

The numbers between brackets in the margin represent the marks assigned to the question. The maximum grade is 100.

1. Compute the quotient  $\frac{f(a+h) - f(a)}{h}$  (simplifying your final answer as much as possible) in the following cases:

(5) (a)  $f(x) = 10x - 9$ .

(5) (b)  $f(x) = \frac{3x}{x+2}$ .

(5) (c)  $f(x) = 3x^2 - 5x + 1$ .

(2) 2. Consider the sets  $A = \{2, 3, 4, 2, 3\}$  and  $B = \{2, 3, 4\}$ . State whether the following statements are true or false.

- (a) The set  $B$  is not a subset of the set  $A$ .
- (b) The sets  $A$  and  $B$  are the same (i.e. equal).
- (c) The sets  $A$  and  $B$  are different.

3. The tables below represent a relation/operation between inputs (denoted by  $x$ ) and outputs (denoted by  $y$ ).

$x$	$y$	$x$	$y$
1	-3	1	1
2	-2	2	2
3	-1	3	3
0	0		

Table 1.

$x$	$y$	$x$	$y$
-7	11	1	-2
-2	5	3	4
-2	1	6	11
0	-1		

Table 2.

- (5) (a) Find the domain,  $D$ , and the range  $\mathcal{R}$  in each case. Your representation of these sets should look like  $D = \{\dots\}$ .
- (5) (b) Determine, in each case, whether the relation is a function or not.

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4. In each of the following items, find the domain, the range, and all zeros/intercepts, if any, of the given function.

(5) (a)  $f(x) = \frac{3x + 4}{x^2 - 25}$

(5) (b)  $f(x) = -4 + \sqrt{2x + 5}$ .

(5) (c)  $f(x) = \sqrt{\frac{7}{2x - 8}}$

(5) (d)  $f(x) = \frac{9}{\sqrt{x^2 + 9}}$ .

(5) (e)  $f(x) = 4|x| - 4$ .

5. For the following exercises, for each pair of functions, find  $f \circ g(x)$ ,  $g \circ f(x)$  and simplify the results.

(5) (a)  $f(x) = 3x + 8$ ,  $g(x) = x^2 - 2$ .

(5) (b)  $f(x) = |x + 2|$ ,  $g(x) = x^2 + 8\sqrt{x}$ .

(5) (c)  $f(x) = \frac{5}{2x + 3}$ ,  $g(x) = \frac{8}{x}$ .

6. A car rental company rents cars for a flat fee of \$20 and an hourly charge of \$10.25. Therefore, the total cost  $C$  to rent a car is a function of the hours  $t$  the car is rented plus the flat fee.

(3) (a) Write the formula for the function that models this situation.

(5) (b) Find the total cost to rent a car for 2 days and 7 hours.

(5) (c) Determine how long the car was rented if the bill is \$432.73.

7. A certain bacterium grows in culture in a circular region. The radius of the circle, measured in centimeters, is given by

$$r(t) = 8 - \left( \frac{6}{2t^2 + 1} \right),$$

where  $t$  is time measured in hours since a circle of a 2-cm radius of the bacterium was put into the culture.

(5) (a) Express the area of the bacteria as a function of time.

(5) (b) Find the exact and approximate area of the bacterial culture in 3 hours.

(5) (c) Express the circumference of the bacteria as a function of time.

(5) (d) Find the exact and approximate circumference of the bacteria in 3 hours.

**TOTAL MARKS: 100**