Student Name: _____

Teacher Name: _____

Hurlstone Agricultural High School

2024

Year 11

Assessment Task 1

# Mathematics Advanced

**General Instructions**

- **Senior Examiner:** Mrs M. Sabah
- Reading time – 5 minutes
- Working time – 60 minutes
- Write using black or blue pen
- NESA approved calculators may be used
- A Mathematics reference sheet is provided at the back of this paper
- For all Questions in Section II, show relevant mathematical reasoning and/or calculations

**Total Marks: 45**

**Section I – 6 marks**

- Attempt Questions 1 – 6
- Allow about 10 minutes for this section

**Section II – 39 marks**

- Attempt Questions 7 – 9 in the booklets provided
- Allow about 50 minutes for this section

## Section I

**6 marks**
**Attempt Questions 1 – 6**
**Allow about 10 minutes for this section.**

Use the multiple-choice answer sheet for Questions 1 – 6.

**1.** Which of the following is the solution to the equation $x^{-3} = \frac{x}{16}$ where $x \neq 0$?

A. $x = \pm 4$

B. $x = \pm 2$

C. $x = \pm \frac{1}{2}$

D. No Solution

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**2.** Which of the following is the value of the expression $\frac{14^{n+4} + 7^{n+3} \times 2^{n+3}}{13 \times 14^n + 14^n}$ ?

A. 2 940

B. 2 049

C. 2 490

D. 2 094

---

**3.** Which of the following equations is equivalent to $y = \frac{3}{4}x + \frac{1}{2}$?

A. $3x - 4y - 2 = 0$

B. $3x + 4y + 2 = 0$

C. $6x - 8y - 2 = 0$

D. $3x - 4y + 2 = 0$

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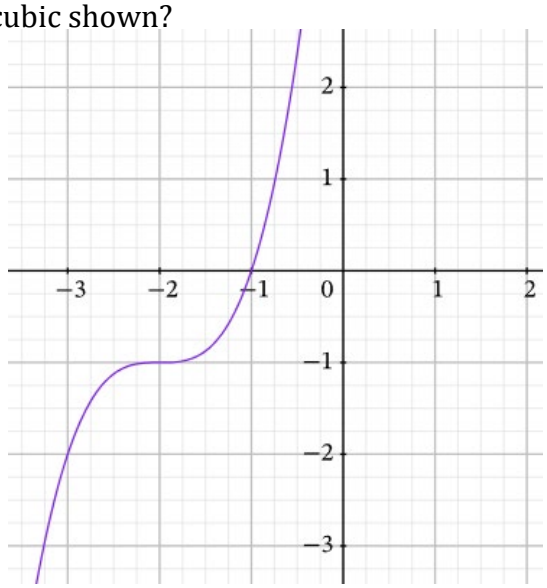
**4.** Which of the following represents the equation of the cubic shown?




A. $y = (x - 2)^3 - 1$

B. $y = (x + 2)^3 - 1$

C. $y = (x + 2)^3 + 1$

D. $y = (x - 2)^3 + 1$

**Section I continues on next page ...**

**5.** Consider $f(x) = \dfrac{1}{1+x}$, then which of the following is equal to $f\big(f(x)\big)$ ?

A. $\dfrac{1}{(1+x)^2}$

B. $\dfrac{1+x}{2+x}$

C. $1$

D. $\dfrac{1}{2+x}$

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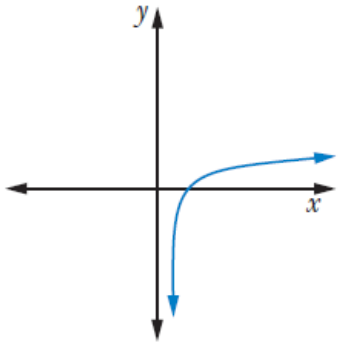
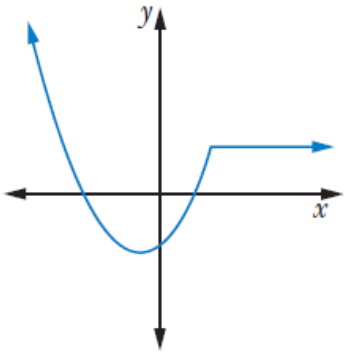
**6.** Which of the following represents a one-to-one function?

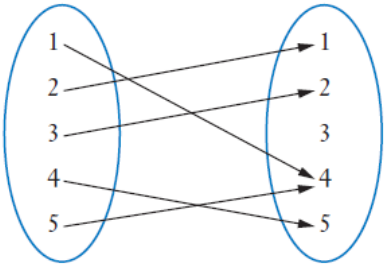
A.



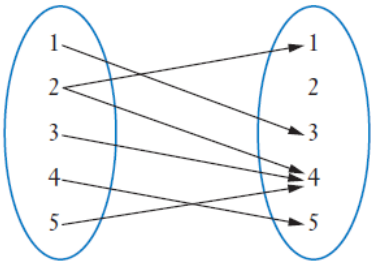

B.




C.




D.




## ~ End of Section I ~

NSW Education Standards Authority

**2020** HIGHER SCHOOL CERTIFICATE EXAMINATION

# Mathematics Advanced
# Mathematics Extension 1
# Mathematics Extension 2

## REFERENCE SHEET

### Measurement

#### Length

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

#### Area

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

$$A = \frac{h}{2}(a + b)$$

#### Surface area

$$A = 2\pi r^2 + 2\pi rh$$

$$A = 4\pi r^2$$

#### Volume

$$V = \frac{1}{3}Ah$$

$$V = \frac{4}{3}\pi r^3$$

### Financial Mathematics

$$A = P(1 + r)^n$$

#### Sequences and series

$$T_n = a + (n-1)d$$

$$S_n = \frac{n}{2}[2a + (n-1)d] = \frac{n}{2}(a + l)$$

$$T_n = ar^{n-1}$$

$$S_n = \frac{a(1 - r^n)}{1 - r} = \frac{a(r^n - 1)}{r - 1}, \quad r \neq 1$$

$$S = \frac{a}{1 - r}, \quad |r| < 1$$

### Functions

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

For $ax^3 + bx^2 + cx + d = 0$:

$$\alpha + \beta + \gamma = -\frac{b}{a}$$

$$\alpha\beta + \alpha\gamma + \beta\gamma = \frac{c}{a}$$

$$\text{and } \alpha\beta\gamma = -\frac{d}{a}$$

#### Relations

$$(x - h)^2 + (y - k)^2 = r^2$$

### Logarithmic and Exponential Functions

$$\log_a a^x = x = a^{\log_a x}$$

$$\log_a x = \frac{\log_b x}{\log_b a}$$

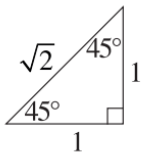
$$a^x = e^{x \ln a}$$

## Trigonometric Functions

$$\sin A = \frac{\text{opp}}{\text{hyp}}, \quad \cos A = \frac{\text{adj}}{\text{hyp}}, \quad \tan A = \frac{\text{opp}}{\text{adj}}$$

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

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

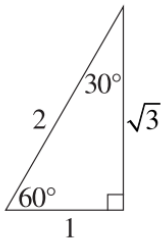



$$c^2 = a^2 + b^2 - 2ab\cos C$$

$$\cos C = \frac{a^2 + b^2 - c^2}{2ab}$$

$$l = r\theta$$

$$A = \frac{1}{2}r^2\theta$$




### Trigonometric identities

$$\sec A = \frac{1}{\cos A},\ \cos A \neq 0$$

$$\text{cosec}\, A = \frac{1}{\sin A},\ \sin A \neq 0$$

$$\cot A = \frac{\cos A}{\sin A},\ \sin A \neq 0$$

$$\cos^2 x + \sin^2 x = 1$$

### Compound angles

$$\sin(A + B) = \sin A\cos B + \cos A\sin B$$

$$\cos(A + B) = \cos A\cos B - \sin A\sin B$$

$$\tan(A + B) = \frac{\tan A + \tan B}{1 - \tan A\tan B}$$

If $t = \tan\frac{A}{2}$ then $\sin A = \frac{2t}{1+t^2}$

$$\cos A = \frac{1-t^2}{1+t^2}$$

$$\tan A = \frac{2t}{1-t^2}$$

$$\cos A\cos B = \frac{1}{2}\left[\cos(A - B) + \cos(A + B)\right]$$

$$\sin A\sin B = \frac{1}{2}\left[\cos(A - B) - \cos(A + B)\right]$$

$$\sin A\cos B = \frac{1}{2}\left[\sin(A + B) + \sin(A - B)\right]$$

$$\cos A\sin B = \frac{1}{2}\left[\sin(A + B) - \sin(A - B)\right]$$

$$\sin^2 nx = \frac{1}{2}(1 - \cos 2nx)$$

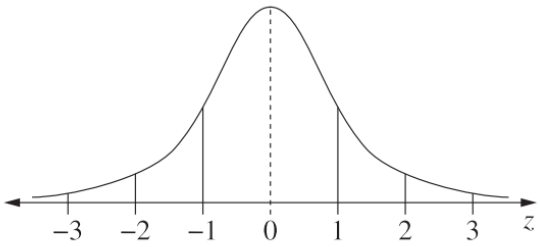
$$\cos^2 nx = \frac{1}{2}(1 + \cos 2nx)$$

## Statistical Analysis

$$z = \frac{x - \mu}{\sigma}$$

An outlier is a score
less than $Q_1 - 1.5 \times IQR$
or
more than $Q_3 + 1.5 \times IQR$

### Normal distribution




- approximately 68% of scores have $z$-scores between –1 and 1
- approximately 95% of scores have $z$-scores between –2 and 2
- approximately 99.7% of scores have $z$-scores between –3 and 3

$$E(X) = \mu$$

$$\text{Var}(X) = E\left[(X - \mu)^2\right] = E\left(X^2\right) - \mu^2$$

### Probability

$$P(A \cap B) = P(A)P(B)$$

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

$$P(A|B) = \frac{P(A \cap B)}{P(B)},\ P(B) \neq 0$$

### Continuous random variables

$$P(X \leq r) = \int_a^r f(x)\,dx$$

$$P(a < X < b) = \int_a^b f(x)\,dx$$

### Binomial distribution

$$P(X = r) = {}^nC_r p^r (1-p)^{n-r}$$

$$X \sim \text{Bin}(n, p)$$

$$\Rightarrow \quad P(X = x) = \binom{n}{x} p^x (1-p)^{n-x},\ x = 0, 1, \ldots, n$$

$$E(X) = np$$

$$\text{Var}(X) = np(1-p)$$

## Differential Calculus

| Function | Derivative |
|---|---|
| $y = f(x)^n$ | $\frac{dy}{dx} = nf'(x)[f(x)]^{n-1}$ |
| $y = uv$ | $\frac{dy}{dx} = u\frac{dv}{dx} + v\frac{du}{dx}$ |
| $y = g(u)$ where $u = f(x)$ | $\frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}$ |
| $y = \frac{u}{v}$ | $\frac{dy}{dx} = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$ |
| $y = \sin f(x)$ | $\frac{dy}{dx} = f'(x)\cos f(x)$ |
| $y = \cos f(x)$ | $\frac{dy}{dx} = -f'(x)\sin f(x)$ |
| $y = \tan f(x)$ | $\frac{dy}{dx} = f'(x)\sec^2 f(x)$ |
| $y = e^{f(x)}$ | $\frac{dy}{dx} = f'(x)e^{f(x)}$ |
| $y = \ln f(x)$ | $\frac{dy}{dx} = \frac{f'(x)}{f(x)}$ |
| $y = a^{f(x)}$ | $\frac{dy}{dx} = (\ln a)f'(x)a^{f(x)}$ |
| $y = \log_a f(x)$ | $\frac{dy}{dx} = \frac{f'(x)}{(\ln a)f(x)}$ |
| $y = \sin^{-1} f(x)$ | $\frac{dy}{dx} = \frac{f'(x)}{\sqrt{1-[f(x)]^2}}$ |
| $y = \cos^{-1} f(x)$ | $\frac{dy}{dx} = -\frac{f'(x)}{\sqrt{1-[f(x)]^2}}$ |
| $y = \tan^{-1} f(x)$ | $\frac{dy}{dx} = \frac{f'(x)}{1+[f(x)]^2}$ |

## Integral Calculus

$$\int f'(x)[f(x)]^n dx = \frac{1}{n+1}[f(x)]^{n+1} + c \quad \text{where } n \neq -1$$

$$\int f'(x)\sin f(x)\,dx = -\cos f(x) + c$$

$$\int f'(x)\cos f(x)\,dx = \sin f(x) + c$$

$$\int f'(x)\sec^2 f(x)\,dx = \tan f(x) + c$$

$$\int f'(x)e^{f(x)}dx = e^{f(x)} + c$$

$$\int \frac{f'(x)}{f(x)}dx = \ln|f(x)| + c$$

$$\int f'(x)a^{f(x)}dx = \frac{a^{f(x)}}{\ln a} + c$$

$$\int \frac{f'(x)}{\sqrt{a^2-[f(x)]^2}}dx = \sin^{-1}\frac{f(x)}{a} + c$$

$$\int \frac{f'(x)}{a^2+[f(x)]^2}dx = \frac{1}{a}\tan^{-1}\frac{f(x)}{a} + c$$

$$\int u\frac{dv}{dx}dx = uv - \int v\frac{du}{dx}dx$$

$$\int_a^b f(x)\,dx$$

$$\approx \frac{b-a}{2n}\left\{f(a)+f(b)+2\left[f\left(x_1\right)+\cdots+f\left(x_{n-1}\right)\right]\right\}$$

where $a = x_0$ and $b = x_n$

## Combinatorics

$${}^nP_r = \frac{n!}{(n-r)!}$$

$$\binom{n}{r} = {}^nC_r = \frac{n!}{r!(n-r)!}$$

$$(x+a)^n = x^n + \binom{n}{1}x^{n-1}a + \cdots + \binom{n}{r}x^{n-r}a^r + \cdots + a^n$$

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## Vectors

$$\left|\underset{\sim}{u}\right| = \left|x\underset{\sim}{i} + y\underset{\sim}{j}\right| = \sqrt{x^2+y^2}$$

$$\underset{\sim}{u}\cdot\underset{\sim}{v} = \left|\underset{\sim}{u}\right|\left|\underset{\sim}{v}\right|\cos\theta = x_1x_2 + y_1y_2,$$

where $\underset{\sim}{u} = x_1\underset{\sim}{i} + y_1\underset{\sim}{j}$

and $\underset{\sim}{v} = x_2\underset{\sim}{i} + y_2\underset{\sim}{j}$

$$\underset{\sim}{r} = \underset{\sim}{a} + \lambda\underset{\sim}{b}$$

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## Complex Numbers

$$z = a + ib = r(\cos\theta + i\sin\theta)$$
$$= re^{i\theta}$$

$$\left[r(\cos\theta + i\sin\theta)\right]^n = r^n(\cos n\theta + i\sin n\theta)$$
$$= r^ne^{in\theta}$$

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## Mechanics

$$\frac{d^2x}{dt^2} = \frac{dv}{dt} = v\frac{dv}{dx} = \frac{d}{dx}\left(\frac{1}{2}v^2\right)$$

$$x = a\cos(nt+\alpha) + c$$

$$x = a\sin(nt+\alpha) + c$$

$$\ddot{x} = -n^2(x-c)$$

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Students Name: _____

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Hurlstone Agricultural High School
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Assessment Task 1

# Mathematics Advanced

## Multiple-Choice Answer Sheet

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

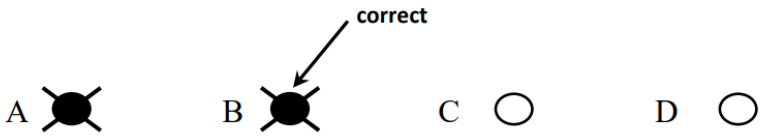
Sample: $2 + 4 =$ (A) 2 (B) 6 (C) 8 (D) 9

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.




| Question | | | | |
|---|---|---|---|---|
| 1. | A ○ | B ○ | C ○ | D ○ |
| 2. | A ○ | B ○ | C ○ | D ○ |
| 3. | A ○ | B ○ | C ○ | D ○ |
| 4. | A ○ | B ○ | C ○ | D ○ |
| 5. | A ○ | B ○ | C ○ | D ○ |
| 6. | A ○ | B ○ | C ○ | D ○ |

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# Mathematics Advanced
# Section II

## Question 7
## (13 Marks)

## Algebraic Techniques

- Answer each question in the space provided.
- Your responses should include relevant mathematical reasoning and/or calculations.

**Question 7**

(a) Solve the quadratic equation $10 + 6x - x^2 = 0$ by completing the square. **2**

(b) Show that the expression below simplifies to a positive integer, stating its value. **3**

$$\frac{1+\sqrt{7}}{3-\sqrt{7}} - \frac{8-\sqrt{7}}{\sqrt{7}-2}$$

**Question 7 continued …**

(c) Solve the equation $3x(x+4) = -3x + 4$, giving your answer to 2 decimal places. **2**

(d) Factorise the expression $2b^3 + 3a^3 + 3ab^2 + 2a^2b$. **2**

(e)

Given

$$y = \frac{2m+4}{m^2-25} \times \frac{m+5}{m^2+3m+2} \div \frac{2}{3m^2-16m+5}$$

(i) Show that the equation above simplifies to $y = \frac{3m-1}{m+1}$. **2**

(ii) Make $m$ the subject of the equation from (i). **2**

**~ End of Question 7 ~**

Students Name: _____

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# Mathematics Advanced
# Section II

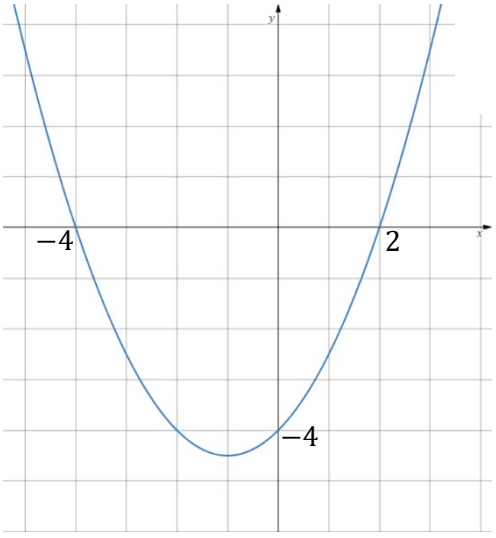
## Question 8
## (13 Marks)

## Linear, Quadratic and Cubic Functions

- Answer each question in the space provided.
- Your responses should include relevant mathematical reasoning and/or calculations.

**Question 8**

(a) Find the equation of the parabola shown in the graph below. **2**

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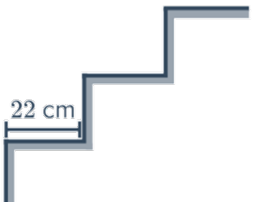
(b) A Glenfield station staircase is built so that its maximum steepness (gradient) is 0.6.
Each step goes in by 22 cm.
Yashika counted 31 steps from the platform to the concourse.

What is the vertical height, in metres, of the staircase? **2**

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**Question 8 continued …**

(c) The height in metres, $h$, of a golf ball is given by the equation $h = -16.1t^2 + 137t + 3$, where $t$ is the time in seconds after it was struck.

Jammy hit a golf ball modelling the equation.

He wins a prize if the ball reaches a height of 301 m.

Does Jammy win a prize? Justify your answer, include calculations. **2**

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(d) Solve the equations $y = x + 1$ and $x^2 + y^2 = 13$ simultaneously. **2**

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(e) A quadratic function has the equation $y = x^2 + 6x - 7$.
Find the coordinates of the vertex. **1**

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(f)
The point $A$ has coordinates $(-2, 7)$ and the point $B$ has coordinates $(4, p)$.
The point $M$ is the midpoint of $AB$ and has coordinates $(q, \frac{9}{2})$.

(i) find the values of $p$ and $q$. **2**

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(ii) find the equation, in general form, of the perpendicular bisector of $AB$. **2**

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## ~ End of Question 8 ~

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# Mathematics Advanced
# Section II

## Question 9
## (13 Marks)

## Introduction to Functions

## Further Functions and Relations

- Answer each question in the space provided.
- Your responses should include relevant mathematical reasoning and/or calculations.

**Question 9**

(a) Given that $f(x) = 2x + 3$ and $g(x) = 5x + b$.

Find the value of $b$ given that $g\big(f(x)\big) = f\big(g(x)\big)$. **2**

(b) Solve $|-6x + 3| = 27$. **2**

(c) Determine if the function $f(x) = -3x^3 + 2x$ is even, odd or neither. **2**

**Question 9 continued …**

(d) Consider the function $f(x) = |x - 3| - 2$.

(i) Sketch the graph of $f(x)$, showing all important features. **2**

(ii) State the domain and range of $f(x)$ in interval notation. **2**

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(e) State the domain and range of $h(x) = \sqrt{9 - x^2}$. **1**

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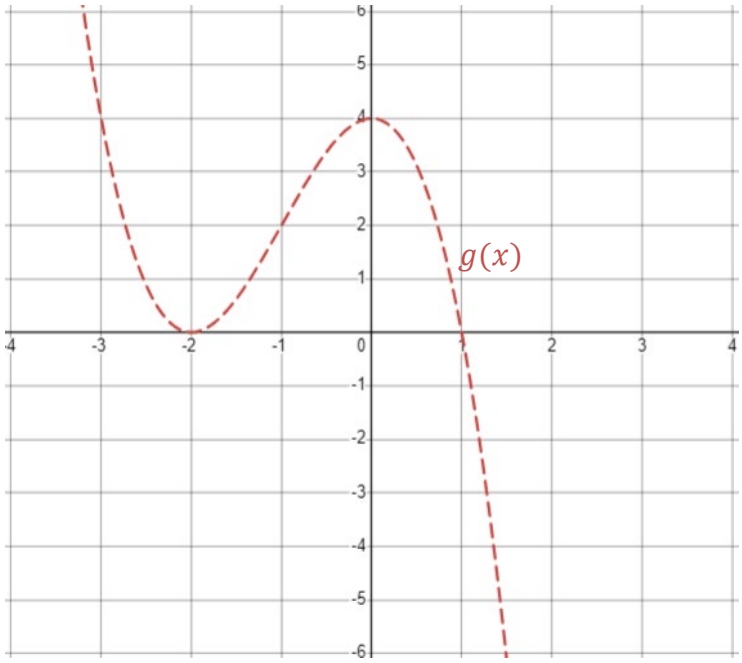
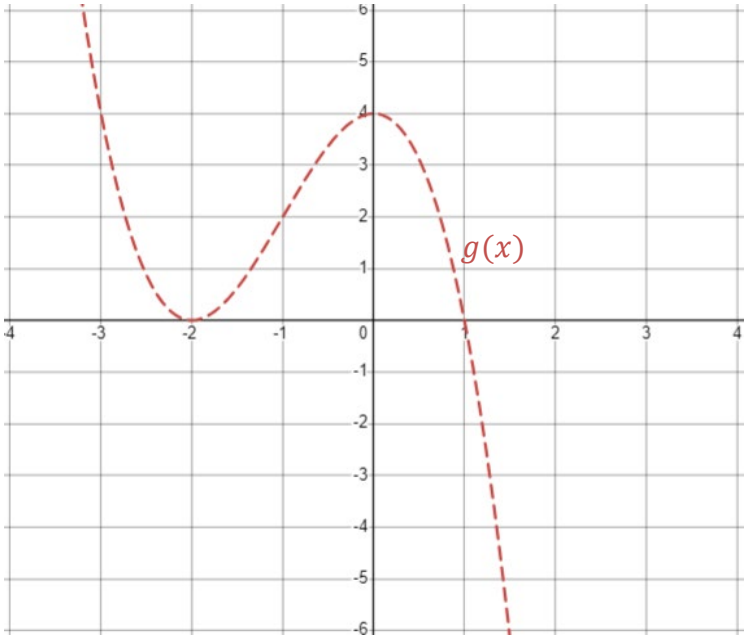
(f) The graph below shows the curve $y = g(x)$.

(i) Sketch the graph of $y = g(x - 2)$, showing all important features. **1**




(ii) Sketch the graph of $y = -g(x)$, showing all important features. **1**




## ~ End of Question 9 ~

## END OF TASK 1

**2024 Year 11 Assessment Task Extra Writing Page.** **Please label the questions clearly.**

**Question Number** | | **Part** | |

**2024 Year 11 Assessment Task Extra Writing Page.** **Please label the questions clearly.**

**Question Number** | | **Part** | |

| Year 11 | Mathematics Advanced | 2024 Task 1 |
|---|---|---|
| Multiple Choice Qs | Solutions and Marking Guidelines | |

**Outcomes Addressed in this Question**

**MA11-2** uses the concepts of functions and relations to model, analyse and solve practical problems

| Question | Solutions | Marking Guidelines |
|---|---|---|
| **1** | $x^{-3} = \frac{x}{16}$<br>$\frac{1}{x^3} = \frac{x}{16}$<br>$x^4 = 16$<br>$x = \pm 2$ ***Answer: B*** | |
| **2** | $\frac{14^{n+4} + 7^{n+3} \times 2^{n+3}}{13 \times 14^n + 14^n}$<br>$= \frac{14^{n+4} + (7 \times 2)^{n+3}}{14^n(13+1)}$<br>$= \frac{14^{n+4} + 14^{n+3}}{14^n(13+1)}$<br>$= \frac{14^n \times (14^4 + 14^3)}{14^n(14)}$<br>$= \frac{(14^4+14^3)}{(14)} = 2940$ ***Answer: A*** | |
| **3** | $y = \frac{3}{4}x + \frac{1}{2}?$<br>$8y = 6x + 4$<br>$4y = 3x + 2$<br>$0 = 3x - 4y + 2$<br>$\therefore D$ | |
| **4** | The cubic $y = x^3$ has been translated 2 places to the left and 1 place down.<br>$\therefore y = (x+2)^3 - 1$<br>$\therefore$ ***B*** | |
| **5** | B | |
| **6** | A | |

| Year 11 | Mathematics Advanced 2024 | TASK 1 |
|---|---|---|
| | Solutions and Marking Guidelines | |

**Outcomes Addressed in this Question**

**MA11-1** uses algebraic and graphical techniques to solve, and where appropriate, compare alternative solutions to problems

| Part / Outcome | Solutions | Marking Guidelines |
|---|---|---|
| **ER Q7(a) MA11-1** | $10 + 6x - x^2 = 0$<br>$10 + 6x - x^2 = 0$<br>$x^2 - 6x - 10 = 0$<br>$x^2 - 6x + (-3)^2 - 9 - 10 = 0$<br>$(x-3)^2 = 19$<br>$x - 3 = \pm\sqrt{19}$<br>$x = 3 \pm \sqrt{19}$ | **2 marks** – Correct solution<br>**1 mark** – Substantially correct |
| **ER Q7 (b) MA11-1** | $\frac{1+\sqrt{7}}{3-\sqrt{7}} - \frac{8-\sqrt{7}}{\sqrt{7}-2}$<br>$= \frac{1+\sqrt{7}}{3-\sqrt{7}} \times \frac{3+\sqrt{7}}{3+\sqrt{7}} - \frac{8-\sqrt{7}}{\sqrt{7}-2} \times \frac{\sqrt{7}+2}{\sqrt{7}+2}$<br>$= \frac{3+\sqrt{7}+3\sqrt{7}+7}{9-7} - \frac{8\sqrt{7}+16-7-2\sqrt{7}}{7-4}$<br>$= \frac{10+4\sqrt{7}}{2} - \frac{6\sqrt{7}+9}{3}$<br>$= 5 + 2\sqrt{7} - 2\sqrt{7} - 3 = 2$ | **3 marks** – Correct solution<br>**2 marks** – Substantially correct solution.<br>**1 mark** – some correct working towards correct solution |
| **ER Q7 (c) MA11-1** | $3x(x+4) = -3x + 4$<br>$3x^2 + 15x - 4 = 0$<br>$x = \frac{-15 \pm \sqrt{15^2 - 4(3)(-4)}}{2(3)}$<br>$x = 0.25 \; or \; -5.25 \; (\; to \; 2 \; decimal \; places)$ | **2 marks** – Correct solution<br>**1 mark** – Substantially correct |
| **ER Q7 (d) MA11-1** | $2b^3 + 3ab^2 + 3a^3 + 2a^2b$<br>$= b^2(2b+3a) + a^2(3a+2b)$<br>$= (2b+3a)(a^2+b^2)$ | **2 marks** – Correct solution<br>**1 mark** – Substantially correct |
| **ER Q7 (e)(i) MA11-1** | $y = \frac{2m+4}{m^2-25} \times \frac{m+5}{m^2+3m+2} \div \frac{2}{3m^2-16m+5}$<br>$y = \frac{\cancel{2(m+2)}}{\cancel{(m-5)(m+5)}} \times \frac{\cancel{m+5}}{(m+1)\cancel{(m+2)}} \times \frac{(3m-1)\cancel{(m-5)}}{\cancel{2}}$ | **2 marks** – Correct solution |

| | | |
|---|---|---|
| | $y = \frac{3m-1}{m+1}$ | **1 mark** – Substantially correct |
| **ER Q7 (e)(ii) MA11-1** | $y = \frac{3m-1}{m+1}$<br><br>$y(m+1) = 3m-1$<br>$my + y = 3m-1$<br>$my - 3m = -1-y$<br>$m(y-3) = -(1+y)$<br>$m = -\frac{(y+1)}{(y-3)}$ | **2 marks** – Correct solution<br>**1 mark** – Substantially correct |

| Year 11 | Mathematics Advanced | 2024 Task 1 |
|---|---|---|
| Solutions and Marking Guidelines | | |
| **Outcomes Addressed in this Question** | | |
| **MA11-2** uses the concepts of functions and relations to model, analyse and solve practical problems | | |

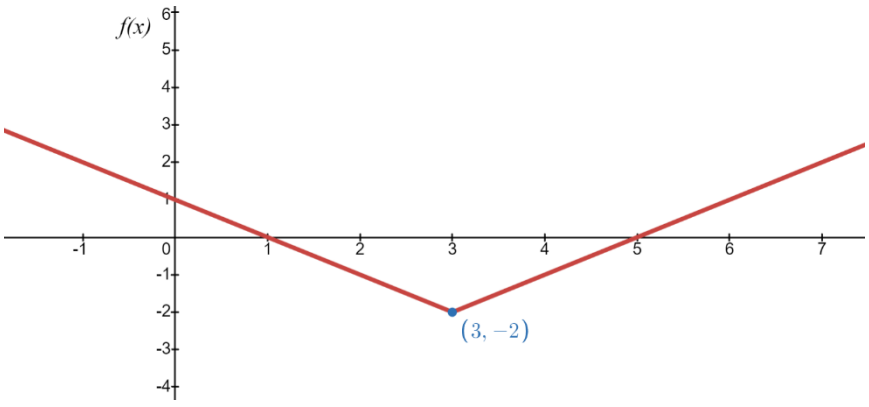
| **Question** | **Solutions** | **Marking Guidelines** |
|---|---|---|
| Question 8 | | |
| a. | $y = a(x+4)(x-2)$<br>Point $(0,-4)$ lies on the parabola<br>$(-4) = a((0)+4)((0)-2)$<br>$-4 = -8a$<br>$\frac{1}{2} = a$<br><br>$\therefore$ equation of parabola is<br>$y = \frac{1}{2}(x+4)(x-2)$ | 2 marks: correct solution<br>1 mark: significant progress towards a correct solution |
| b. | Gradient of each step $= \frac{\text{rise}}{\text{run}}$<br>Let height of each step $= h$<br>$0.6 = \frac{h}{22}$<br><br>$h = 13.2$ cm<br><br>$\therefore$ height of vertical staircase is $= 13.2 \times 31$<br>$= 409.2$ m | 2 marks: correct solution<br>1 mark: significant progress towards a correct solution |
| c | $h = -16.1t^2 + 137t + 3$<br><br>$301 = -16.1t^2 + 137t + 3$<br><br>$16.1t^2 - 137t + 298 = 0$<br><br>$\Delta = b^2 - 4ac$<br>$\Delta = (-137)^2 - 4(16.1)(298)$<br>$\Delta = -422.2 < 0$<br>So equation has no solution<br>$\therefore$ Jammy did not win a prize | 2 marks: correct solution<br>1 mark: significant progress towards a correct solution |
| d | $y = x + 1 \ldots\ldots\ldots (1)$<br>$x^2 + y^2 = 13 \ldots\ldots\ldots\ldots (2)$<br><br>Sub (1) into (2):<br><br>$x^2 + (x+1)^2 = 13$<br>$x^2 + x^2 + 2x + 1 = 13$<br>$2x^2 + 2x - 12 = 0$<br>$x^2 + x - 6 = 0$<br>$(x+3)(x-2) = 0$<br>$x = 2$ or $x = -3$<br><br>When $x = 2,\ y = 3$<br>When $x = -3,\ y = -2$<br><br>$\therefore$ Solutions are<br>$x = 2,\ y = 3$ and $x = -3,\ y = -2$ | 2 marks: correct solution<br>1 mark: significant progress towards a correct solution |

| Question | | |
|---|---|---|
| e | $y = x^2 + 6x - 7$<br>Axis of symmetry:<br>$x = -\frac{b}{2a}$<br>$x = -\frac{6}{2(1)} = -3$<br>When $x = -3, y = -16$.<br>$\therefore$ Vertex $(-3, -16)$ | 1 mark: correct solution |
| f i) | $M\left(q, \frac{9}{2}\right) = \left(\frac{-2+4}{2}, \frac{7+p}{2}\right)$<br>$M\left(q, \frac{9}{2}\right) = \left(1, \frac{7+p}{2}\right)$<br>$q = 1,$ $\frac{9}{2} = \frac{7+p}{2}$<br>$18 = 14 + 2p$<br>$4 = 2p$<br>$p = 2$ | 2 marks: correct solution<br>1 mark: significant progress towards a correct solution |
| f ii) | $M\left(1, \frac{9}{2}\right)$, $A(-2, 7)$, $B(4, 2)$<br>$m_{AB} = \frac{2-7}{4-(-2)}$<br>$m_{AB} = -\frac{5}{6}$<br>Gradient of perpendicular bisector<br>$= \frac{6}{5}$<br>It passes through the midpoint<br>$M\left(1, \frac{9}{2}\right)$<br>$y - y_1 = m(x - x_1)$<br>$y - \frac{9}{2} = \frac{6}{5}(x - 1)$<br>$10y - 45 = 12(x - 1)$<br>$10y - 45 = 12x - 12$<br>$0 = 12x - 12 - 10y + 45$<br>$\therefore 12x - 10y + 33 = 0$ | 2 marks: correct solution<br>1 mark: significant progress towards a correct solution |

| Year 11 | Mathematics Advanced | Assessment Task 1 2024 |
|---|---|---|
| Question No. 9 | Solutions and Marking Guidelines | |

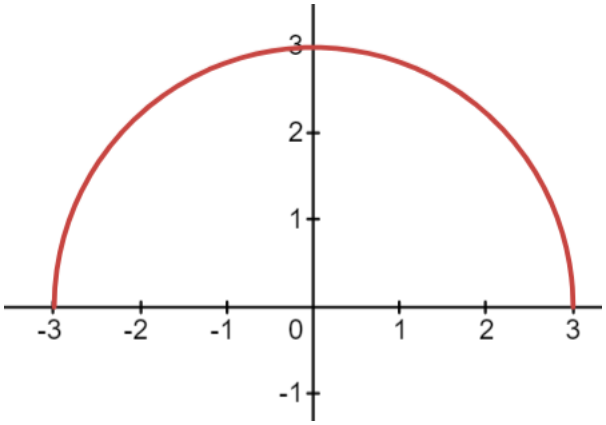
**Outcomes Addressed in this Question**

**MA11-2** uses the concepts of functions and relations to model, analyse and solve practical problems

| Part | Solutions | Marking Guidelines |
|---|---|---|
| **(a)** | $g(f(x)) = f(g(x))$<br>$g(2x+3) = f(5x+b)$<br>$5(2x+3)+b = 2(5x+b)+3$<br>$10x+15+b = 10x+2b+3$<br>$12 = b$<br>$b = 12$ | **2 marks**<br>For correct solution<br><br>**1 mark**<br>Substantial progress towards the correct solution. |
| **(b)** | $\lvert -6x+3\rvert = 27$<br>$-(-6x+3) = 27 \quad or \quad +(-6x+3) = 27$<br>$6x-3 = 27 \quad or \quad -6x+3 = 27$<br>$6x = 30 \quad or \quad -6x = 24$<br>$x = 5 \quad or \quad x = -4$ | **2 marks**<br>For correct solution<br><br>**1 mark**<br>Substantial progress towards the correct solution. |
| **(c)** | $Consider\ f(-x) = -3(-x)^3 + 2(-x)$<br>$= -3(-x^3) - 2x$<br>$= 3x^3 - 2x$<br>$= -(-3x^3 + 2)$<br>$\therefore f(-x) = -f(x)$<br>$\therefore f(x)\ is\ an\ ODD\ function$ | **2 marks**<br>For correct solution<br><br>**1 mark**<br>Substantial progress towards the correct solution. |
| **(d)** | $f(x) = \lvert x-3\rvert - 2$ | |
| **(i)** |  | **2 marks**<br>For correct solution<br><br>**1 mark**<br>Substantial progress towards the correct solution. |
| **(ii)** | Domain: $(-\infty, \infty)$<br><br>Range: $[-2, \infty)$ | **2 marks**<br>For correct solution<br><br>**1 mark**<br>Substantial progress towards the correct solution. |

**(e)**

$h(x) = \sqrt{9 - x^2}$



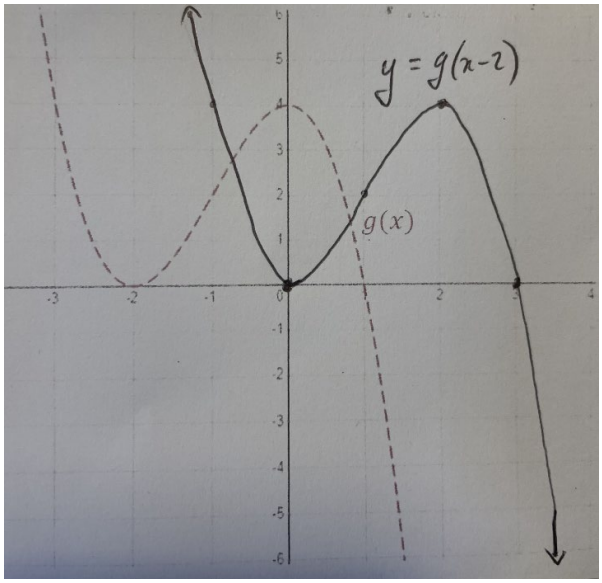

Domain: $-3 \leq x \leq 3$ *or* $|x| \leq 3$ *or* $[-3, 3]$

Range: $0 \leq h(x) \leq 3$ *or* $[0, 3]$

**1 mark**
For correct solution

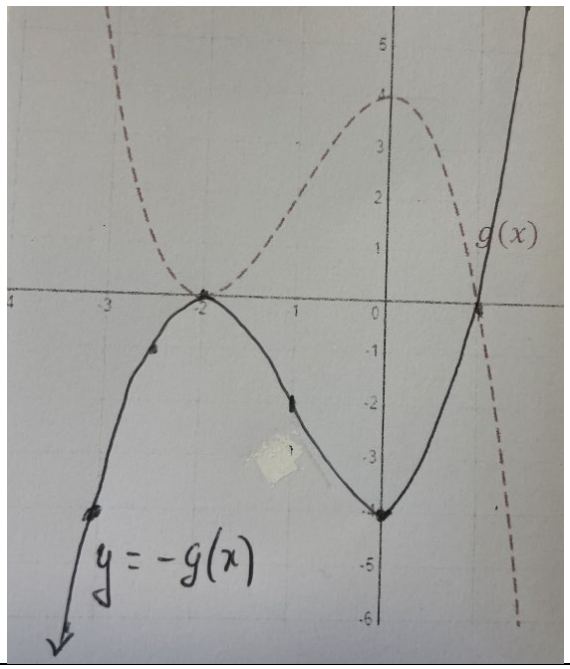
**(f)**

**(i)**




**1 mark**
For correct solution

**(ii)**




**1 mark**
For correct solution