

**Mathematical studies**  
**Standard level**  
**Paper 1**

Monday 12 November 2018 (afternoon)

Candidate session number

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1 hour 30 minutes

**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  $350 \text{ cm}^2$ .

- (a) Calculate the volume of this hemisphere in  $\text{cm}^3$ .  
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]

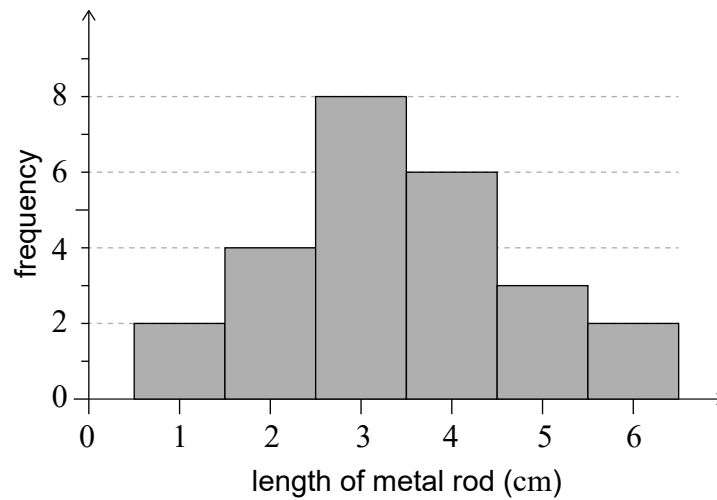
**Working:**

**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  $\chi^2$  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) .....

.....

.....

.....



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) .....

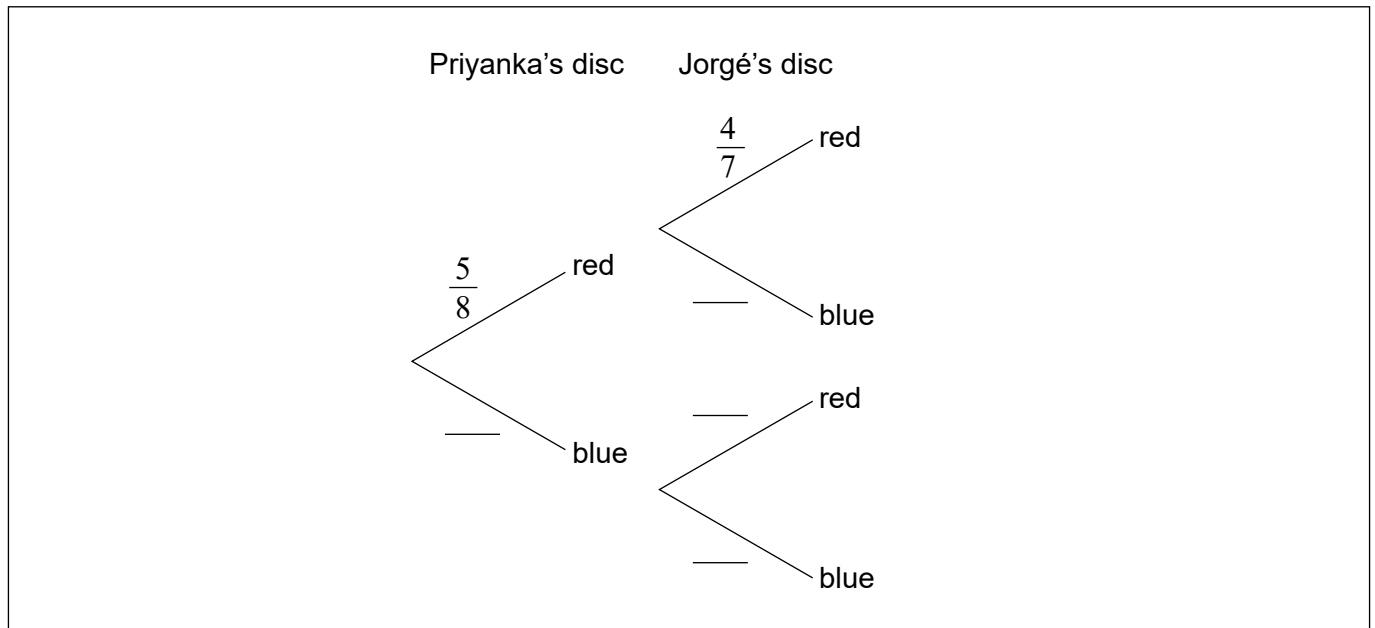




8. A bag contains 5 red and 3 blue discs, all identical except for the colour. First, Priyanka takes a disc at random from the bag and then Jorgé takes a disc at random from the bag.

(a) Complete the tree diagram.

[3]



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

[3]

**Working:**

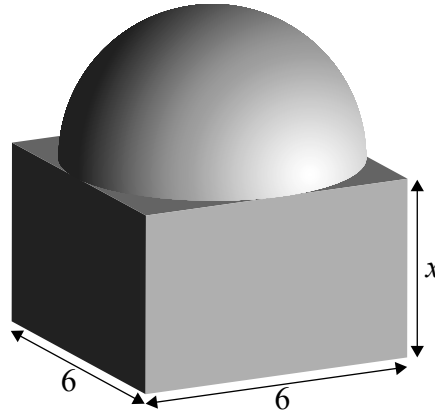
**Answer:**

(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]
- $1 \text{ cm}^3$  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) .....

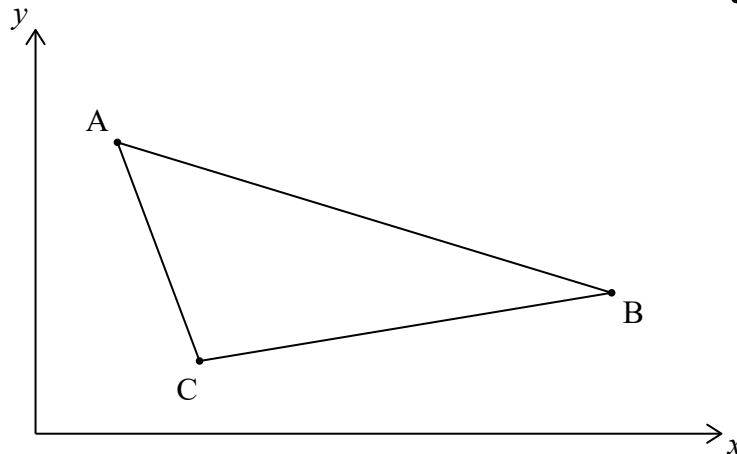
(b) .....

(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  $\hat{ACB}$  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:**

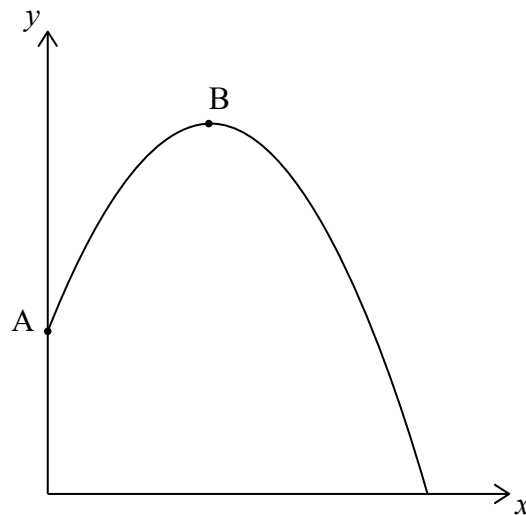
- (a) .....
- (b) .....
- .....
- (c) .....



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) .....

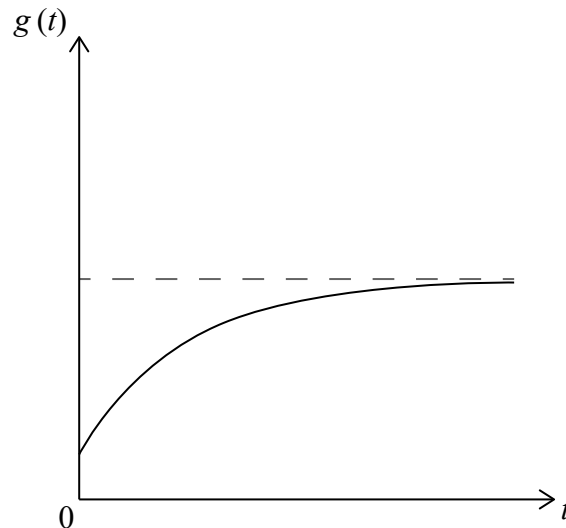


15. The amount of yeast,  $g$  grams, in a sugar solution can be modelled by the function,

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

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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