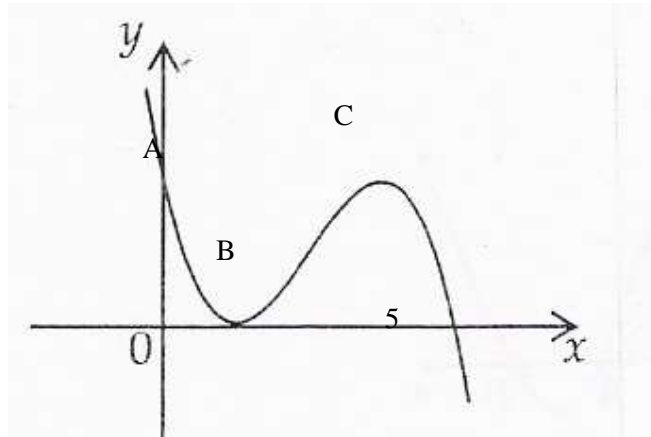


Higher Ink Exercise
Block 2 - Graphs and Functions

Calculators should only be used when necessary

1. The diagram below shows the graph of the function $y = f(x)$.



a) On separate axes, sketch the graphs of:

- i. $y = f(x) + 2$
- ii. $y = f(x + 4)$
- iii. $y = -f(x + 1)$
- iv. $y = -2 - f(x)$
- v. $y = f^{-1}(x)$

[7]

b) If you had the equation of the function $f(x)$, explain how you could find:

- i. Point A
- ii. Point B
- iii. Point C

[3]

2. Three functions, $g(x)$, $h(x)$ and $j(x)$ are defined by:

$$\begin{aligned}g(x) &= 3x + 2 \\h(x) &= 5 - x^2 \\j(x) &= \sqrt{x}\end{aligned}$$

a) Find an expression for:

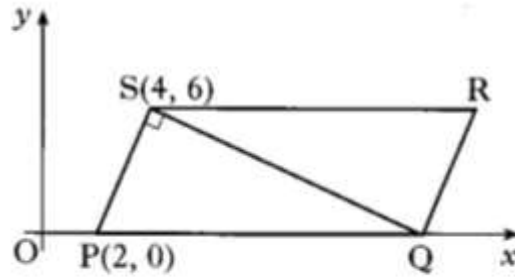
- i. $h(g(x))$
- ii. $g(h(x))$
- iii. $h(h(x))$

[6]

b) For the expression $j(g(x))$, show that a suitable domain for x would be $x \geq -\frac{2}{3}$

[3]

3. The parallelogram PQRS is shown in the diagram below.



- a) Show that the equation of QS is $x + 3y = 22$.
- b) Hence find the coordinates of Q and R.

[6]

4. Sketch the graph of $f(x) = x^3 - 4x^2 + x + 6$. Annotate your graph with the following points:
- i. y-intercept
 - ii. roots
 - iii. stationary points (2dp)

[7]

Total [32]

Higher Ink Exercise
Block 2 - Graphs and Functions

Marking Scheme

Question 1

a)

- i. Shifts up by 2. Point (5,2) shown.
- ii. Shifts left by 4. Point (1,0) shown.
- iii. Reflected on x-axis.
- Moved left by 1. Point (4,0) shown.
- iv. Reflected on x-axis.
- Moved down by 2.
- v. Reflected on $y = x$.

b)

- i. Set $x = 0$ and solve.
- ii. Either differentiate to find minimum turning point or by synthetic division.
- iii. Differentiate to find maximum turning point.

Question 2

a)

- i. $h(g(x)) = 5 - (3x + 2)^2$
 $= -9x^2 - 12x - 1$
- ii. $g(h(x)) = 3(5 - x^2) + 2$
 $= -3x^2 + 17$
- iii. $h(h(x)) = 5 - (5 - x^2)^2$
 $= -x^4 + 10x^2 - 20$

b)

- $j(g(x)) = \sqrt{3x + 2}$
- $\Rightarrow 3x + 2 \geq 0$
- $\Rightarrow 3x \geq -2 \Rightarrow x \geq -\frac{2}{3}$

Question 3

a)

- $m_{PS} = 3 \therefore m_{QS} = -\frac{1}{3}$
- $y - 6 = -\frac{1}{3}(x - 4)$
- $\Rightarrow 3y - 18 = -3(x - 4) \Rightarrow x + 3y = 22$

b)

- At Q, $y = 0 \therefore x + 3(0) = 22$
- $\therefore x = 22$. Q = (22, 0)
- At R, $y = 6$ and $x = 24$. R = (24, 6)

Question 4

- i. $f(0) = (0)^3 - 4(0)^2 + (0) + 6 = 6 \therefore (0,6)$
- ii. $f(x) = (x + 1)(x^2 - 5x + 6) = 0$
 \therefore root at (-1,0)
- $f(x) = (x + 1)(x - 2)(x - 3) = 0 \therefore$ roots at (2,0) & (3,0)
- iii. $f'(x) = 3x^2 - 8x + 1 = 0$
 $\Rightarrow x = 2.54$ and $x = 0.13$
- $f(2.54) = -0.88 \therefore$ TP at (2.54, -0.88)

- $f(0.13) = 6.06 \therefore \text{TP at } (0.13, 6.06)$