

Mathematical studies
Standard level
Paper 1

Monday 12 November 2018 (afternoon)

Candidate session number

1 hour 30 minutes

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Instructions to candidates

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- A graphic display calculator is required for this paper.
- A clean copy of the **mathematical studies SL formula booklet** is required for this paper.
- Answer all questions.
- Answers must be written within the answer boxes provided.
- Unless otherwise stated in the question, all numerical answers should be given exactly or correct to three significant figures.
- The maximum mark for this examination paper is **[90 marks]**.



Maximum marks will be given for correct answers. Where an answer is incorrect, some marks may be given for a correct method, provided this is shown by written working. Answers must be written within the answer boxes provided. Solutions found from a graphic display calculator should be supported by suitable working, for example, if graphs are used to find a solution, you should sketch these as part of your answer.

1. The volume of a hemisphere, V , is given by the formula

$$V = \sqrt{\frac{4S^3}{243\pi}},$$

where S is the total surface area.

The total surface area of a given hemisphere is 350 cm^2 .

- (a) Calculate the volume of this hemisphere in cm^3 .
Give your answer correct to **one decimal place**. [3]
- (b) Write down your answer to part (a) correct to the nearest integer. [1]
- (c) Write down your answer to **part (b)** in the form $a \times 10^k$, where $1 \leq a < 10$ and $k \in \mathbb{Z}$. [2]

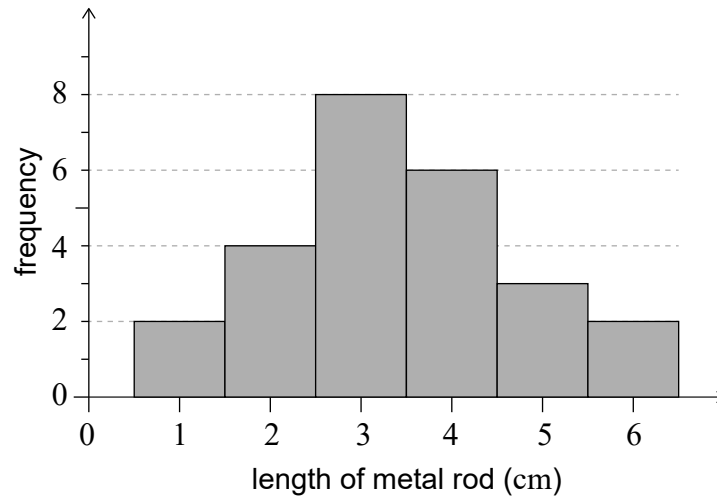
Working:

Answers:

- (a)
- (b)
- (c)



2. The histogram shows the lengths of 25 metal rods, each measured correct to the nearest cm.



- (a) Write down the modal length of the rods. [1]
- (b) Find the median length of the rods. [3]

The upper quartile is 4 cm.

- (c) Calculate
- (i) the lower quartile;
- (ii) the interquartile range. [2]

Working:

Answers:

- (a)
- (b)
- (c) (i)
- (ii)



3. Harry travelled from the USA to Mexico and changed 700 dollars (USD) into pesos (MXN).

The exchange rate was $1 \text{ USD} = 18.86 \text{ MXN}$.

- (a) Calculate the amount of MXN Harry received. [2]

On his return, Harry had 2400 MXN to change back into USD.
There was a 3.5% commission to be paid on the exchange.

- (b) Calculate the value of the commission, in MXN, that Harry paid. [2]

The exchange rate for this exchange was $1 \text{ USD} = 17.24 \text{ MXN}$.

- (c) Calculate the amount of USD Harry received. Give your answer correct to the nearest cent. [2]

Working:

Answers:

- (a)
- (b)
- (c)



4. Abhinav carries out a χ^2 test at the 1% significance level to determine whether a person's gender impacts their chosen professional field: engineering, medicine or law. He surveyed 220 people and the results are shown in the table.

	Engineering	Medicine	Law
Male	55	30	25
Female	35	45	30

- (a) State the null hypothesis, H_0 , for this test. [1]
- (b) Calculate the expected number of male engineers. [2]
- (c) Find the p -value for this test. [2]
- Abhinav rejects H_0 .
- (d) State a reason why Abhinav is incorrect in doing so. [1]

Working:

Answers:

- (a)
-
-
- (b)
- (c)
- (d)
-



5. The table shows the first five terms of three sequences: u_n , v_n and w_n .

	n				
	1	2	3	4	5
u_n	10	20	40	80	160
v_n	10	20	30	60	100
w_n	10	20	30	40	50

- (a) State which sequence is
- (i) arithmetic;
- (ii) geometric. [2]
- (b) Find the exact value of the 11th term of the geometric sequence. [2]
- (c) Find the sum of the first 20 terms of the arithmetic sequence. [2]

Working:

Answers:

- (a) (i)
- (ii)
- (b)
- (c)



6. (a) Complete the following truth table.

[4]

p	q	$p \vee q$	$\neg q$	$p \wedge \neg q$	$\neg(p \vee q)$	$(p \wedge \neg q) \Rightarrow \neg(p \vee q)$
T	T	T				
T	F	T				
F	T	T				
F	F	F				

(b) State whether the statement $(p \wedge \neg q) \Rightarrow \neg(p \vee q)$ is a contradiction, a tautology or neither. Give a reason for your answer.

[2]

Working:

Answer:

(b)

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.....

.....



7. Nick has \$150 000 in a trust fund. Each year he donates 8% of the money remaining in his trust fund to charity.

- (a) Determine the maximum number of years Nick can donate to charity while keeping at least \$50 000 in the trust fund. [3]

Louise invests \$200 000 in a bank account that pays a nominal interest rate of 5%, **compounded quarterly**, for eight years.

- (b) Calculate the value of Louise's investment at the end of this time. Give your answer correct to the nearest cent. [3]

Working:

Answers:

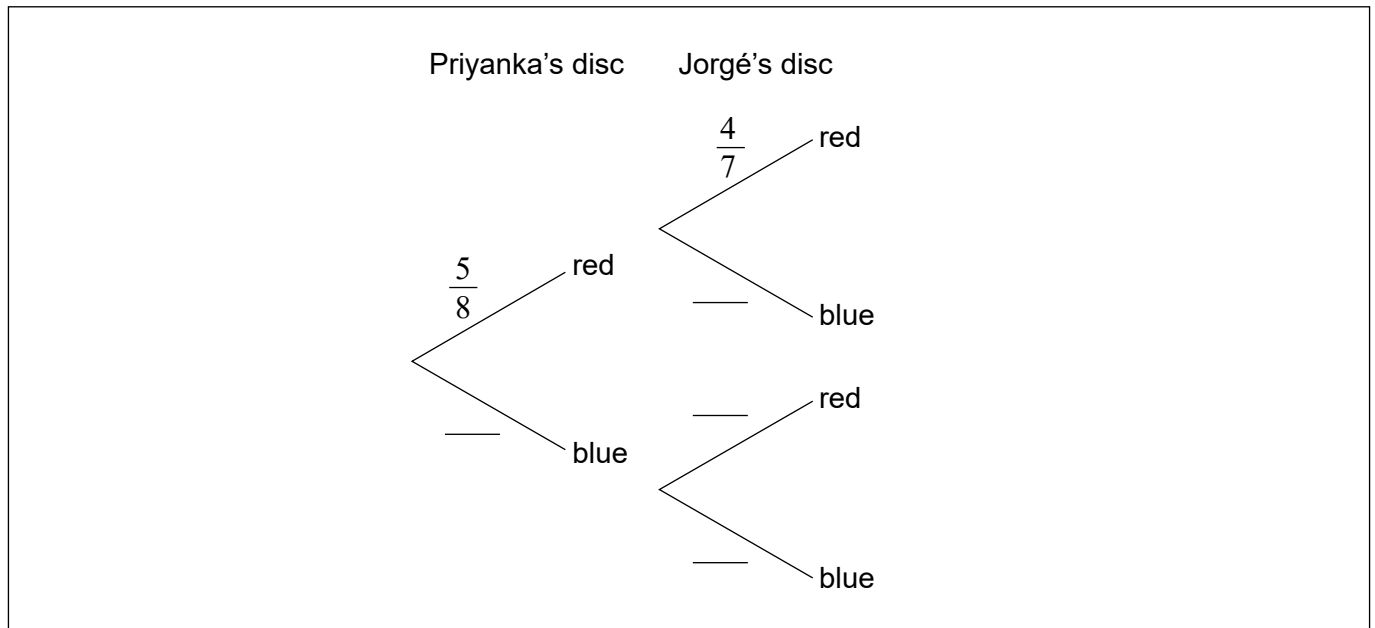
- (a)
- (b)



8. A bag contains 5 red and 3 blue discs, all identical except for the colour. First, Priyanka takes a disc at random from the bag and then Jorgé takes a disc at random from the bag.

(a) Complete the tree diagram.

[3]



(b) Find the probability that Jorgé chooses a red disc.

[3]

Working:

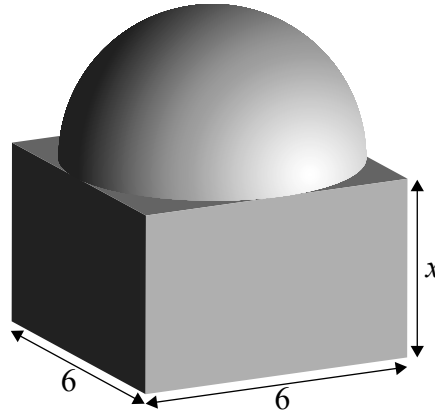
Answer:

(b)



9. A solid glass paperweight consists of a hemisphere of diameter 6 cm on top of a cuboid with a square base of length 6 cm, as shown in the diagram.

diagram not to scale



The height of the cuboid, x cm, is equal to the height of the hemisphere.

- (a) (i) Write down the value of x .
- (ii) Calculate the volume of the paperweight. [4]
- 1 cm^3 of glass has a mass of 2.56 grams.
- (b) Calculate the mass, in grams, of the paperweight. [2]

Working:

Answers:

- (a) (i)
- (ii)
- (b)



10. Consider the following statements.

p : it can go wrong
 q : it does go wrong

(a) Write down in symbolic form:

If it does not go wrong then it cannot go wrong. [2]

(b) Write down in words the argument $p \Rightarrow q$. [2]

(c) Write down in words the inverse of $p \Rightarrow q$. [2]

Working:

Answers:

(a)

(b)

.....

.....

(c)

.....

.....



11. Consider the curve $y = 5x^3 - 3x$.

(a) Find $\frac{dy}{dx}$. [2]

The curve has a tangent at the point $P(-1, -2)$.

(b) Find the gradient of this tangent at point P . [2]

(c) Find the equation of this tangent. Give your answer in the form $y = mx + c$. [2]

Working:

Answers:

(a)

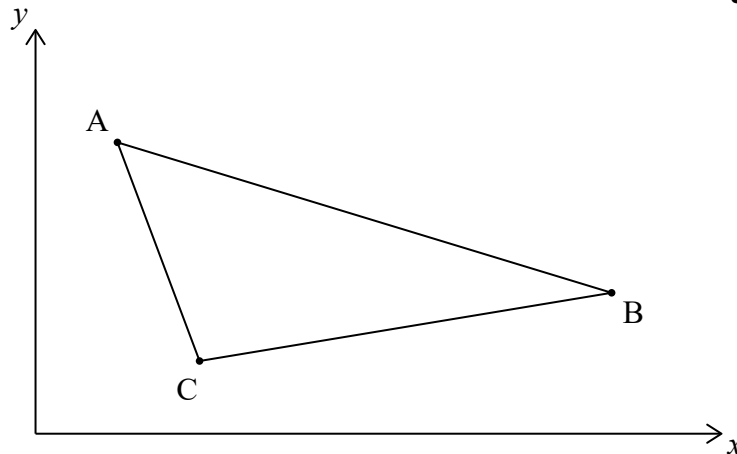
(b)

(c)



12. The diagram shows a triangle defined by the points $A(3, 9)$, $B(15, 6)$ and $C(5, 3)$.

diagram not to scale



- (a) Calculate the gradient of the line AC . [2]
- (b) Determine, giving a reason, whether angle $\hat{A}CB$ is a right angle. [2]

The straight line, L , is parallel to BC and passes through A .

- (c) Find the equation of L .
Give your answer in the form $ax + by + d = 0$, where a , b and d are integers. [2]

Working:

Answers:

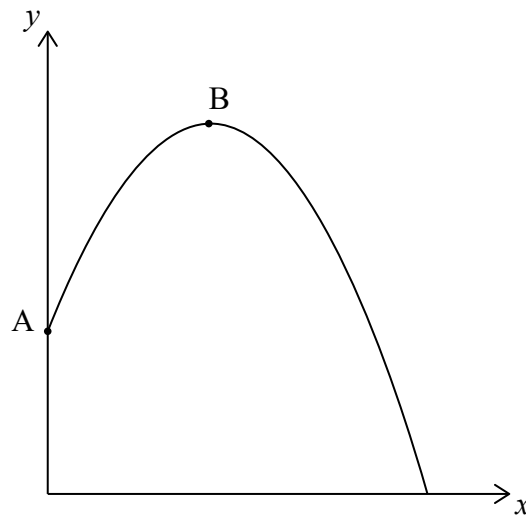
- (a)
- (b)
-
- (c)



13. Bella throws a ball from the top of a wall onto flat horizontal ground.

The path of the ball is modelled by the quadratic curve $y = 3 + 4x - x^2$, where x represents the horizontal distance the ball is thrown and y represents the height of the ball above the ground. All distances are measured in metres.

The wall lies along the y -axis. The curve intersects the y -axis at point A and has its vertex at point B.



- (a) Write down the height in metres from which the ball was thrown. [1]
- (b) Calculate the maximum height, above the ground, reached by the ball. [3]
- (c) Find the horizontal distance from the base of the wall to the point at which the ball hits the ground. [2]

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(Question 13 continued)

Working:

Answers:

- (a)
- (b)
- (c)



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will not be marked.



14. The marks achieved by students taking a college entrance test follow a normal distribution with mean 300 and standard deviation 100.

In this test, 10% of the students achieved a mark greater than k .

- (a) Find the value of k . [2]

Marron College accepts only those students who achieve a mark of at least 450 on the test.

- (b) Find the probability that a randomly chosen student will be accepted by Marron College. [2]
- (c) Given that Naomi attends Marron College, find the probability that she achieved a mark of at least 500 on the test. [2]

Working:

Answers:

- (a)
- (b)
- (c)

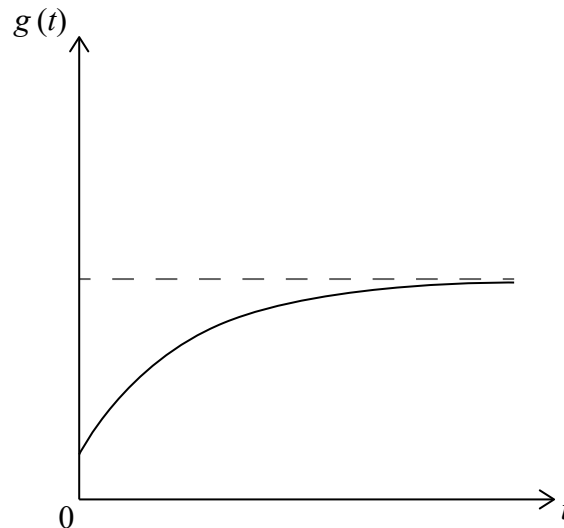


15. The amount of yeast, g grams, in a sugar solution can be modelled by the function,

$$g(t) = 10 - k(c^{-t}) \text{ for } t \geq 0$$

where t is the time in minutes.

The graph of $g(t)$ is shown.



The initial amount of yeast in this solution is 2 grams.

- (a) Find the value of k . [2]

The amount of yeast in this solution after 3 minutes is 9 grams.

- (b) Find the value of c . [3]
(c) Write down the maximum amount of yeast in this solution. [1]

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(Question 15 continued)

Working:

Answers:

- (a)
- (b)
- (c)



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