9000$$

$$= \$37\,911.60$$

(ii) An annuity pays \$6000 every three months for one year. What is the present value of the annuity given an interest rate of 4% per annum, compounding quarterly. 1

Solution

$$n = 4 \quad r = 1\%$$

$$3.9020 \times 6000$$

$$= \$23\,412$$

(iii) What is the value of an annuity that would provide a present value of \$43 230 after 3 years at 8% per annum compound interest? Answer to the nearest dollar. 1

Solution

$$n = 3 \quad r = 8\%$$

$$43\,230 \div 2.5771$$

$$= \$16\,774.67$$

$$= \$16\,775$$

QUESTION TWENTY SEVEN (15 marks)

Marks

- (a) During a fitness test, the number of sit-ups, s , and the number of push-ups, p , performed by ten pupils are recorded. The results are in the table below.

Sit-ups (s)	0	5	15	20	25	30	35	40	45	50
Push-ups (p)	10	15	25	25	33	48	45	50	50	60

- (i) Calculate the value of the correlation coefficient, r . Give your answer correct to two decimal places. 1

Solution

$$r \approx 0.97707648 \dots$$

$$\approx 0.98$$

- (ii) Use the formulas to find the gradient and y -intercept of the least-squares line of best fit for this data. Round your answers to one decimal place. 2

Solution

$$\text{gradient} = r \times \frac{\sigma_y}{\sigma_x}$$

$$= 0.98 \times \frac{16.00281 \dots}{15.819292 \dots}$$

$$= 0.99136 \dots$$

$$= 1.0 \text{ (1dp)}$$

$$y_{\text{int}} = \bar{y} - m\bar{x}$$

$$= 36.1 - 1.0 \times 26.5$$

$$= 9.6$$

- (iii) Hence, write the equation of the least-squares line of best fit. 1

Solution

$$y = 1.0x + 9.6$$

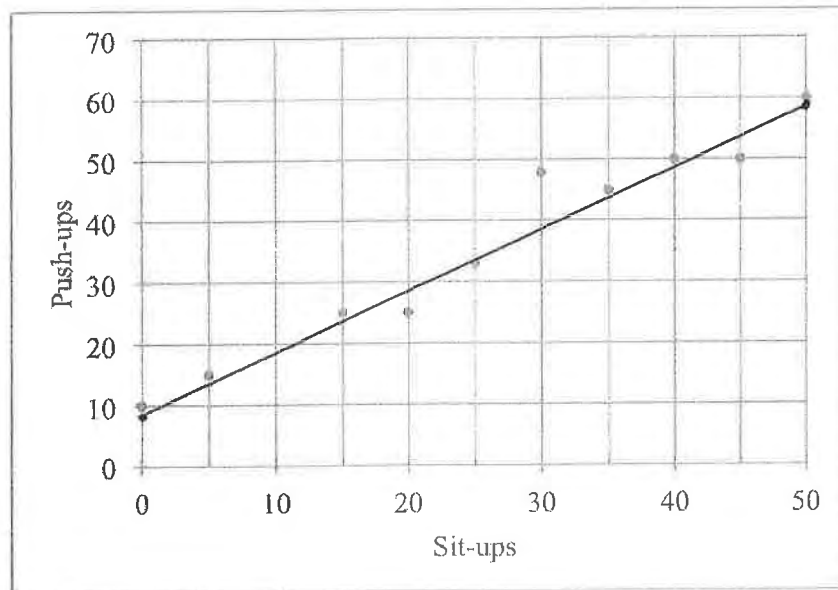
$$p = 1.0s + 9.6$$

QUESTION TWENTY SEVEN (Continued)

(iv) Draw the least-squares line of best fit on the scatterplot below.

1

$\bar{x} = 0$ $\rho = 9.6$
 $s = 50$ $\rho = 59.6$



(b) The two-way table shows the gender of drivers and whether their headlights are on or off at sunset.

	Headlights on	Headlights off	Total
Female drivers	15	A	80
Male drivers	12	93	105
	B	158	

(i) What are the values of A and B?

1

Solution

$$A = 80 - 15 = 65$$

$$B = 15 + 12 = 27$$

QUESTION TWENTY SEVEN (Continued)

(ii) What fraction of the cars had male drivers?

1

Solution

$$\frac{105}{185} = \frac{21}{37}$$

(iii) What percentage of the cars driven by males had their headlights on? Round your answer to the nearest percent.

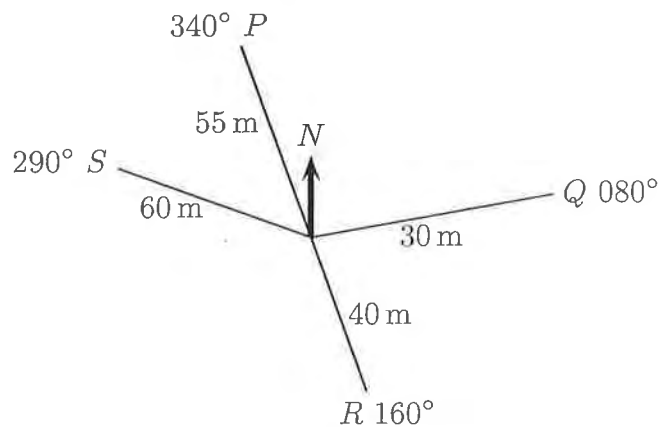
1

Solution

$$\frac{12}{105} \times 100$$

$$= 11.428\dots \approx 11\% \text{ (nearest percent)}$$

(c) A radial survey of a field is shown below.



(i) What is the size of $\angle POQ$?

1

Solution

$$20^\circ + 80^\circ$$

$$\angle POQ = 100^\circ$$

QUESTION TWENTY SEVEN (Continued)

(ii) Calculate the length of PQ , correct to the nearest metre.

2

Solution

$$\begin{aligned}
 PQ^2 &= 55^2 + 30^2 - 2 \times 55 \times 30 \times \cos 100 \\
 &= 4498.038 \dots \\
 PQ &= 67.067 \dots \\
 &\approx 67 \text{ m (nearest metre)}
 \end{aligned}$$

(iii) The triangular area ROQ is going to be planted with barley. What is the size of this area? Answer correct to 2 significant figures.

2

Solution

$$\begin{aligned}
 \text{Area} &= \frac{1}{2} ab \sin C & \angle ROQ &= 80^\circ \\
 &= \frac{1}{2} \times 30 \times 40 \sin 80 \\
 &= 590.884 \dots \\
 &\approx 590.88 \text{ m}^2 \\
 &\approx 590 \text{ m}^2 \text{ (2 sig fig)}
 \end{aligned}$$

penalise rounding

QUESTION TWENTY SEVEN (Continued)

(d) Young's rule is used to prescribe medicine for children. Young's rule states:

$$D = \frac{yA}{y + 12}$$

where y is the child's age in years and A is the adult dosage and D is the child dosage, both in milligrams.

Owen buys a prescription for 1200 mg of medicine. The adult dose is 50 mg and the recommended dosage for Owen's child, calculated by Young's rule, is 10 mg.

(i) How old is Owen's child?

1

Solution

$$10 = \frac{y \times 50}{y + 12}$$

$$10y + 120 = 50y$$

$$40y = 120$$

$$y = 3$$

The child is 3 years old.

(ii) It is recommended that the medicine be taken at most 4 times a day. What is the minimum number of days the prescription will last for Owen's child?

1

Solution

$$1200 \div (4 \times 10)$$

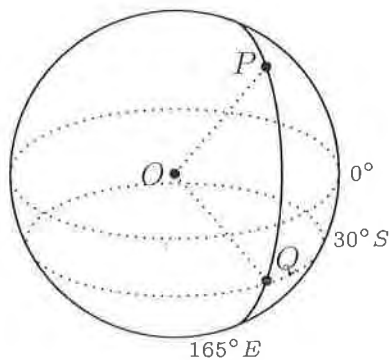
$$= 30$$

It will last for a minimum of 30 days

QUESTION TWENTY EIGHT (15 marks)

Marks

- (a) Two cities, P and Q , lie on the 165°E longitude of the Earth's spherical surface. City Q lies at a latitude of 30°S . In the diagram below, O is the centre of the Earth.



- (i) Given that $\angle POQ = 55^\circ$, what are the coordinates of city P ?

2

Solution $\angle POQ = 55^\circ \therefore P$ lies on 25°N

$P(25^\circ\text{N}, 165^\circ\text{E})$

- (ii) Calculate the distance between P and Q . Give your answer to the nearest 10 km.

3

Solution

$$PQ = \frac{\theta}{360} \times 2\pi r$$

penalise rounding

$$= \frac{55}{360} \times 2 \times \pi \times 6400$$

$$= 6143.5589 \dots$$

$$\approx 6140\text{km (nearest 10)}$$

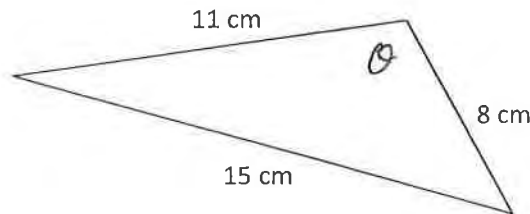
QUESTION TWENTY EIGHT (Continued)

- (iii) A plane leaves P and flies nonstop directly towards Q at a constant speed of 875 km/h. Determine the time it would take to fly from city P to city Q . Give your answer correct to the nearest minute. 2

Solution

$$\begin{aligned}
 T &= \frac{D}{S} \\
 &= \frac{6140}{875} \\
 &= 7 \text{ hours } 1 \text{ min } 1.71 \text{ sec.} \\
 &= 7 \text{ hours } 1 \text{ minute (nearest minute)}
 \end{aligned}$$

- (b) Use the cosine rule to calculate the largest angle in the triangle. Give your answer to the nearest degree. 2



Solution

$$\cos \theta = \frac{11^2 + 8^2 - 15^2}{2 \times 11 \times 8}$$

$$\theta = 103^\circ 8' 11.61''$$

The largest angle is 103° (nearest degree)

QUESTION TWENTY EIGHT (Continued)

(c) At the final stage of manufacture, new cars undergo two independent tests: a mechanical test and a paint test. The probability that a car will pass the mechanical test is 0.9 and the probability that a car will pass the paint test is 0.95.

Determine the probability that a car selected at random will:

(i) Pass both tests.

2

Solution

Mechanical

Paint

0.9 P 0.95 P PP 0.855

0.05 F PF 0.045

0.1 F 0.95 P FP 0.095

0.05 F FF 0.005

$P(\text{pass both}) = 0.855$

$\frac{171}{200}$

(ii) Pass only one of the tests.

2

Solution

$$P(\text{pass one}) = 0.045 + 0.095$$

$$= 0.14$$

$\frac{7}{50}$

(iii) Pass at least one of the tests.

2

Solution

$$P(\text{pass at least one}) = 1 - P(FF)$$

$$= 1 - 0.005$$

$$= 0.995$$

$\frac{199}{200}$

QUESTION TWENTY NINE (15 marks)

Marks

- (a) The table below gives the future value in dollars of an annuity with a contribution of \$1 per period. The values are rounded to 4 decimal places.

Future Value Interest Factors
(Future value of an annuity with a contribution of \$1 at the end of each period)

Period	Interest Rate Per Period											
	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	2.0100	2.0200	2.0300	2.0400	2.0500	2.0600	2.0700	2.0800	2.0900	2.1000	2.1100	2.1200
3	3.0301	3.0604	3.0909	3.1216	3.1525	3.1836	3.2149	3.2464	3.2781	3.3100	3.3421	3.3744
4	4.0604	4.1216	4.1836	4.2465	4.3101	4.3746	4.4399	4.5061	4.5731	4.6410	4.7097	4.7793
5	5.1010	5.2040	5.3091	5.4163	5.5256	5.6371	5.7507	5.8666	5.9847	6.1051	6.2278	6.3528
6	6.1520	6.3081	6.4684	6.6330	6.8019	6.9753	7.1533	7.3359	7.5233	7.7156	7.9129	8.1152
7	7.2135	7.4343	7.6625	7.8983	8.1420	8.3938	8.6540	8.9228	9.2004	9.4872	9.7833	10.0890
8	8.2857	8.5830	8.8923	9.2142	9.5491	9.8975	10.2598	10.6366	11.0285	11.4359	11.8594	12.2997
9	9.3685	9.7546	10.1591	10.5828	11.0266	11.4913	11.9780	12.4876	13.0210	13.5795	14.1640	14.7757
10	10.4622	10.9497	11.4639	12.0061	12.5779	13.1808	13.8164	14.4866	15.1929	15.9374	16.7220	17.5487
11	11.5668	12.1687	12.8078	13.4864	14.2068	14.9716	15.7836	16.6455	17.5603	18.5312	19.5614	20.6546
12	12.6825	13.4121	14.1920	15.0258	15.9171	16.8699	17.8885	18.9771	20.1407	21.3843	22.7132	24.1331

Mahalia wants to save for a European vacation that she is planning to take in three years. She has decided to deposit \$1000 on 31st March, 30th June, 30th September and 31st December each year. The annual rate of interest is 4% per annum, compounding quarterly.

- (i) Use the table above to calculate the amount of money Mahalia will have in her bank account at the end of the three years. 3

Solution

$$r = 1\% \quad n = 12$$

$$12.6825 \times 1000$$

$$= \$12682.50$$

She will have \$12682.50

- (ii) Calculate the total interest that Mahalia has received over the three years. 2

Solution

$$I = 12682.50 - 12000$$

$$= \$682.50$$

She has received \$682.50 in interest.

QUESTION TWENTY NINE (Continued)

- (iii) After visiting the travel agent, Mahalia realises she will need \$14 000 and that depositing \$1000 per quarter would not be enough. Using the table, calculate the amount that she will need to deposit each quarter, so that she has enough money for this trip at the end of the three years. Give your answer to the nearest cent. 2

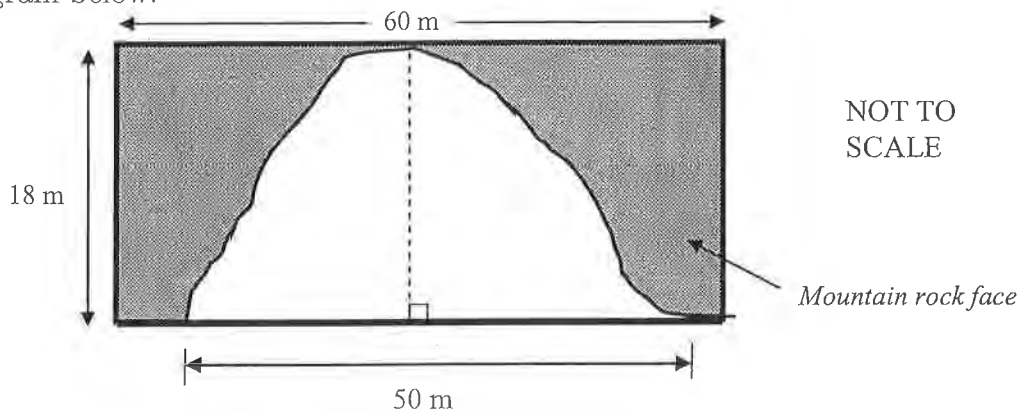
Solution

$$\begin{aligned} 14\,000 &\div 12.6825 \\ &= 1103.8833 \dots \\ &\approx 1103.88 \end{aligned}$$

She needs to deposit \$1103.88 per quarter

QUESTION TWENTY NINE (Continued)

(b) Construction work begins on a tunnel, which is to be drilled through a rectangular section of a mountain rock face. The tunnel is to have an opening that is 50 metres wide and 18 metres high. The tunnel has a constant cross-section, shown in the diagram below.



(i) Use one application of Simpson's rule to calculate the approximate area of the tunnel opening that will be cut out from the rock face. Give your answer to the nearest square metre. 2

Solution

$$h \approx \frac{25}{3} (0 + 4 \times 18 + 0)$$

$$\approx 600 \text{ m}^2$$

(ii) The tunnel will be 2.5 km long and will cost \$57 million to excavate. What is the cost to excavate each cubic metre of rock from the tunnel? 2

Solution

$$2.5 \text{ km} = 2500 \text{ m}$$

$$V = 600 \times 2500$$

$$= 1500000 \text{ m}^3$$

$$57000000 \div 1500000$$

$$\text{Cost per m}^3 = \$38$$

QUESTION TWENTY NINE (Continued)

- (c) Car registration plates consist of two letters, followed by two numbers, followed by two letters. One example of a registration plate is shown below.
All 26 letters and 10 digits may be repeated in any particular plate.



- (i) How many different registration plates can be made?

1

Solution

$$26^2 \times 10^2 \times 26^2$$
$$= 45697600$$

QUESTION TWENTY NINE (Continued)

- (ii) Jacob and Mandy both drive their family car and want the first two letters of their registration plate to be: 1

J M

How many different registration plates would have these letters in the first two places?

Solution

$$1 \times 1 \times 10 \times 10 \times 26 \times 26$$

$$= 67\,600$$

- (iii) Jacob and Mandy buy their car in 2014 and want to have their registration plate to have the first two letters and the middle digits as: 2

J M 14

(They do not mind what letters are used for the last two places.)

If Jacob and Mandy are randomly assigned a registration plate, what is the probability that they will get the registration plate they want? Leave your answer as a simplified fraction.

Solution

$$\frac{1 \times 1 \times 1 \times 1 \times 26 \times 26}{4\,569\,7600}$$

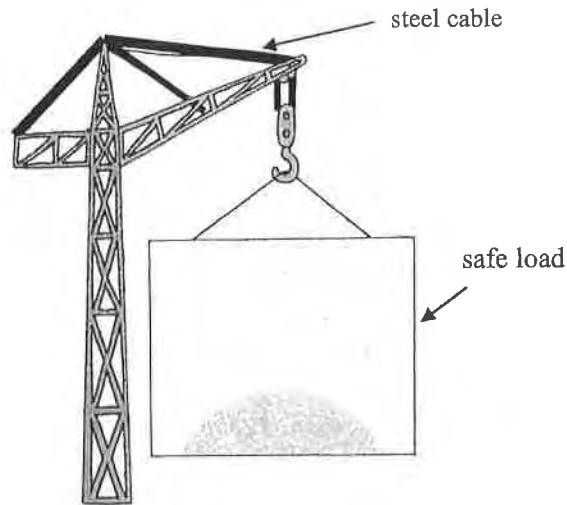
$$= \frac{676}{4\,569\,7600}$$

$$= \frac{1}{67600}$$

QUESTION THIRTY (15 marks)

Marks

- (a) The maximum safe load, L , measured in tonnes, that can be suspended from a steel cable is directly related to the square of the diameter of the cable, d , in millimetres.



A cable with a diameter of 25 mm can safely support a maximum load of 4.375 tonnes.

- (i) Show that $L = 0.007d^2$.

2

Solution

$$L = kd^2$$

$$4.375 = k \times 25^2$$

$$k = \frac{4.375}{25^2}$$

$$= 0.007$$

$$\therefore L = 0.007d^2$$

as required.

- (ii) What is the maximum safe load that can be supported by a cable with diameter 30 mm?

1

Solution

$$L = 0.007 \times 30^2$$

$$= 6.3 \text{ tonnes}$$

QUESTION THIRTY (Continued)

- (iii) Suppose a cable of diameter d supports a weight L . Find the percentage increase of the diameter, if a new cable of diameter D supports twice the weight, that is, $2L$.

3

Solution

$$L = 0.007d^2$$

$$2L = 0.007D^2$$

$$L = 0.0035D^2$$

$$0.007d^2 = 0.0035D^2$$

$$2d^2 = D^2$$

$$D = \sqrt{2d^2}$$

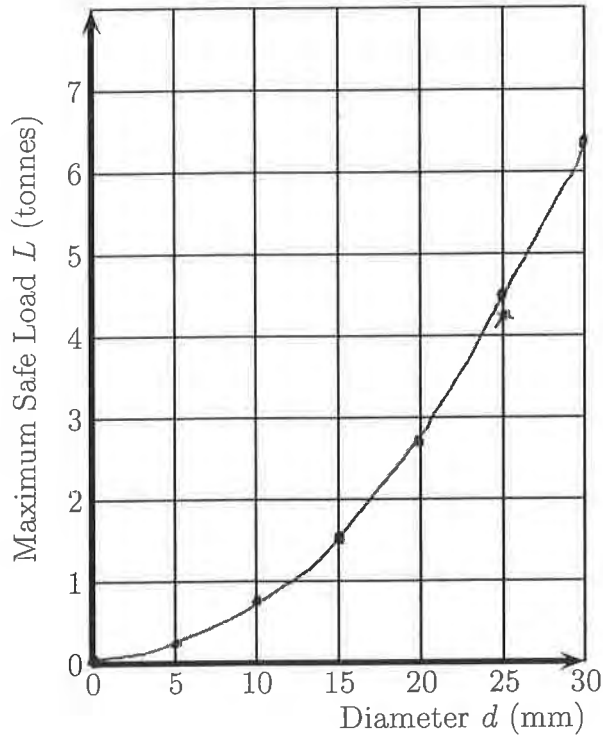
$$D = 1.414213\dots d$$

which is an increase

of approx. 41%

QUESTION THIRTY (Continued)

- (iv) Sketch a graph on the grid below, relating the weight of the safe load, L , to the diameter, d , of the cable for diameters from 0 mm to 30 mm. Use diameter increments of 5 mm. 2



$$L = 0.007d^2$$

QUESTION THIRTY (Continued)

(b) A large group of people undertook a survey regarding the number of hours of sleep they had in a certain week. The results of the survey were normally distributed with 95% of the people indicating that they had between 42 and 54 hours of sleep per week.

(i) Determine the mean number of hours of sleep per week of the group. 2

Solution

$$\begin{aligned} \text{mean} &= \frac{42 + 54}{2} \\ &= 48 \end{aligned}$$

The mean is 48

(ii) What was the standard deviation? 1

Solution

$$\begin{aligned} 48 + 2s &= 54 \\ 2s &= 6 \\ s &= 3 \end{aligned}$$

The standard deviation is 3 hours.

(iii) A person from the group has a z-score of -2.5 . How many hours of sleep per week do they have? 2

Solution

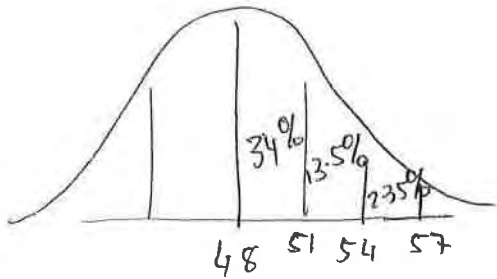
$$\begin{aligned} z &= \frac{x - \bar{x}}{s} \\ -2.5 &= \frac{x - 48}{3} \end{aligned}$$

$$x = 40.5$$

They have 40.5 hours sleep

- (iv) A person is selected randomly from the group. Determine the probability as a percentage that they had between 51 and 57 hours of sleep per week. 2

Solution



$$13.5 + 2.35$$
$$= 15.85\%$$

————— End of Section II —————

END OF EXAMINATION