

# Supervision Instructions

## Mathematics Methods (Unit 1-2)

### Task #3

18<sup>th</sup> May 2021 – Period 4

Task consists of two papers: **Paper 1** and **Paper 2**. Students will have access to only one paper at a time.

#### **Paper 1:**

- 15 minutes
- Calculator is not allowed

After 15 minutes **Paper 1** is to be collected and **Paper 2** will be given.

#### **Paper 2:**

- 25 minutes
- Calculator is allowed

After 25 minutes **Paper 2** is to be collected.

Check that students put their names.

Name:

Marks:

**Instructions**

Answer **all** questions in the spaces provided.

In all questions where a numerical answer is required, an exact value must be given unless otherwise specified.

In questions where more than one mark is available, appropriate working **must** be shown.

Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.

**Question 1**

Sketch the graph of  $f: [3, \infty) \rightarrow \mathbb{R}, f(x) = \sqrt{x-3}$  and find the inverse function  $f^{-1}$ .

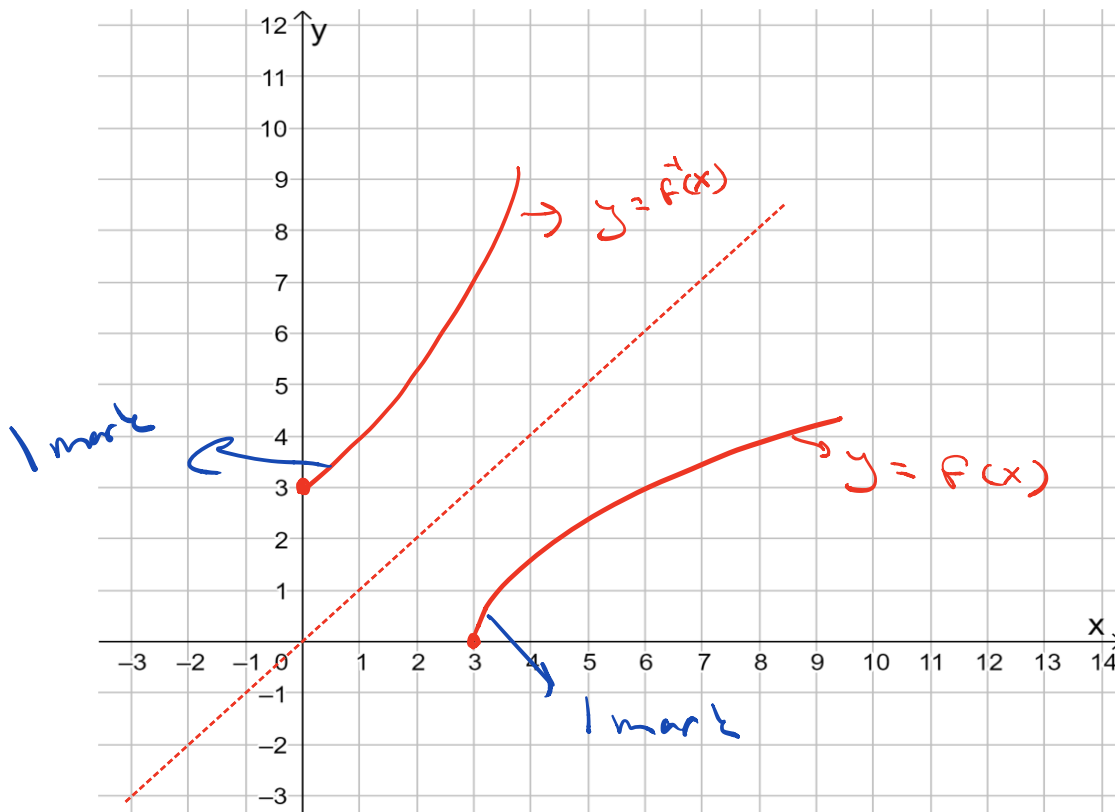
3 marks

Sketch the graph of  $f^{-1}$  on the same set of axes.

$x = \sqrt{y-3} \quad x^2 = y-3 \quad y = x^2+3$  (0 mark for this)

$f^{-1}(x) = x^2+3$  → 1 mark

Or  $f^{-1}: [0, \infty) \rightarrow \mathbb{R}, f^{-1}(x) = x^2+3$



### Question 2

Describe a sequence of transformations applied to the graph of  $y = x^4$  to obtain

3 marks

$$y = \left(\frac{x}{3} + 1\right)^4 + 2.$$

$n = \frac{1}{3}$ ,  $h = -3$ ,  $k = 2$  and  $a = 1$   
 $y = \left(\frac{1}{3}(x+3)\right)^4 + 2$   
 $n = \frac{1}{3}$  so dilation of factor 3 from the y-axis parallel to x-axis → 1 mark  
 $h = -3$  so horizontal translation 3 units to the left  
 $k = 2$  so vertical translation 2 units upward  
 1 mark ←

### Question 3

a. Form the rule for the inverse of  $y^2 = x - 2$ .

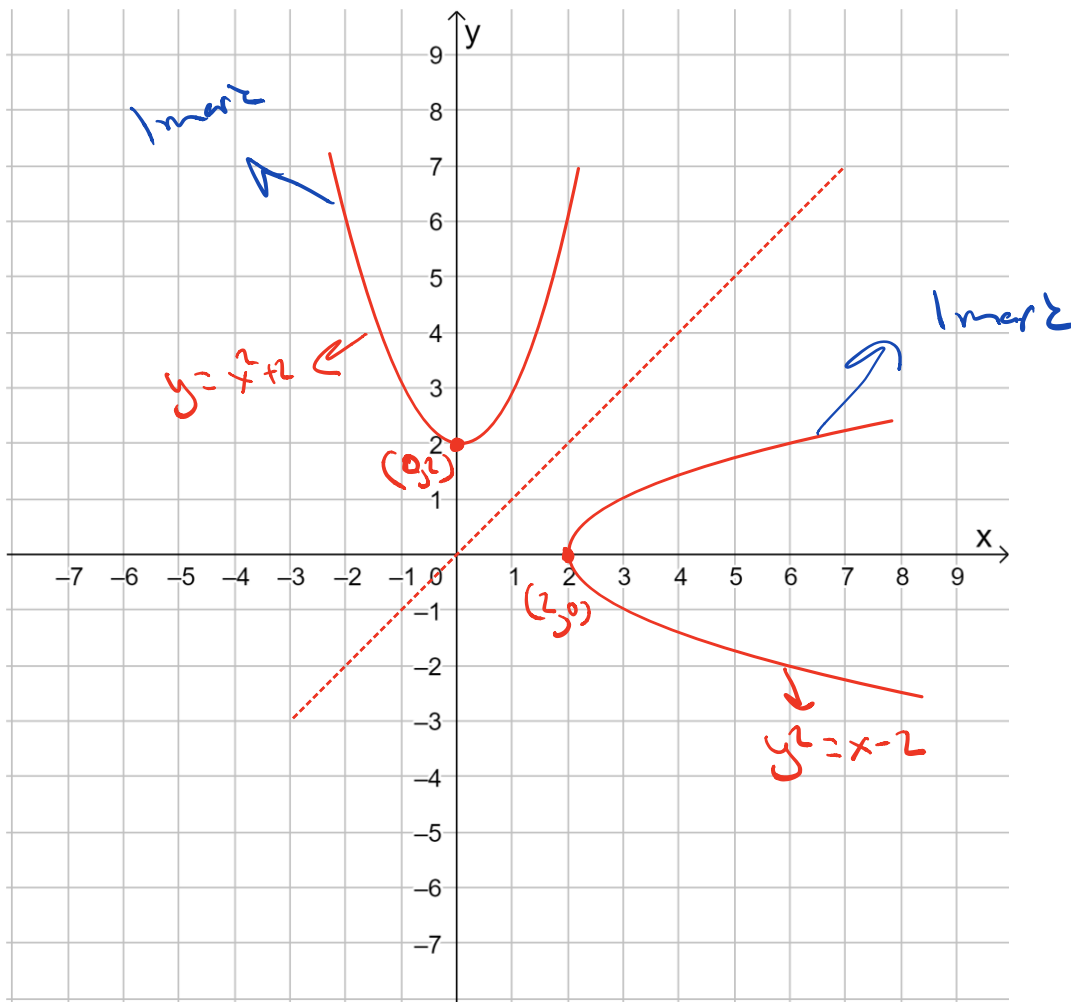
1 mark

$$x^2 = y - 2 \quad x^2 + 2 = y$$

$$y = x^2 + 2 \rightarrow 1 \text{ mark}$$

b. Hence sketch the graphs of  $y^2 = x - 2$  and its inverse on the same set of axes.

2 marks



c. State the type of correspondence of each graph.

1 mark

1 mark {  $y^2 = x - 2 \rightarrow$  one-to-many correspondence  
 $y = x^2 + 2 \rightarrow$  many-to-one correspondence



## 2021 Mathematical Methods (Unit 1-2)

### Task 3

*Paper 2 – Calculator allowed*

Number of marks: 15

Writing time: 25 minutes

Name:

Marks – Section 1:

Section 2:

### SECTION 1

#### Instructions for Section 1

Answer **all** questions in pencil on the answer sheet provided for multiple-choice questions.

Choose the response that is **correct** for the question.

A correct answer scores 1, an incorrect answer scores 0.

Marks will **not** be deducted for incorrect answers.

No marks will be given if more than one answer is completed for any question.

#### Question 1

The graph of the function  $f : D \rightarrow R, f(x) = \frac{3x-5}{2-x}$ , where  $D$  is the maximal domain has asymptotes:

**A**  $x = 2, y = -3$

**B**  $x = -2, y = 3$

**C**  $x = 3, y = -2$

**D**  $x = 2, y = 3$

**E**  $x = -2, y = -3$

#### Question 2

Which of the following is correct for the graph of  $y = \sqrt[3]{8x+1}$ ?

**A** The endpoint of the domain is  $\left(-\frac{1}{8}, 0\right)$ .

**B** The endpoint of the domain is  $\left(-\frac{1}{2}, 0\right)$ .

**C** There is a point of inflection at  $\left(-\frac{1}{8}, 0\right)$ .

**D** There is a point of inflection at  $(0, 1)$ .

**E** There is a point of inflection at  $\left(-\frac{1}{2}, 0\right)$ .

### Question 3

The radius measure of the circle  $(2x+1)^2 + (2y+1)^2 = 100$  is:

- A 100
- B 10
- C  $7\sqrt{2}$
- D  $5\sqrt{2}$
- E 5**

$$4\left(x + \frac{1}{2}\right)^2 + 4\left(y + \frac{1}{2}\right)^2 = 100$$

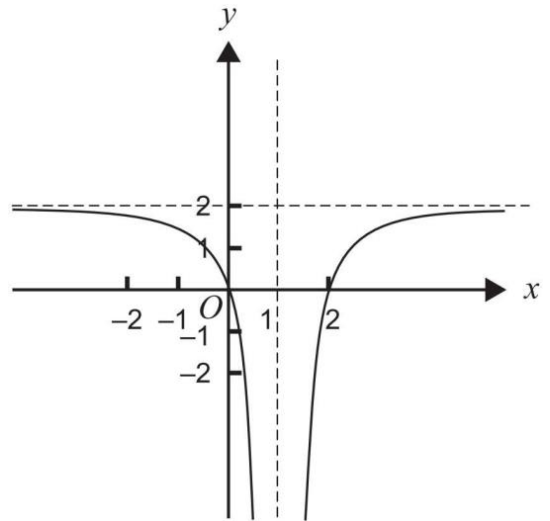
$$\left(x + \frac{1}{2}\right)^2 + \left(y + \frac{1}{2}\right)^2 = 25$$

### Question 4

Part of the graph of the function with rule  $y = \frac{a}{(x+b)^2} + c$  is shown below.

The values of  $a$ ,  $b$  and  $c$  respectively are

- |          | $a$ | $b$ | $c$ |
|----------|-----|-----|-----|
| A        | 2   | -1  | 0   |
| <b>B</b> | -2  | -1  | 2   |
| C        | 2   | 1   | 1   |
| D        | 2   | -2  | 1   |
| E        | -2  | 1   | 2   |

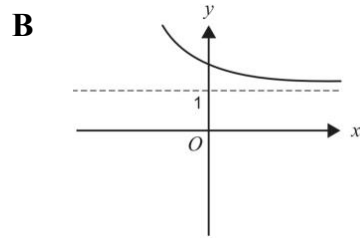
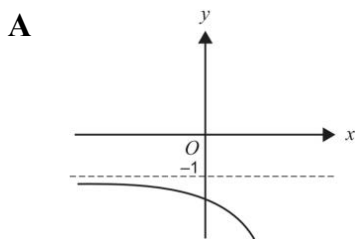
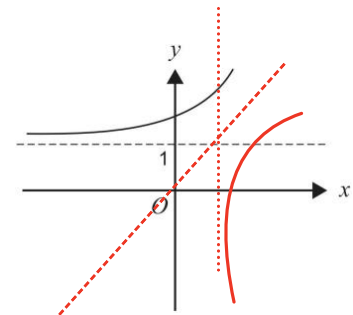


### Question 5

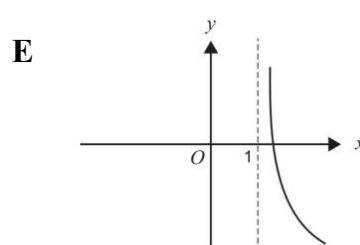
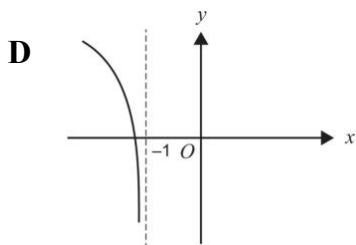
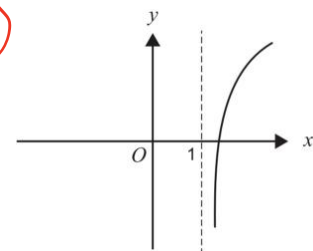
The graph of the function with equation  $y = f(x)$  is shown below.

(A one to-one scale has been used.)

Which one of the following is most likely to be the graph of the inverse function?



**C**



## SECTION 2

### Instructions for Section 2

Answer **all** questions in the spaces provided.

In all questions where a numerical answer is required, an exact value must be given unless otherwise specified.

In questions where more than one mark is available, appropriate working **must** be shown.

Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.

#### Question 1

$$\text{Let } f: \mathbb{R} \setminus \{-2\} \rightarrow \mathbb{R}, f(x) = \frac{2x+1}{x+2}.$$

3 marks

Find the rule and domain of  $f^{-1}$ , the inverse function of  $f$ .

Interchanging  $x$  and  $y$  in the equation of original function  $\rightarrow$  1 mark

$$f^{-1}(x) = -2 - \frac{3}{x-2}$$

or

$$f^{-1}(x) = \frac{3}{2-x} - 2$$

$\rightarrow$  1 mark

$$f^{-1} = \mathbb{R} \setminus \{2\}$$

1 mark

or

$$f^{-1}: \mathbb{R} \setminus \{2\} \rightarrow \mathbb{R}, f^{-1}(x) = -2 - \frac{3}{x-2} \rightarrow 2 \text{ marks}$$

#### Question 2

A circle has the equation  $x^2 + (y+4)^2 = 16$ .

a. State the centre and radius.

Center  $(0, -4)$

$$r = 4$$

1 mark

1 mark

b. Give the equation of the top semicircle function.

2 marks

$$x^2 + (y+4)^2 = 16$$

$$(y+4)^2 = 16 - x^2$$

$$y+4 = \pm \sqrt{16-x^2}$$

$$y = \pm \sqrt{16-x^2} - 4 \rightarrow 1 \text{ mark}$$

$$y = \sqrt{16-x^2} - 4$$

1 mark

### Question 3

a. Sketch the graph of the following function and state its range:

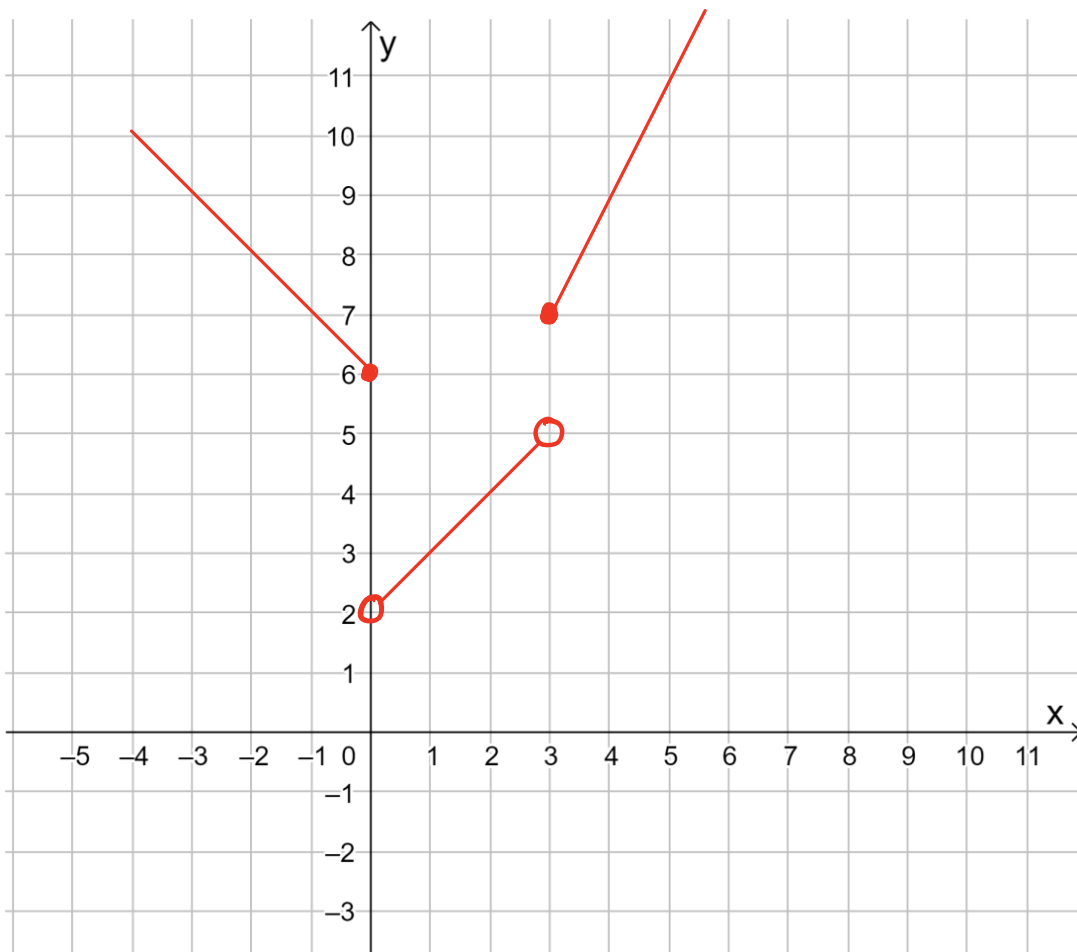
3 marks

$$f(x) = \begin{cases} -x+6, & x \leq 0 \\ x+2, & 0 < x < 3 \\ 2x+1, & x \geq 3 \end{cases}$$

$$r_f = (2, 5) \cup [6, \infty) \rightarrow 1 \text{ mark}$$

2 marks  $\rightarrow$  All 3 graphs are correct (including endpoints)

1 mark  $\rightarrow$  if only 1 graph is wrong



b. Explain whether or not the function is continuous at  $x = 3$ .

1 mark

from graph

or

mathematical solution

The left and right branches are not joining  
So it is not continuous

when  $x = 3$

$$2+3 = 5$$

$$2 \times 3 + 1 = 7$$

} so it's not continuous

1 mark