

**Instructions:** This quiz has 20 questions. The use of calculators is forbidden. Click on the box with the right answer. To initialise the quiz you must click on “BEGIN QUIZ.” When you finish the quiz you click on “END QUIZ” in order to see your score.

**Begin Quiz** Answer each of the following.

1. Determine the set

$$\{x \in \mathbb{R} : x^2 - x - 6 \leq 0\} \cap \left\{x \in \mathbb{R} : \frac{1-x}{x+3} \geq 1\right\}.$$

$$]-3; -1]$$

$$[-2; 3]$$

$$[-2; -1]$$

$$[0; 4]$$

2. Which of the following sketches best represents the plane region

$$\mathcal{R} = \{(x, y) \in \mathbb{R}^2 : x^2 + y^2 \leq 4, |x| \geq 1, |y| \geq 1\} ?$$

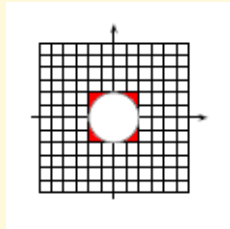


Figure 1: I

I

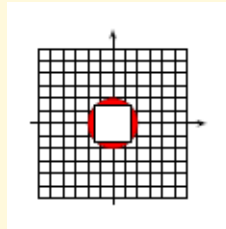


Figure 2: II

II

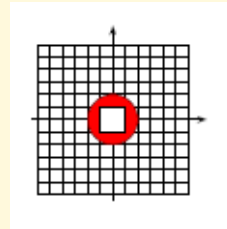


Figure 3: III

III

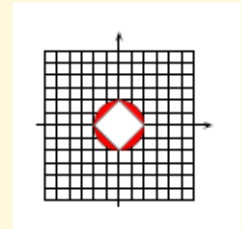


Figure 4: IV

IV

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3. A circle has a diameter with endpoints at  $(a, -b)$  and  $(-a, 3b)$ . Find its equation.

$$x^2 + (y - b)^2 = a^2 + 4b^2$$

$$(x - a)^2 + (y + b)^2 = a^2 + b^2$$

$$x^2 + (y - b)^2 = \sqrt{a^2 + 4b^2}$$

$$x^2 + (y + b)^2 = a^2 + 4b^2$$

4. How many of the following curves are symmetric with respect to the origin?

$$I : y = x^2 \quad II : y^2 = x^2 \quad III : y^2 = x^3$$

none                      exactly one                      exactly two                      all three

5. Consider the three functions

$$a(x) = \sqrt{\frac{2-x}{x+1}}; \quad b(x) = \sqrt{2-x} + \sqrt{x+1}; \quad c(x) = \sqrt{\frac{x+1}{2-x}}$$

and the three sets of real numbers

$$I : [-1; 2] \quad II : ]-1; 2] \quad III : [-1; 2[.$$

Match each function with its domain of definition.

$$(I, a), (II, b), (III, c)$$

$$(I, b), (II, c), (III, a)$$

$$(I, b), (II, a), (III, c)$$

$$(I, c), (II, b), (III, a)$$

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6.  $a, b, c$  are strictly positive real constants. Select the equation that best represents the behaviour of each curve.

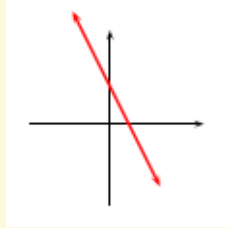


Figure 5: I

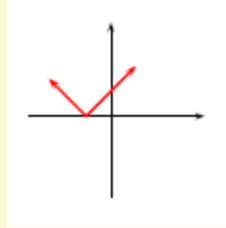


Figure 6: II

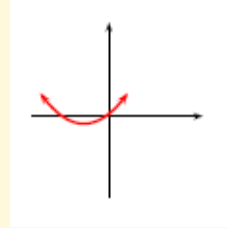


Figure 7: III

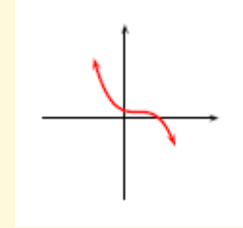


Figure 8: IV

I is  $y = ax + b$ , II is  $y = a|x + b|$ , III is  $y = a(x + b)^2 + c$ , IV is  $y = a(x + b)^3 + c$   
 I is  $y = -ax - b$ , II is  $y = a|x - b|$ , III is  $y = a(x - b)^2 - c$ , IV is  $y = a(x - b)^3 + c$   
 I is  $y = -ax + b$ , II is  $y = a|x + b|$ , III is  $y = a(x + b)^2 - c$ , IV is  $y = -a(x - b)^3 + c$   
 I is  $y = -ax + b$ , II is  $y = -a|x + b|$ , III is  $y = a(x + b)^2 - c$ , IV is  $y = -a(x - b)^3 + c$   
 I is  $y = -ax + b$ , II is  $y = -a|x + b|$ , III is  $y = a(x - b)^2 - c$ , IV is  $y = -a(x - b)^3 + c$   
 I is  $y = -ax + b$ , II is  $y = a|x - b|$ , III is  $y = a(x + b)^2 - c$ , IV is  $y = -a(x - b)^3 - c$   
 I is  $y = ax - b$ , II is  $y = a|x - b|$ , III is  $y = a(x + b)^2 - c$ , IV is  $y = -a(x - b)^3 + c$

7. Let  $a, b$  non-zero real constants. Find the equation of the straight line perpendicular to  $ax - by = 1$  and passing through  $(\frac{1}{a}, \frac{1}{b})$ .

$$ax - by = a^2 + b^2 \quad bx + ay = \frac{a}{b} + \frac{b}{a} \quad ax + by = a^2 + b^2 \quad bx - ay = \frac{a}{b} - \frac{b}{a}$$

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8. An open rectangular box has height  $h$  and a square base with a perimeter  $4x$ . The surface area of the outside of the box is

$$2x^2 + 4xh \qquad 4x + h \qquad x^2h \qquad x^2 + 4xh$$

9. A curve of the form  $y = ax^2 + bx + c$  has its minimum point at  $(-1, 1)$  and passes through  $(0, 3)$ . Find  $a + b + c$ .

$$9 \qquad 5 \qquad 8 \qquad 2$$

10. Let  $f(x) = 2x + 1$  and  $g(x) = x^2 - 2$ . For which  $x$  is it true that  $(f \circ g)(x) = (g \circ f)(x)$ ?

$$x \in \{-1, 1\} \text{ only}$$

$$x \in \{-1, 2, -\sqrt{5}\} \text{ only}$$

$$x \in \{-\sqrt{5}, \sqrt{5}\} \text{ only}$$

$$x \in \{-1, 1, -\sqrt{5}, \sqrt{5}\} \text{ only}$$

11. Let  $f(x) = \sqrt[3]{x-1} + 2$  and  $g(x) = x^2$ . What is  $(g \circ f^{-1})(3)$ ?

$$\frac{1}{9} \qquad 4 \qquad \frac{1}{3} \qquad 9$$

12. If  $\frac{1+i}{1-i} + (2-i)^2 = a + bi$ , where  $a, b$  are real numbers, determine  $a^2 + b^2$ .

$$0 \qquad 6 \qquad 12 \qquad 18$$

13. Let  $f$  and  $g$  be odd functions defined over all real numbers. Which of the following functions is (are) necessarily even?

$$a(x) = f(|x|) + g(-|x|); \quad b(x) = xf(x)g(x^3); \quad c(x) = |f(x)g(x)|$$

$$\text{none} \qquad \text{exactly one} \qquad \text{exactly two} \qquad \text{all}$$

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14. Which of the following graphs most resembles the curve  $y = x(x - 1)(x + 1)^2$ ?

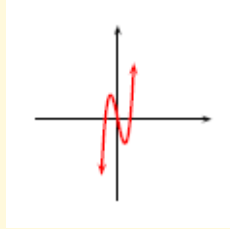


Figure 9: I



Figure 10: II

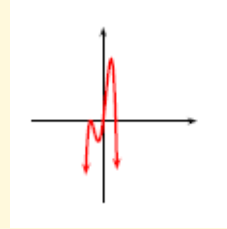


Figure 11: III

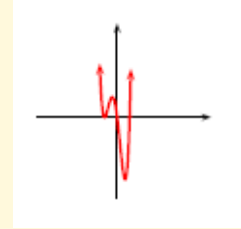


Figure 12: IV

I

II

III

IV

15. If  $q$  is a rational function satisfying the following:

- the denominator of  $q$  has degree 2
- $q$  has simple poles only at  $x = -2$  and  $x = 3$
- $q$  has zeroes at  $x = 2$  and  $x = -3$
- $\lim_{x \rightarrow +\infty} q(x) = -2$

then  $q(x) =$

$$q(x) = \frac{x^2 + x - 6}{x^2 - x - 6}$$

$$q(x) = \frac{-2x^2 - 2x + 12}{x^2 - x - 6}$$

$$q(x) = \frac{x^3 + x^2 - 6x}{x^2 - x - 6}$$

$$q(x) = \frac{-2x^2 - x + 6}{x^2 - x - 6}$$

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16. Which of the following graphs most resembles the curve  $y = -\sqrt{1-x}$ ?

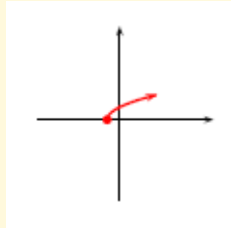


Figure 13: I

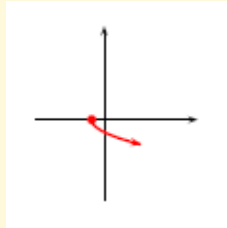


Figure 14: II

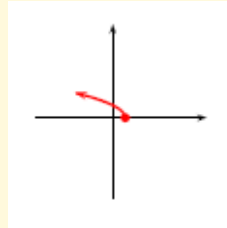


Figure 15: III

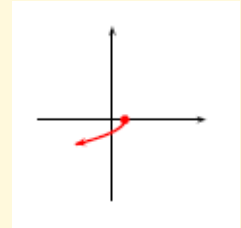


Figure 16: IV

I

II

III

IV

17. If  $x^4 + 2x^3 - 4x^2 - 5x - 6 = 0$  and  $x$  is an integer, then

$$x \in \{-2, -3\}$$

$$x \in \{-2, 3\}$$

$$x \in \{2, -3\}$$

$$x \in \{2, 3\}$$

18. The curve  $y = x - \frac{2}{x}$  undergoes the following successive transformations: a translation one unit left, and a reflexion about the  $y$ -axis. What is the equation of the resulting curve?

$$y = 1 + x - \frac{2}{1-x}$$

$$y = 1 - x + \frac{2}{1-x}$$

$$y = 1 - x - \frac{2}{1-x}$$

$$y = \frac{2}{x} - x - 1$$

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19. Which of the following graphs most resembles the curve  $y = (|x| + 1)(|x| - 2)$ ?

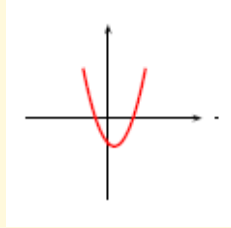


Figure 17: A

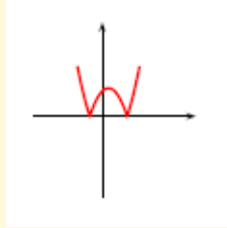


Figure 18: B

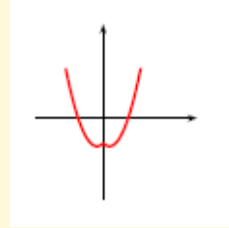


Figure 19: C

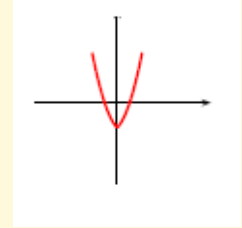


Figure 20: D

A

B

C

D

20. If  $f : \mathbb{R} \rightarrow \mathbb{R}$  is a function such that  $f(1 - 2x) = 4x^2$ , then  $(f \circ f)(x) =$

$4x^2(1 - 2x)^2$	$x^2(1 - x)^2$	$x^2(2 + x)^2$	$x^2(2 - x)^2$
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End Quiz

Author: David A. SANTOS, January 2006

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