



**MATHEMATICS SPECIALIST 3,4**  
**TEST 2 SECTION ONE 2016**  
**NON Calculator Section**  
**Chapters 3 and 4**

Name \_\_\_\_\_

Time: 35 minutes  
Total: 35 marks

**Question 1**

**(7 marks)**

Two functions are defined as  $f(x) = \sqrt{x-1}$  and  $g(x) = \frac{1}{x-1}$

(a) Evaluate  $gf\left(\frac{13}{9}\right)$

**(2 marks)**

(b) Find in simplified form  $gg(x)$ .

**(2 marks)**

(c) Determine the domain of  $f(g(x))$

**(3 marks)**

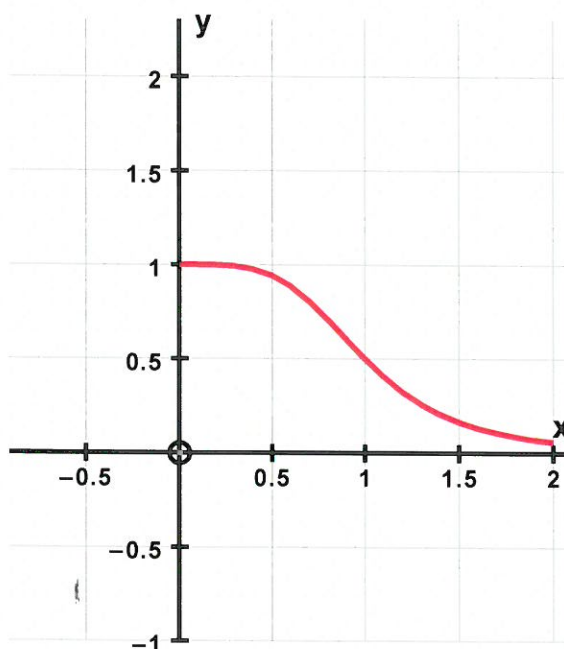
**Question 2****(6 marks)**

- (a) Determine the domain and range of  $f(g(x))$  given that  $f(x) = \frac{12}{x+1}$  and  $g(x) = \sqrt{x+1}$  (3)

- (b) Given that  $f(x) = 2x + 3$  and  $g(f(x)) = 4x^2 + 12x + 11$ , find  $g(x)$ . (3)

**Question 3****(6 marks)**

The graph of function  $f(x) = \frac{1}{x^4 + 1}$  for the domain  $0 < x < 2$  is shown below.



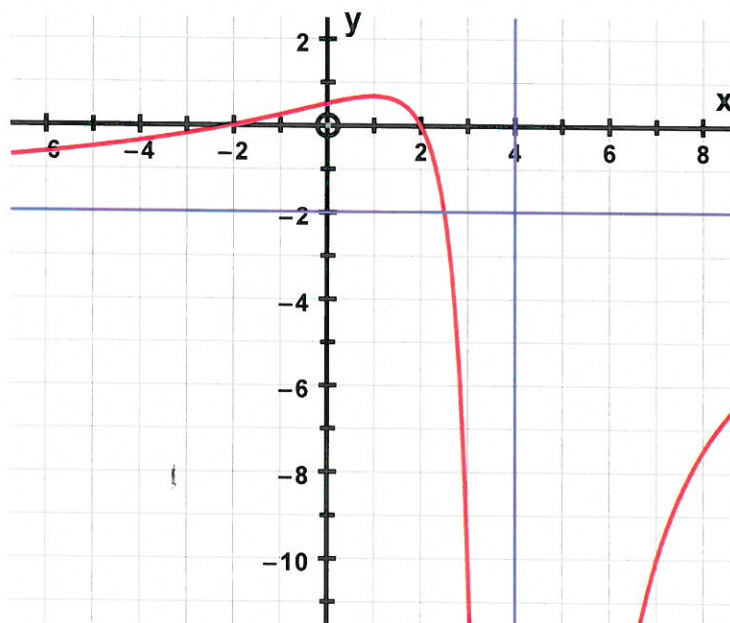
- (a) Determine the exact value for  $\lim_{x \rightarrow 2^+} f(x)$  (2)
- (b) On the axes given above, sketch the graph of the inverse function,  $y = f^{-1}(x)$  (2)
- (c) Obtain the rule for  $f^{-1}(x)$ . (2)

**Question 4**

**(5 marks)**

A rational function  $R(x)$  is sketched below. Function  $R(x)$  has the following properties:

- Only one pole or a discontinuity at  $x = 4$
- Two horizontal intercepts at  $x = 2$  and  $x = -2$ .
- A horizontal asymptote at  $y = -2$



- (a) If  $R(x) = \frac{k(x^2 - a)}{(x - b)(x - c)}$  explain why  $k = -2, a = 4, b = 4$  and  $c = 4$

(4)

- (b) Determine  $\lim_{x \rightarrow 4} R(x)$ .

(1)

**Question 5****(7 marks)**

Solve the following.

(a)  $|x-2| > 4$

(1)

(b)  $|x-7| \leq |x-11|$

(2)

$$(c) \quad |3x+4| \geq |5x+2|$$

(2)

†

$$(d) \quad |x-6| \leq 4x+3$$

(2)

†



**MATHEMATICS SPECIALIST 3,4**  
**TEST 2 SECTION TWO 2016**  
**Calculator Section**  
**Chapters 3 and 4**

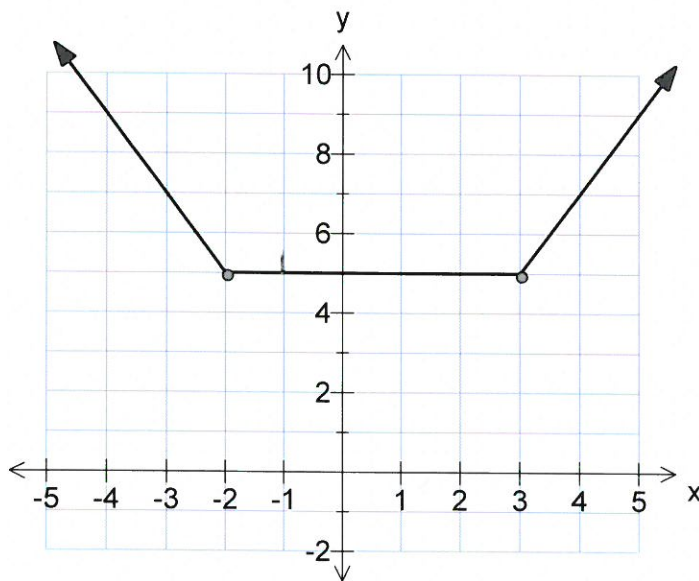
Name \_\_\_\_\_

Time: 20 minutes  
Total: 20 marks

**Question 1**

**(5 marks)**

The function  $f$ , defined for all real  $x$  by  $f(x) = |x - a| + |x + b|$ , where  $a$  and  $b$  are positive integers, has the following graph.



- (a) Find the values of  $a$  and  $b$ .
- (b) Express  $f(x)$  as a piecewise function.

**Question 2****(5 marks)**

At 10.00am, two bumper cars at the royal show, G and T, have position vectors,  $r$  m, and velocity vectors,  $v$  m/s, as shown below:

$$\begin{aligned} \mathbf{r}_G &= 3\mathbf{i} + 9\mathbf{j} & \mathbf{v}_G &= -\mathbf{i} - \mathbf{j} \\ \mathbf{r}_T &= 9\mathbf{i} & \mathbf{v}_T &= -5\mathbf{i} + 5\mathbf{j} \end{aligned}$$

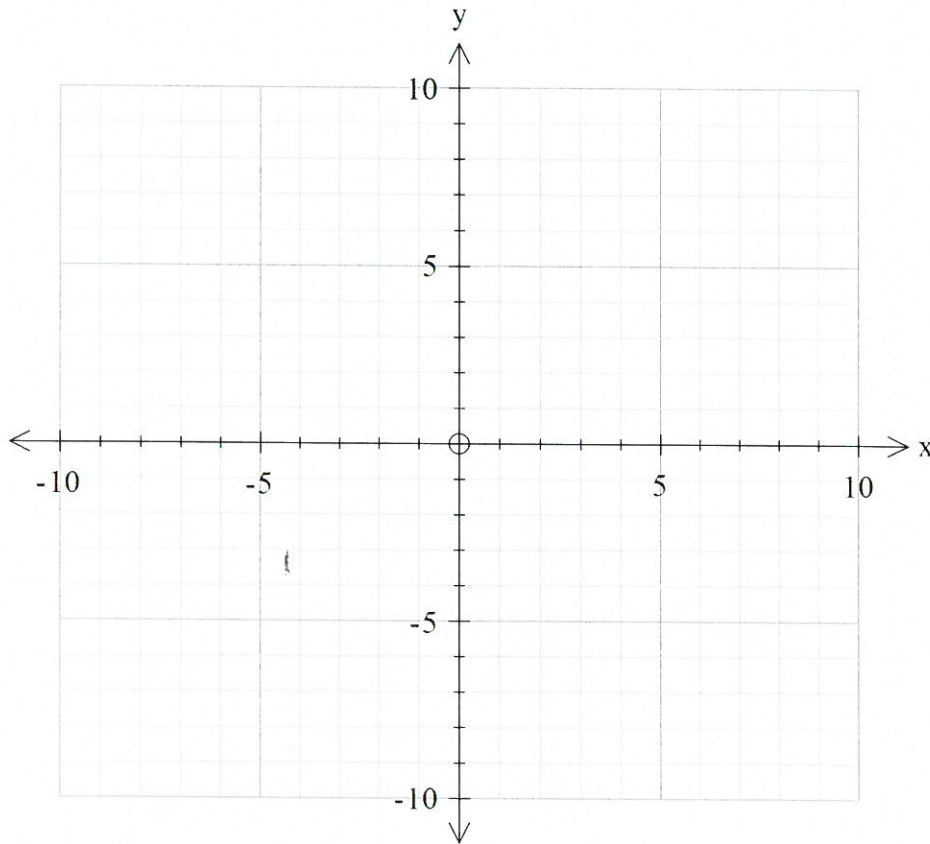
Prove that the bumper cars will collide if they continue with these velocities and find the time and location of the collision.



**Question 3**

**(5 marks)**

Sketch the graph  $y = \frac{x^3}{(x+4)(2x-3)}$ , the asymptotes and describe the behaviour of the graph as  $x \rightarrow \pm\infty$ . Give the equations for the vertical and other asymptotes.



**Question 4**

**(5 marks)**

Find the Cartesian equation of the line perpendicular to the vector  $7\underline{i} + 5\underline{j}$  and passing through the point  $(-1, 3)$