



ALL SAINTS'
COLLEGE

MATHEMATICS DEPARTMENT

Year 11 Methods - Test Number 2 2020 Functions

Resource Free

Name: _____

Teacher: _____

Marks: 37

Reading Time: 3 minutes

Working Time: 25 minutes

Instructions: You ARE NOT permitted any notes or calculators.

The formula sheet will be provided.

Question 1**[2, 2 = 4 marks]**

Solve the following equations:

a) $3x^2 - 12x = 0$

$$3x(x-4) = 0$$

$$x = 0$$

✓

$$x = 4$$

✓

b) $x^2 - 11x = 60$

$$x^2 - 11x - 60 = 0$$

$$(x-15)(x+4) = 0$$

$$x = 15$$

✓

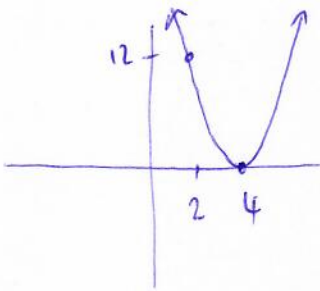
$$x = -4$$

✓

Question 2**[3 marks]**

Find, in the form $y = ax^2 + bx + c$, the equation of the quadratic whose graph:

- a) Touches the x-axis only at 4 and passes through (2, 12)



$$\begin{aligned}y &= a(x-4)^2 \\12 &= a(-2)^2 \\12 &= 4a \\a &= 3\end{aligned}$$

$$\begin{aligned}y &= 3(x-4)^2 \\&= 3x^2 - 24x + 48\end{aligned}$$

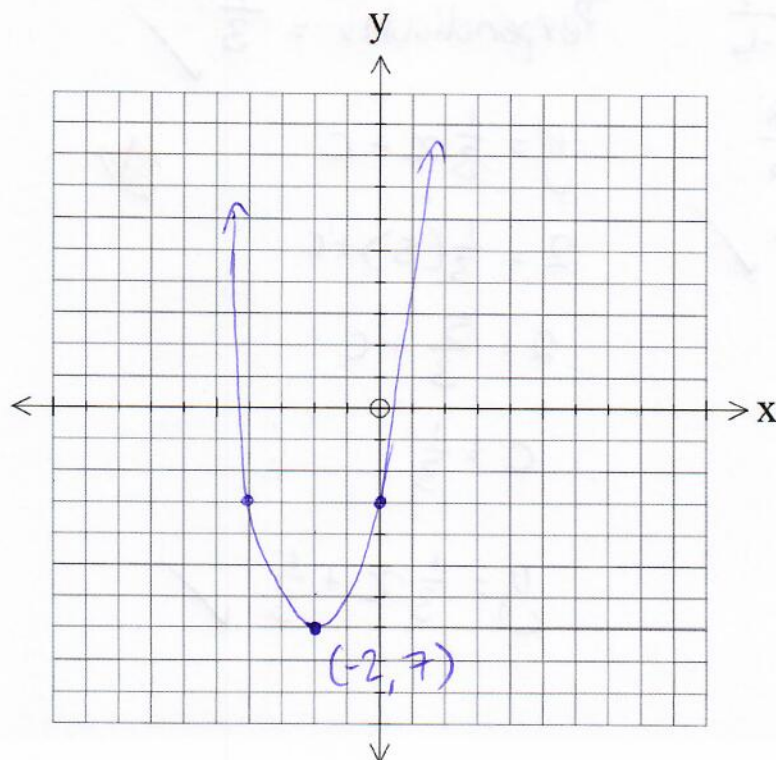
Question 3**[2, 2 = 4 marks]**

- a) Write the quadratic $y = x^2 + 4x - 3$ in the form $y = a(x-h)^2 + k$

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

$$y = (x+2)^2 - 7$$

- b) Hence, sketch the graph of $y = x^2 + 4x - 3$



✓ x & y intercepts
✓ shape

Question 4**[2 marks]**

Find the values of k for which $2x^2 - 12x + k = 0$ has a repeated root.

$$\Delta = 0$$

$$b^2 - 4ac = 0$$

$$(-12)^2 - 4(2)k = 0 \checkmark$$

$$144 - 8k = 0$$

$$8k = 144$$

$$k = 18 \checkmark$$

Question 5**[1, 3 = 4 marks]**

Given A has coordinates (6,7) and the midpoint of AB is (9, -2)

a) Determine the coordinates of B

$$A \quad (6, 7)$$

$$\text{mid} \quad (9, -2)$$

$$B \quad (12, -11) \checkmark$$

b) Determine the equation of the line perpendicular to AB and going through point (5,2)

$$m_{AB} = \frac{-11-7}{12-6}$$

$$= \frac{-18}{6}$$

$$= -3 \checkmark$$

$$\text{Perpendicular} = \frac{1}{3} \checkmark$$

$$y = \frac{1}{3}x + c$$

$$2 = \frac{1}{3}(5) + c$$

$$2 = \frac{5}{3} + c$$

$$c = \frac{1}{3}$$

$$y = \frac{1}{3}x + \frac{1}{3} \checkmark$$

Question 6**[1, 1, 3 = 5 marks]**If $f(x) = 2x - x^2$ and $g(x) = 3x - 4$ a) Evaluate $f(2)$

$$\begin{aligned} &= 2(2) - 2^2 \\ &= 0 \checkmark \end{aligned}$$

b) Show that $g(b+2) = 3b+2$

$$\begin{aligned} g(b+2) &= 3(b+2) - 4 \checkmark \\ &= 3b + 6 - 4 \\ &= 3b + 2 \end{aligned}$$

c) Determine the values of b such that $f(b) = g(b)$

$$2b - b^2 = 3b - 4 \checkmark$$

$$0 = b^2 + b - 4$$

$$0 = \left(b + \frac{1}{2}\right)^2 - \frac{1}{4} - 4$$

$$0 = \left(b + \frac{1}{2}\right)^2 - \frac{17}{4} \checkmark$$

$$\left(b + \frac{1}{2}\right)^2 = \frac{\sqrt{17}}{4}$$

$$b + \frac{1}{2} = \pm \frac{\sqrt{17}}{2}$$

$$b = \frac{-1 + \sqrt{17}}{2}$$

and

$$b = \frac{-1 - \sqrt{17}}{2} \checkmark$$

Question 7

[1, 4, 2 = 7 marks]

- a) Show that -2 is an x-intercept of the graphs of $f(x) = 3x^3 - 5x^2 - 42x - 40$

$$\begin{aligned} f(-2) &= 3(-2)^3 - 5(-2)^2 - 42(-2) - 40 \\ &= -24 - 20 + 84 - 40 \quad \checkmark \\ &= 0 \end{aligned}$$

- b) Find any other x-intercepts

$$\begin{array}{r} 3x^2 - 11x - 20 \\ x+2 \overline{) 3x^3 - 5x^2 - 42x - 40} \\ \underline{3x^3 + 6x^2} \\ -11x^2 - 42x \\ \underline{-11x^2 - 22x} \\ -20x - 40 \\ \underline{-20x - 40} \\ 0 \end{array} \quad \checkmark$$

$$\begin{array}{r} 3 \quad -5 \quad -42 \quad -40 \\ -2 \overline{) -6 \quad 22 \quad 40} \\ \quad 3 \quad -11 \quad -20 \quad 0 \quad \checkmark \end{array}$$

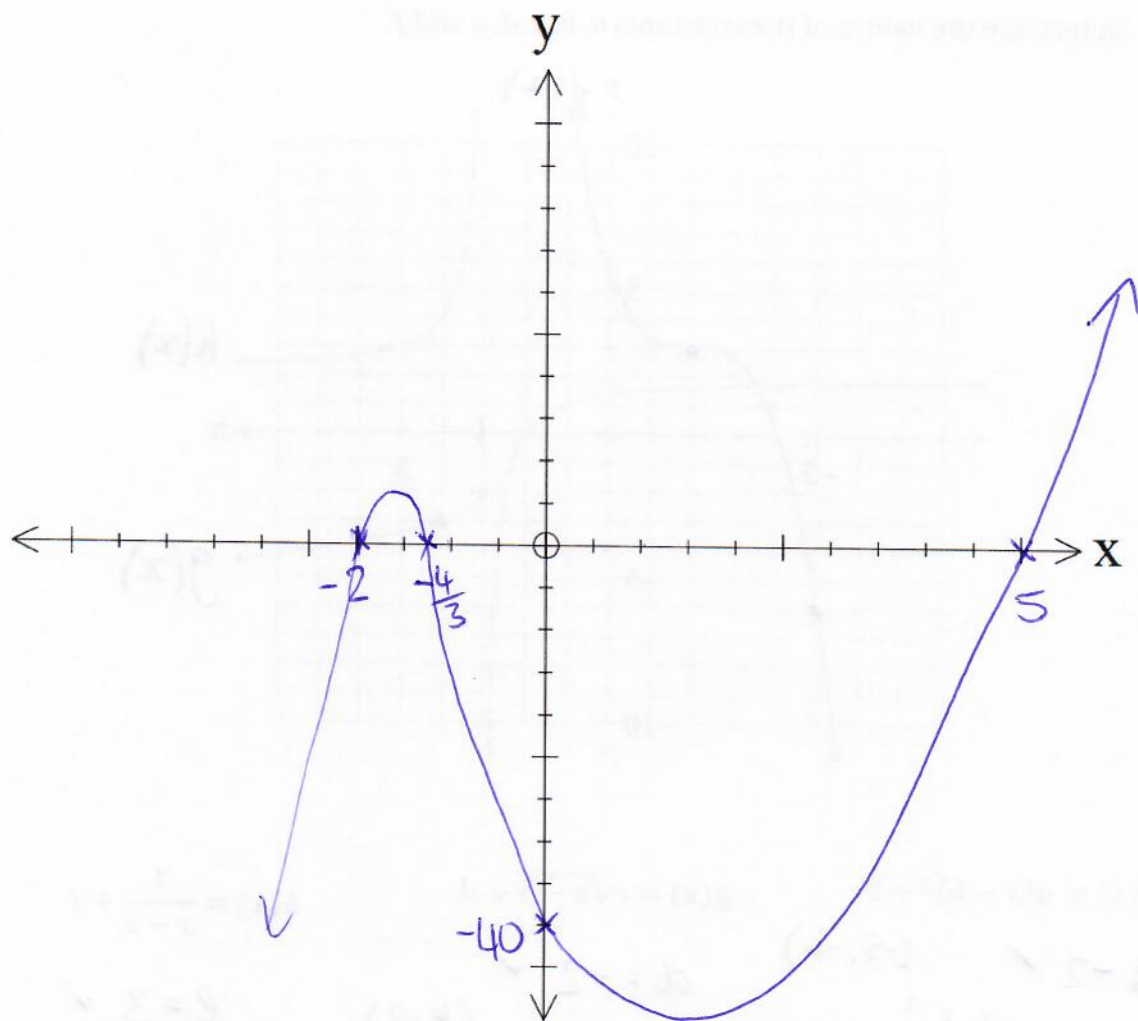
$$(x+2)(3x^2 - 11x - 20)$$

-60

$$\begin{aligned} f(x) &= (x+2)(3x^2 - 11x - 20) \quad \checkmark \\ &= (x+2)(3x^2 - 15x + 4x - 20) \\ &= (x+2)(3x(x-5) + 4(x-5)) \\ &= (x+2)(x-5)(3x+4) \quad \checkmark \end{aligned}$$

$$x = -2, \quad \underbrace{x = 5, \quad x = -\frac{4}{3}}_{\checkmark}$$

c) Using the information from part b) sketch the graph $f(x) = 3x^3 - 5x^2 - 42x - 40$



✓ intercepts $(x \text{ \& } y)$

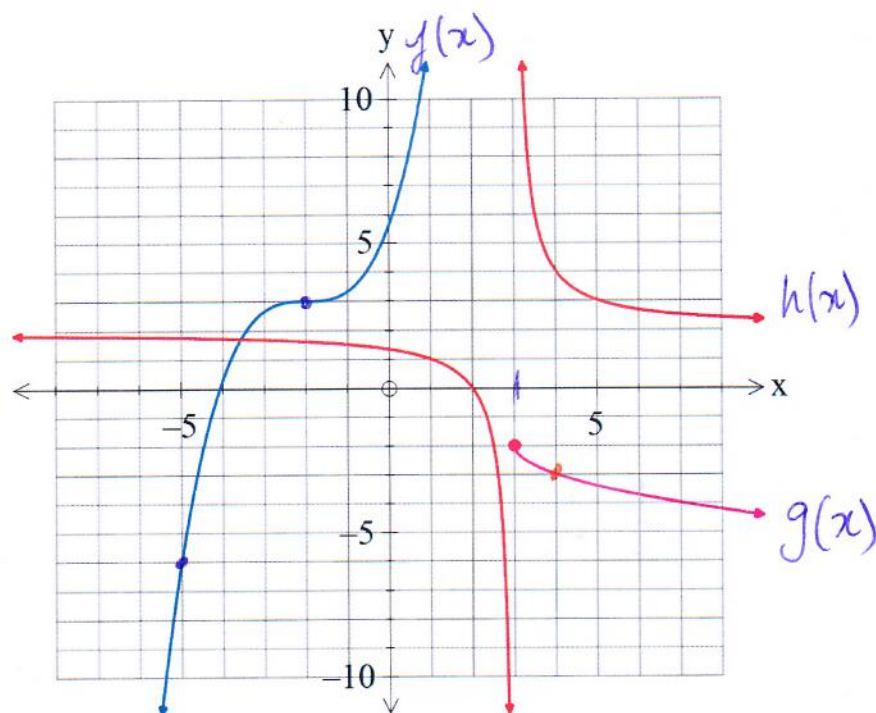
✓ shape

Question 7

[6, 1, 1 = 8 marks]

The three equations given below are for the three graphs shown below.

- a) Determine the values of the constants a, b, c, d, e and f



$$f(x) = a(x - b)^3 + 3$$

$$b = -2 \checkmark \quad (-5, -6)$$

$$-6 = a(-3)^3 + 3$$

$$-9 = -27a$$

$$a = \frac{1}{3} \checkmark$$

$$g(x) = c\sqrt{x-3} + d$$

$$d = -2 \checkmark$$

$$(4, -3)$$

$$-3 = c\sqrt{4-3} - 2$$

$$-3 = c - 2$$

$$c = -1 \checkmark$$

$$h(x) = \frac{1}{x-e} + f$$

$$e = 3 \checkmark$$

$$f = 2 \checkmark$$

- b) State the natural domain of $g(x)$

$$\{x \in \mathbb{R}; x \geq 3\} \checkmark$$

- c) State the range of $h(x)$

$$\{y \in \mathbb{R}; y \neq 2\} \checkmark$$



ALL SAINTS'
COLLEGE

MATHEMATICS DEPARTMENT

Year 11 Methods - Test Number 2 2020 Functions

Resource Rich

Name: _____

Teacher: _____

Marks: 15

Reading Time: 2 minutes

Working Time: 15 minutes

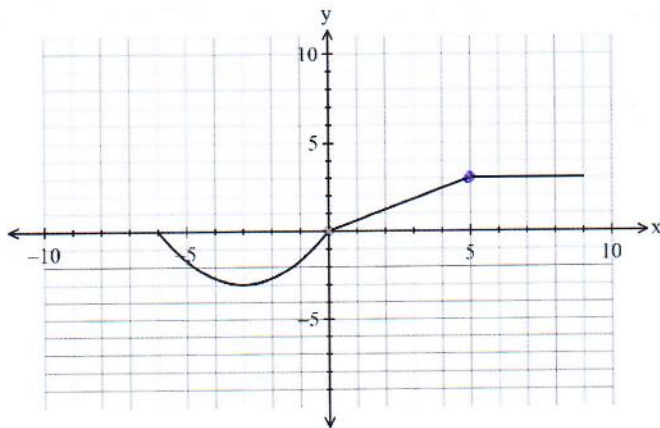
Instructions: You ARE permitted 1 page of notes and your calculator.

The formula sheet will be provided.

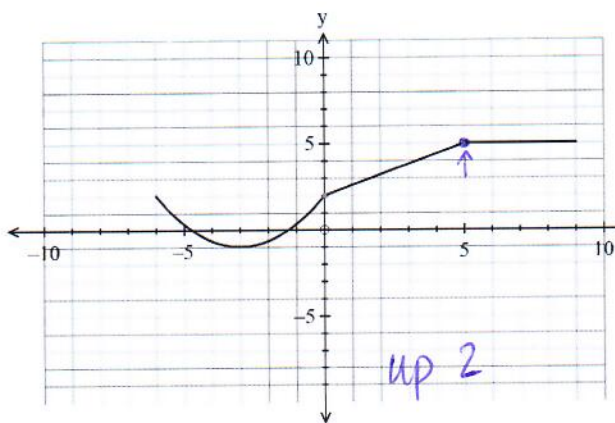
Question 1

[2, 2 = 4 marks]

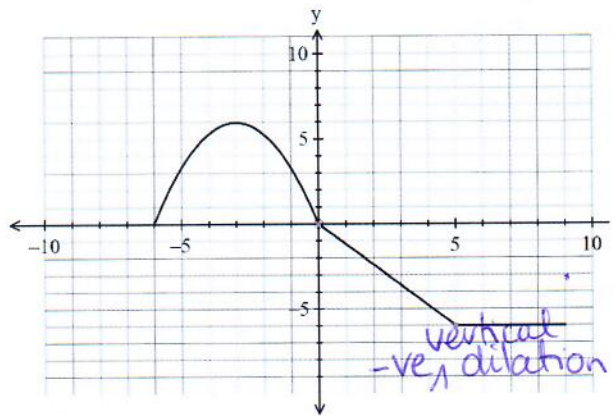
Consider the graph of $y = f(x)$



a) Using function notation to describe the transformations below

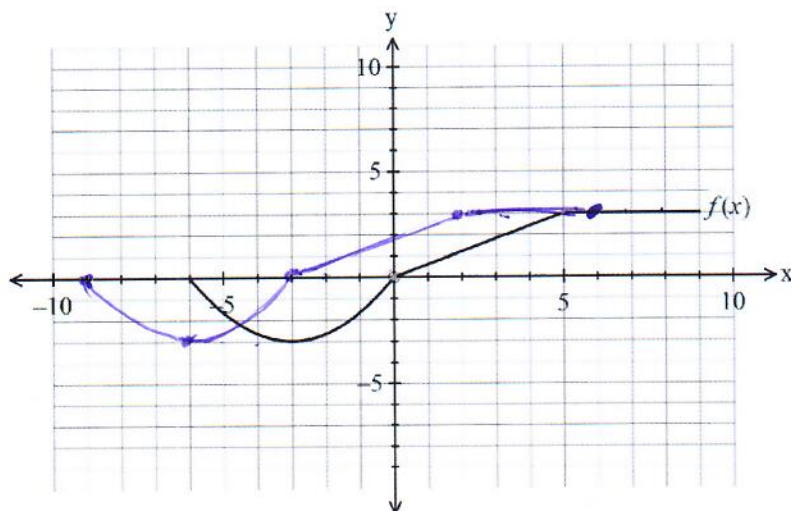


$f(x) + 2$ ✓



$-2f(x)$ ✓

b) Draw the graph of $f(x + 3)$ on the graph below



Question 2**[2 marks]**

Write down the successive transformations that map $y = f(x)$ to $y = 2f(x) - 4$

vertical dilation by a sf of 2 ✓

then a vertical translation, 4 units down ✓

Question 3**[4 marks]**

Consider the circle with centre O and a chord AB subtended by an angle of θ radians at the centre. Given that the area of the sector OAB is $\frac{25\pi}{12} \text{ cm}^2$ and arc length $\frac{5\pi}{6}$. Determine the radius of the circle and the angle θ .

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

$$l = \theta r$$

$$\frac{1}{2} \theta r^2 = \frac{25\pi}{12}$$

$$\theta r = \frac{5\pi}{6}$$

$$r = \frac{5\pi}{6\theta}$$

$$\text{sim eqn } \begin{cases} \frac{1}{2} \theta r^2 = \frac{25\pi}{12} \\ \theta r = \frac{5\pi}{6} \end{cases} \checkmark \checkmark$$

$$\theta = \frac{\pi}{6} \checkmark$$

$$r = 5 \checkmark$$

$$\frac{1}{2} \theta \left(\frac{5\pi}{6\theta} \right)^2 = \frac{25\pi}{12}$$

$$\theta = \frac{\pi}{6} \checkmark$$

$$r = \frac{5\pi}{6 \left(\frac{\pi}{6} \right)}$$

$$r = 5 \checkmark$$

$$\theta = \frac{5\pi}{6r}$$

$$\frac{1}{2} \left(\frac{5\pi}{6r} \right) r^2 = \frac{25\pi}{12}$$

$$\frac{5\pi r}{12} = \frac{25\pi}{12}$$

$$r = 5 \checkmark$$

$$\theta = \frac{5\pi}{6 \cdot 5}$$

$$\theta = \frac{\pi}{6} \checkmark$$

$\theta \checkmark$

$r \checkmark$

working ✓✓

Question 5**[1, 1, 2, 1 = 5 marks]**

Ship A is equipped with a radar which detects objects within a certain distance of the ship.

The radar's detection region is within the circle defined by $(x - 4)^2 + \left(y - \frac{5}{2}\right)^2 = 25$

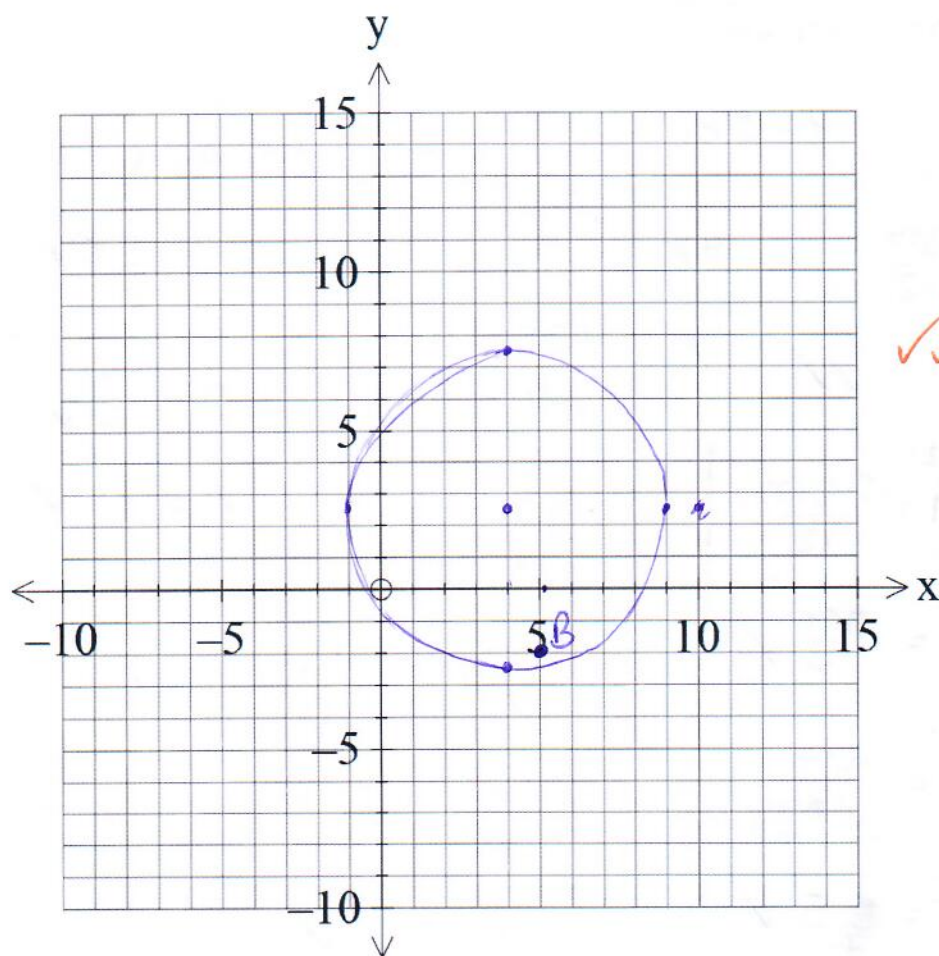
- a) State the coordinates of the location of **Ship A**

$(4, \frac{5}{2})$ ✓

- b) Determine the radius of the ship's radar.

5 ✓

- c) Draw an accurate sketch the relation showing Ship A's location and detection region



- d) Ship B is located at $(6, -2)$. Will ship A be able to detect ship B.

Yes ✓