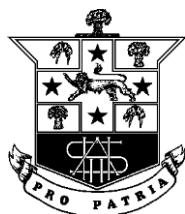


STUDENT NAME: \_\_\_\_\_

TEACHER: \_\_\_\_\_



HURLSTONE AGRICULTURAL  
HIGH SCHOOL

2020

Year 11 Task 1

# Mathematics Advanced

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**Examiners**

- Mr. G. Huxley, Ms T. Tarannum, Ms L Yuen

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**General****Instructions**

- Reading time –
- Working time – 40 min (Submit by 4pm)
- Write using black pen
- NESA-approved calculators may be used
- A Reference sheet is provided (on Edmodo)
- In Questions 4 – 6, show relevant mathematical reasoning and/or calculations

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**Total marks:**

30

**Section I – 3 marks (pages 2 -3)**

- Attempt Questions 1 – 3
- Allow about 4 minutes for this section

**Section II – 27 marks (pages 4 – 9)**

- Attempt Questions 4 – 6
- Allow about 36 minutes for this section

## SECTION I

**3 marks**

**Attempt Questions 1 – 3**

**Allow about 4 minutes for this section.**

Use the multiple-choice answer sheet for Questions 1 – 3.

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### Question 1

Which of the following is the simplest form of  $\frac{(m^{-2}n^3)^2}{m^{-4}n^{-1}}$ ?

- A.  $n^7$
- B.  $n^4$
- C.  $m^4n^7$
- D.  $\frac{n^7}{m^8}$

### Question 2

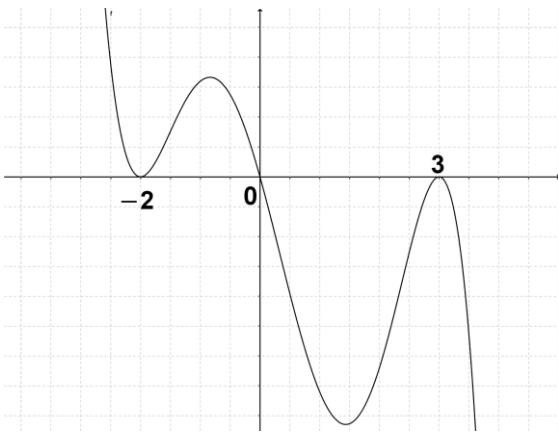
Which of the following straight lines is perpendicular to the line  $3x + 6y - 4 = 0$ ?

- A.  $6x + 3y - 4 = 0$
- B.  $3x - 6y - 4 = 0$
- C.  $6x - 3y - 4 = 0$
- D.  $3x + 6y + 4 = 0$

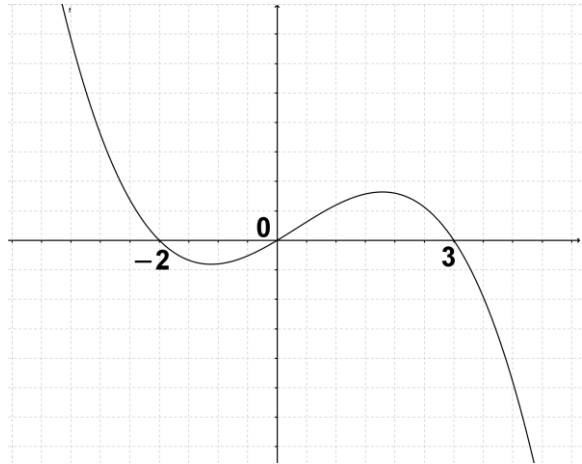
### Question 3

Which of the following could be the graph of  $y = x(x + 2)^2(x - 3)$ ?

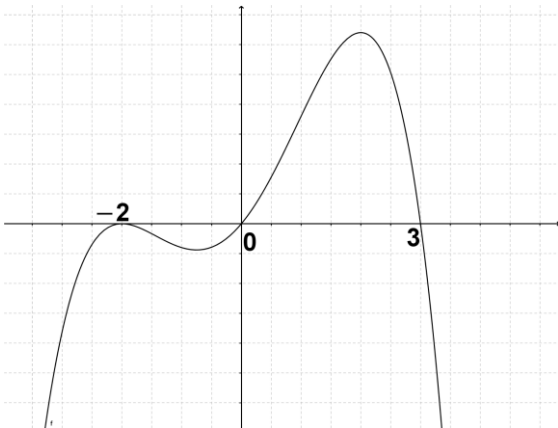
A.



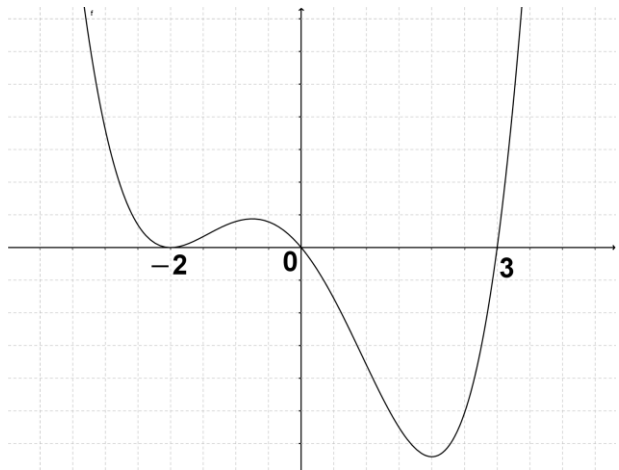
B.



C.



D.



**End of Section I**

Name: \_\_\_\_\_

## SECTION II

27 marks

Attempt Questions 4 – 6

Allow about 36 minutes for this section.

In Questions 4 – 6, your responses should include relevant mathematical reasoning and/or calculations.

- **Write your name at the top of each page.** Answer the questions in the space provided. These spaces provide guidance for the expected length of response
- Extra writing space is provided at the back of this question booklet. If you used this space, clearly indicate which question and part you are answering.

### Question 4 (9 marks)

Marks

- (a) Factorise the expression:  $6a^2 - a - 2$  2

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- (b) Simplify fully:  $\frac{a^3 + a^2b}{a^2 - b^2} \times \frac{a - b}{a}$  2

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**Name:** \_\_\_\_\_

- (c) Express the following with a rational denominator.

**2**

$$\frac{3}{\sqrt{3}-2} = \underline{\hspace{10cm}}$$
  
$$\underline{\hspace{10cm}}$$
  
$$\underline{\hspace{10cm}}$$

- (d) **Use the method of completing the square** to solve the following:  
 $x^2 + 4x + 3 = 0$

**3**

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**End of Question 4**

Name: \_\_\_\_\_

**Question 5 (9 marks)**

**Marks**

(a) A function is defined by :

$$f(x) = \begin{cases} x^2 & \text{for } x < 0 \\ 2x & \text{for } 0 \leq x \leq 3 \\ 6 & \text{for } x > 3 \end{cases}$$

(i) Find the value of  $f(-3)$  **1**

\_\_\_\_\_

(ii) Draw a sketch of this function for  $-5 \leq x \leq 5$  **2**

(b) Given  $f(x) = -x^2 + 2x$  and  $g(x) = (x-1)$

(i) Write a simplified expression for  $f(g(x))$ . **2**

\_\_\_\_\_

\_\_\_\_\_

(ii) Write down the range of  $f(g(x))$  in interval notation. **1**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Name: \_\_\_\_\_

- (c) (i) Write down the discriminant of  $2x^2 + (k - 2)x + 8$ , where  $k$  is a constant. **1**

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- (ii) Hence, or otherwise, find the values of  $k$  for which the parabola

$$y = 2x^2 + kx + 9$$

does not intersect the line  $y = 2x + 1$

**2**

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**End of Question 5**

Name: \_\_\_\_\_

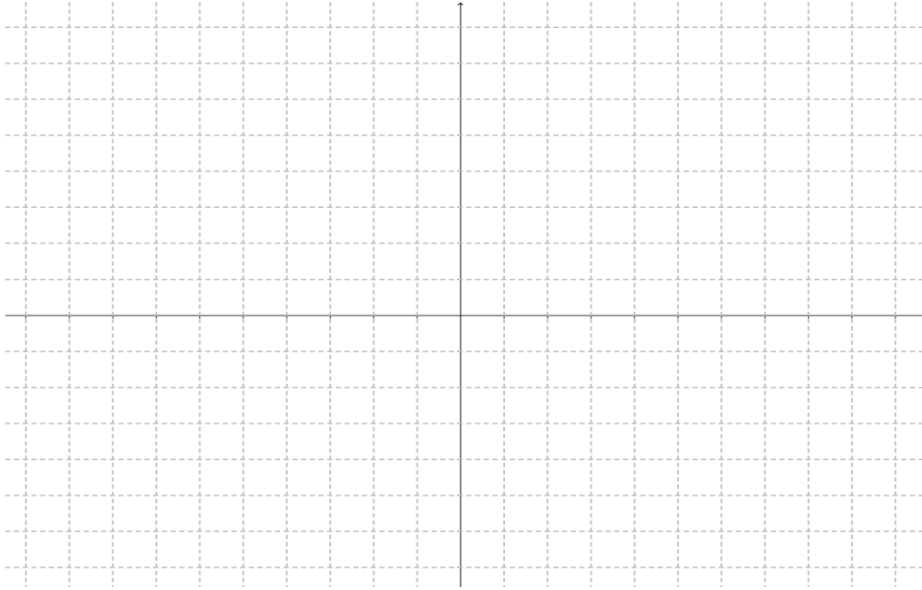
**Question 6 (9 marks)**

**Marks**

(a) Sketch the graph of  $y=(x-2)^3+1$  on the number plane below.

Your sketch should include labels of the  $x$  and  $y$  intercepts.

**2**

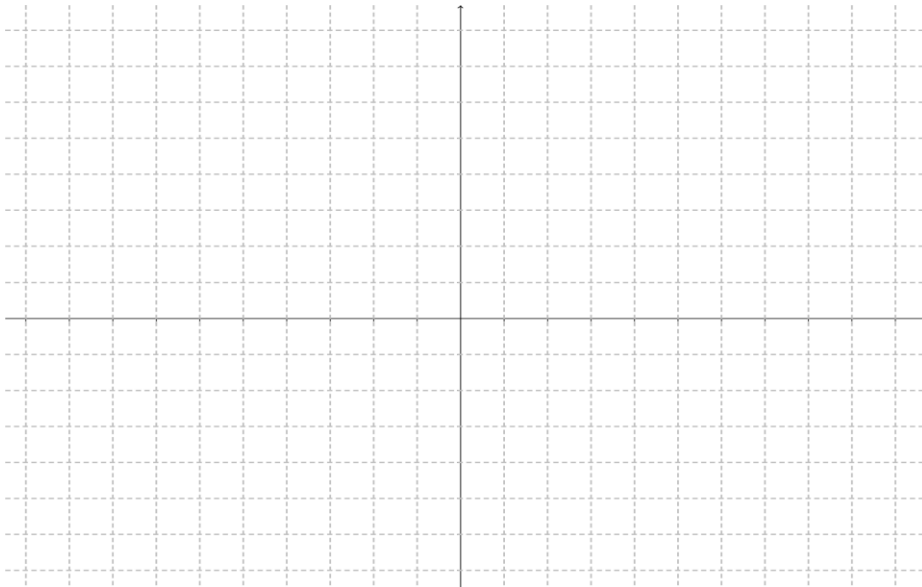


(b) (i) Sketch the graph of  $x^2+(y-1)^2=4$  on the following number plane.

**2**

(ii) State the range of the graph in (i). \_\_\_\_\_

**1**

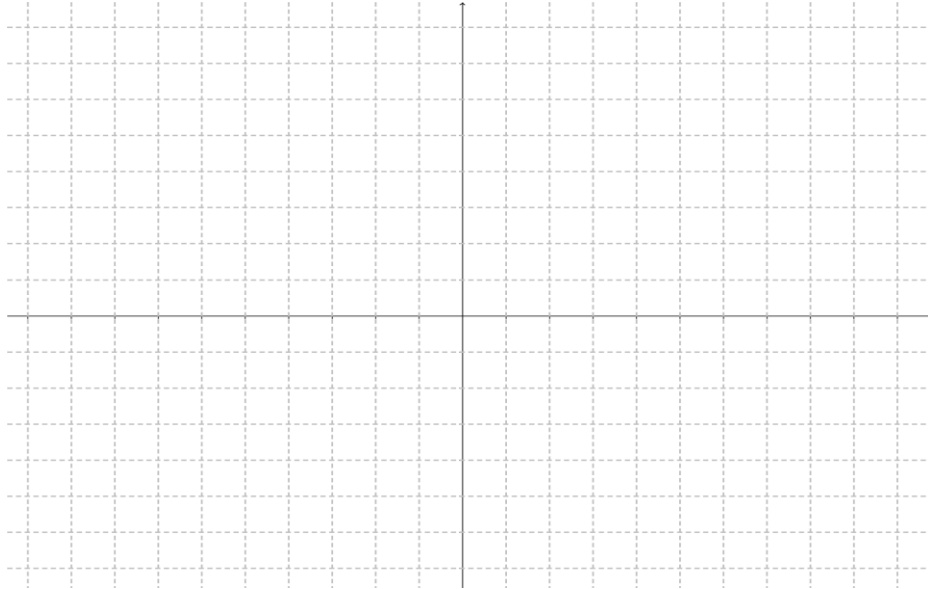




Name: \_\_\_\_\_

(c) (i) Sketch the graph of  $y = \frac{9}{x}$  on the number plane below. **1**

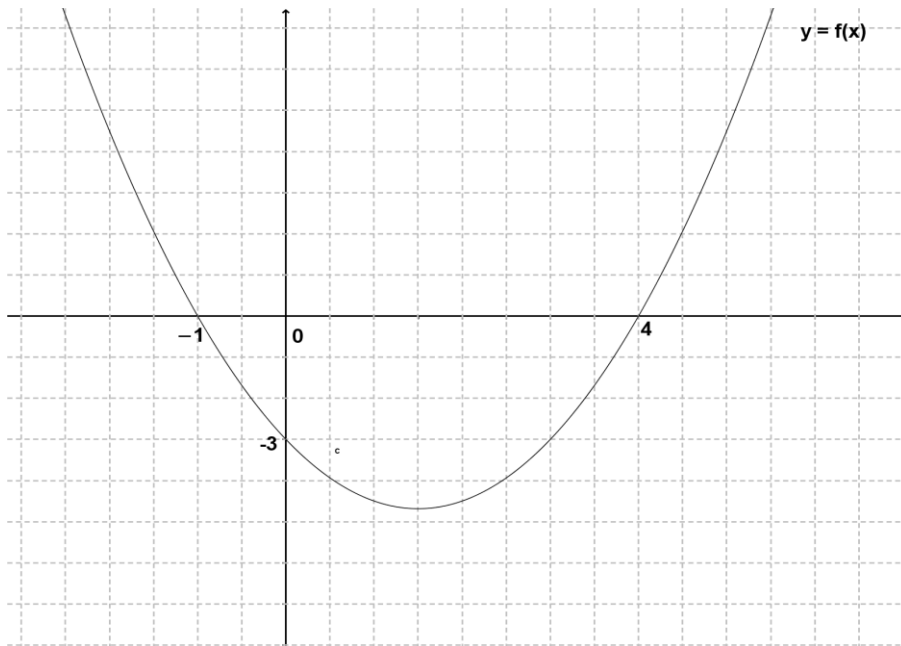
(ii) Label the point/s on the curve in (i) that are closest to the origin. **1**



(d) The graph of  $y = f(x)$  is drawn below.

On the same number plane, draw the graph of  $y = -f(x)$

Your sketch should be neat and accurate. **2**



**End of Question 6**

**END OF TASK**

Name: \_\_\_\_\_

**Extra writing space**

**If you use this space, clearly indicate which part you are answering**

Extra writing space with horizontal dashed lines for answers.



HURLSTONE AGRICULTURAL

HIGH SCHOOL

Student Name \_\_\_\_\_

**Year 11**

**Mathematics Advanced  
2020 Assessment Task 1**

Teacher \_\_\_\_\_

MULTIPLE CHOICE ANSWER SHEET

|  |
|--|
|  |
|--|

**Question**

1.   A   ☐      B   ☐      C   ☐      D   ☐
2.   A   ☐      B   ☐      C   ☐      D   ☐
3.   A   ☐      B   ☐      C   ☐      D   ☐

| Question | Marks          |
|----------|----------------|
| MC       |                |
| 4        |                |
| 5        |                |
| 6        |                |
| Total    | <div></div> 30 |

**All My Own Work Declaration:**

I, \_\_\_\_\_ confirm that the enclosed material is all my own work.

I have not copied from any source apart from the research that I have done with relevant texts and technologies.



HURLSTONE AGRICULTURAL

HIGH SCHOOL

Year 11

**Mathematics Advanced  
2020 Assessment Task 1**

MULTIPLE CHOICE ANSWER SHEET

Student Name DILLON

Teacher Solutions

**Question**

1. A ☒ B ☐ C ☐ D ☐
2. A ☐ B ☐ C ☒ D ☐
3. A ☐ B ☐ C ☐ D ☒

| Question | Marks |
|----------|-------|
| MC       |       |
| 4        |       |
| 5        |       |
| 6        |       |
| Total    | 30    |

**All My Own Work Declaration:**

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Name: \_\_\_\_\_

## SECTION II

27 marks

Attempt Questions 4 – 6

Allow about 36 minutes for this section.

In Questions 4 – 6, your responses should include relevant mathematical reasoning and/or calculations.

- Write your name at the top of each page. Answer the questions in the space provided. These spaces provide guidance for the expected length of response
- Extra writing space is provided at the back of this question booklet. If you used this space, clearly indicate which question and part you are answering.

### Question 4 (9 marks)

Marks

(a) Factorise the expression:  $6a^2 - a - 2$

2

$$\begin{array}{r} -4a \\ -a \end{array}$$

$$\begin{aligned} &6a^2 - 4a + 3a - 2 \\ &= 2a(3a - 2) + 1(3a - 2) \\ &= (3a - 2)(2a + 1) \end{aligned}$$

2 marks – correct factorisation

1 mark – attempts to split middle term (or equivalent merit)

(b) Simplify fully:

$$\frac{a^3 + a^2b}{a^2 - b^2} \times \frac{a - b}{a}$$

2

$$= \frac{a^2(a+b)}{(a-b)(a+b)} \times \frac{a-b}{a}$$

2 marks – correct solution

$$= a$$

1 mark – factorisation of  $a^3 + a^2b$  or  $a^2 - b^2$  (or equivalent merit)



Name: \_\_\_\_\_

- (c) Express the following with a rational denominator.

2

$$\frac{3}{\sqrt{3}-2} = \frac{3}{\sqrt{3}-2} \times \frac{\sqrt{3}+2}{\sqrt{3}+2}$$

2 marks — correct solution

$$= \frac{3(\sqrt{3}+2)}{3-4}$$

1 mark — multiplies by conjugate (or equivalent merit)

$$= \frac{3(\sqrt{3}+2)}{-1} \text{ or } -3(\sqrt{3}+2) \text{ or } -3\sqrt{3}-6$$

- (d) Use the method of completing the square to solve the following:

3

$$x^2 + 4x + 3 = 0$$

$$x^2 + 4x = -3$$

3 marks — correct answers (by correct method)

$$x^2 + 4x + (2)^2 = -3 + (2)^2$$

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

2 marks — generates perfect square  
≠ take square root of both sides (or equivalent merit)

$$x+2 = \pm\sqrt{1} = \pm 1$$

$$\therefore x = -2 \pm 1 = -3 \text{ or } -1$$

1 mark — attempts to complete the square

End of Question 4



## Question 5 (9 marks)

Marks

- (a) A function is defined by:

$$f(x) = \begin{cases} x^2 & \text{for } x < 0 \\ 2x & \text{for } 0 \leq x \leq 3 \\ 6 & \text{for } x > 3 \end{cases}$$

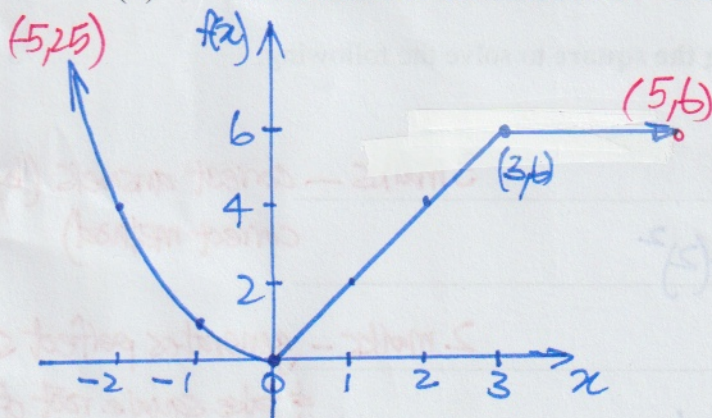
- (i) Find the value of
- $f(-3)$

1

$$f(-3) = (-3)^2 = 9$$

1 mark - correct answer

- (ii) Draw a sketch of this function for
- $-5 \leq x \leq 5$



\* need to see / have implied the endpoints of domain.

2 marks - correct graph, showing / implied (3, 6) as the intersection \*

1 mark - correct graph, without (3, 6) or 2/3 graphs correctly drawn.

- (b) Given
- $f(x) = -x^2 + 2x$
- and
- $g(x) = (x-1)$

- (i) Write a simplified expression for
- $f(g(x))$
- .

2

$$f(g(x)) = f(x-1) = -(x-1)^2 + 2(x-1)$$

2 marks - correct solution

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

1 mark - initial substitution

$$= -x^2 + 4x - 3$$

$$= -(x^2 - 4x + 3) = -(x-3)(x-1)$$

for  $f(x-1)$  (or equivalent merit)

- (ii) Write down the range of
- $f(g(x))$
- in interval notation.

$$= (3-x)(x-1) \text{ or } (x-3)(1-x)$$

$$f(g(x)) = -x^2 + 4x - 3 = -(x^2 - 4x + 3) = -(x-1)(x-3)$$

$$\text{Vertex occurs at } x = -\frac{b}{2a} = -\frac{4}{2 \cdot -1} = 2$$

1 mark - correct answer (in correct form)

$$\text{Vertex is } (2, 1).$$

$$\text{Range is } y \leq 1. \text{ In interval notation } (-\infty, 1]$$

Only need this.



Name: \_\_\_\_\_

- (c) (i) Write down the discriminant of  $2x^2 + (k-2)x + 8$ , where  $k$  is a constant. 1

$$\begin{aligned}\Delta &= b^2 - 4ac = (k-2)^2 - 4 \cdot 2 \cdot 8 \quad \text{156} \quad \text{1 mark - correct answer} \\ &= k^2 - 4k + 4 - 64 \\ &= k^2 - 4k - 60 \quad (k-10)(k+6)\end{aligned}$$

- (ii) Hence, or otherwise, find the values of  $k$  for which the parabola

$$y = 2x^2 + kx + 9$$

does not intersect the line  $y = 2x + 1$

2

For the line & the parabola to intersect

$$2x^2 + kx + 9 = 2x + 1$$

$$2x^2 + kx - 2x + 8 = 0$$

$$\text{i.e. } 2x^2 + (k-2)x + 8 = 0 \quad \dots (1)$$

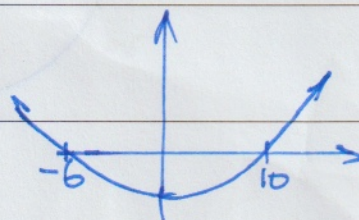
If the line & parabola do not intersect,  $\Delta$  of (1) is such that  $\Delta < 0$  (no real roots)

$$\text{i.e. } k^2 - 4k - 60 < 0$$

$$(k-10)(k+6) < 0$$

$$-6 < k < 10$$

From graph  
(or alternate methods)  
critical points, etc.



End of Question 5

2 marks — correct answer (with correct method shown)

1 mark — determines equation of quadratic (i.e. 1) or solves  $\Delta < 0$  correctly



Name: \_\_\_\_\_

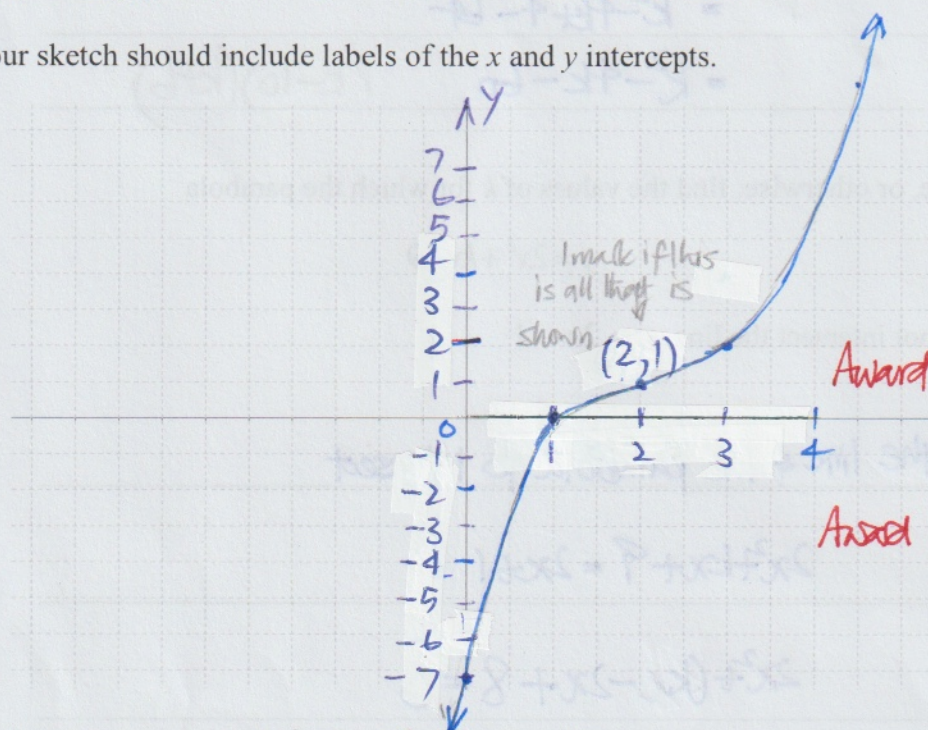
**Question 6 (9 marks)**

**Marks**

(a) Sketch the graph of  $y=(x-2)^3+1$  on the number plane below.

Your sketch should include labels of the  $x$  and  $y$  intercepts.

2



Award 2 - correct graph with intercepts indicated

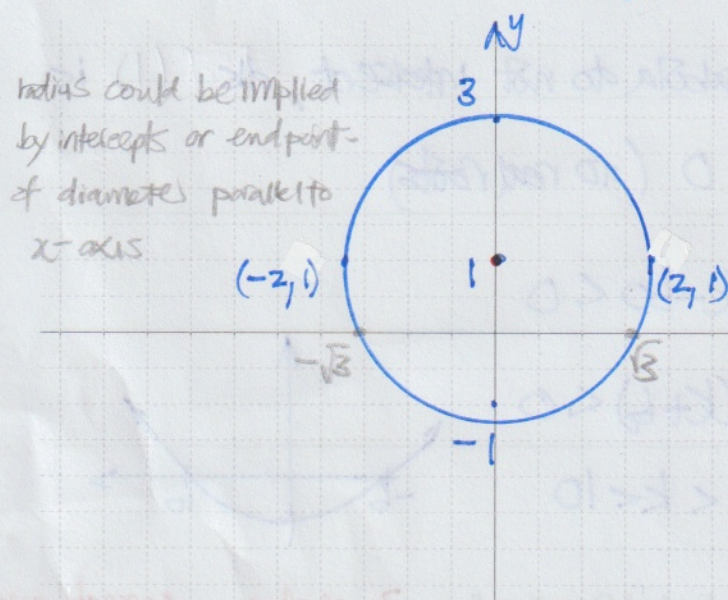
Award 1 - correct graph without both intercepts (or equivalent merit)

(b) (i) Sketch the graph of  $x^2+(y-1)^2=4$  on the following number plane.

2

(ii) State the range of the graph in (i).

$-1 \leq y \leq 3$  or  $[-1, 3]$  Award 1 + correct answer



Award 2 - correct graph (must be a circle) with both correct centre & correct radius

Award 1 - correct graph (must be a circle) but missing either radius or centre (or equivalent merit)



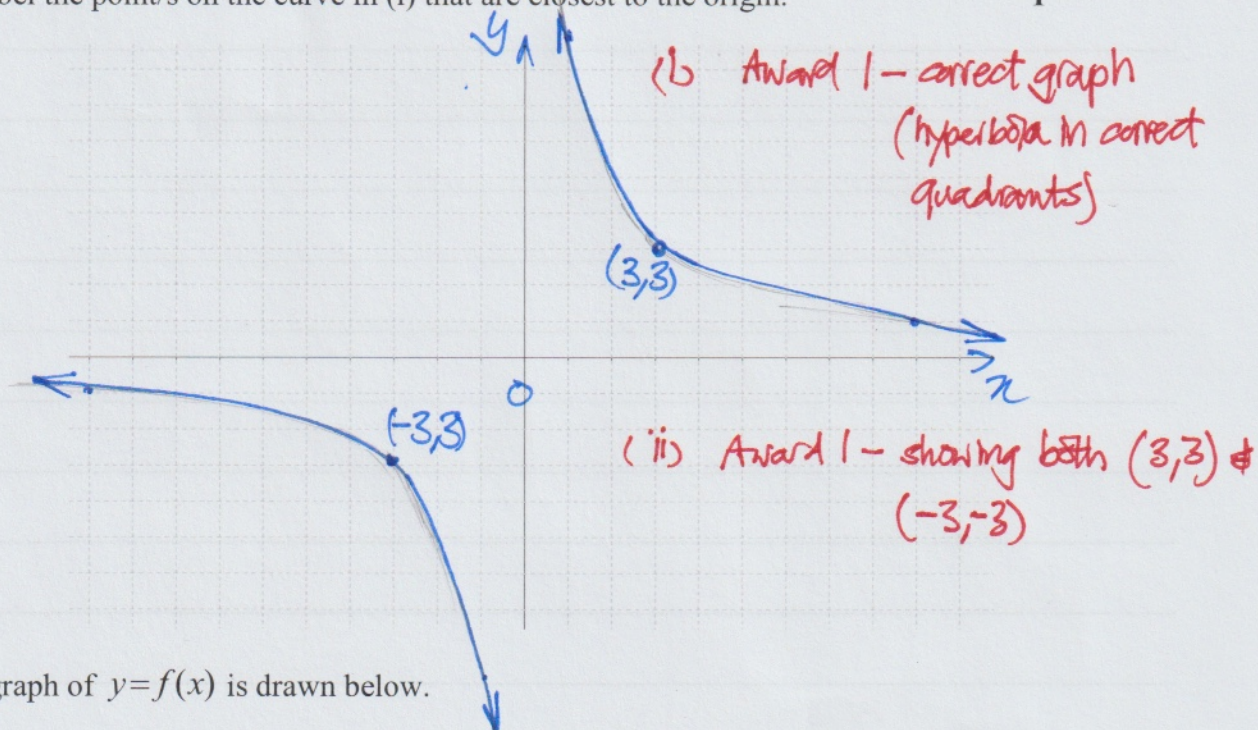
Name: \_\_\_\_\_

(c) (i) Sketch the graph of  $y = \frac{9}{x}$  on the number plane below.

1

(ii) Label the point/s on the curve in (i) that are closest to the origin.

1

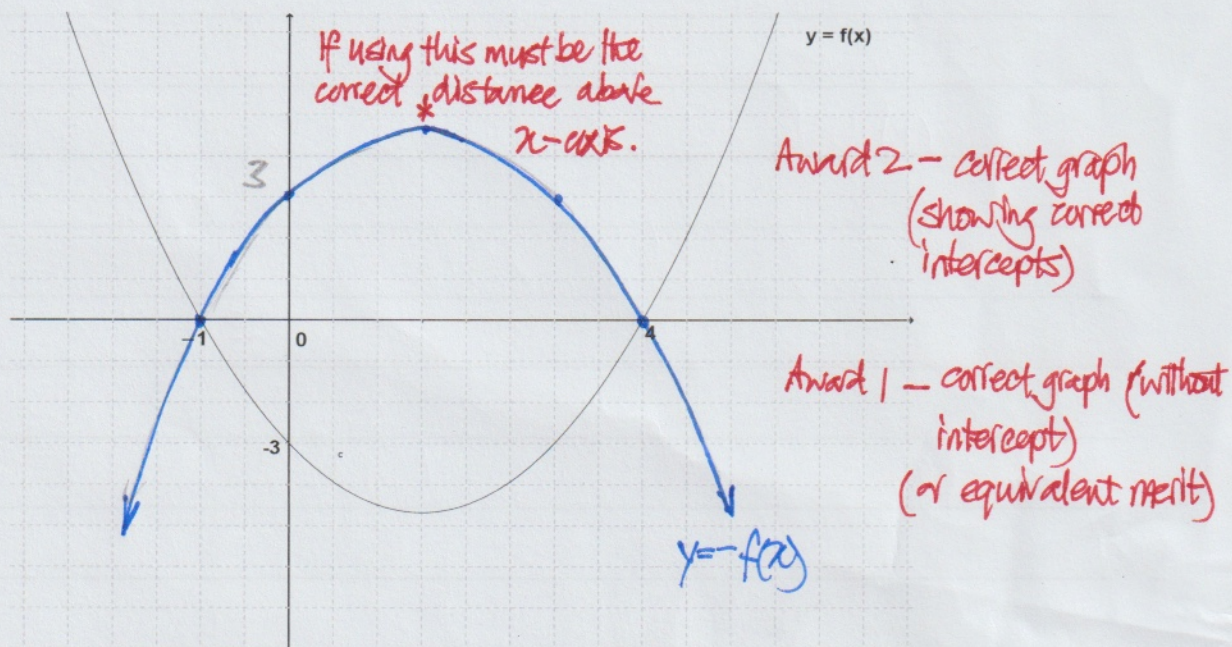


(d) The graph of  $y = f(x)$  is drawn below.

On the same number plane, draw the graph of  $y = -f(x)$

Your sketch should be neat and accurate.

2



End of Question 6

END OF TASK