



**BAULKHAM HILLS HIGH SCHOOL 2023  
YEAR 11 ASSESSMENT TASK 1  
MATHEMATICS ADVANCED**

**MARKING COVER SHEET**

**FINAL MARK**

**NAME:** \_\_\_\_\_ **Teacher:** \_\_\_\_\_

| Page                   | Functions F1   | Statistics S1   | Total |
|------------------------|----------------|-----------------|-------|
| <b>Multiple Choice</b> | Q2 -7, 9<br>/7 | Q1, 8, 10<br>/3 | /10   |
| <b>Page-8</b>          | Q11, 12a<br>/6 |                 | /6    |
| <b>Page-9</b>          | Q12b, 13<br>/7 |                 | /7    |
| <b>Page-10</b>         | Q15<br>/3      | Q14<br>/2       | /5    |
| <b>Page-11</b>         | Q16, 17<br>/5  |                 | /5    |
| <b>Page-12</b>         | Q19<br>/2      | Q18<br>/3       | /5    |
| <b>Page-13</b>         | Q20, 21<br>/4  |                 | /4    |
| <b>Page-14</b>         | Q22, 23<br>/5  |                 | /5    |
| <b>Page-15</b>         | Q24<br>/5      |                 | /5    |
| <b>Page-16</b>         |                | Q25<br>/5       | /5    |
| <b>Page-17</b>         | Q26, 27<br>/4  |                 | /4    |
| <b>Page-18</b>         | Q28<br>/4      |                 | /4    |
| <b>Page-19</b>         | Q29, 30<br>/4  |                 | /4    |
| <b>Page-20</b>         | Q31, 32<br>/5  |                 | /5    |
| <b>Page-21</b>         | Q34<br>/3      | Q33<br>/2       | /5    |
| <b>TOTAL</b>           | /64            | /15             | /79   |



BAULKHAM HILLS HIGH SCHOOL  
YEAR 11 ASSESSMENT TASK 1, 2023  
MATHEMATICS ADVANCED

NAME: \_\_\_\_\_

Teacher: \_\_\_\_\_

## Mathematics

### Section I – Multiple Choice

Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

Sample:  $2 + 4 =$  (A) 2 (B) 6 (C) 8 (D) 9  
A ☐ B ☒ C ☐ D ☐

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

A ☒ B ☒ C ☐ D ☐

If you change your mind and have crossed out what you consider to be the correct answer, then indicate the correct answer by writing the word *correct* and drawing an arrow as follows.

A ☒ B ☒ C ☐ D ☐  
*correct* (arrow pointing to B)

- Start Here →
- |                            |                         |                         |                         |                             |                         |                         |                         |
|----------------------------|-------------------------|-------------------------|-------------------------|-----------------------------|-------------------------|-------------------------|-------------------------|
| 1. A <input type="radio"/> | B <input type="radio"/> | C <input type="radio"/> | D <input type="radio"/> | 6. A <input type="radio"/>  | B <input type="radio"/> | C <input type="radio"/> | D <input type="radio"/> |
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2023

## PRELIMINARY ASSESSMENT TASK 1

# Mathematics Advanced

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### General Instructions

- Reading time – 10 minutes
- Working time – 1 hour 30 minutes
- Write using black pen
- Calculators approved by NESA may be used
- A reference sheet is provided at the back of this paper
- In Questions 11 – 34, show relevant mathematical reasoning and/or calculations

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### Total marks: 79

#### Section I – 10 marks (pages 4 – 7)

- Attempt Questions 1 – 10
- Allow about 15 minutes for this section

#### Section II – 69 marks (pages 8 – 21)

- Attempt Questions 11 – 34
- Allow about 1 hour and 15 minutes for this section

## Section I

**10 marks**

**Attempt Questions 1 – 10**

**Allow about 15 minutes for this section**

Use the multiple-choice answer sheet for Questions 1 – 10.

---

- 1** A fair 6-sided die is rolled twice. What is the probability of getting at least one 6?

- A.  $\frac{1}{3}$
  - B.  $\frac{1}{6}$
  - C.  $\frac{11}{36}$
  - D.  $\frac{5}{18}$
- 

- 2** What is the minimum value of the function  $y = 2x^2 + 6x + 2$ ?

- A.  $\frac{-23}{2}$
- B.  $\frac{-7}{2}$
- C.  $\frac{-5}{2}$
- D.  $\frac{31}{2}$

3 Which of the following functions is **NOT** a one-to-one function?

A.  $f(x) = 4 - x^2, x \geq 0$

B.  $f(x) = 1 - 4x$

C.  $f(x) = \sqrt{4 - x^2}$

D.  $f(x) = \frac{4}{x}$

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4 Which of the following is **not** a polynomial?

A.  $x^2 + 5x + 12$

B.  $\frac{6}{x}(3x^2 + 2x)$

C.  $(2x + 7)3x^{\frac{1}{2}}$

D.  $2x(x^5 + 2x^3 - 4)^3$

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5 What is  $\frac{1}{4\sqrt[3]{(x+3)^5}}$  in index form?

A.  $4(x+3)^{\frac{-5}{3}}$

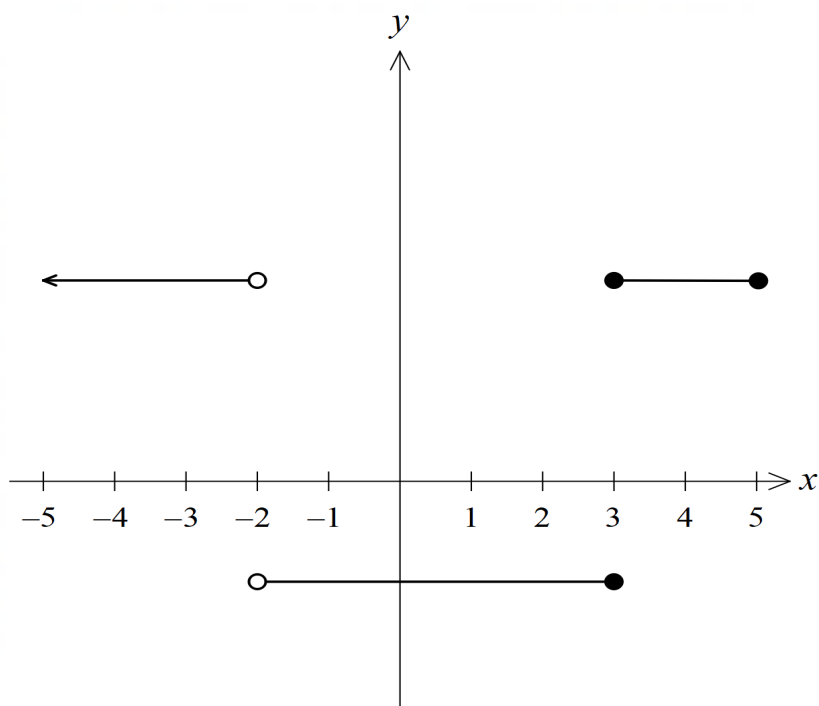
B.  $4(x+3)^{\frac{5}{3}}$

C.  $\frac{1}{4}(x+3)^{\frac{3}{5}}$

D.  $\frac{1}{4}(x+3)^{\frac{-5}{3}}$

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- 6 What is the domain of the graph drawn below?



- A. All real  $x$ .  
B.  $x \leq 5$ ,  $x \neq -2$   
C.  $-4 > x \geq 5$   
D.  $x < 5$ ,  $x \neq -2$
- 
- 7 Which of the following is equivalent to  $8x^3 - 10x^2 + 3x$ ?

- A.  $x(4x + 3)(2x - 1)$   
B.  $x(4x - 3)(2x - 1)$   
C.  $x(4x - 3)(2x + 1)$   
D.  $x(4x + 3)(2x + 1)$
-

- 8 All of Bob's friends either jog or go to the gym. He knows that 70% of his friends jog, and 35% jog and go to a gym. What percentage of Bob's friends go to the gym, but do not jog?

A. 35%  
B. 65%  
C. 30%  
D. 70%

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- 9 What is the natural domain of  $f(x) = \frac{1}{\sqrt{3-x}}$ ?

A.  $(-\infty, 3]$   
B.  $(-\infty, 3)$   
C.  $[3, \infty)$   
D.  $(3, \infty)$

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- 10 In a best of three sets tennis match (where the first player to win two sets wins the match), Chris has a probability of  $\frac{2}{3}$  of winning a set. What is the probability that Chris wins the match?

A.  $\frac{2}{3}$   
B.  $\frac{8}{9}$   
C.  $\frac{20}{27}$   
D.  $\frac{64}{81}$

**End of Section I**

## Section II

69 marks

Attempt Questions 11–34

Allow about 1 hour and 15 minutes for this section

### Instructions

- Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.
- Your responses should include relevant mathematical reasoning and/or calculations.
- Extra writing paper is available. If you use extra paper, write your name, your teacher's name on the paper and clearly indicate which question you are answering.

### Question 11 (4 marks)

- (a) Simplify  $4\sqrt{12} - \sqrt{50} - \sqrt{27}$ . 2

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- (b) Simplify  $4y^{-2}(x)^{\frac{3}{2}}$ , leaving your answer without fractional or negative indices. 2

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### Question 12 (4 marks)

- (a) Factorise  $x^3 - 64x$ . 2

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- (b) Factorise  $x^2 - 11xy - 1 + 11y$ . 2

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**Question 13 (5 marks)**

Simplify the following:

- (a)  $\frac{6}{x+4} + \frac{3x}{x^2+8x+16}$  2

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- (b)  $\frac{x^2-9}{x^2-2x-15} \div \frac{x^2-5x+6}{3x^2-12}$  3

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**Question 14** (2 marks)

Amy buys 4 tickets in a raffle in which 50 tickets are sold. The tickets are drawn for first and second prizes.

- (a) What is the probability that Amy wins the first prize? 1

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- (b) What is the probability that Amy does not win the first prize but wins the second prize? 1

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**Question 15** (3 marks)

Given that  $f(x) = x^2 + 2$  and  $g(x) = 2x + 5$ , find a simplified expression for:

- (a)  $f(x) \times g(x)$  1

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- (b)  $2g(a^2) - f(2a)$  2

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**Question 16** (3 marks)

Boyle's Law is a gas law that states that the pressure **P** in a container is inversely proportional to the volume **V** of the container. At a given time, the volume of the container is  $27.5 \text{ cm}^3$  and the pressure is  $2.5 \text{ kg/cm}^2$ .

- (a) Find the pressure if the volume is reduced to  $20 \text{ cm}^3$ . **2**

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- (b) Find the volume if the pressure is  $2.75 \text{ kg/cm}^2$ . **1**

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**Question 17** (2 marks)

A function is defined as  $f(x) = \begin{cases} -x+8, & x < -8 \\ -x^2-3, & -8 \leq x < 4. \\ x^3, & x \geq 4 \end{cases}$  **2**

Evaluate  $f(-3) + f(4)$ .

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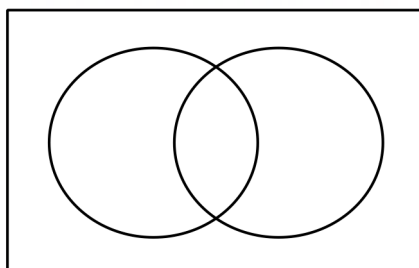
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**Question 18** (3 marks)

In a group of 35 students, all either play sport or a musical instrument, 14 play both and 8 only play sport.

- (a) Complete the Venn diagram for the given information.

1



- (b) Find the probability that a student chosen at random will play a musical instrument given that the student plays sport.

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- (c) Find the probability that a student chosen at random will not play sport given that the student plays a musical instrument.

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**Question 19** (2 marks)

Simplify  $\frac{5^{2m} - 5^m}{5^m - 1}$ .

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**Question 20** (3 marks)

Solve the simultaneous equations  $x + 3y = 2$  and  $y = 2x + 11$ .

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**Question 21** (1 mark)

Alex solves a linear function simultaneously with a quadratic function to find any points of intersection, if they exist. Describe what happens geometrically if Alex finds that there is no solution.

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**Question 22** (2 marks)

Solve  $6 - 3x - 5x^2 = 0$  and give your answer correct to 3 decimal places.

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**Question 23** (3 marks)

Rationalise the denominator  $\frac{7 + \sqrt{5}}{\sqrt{5} - 1}$ .

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**Question 24 (5 marks)**

- (a) Express  $x^2 - 6x + 8$  in the form of  $(x - h)^2 + k$ . 2

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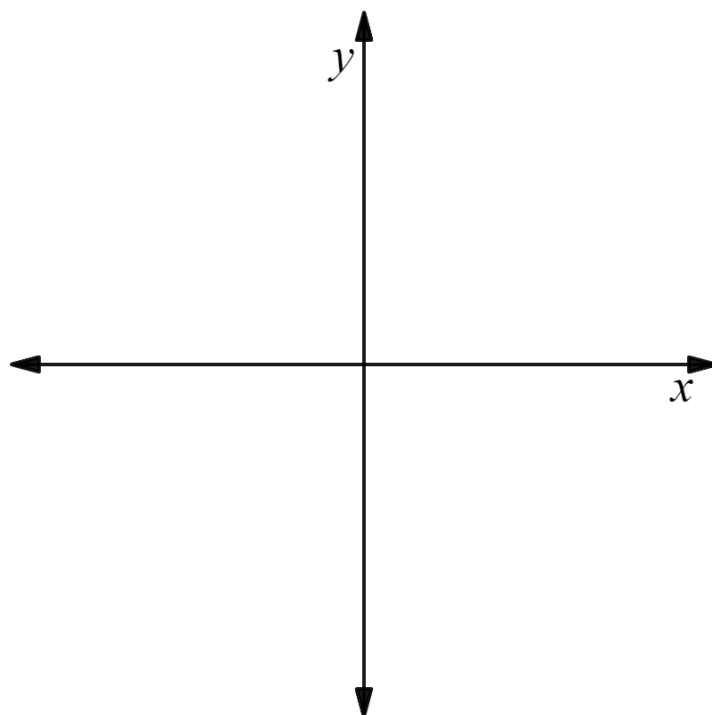
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- (b) Hence, sketch the quadratic function  $f(x) = x^2 - 6x + 8$ . Show all the important features of the graph. 2

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- (c) State the range of function  $f(x) = x^2 - 6x + 8$  using interval notation. 1

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**Question 25 (5 marks)**

A box contains twelve chocolates, four of which are milk chocolate and eight are dark chocolate. Nathan eats three chocolates chosen randomly from the box.

- (a) Draw a probability tree diagram showing the above information. **1**

- (b) Find the probability that the first chocolate eaten is a dark chocolate. **1**

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- (c) Find the probability that Nathan eats three dark chocolates. **1**

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- (d) Find the probability that Nathan eats exactly one dark chocolate. **2**

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**Question 26** (2 marks)

- (a) Find the discriminant of the quadratic equation  $2x^2 - 9x + 7 = 0$ . **1**

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- (b) Hence, determine whether the roots are rational or irrational. **1**

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**Question 27** (2 marks)

- For what values of  $k$  does the quadratic equation  $9x^2 + kx + 1 = 0$  have equal roots? **2**

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**Question 28** (4 marks)

Find the domain and range of the following functions:

(a)  $f(x) = \sqrt{25 - x^2}$  **2**

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(b)  $g(x) = \frac{1}{x-1} + 2$  **2**

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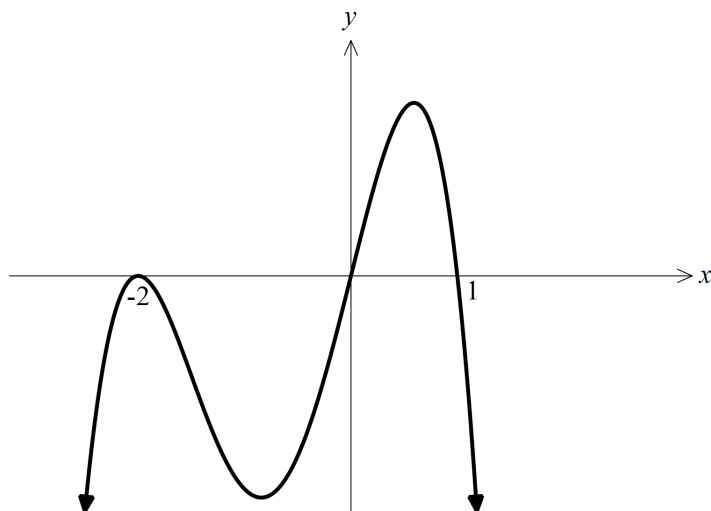
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**Question 29** (1 mark)

The diagram below has leading coefficient either 1 or -1. Write down a possible equation of the polynomial of degree 4.

**1**

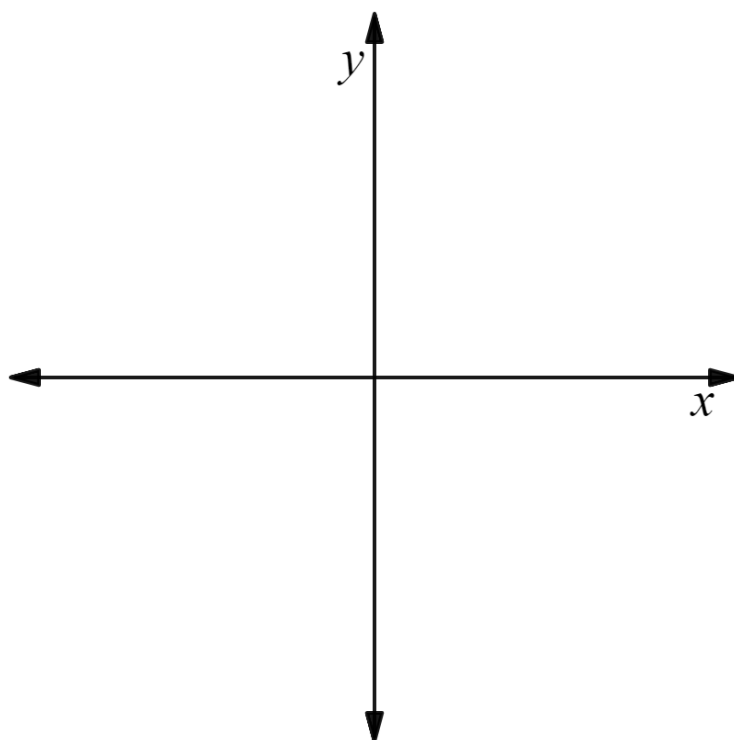


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**Question 30** (3 marks)

Sketch the graph of  $y = -(x-3)(x^2-1)$ , showing all important features.

**3**



**Question 31** (3 marks)

The cost of producing  $x$  litres of orange juice is  $(20 + x)$  dollars. If the income from the sale of  $x$  litres of the juice is  $2x^2$  dollars, calculate the number of litres that must be sold to make a profit of \$800. **3**

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**Question 32** (2 marks)

Solve  $3^x + 3^{x+1} - 36 = 0$ . **2**

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**Question 33 (2 marks)**

Given that  $P(X) = 0.6$  and  $P(X \cup Y) = 0.78$ . Determine whether  $X$  and  $Y$  are independent if  $P(Y) = 0.45$

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**Question 34 (3 marks)**

Solve  $x - \sqrt{25 - x^2} = 1$ .

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**End of Paper**

### ADDITIONAL WORKING OUT SPACE:

If you are continuing a question on this page, write “Continued on extra page” at the end of the allocated space for the question you are continuing. Write the question number clearly before continuing/starting a question on this page.

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MATHEMATICS ADVANCED**

**MARKING COVER SHEET**

**FINAL MARK**

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MATHEMATICS ADVANCED

NAME: \_\_\_\_\_

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## Mathematics

### Section I – Multiple Choice

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A ☐ B ☒ C ☐ D ☐

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*correct* (arrow pointing to B)

- Start Here →
- |                                                                                                               |                                                                                                                |
|---------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|
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2023

## PRELIMINARY ASSESSMENT TASK 1

# Mathematics Advanced

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## Section I

10 marks

Attempt Questions 1 – 10

Allow about 15 minutes for this section

Use the multiple-choice answer sheet for Questions 1 – 10.

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- 1 A fair 6-sided die is rolled twice. What is the probability of getting at least one 6?

A.  $\frac{1}{3}$

B.  $\frac{1}{6}$

☒ C.  $\frac{11}{36}$

D.  $\frac{5}{18}$

$$\begin{aligned} &1 - P(\text{No 6's}) \\ &1 - \frac{5}{6} \times \frac{5}{6} \\ &1 - \frac{25}{36} = \frac{11}{36} \end{aligned}$$

- 2 What is the minimum value of the function  $y = 2x^2 + 6x + 2$ ?

A.  $\frac{-23}{2}$

B.  $\frac{-7}{2}$

☒ C.  $\frac{-5}{2}$

D.  $\frac{31}{2}$

$$\begin{aligned} &2(x^2 + 3x + 1) \\ &2\left[\left(x + \frac{3}{2}\right)^2 - \frac{5}{4}\right] \\ &2\left(x + \frac{3}{2}\right)^2 - \frac{5}{2} \\ &\therefore \text{Vertex } \left(-\frac{3}{2}, -\frac{5}{2}\right) \\ &\therefore \text{Minimum value is } -\frac{5}{2} \end{aligned}$$

3 Which of the following functions is **NOT** a one-to-one function?

A.  $f(x) = 4 - x^2, x \geq 0$

B.  $f(x) = 1 - 4x$

☒ C.  $f(x) = \sqrt{4 - x^2}$  *It doesn't satisfy the horizontal line test.*

D.  $f(x) = \frac{4}{x}$

---

4 Which of the following is **not** a polynomial?

A.  $x^2 + 5x + 12$

B.  $\frac{6}{x}(3x^2 + 2x)$

☒ C.  $(2x + 7)3x^{\frac{1}{2}}$  *as the power of x is in fraction*

D.  $2x(x^5 + 2x^3 - 4)^3$

---

5 What is  $\frac{1}{4\sqrt[3]{(x+3)^5}}$  in index form?

A.  $4(x+3)^{\frac{-5}{3}}$

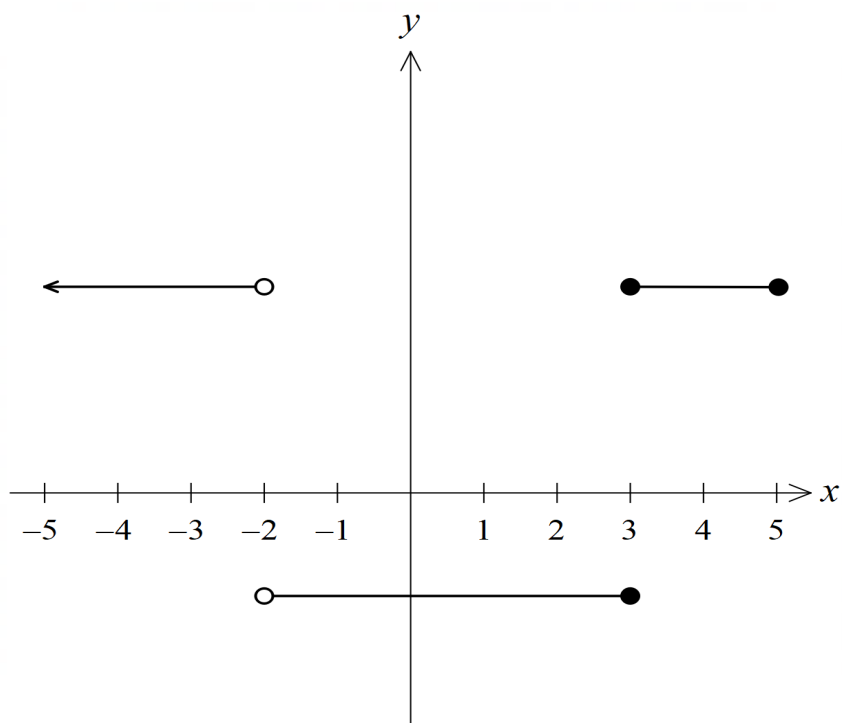
B.  $4(x+3)^{\frac{5}{3}}$

C.  $\frac{1}{4}(x+3)^{\frac{3}{5}}$

☒ D.  $\frac{1}{4}(x+3)^{\frac{-5}{3}}$

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- 6 What is the domain of the graph drawn below?



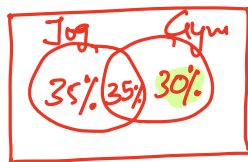
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- 
- 7 Which of the following is equivalent to  $8x^3 - 10x^2 + 3x$ ?

- A.  $x(4x+3)(2x-1)$   
B.  $x(4x-3)(2x-1)$   
C.  $x(4x-3)(2x+1)$   
D.  $x(4x+3)(2x+1)$

$$\begin{aligned} & x(8x^2 - 10x + 3) \\ & x(8x^2 - 6x - 4x + 3) \\ & x(2x(4x-3) - 1(4x+3)) \\ & x(4x-3)(2x-1) \end{aligned}$$

- 8 All of Bob's friends either jog or go to the gym. He knows that 70% of his friends jog, and 35% jog and go to a gym. What percentage of Bob's friends go to the gym, but do not jog?



- A. 35%  
 B. 65%  
 C. 30%  
 D. 70%

- 9 What is the natural domain of  $f(x) = \frac{1}{\sqrt{3-x}}$ ?

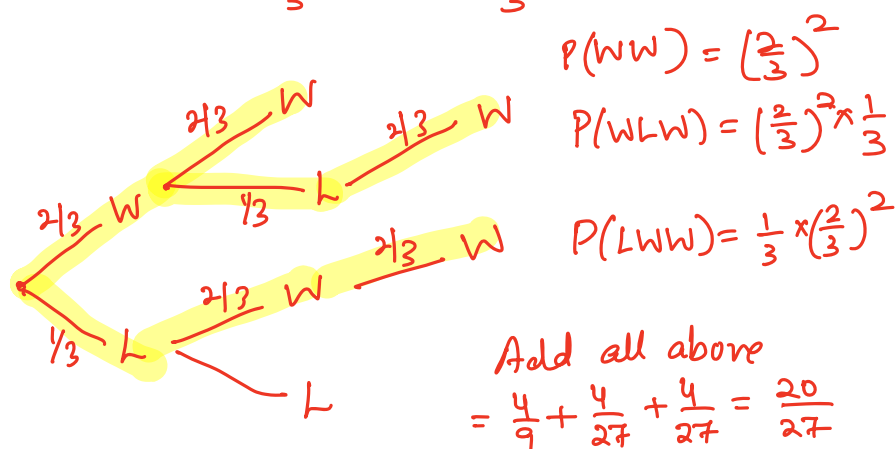
- A.  $(-\infty, 3]$   
 B.  $(-\infty, 3)$   
 C.  $[3, \infty)$   
 D.  $(3, \infty)$

$$\begin{aligned} 3 - x &> 0 \\ x &< 3 \\ (-\infty, 3) \end{aligned}$$

- 10 In a best of three sets tennis match (where the first player to win two sets wins the match), Chris has a probability of  $\frac{2}{3}$  of winning a set. What is the probability that Chris wins the match?

$$P(W) = \frac{2}{3}, \quad P(L) = \frac{1}{3}$$

- A.  $\frac{2}{3}$   
 B.  $\frac{8}{9}$   
 C.  $\frac{20}{27}$   
 D.  $\frac{64}{81}$



End of Section I

## Section II

69 marks

Attempt Questions 11–34

Allow about 1 hour and 15 minutes for this section

### Instructions

- Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.
- Your responses should include relevant mathematical reasoning and/or calculations.
- Extra writing paper is available. If you use extra paper, write your name, your teacher's name on the paper and clearly indicate which question you are answering.

### Question 11 (4 marks)

(a) Simplify  $4\sqrt{12} - \sqrt{50} - \sqrt{27}$ .

2

$$\begin{aligned} & 8\sqrt{3} - 5\sqrt{2} - 3\sqrt{3} \\ & 5\sqrt{3} - 5\sqrt{2} \end{aligned}$$

1 mark for correctly decompose two surds  
2 marks correct solution.

(b) Simplify  $4y^{-2}(x)^{\frac{3}{2}}$ , leaving your answer without fractional or negative indices. 2

$$\frac{4x\sqrt{x}}{y^2}$$

1 mark for correctly changing either negative indices to positive or  $(x)^{\frac{3}{2}}$  to  $x\sqrt{x}$   
2 marks correct solution.

### Question 12 (4 marks)

(a) Factorise  $x^3 - 64x$ .

2

$$\begin{aligned} & x(x^2 - 64) \\ & x(x - 8)(x + 8) \end{aligned}$$

1 mark for one correct factor  
2 marks all correct factors

(b) Factorise  $x^2 - 11xy - 1 + 11y$ .

2

$$\begin{aligned}
 & x^2 - 1 - 11xy + 11y \\
 & (x^2 - 1) - 11y(x - 1) \\
 & (x - 1)(x + 1 - 11y)
 \end{aligned}$$

1 mark for correctly using grouping in pairs  
2 marks for correct factors

### Question 13 (5 marks)

Simplify the following:

(a)  $\frac{6}{x+4} + \frac{3x}{x^2+8x+16}$

2

$$\begin{aligned}
 & \frac{6}{x+4} + \frac{3x}{(x+4)^2} \\
 & \frac{6(x+4) + 3x}{(x+4)^2} \\
 & \frac{9x + 24}{(x+4)^2}
 \end{aligned}$$

1 mark for correctly changing two fractions to a single fraction with common denominator.  
2 marks correct solution.

(b)  $\frac{x^2-9}{x^2-2x-15} \div \frac{x^2-5x+6}{3x^2-12}$

3

$$\begin{aligned}
 & \frac{(x-3)(x+3)}{(x-5)(x+3)} \times \frac{3(x^2-4)}{(x-2)(x-3)} \\
 & \frac{3(x+2)}{x-5} \\
 \text{or} & \frac{3x+6}{x-5}
 \end{aligned}$$

1 mark for factorising at least two expressions.  
2 marks for factorising three expressions and changing  $\div$  into  $\times$ .  
3 marks correct solution

**Question 14** (2 marks)

Amy buys 4 tickets in a raffle in which 50 tickets are sold. The tickets are drawn for first and second prizes.

- (a) What is the probability that Amy wins the first prize?

1

$$\frac{4}{50} = \frac{2}{25} \quad \text{1 mark for correct solution}$$

- (b) What is the probability that Amy does not win the first prize but wins the second prize?

1

$$\frac{46}{50} \times \frac{4}{49} = \frac{92}{1225} \quad \text{1 mark for correct solution}$$

**Question 15** (3 marks)

Given that  $f(x) = x^2 + 2$  and  $g(x) = 2x + 5$ , find a simplified expression for:

- (a)  $f(x) \times g(x)$

1

$$(x^2 + 2)(2x + 5) \\ 2x^3 + 5x^2 + 4x + 10 \quad \text{1 mark for correct expression}$$

- (b)  $2g(a^2) - f(2a)$

2

$$2(2a^2 + 5) - ((2a)^2 + 2) \\ 4a^2 + 10 - 4a^2 - 2 \\ 8$$

1 mark for either expressing correct  $g(a^2)$  or  $f(2a)$   
2 marks for correct answer

**Question 16** (3 marks)

Boyle's Law is a gas law that states that the pressure **P** in a container is inversely proportional to the volume **V** of the container. At a given time, the volume of the container is  $27.5 \text{ cm}^3$  and the pressure is  $2.5 \text{ kg/cm}^2$ .

- (a) Find the pressure if the volume is reduced to  $20 \text{ cm}^3$ .

2

$$\begin{aligned}
 P &\propto \frac{1}{V} \Rightarrow P = \frac{k}{V} \\
 k &= PV = 27.5 \times 2.5 = 68.75 \quad \checkmark \\
 P &= \frac{k}{V} = \frac{68.75}{20} \\
 &= 3.4375 \text{ kg/cm}^2 \quad \checkmark
 \end{aligned}$$

1 mark to find k.  
2 marks for both k and P.

- (b) Find the volume if the pressure is  $2.75 \text{ kg/cm}^2$ .

1

$$V = \frac{k}{P} = \frac{68.75}{2.75} = 25 \text{ cm}^3$$

1 mark for correct solution.

**Question 17** (2 marks)

A function is defined as  $f(x) = \begin{cases} -x+8, & x < -8 \\ -x^2-3, & -8 \leq x < 4 \\ x^3, & x \geq 4 \end{cases}$

2

Evaluate  $f(-3) + f(4)$ .

$$\begin{aligned}
 &-(-3)^2 - 3 + 4^3 \\
 &-12 + 64 \\
 &52
 \end{aligned}$$

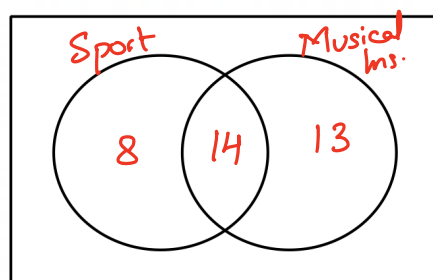
1 mark for either correct  $f(-3)$  or  $f(4)$   
2 marks for correct value.

**Question 18** (3 marks)

In a group of 35 students, all either play sport or a musical instrument, 14 play both and 8 only play sport.

- (a) Complete the Venn diagram for the given information.

1



1 mark to complete the Venn diagram correctly with labelled Sport and Musical instrument.

- (b) Find the probability that a student chosen at random will play a musical instrument given that the student plays sport.

1

.....  $\frac{14}{22}$  or  $\frac{7}{11}$  ..... 1 mark for correct solution.

- (c) Find the probability that a student chosen at random will not play sport given that the student plays a musical instrument.

1

.....  $\frac{13}{27}$  ..... 1 mark for correct solution.

**Question 19** (2 marks)

Simplify  $\frac{5^{2m} - 5^m}{5^m - 1}$ .

2

.....  $\frac{5^m(5^m - 1)}{5^m - 1}$  ..... 1 mark to correctly factorise the numerator.

.....  $5^m$  ..... 2 marks for correct solution.

**Question 20** (3 marks)Solve the simultaneous equations  $x + 3y = 2$  and  $y = 2x + 11$ .

3

$$x + 3y = 2$$

$$x + 3(2x + 11) = 2$$

$$x + 6x + 33 = 2$$

$$7x = -31$$

$$x = -\frac{31}{7}$$

$$y = 2\left(-\frac{31}{7}\right) + 11$$

$$= \frac{-62 + 77}{7}$$

$$= \frac{15}{7}$$

$$\therefore x = -\frac{31}{7}, y = \frac{15}{7}$$

1 mark for correctly using substitution or elimination method to solve simultaneous equations.

2 marks for correctly getting either  $x$  or  $y$  value.

3 marks for correct sol.

**Question 21** (1 mark)

Alex solves a linear function simultaneously with a quadratic function to find any points of intersection, if they exist. Describe what happens geometrically if Alex finds that there is no solution.

1

For no solution, the line and quadratic function doesn't have any point of intersection.

1 mark for correct explanation.

**Question 22** (2 marks)Solve  $6 - 3x - 5x^2 = 0$  and give your answer correct to 3 decimal places.

2

$$-5x^2 - 3x + 6 = 0$$

$$x = \frac{3 \pm \sqrt{9 + 120}}{-10}$$

$$= \frac{3 + \sqrt{129}}{-10}, \quad \frac{3 - \sqrt{129}}{-10}$$

$$= -1.436, \quad 0.836$$

1 mark for correctly using quad. formula/ completing sq. method to solve the equation

2 marks with correct solution including 3 decimal places.

**Question 23** (3 marks)Rationalise the denominator  $\frac{7 + \sqrt{5}}{\sqrt{5} - 1}$ .

3

$$\frac{7 + \sqrt{5}}{\sqrt{5} - 1} \times \frac{\sqrt{5} + 1}{\sqrt{5} + 1}$$

$$\frac{(7 + \sqrt{5})(\sqrt{5} + 1)}{5 - 1}$$

$$\frac{8\sqrt{5} + 12}{4}$$

$$2\sqrt{5} + 3$$

1 mark for multiplying and divide by  $(\sqrt{5} + 1)$

2 marks for multiplying by the conjugate surd and simplifying either num. or den.

3 marks for correct solution in simplified form.

**Question 24** (5 marks)

- (a) Express  $x^2 - 6x + 8$  in the form of  $(x-h)^2 + k$ .

2

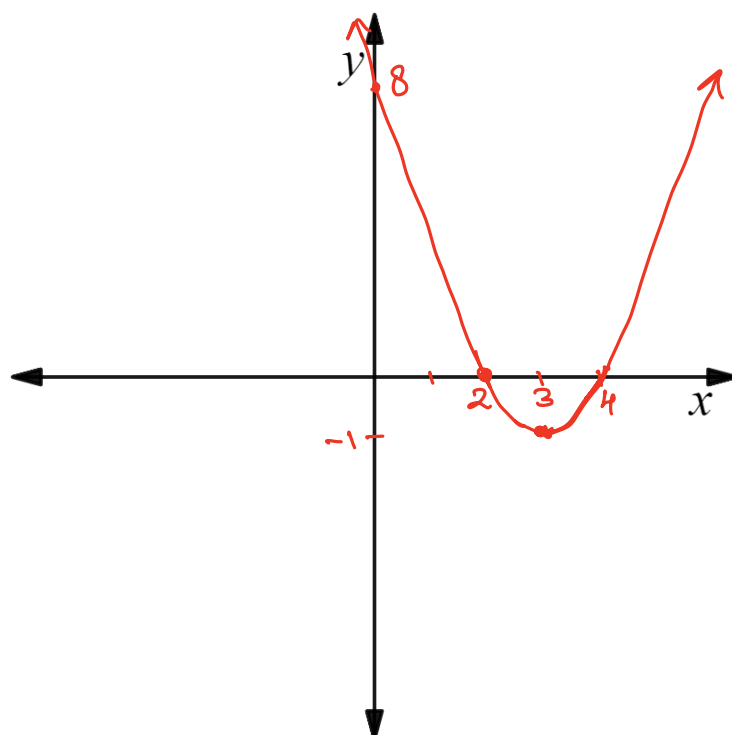
$$\begin{aligned} & x^2 - 6x + 8 \\ & x^2 - 6x + 9 - 1 \\ & (x-3)^2 - 1 \end{aligned}$$

1 mark for either correct h or k.  
2 marks for correctly expressing in given form

- (b) Hence, sketch the quadratic function  $f(x) = x^2 - 6x + 8$ . Show all the important features of the graph.

2

$$\begin{aligned} & \text{y-intercept: } x=0, y=8 \quad (0, 8) \\ & \text{x-intercept: } y=0 \Rightarrow x^2 - 6x + 8 = 0 \\ & \quad (x-4)(x-2) = 0 \Rightarrow x=2, 4. \end{aligned}$$



1 mark for correct shape.  
1 mark for correct x & y intercepts.  
(vertex needs to be shown)

- (c) State the range of function  $f(x) = x^2 - 6x + 8$  using interval notation.

1

$$\text{Range: } y \in [-1, \infty)$$

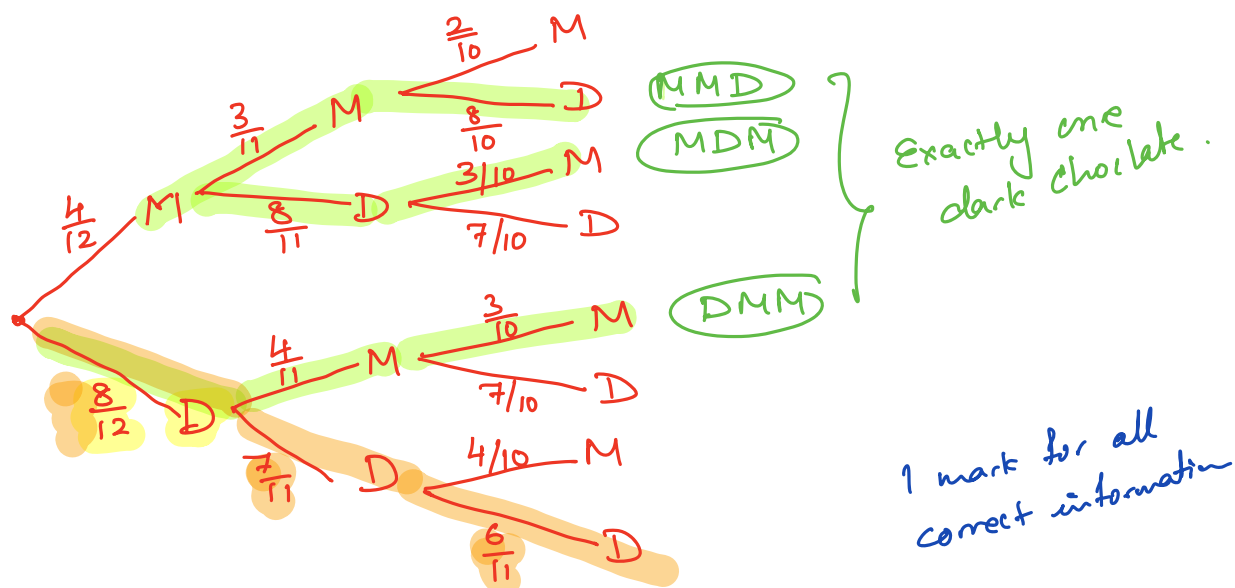
1 mark for correct interval notation

**Question 25** (5 marks)

A box contains twelve chocolates, four of which are Milk chocolate and eight are Dark chocolate. Nathan eats three chocolates chosen randomly from the box.

- (a) Draw a probability tree diagram showing the above information.

1



- (b) Find the probability that the first chocolate eaten is a dark chocolate.

1

$\frac{8}{12} = \frac{2}{3}$  1 mark for correct sol.

- (c) Find the probability that Nathan eats three dark chocolates.

1

$\frac{8}{12} \times \frac{7}{11} \times \frac{6}{10} = \frac{14}{55}$  1 mark for correct sol.

- (d) Find the probability that Nathan eats exactly one dark chocolate.

2

$\left( \frac{8}{12} \times \frac{4}{11} \times \frac{3}{10} \right) \times 3 = \frac{12}{55}$  1 mark for one correct e.g. MMD or MDM or DMM

2 marks for correct solution.

**Question 26** (2 marks)

- (a) Find the discriminant of the quadratic equation  $2x^2 - 9x + 7 = 0$ .

1

$$\begin{aligned}\Delta &= b^2 - 4ac \\ &= (-9)^2 - 4(2)(7) \\ &= 81 - 56 \\ &= 25\end{aligned}$$

1 mark for correct  
discriminant

- (b) Hence, determine whether the roots are rational or irrational.

1

Since discriminant is perfect square  
 $\therefore$  roots are rational.

1 mark for correct  
answer with  
explanation

**Question 27** (2 marks)

For what values of  $k$  does the quadratic equation  $9x^2 + kx + 1 = 0$  have equal roots?

2

$$\begin{aligned}\text{For equal roots: } \Delta &= 0 \\ b^2 - 4ac &= 0 \\ k^2 - 36 &= 0 \\ k &= \pm 6\end{aligned}$$

1 mark for finding the  
discriminant and equating  
it to zero.  
2 marks for correct solution.

**Question 28** (4 marks)

Find the domain and range of the following functions:

(a)  $f(x) = \sqrt{25 - x^2}$

2

Domain:  $x \in [-5, 5]$  or  $-5 \leq x \leq 5$

Range:  $y \in [0, 5]$  or  $0 \leq y \leq 5$

1 mark for correct domain

1 mark for correct range.

(b)  $g(x) = \frac{1}{x-1} + 2$

2

Domain: All real  $x$  except  $x=1$

or  $x \in \mathbb{R} \setminus \{1\}$  or  $x \in (-\infty, 1) \cup (1, \infty)$

Range: All real  $y$  except  $y=2$

or  $y \in \mathbb{R} \setminus \{2\}$  or  $y \in (-\infty, 2) \cup (2, \infty)$

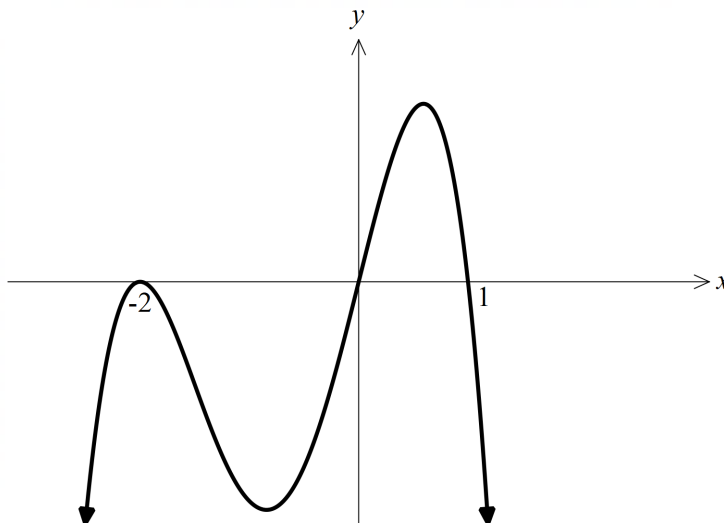
1 mark for correct domain

1 mark for correct range.

**Question 29** (1 mark)

The diagram below has leading coefficient either 1 or -1. Write down a possible equation of the polynomial of degree 4.

1



$$y = -x(x+2)^2(x-1)$$

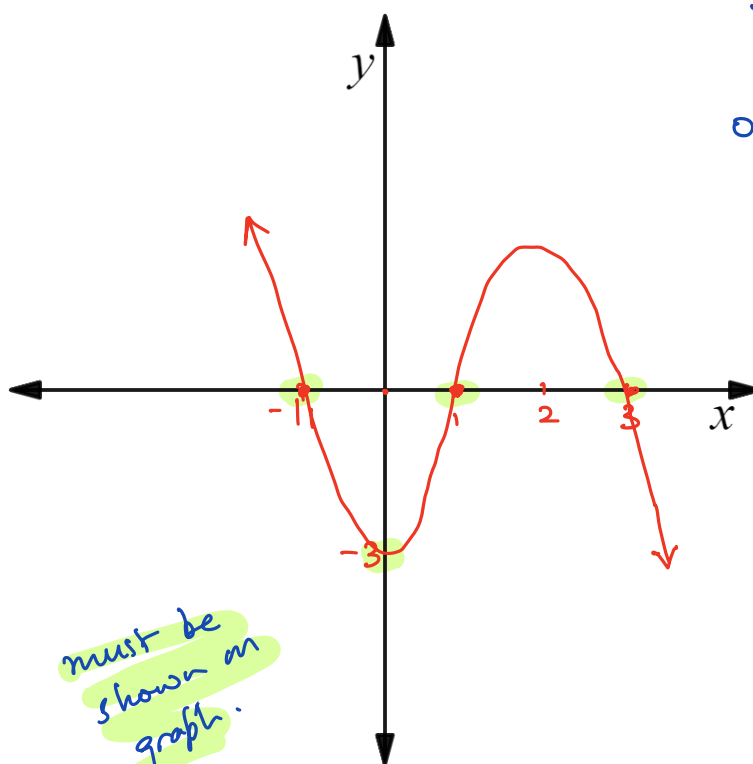
1 mark for correct equation. e.g  $y = \dots$   
 $P(x) = \dots$

**Question 30** (3 marks)

Sketch the graph of  $y = -(x-3)(x^2-1)$ , showing all important features.

3

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



1 mark for shape  
or  
or any 2 correct x-int.  
2 marks for at least  
two correct x-intercepts  
including shape.  
3 marks for correct  
graph (shape, intercepts)

must be shown on graph.

**Question 31** (3 marks)

The cost of producing  $x$  litres of orange juice is  $(20 + x)$  dollars. If the income from the sale of  $x$  litres of the juice is  $2x^2$  dollars, calculate the number of litres that must be sold to make a profit of \$800. 3

$$\begin{aligned}
 &\text{Profit} = \text{Selling Price} - \text{Cost Price} \\
 &800 = 2x^2 - 20 - x \\
 &2x^2 - x - 820 = 0 \\
 &x = \frac{1 \pm \sqrt{1 + 6560}}{4} \\
 &= \frac{1 \pm 81}{4} \\
 &= 20.5, -20 \quad (\text{Reject -ve}) \\
 &\therefore 20.5 \text{ litres must be sold to make a profit of \$800.}
 \end{aligned}$$

{ 1 mark for correct expression of profit  
 2 marks for solving quad. eq.  
 3 marks for correct sol.

**Question 32** (2 marks)

Solve  $3^x + 3^{x+1} - 36 = 0$ . 2

$$\begin{aligned}
 &3^x + 3 \cdot 3^x = 36 \\
 &4 \cdot 3^x = 36 \\
 &3^x = 9 \\
 &3^x = 3^2 \\
 &x = 2
 \end{aligned}$$

{ 1 mark for changing  $3^{x+1} = 3 \cdot 3^x$   
 or  $3^x + 3^{x+1} = 4 \cdot 3^x$   
 2 marks for correct solution.

**Question 33** (2 marks)

Given that  $P(X) = 0.6$  and  $P(X \cup Y) = 0.78$ . Determine whether  $X$  and  $Y$  are independent if  $P(Y) = 0.45$

2

$$\begin{aligned}
 P(X \cup Y) &= P(X) + P(Y) - P(X \cap Y) \\
 0.78 &= 0.6 + 0.45 - P(X \cap Y) \\
 P(X \cap Y) &= 0.27 \\
 P(X) \times P(Y) &= 0.6 \times 0.45 = 0.27 \\
 \text{Since } P(X \cap Y) &= P(X) \times P(Y) \\
 \therefore X \text{ and } Y &\text{ are independent.}
 \end{aligned}$$

1 mark to find  $P(X \cap Y)$   
2 marks for correct solution and showing  $X$  and  $Y$  are independent

**Question 34** (3 marks)

Solve  $x - \sqrt{25 - x^2} = 1$ .

3

$$\begin{aligned}
 x - 1 &= \sqrt{25 - x^2} \quad \text{--- (x)} \\
 \text{Square both sides.} \\
 (x - 1)^2 &= 25 - x^2 \\
 x^2 - 2x + 1 &= 25 - x^2 \\
 2x^2 - 2x - 24 &= 0 \\
 x^2 - x - 12 &= 0 \\
 (x - 4)(x + 3) &= 0 \\
 x = 4, -3 &\quad \text{(Reject -3 as it won't satisfy (x))} \\
 x = 4 &\text{ is the only solution}
 \end{aligned}$$

1 mark to create a quad. eq. by rearranging the terms.  
2 mark to solve the quad. eq. correctly.  
3 marks for correct sol.

End of Paper

If you are continuing a question on this page, write “Continued on extra page” at the end of the allocated space for the question you are continuing. Write the question number clearly before continuing/starting a question on this page.

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