EXPRESSWALA ACADEMY

Maths 1A: Functions

MCQ Test, Set 09

Time: 30 minutes | Maximum marks: 25

Name: _____ Class: _____ Date: _____

1. There are 25 questions. Each has exactly one correct answer: choose A, B, C or D.
2. Each correct answer carries 1 mark. There is no negative marking.
3. The key sheet and worked solutions are at the end of this test.

1. If $A = \{3, 4\}$ and $B = \{p, q, s, t, u\}$, how many elements does $A \times B$ have?

A. 10 **B.** 7 **C.** 25 **D.** 1024

2. If $f : A \to \mathbb{Z}$ is defined by $f(x) = x^2 + 5$ where $A = \{-3, 1, 2, 3\}$, find the range of f.

A. $\{-4, -1, 4\}$ **B.** $\{-3, 1, 2, 3\}$ **C.** $\{6, 9, 14, 15\}$ **D.** $\{6, 9, 14\}$

3. Find the point where the line $y = 4x + 2$ meets the y-axis.

A. $(-\frac{1}{2}, 0)$ **B.** $(0, 2)$ **C.** $(0, -2)$ **D.** $(2, 0)$

4. Find the vertex of the parabola $y = 2x^2 - 8x + 5$.

A. $(-2, -3)$ **B.** $(-3, 2)$ **C.** $(2, 3)$ **D.** $(2, -3)$

5. Find the discriminant of $-x^2 + 4x - 2 = 0$ and state the nature of its roots.

A. 8 **B.** -8 **C.** -4 **D.** 24

6. Solve $-x^2 - 2x \geq 0$.

A. $(-2, 0)$ **B.** $[-2, 0]$
C. $(-\infty, -2] \cup [0, \infty)$ **D.** $(-\infty, -2) \cup (0, \infty)$

7. Solve $-3x^2 + 10x - 8 \geq 0$.

A. $(-\infty, \frac{4}{3}] \cup [2, \infty)$ **B.** $(-\infty, \frac{4}{3}) \cup (2, \infty)$
C. $[\frac{4}{3}, 2]$ **D.** $(\frac{4}{3}, 2)$

8. Solve $|4x - 1| > 1$.

A. $[0, \frac{1}{2}]$ **B.** $(-\infty, 0] \cup [\frac{1}{2}, \infty)$
C. $(-\infty, 0) \cup (\frac{1}{2}, \infty)$ **D.** $(0, \frac{1}{2})$

9. The set of all real x with $|x| = x$ is

A. $(0, \infty)$ **B.** $[0, \infty)$ **C.** $(-\infty, 0]$ **D.** $(-\infty, 0)$

10. Find the value of $[4.6] + [-4.5]$, where $[x]$ is the greatest integer function.

A. -1 **B.** -2 **C.** 0 **D.** 1

11. Using $[x] + \left[x + \frac{1}{n}\right] + \cdots + \left[x + \frac{n-1}{n}\right] = [nx]$, evaluate $[0.33] + \left[0.33 + \frac{1}{2}\right]$.

A. -1 **B.** 2 **C.** 1 **D.** 0

12. Solve $\log_4 x > -2$.

A. $(0, \frac{1}{16})$ **B.** $(\frac{1}{16}, \infty)$ **C.** $(-8, \infty)$ **D.** $(-\infty, 0.0625)$

13. The graph of $y = 6^x$ passes through

A. $(0, 1)$ **B.** $(1, 0)$ **C.** $(1, 1)$ **D.** $(0, 0)$

14. Are $f(x) = 2x$ and $g(x) = \sqrt{4x^2}$ equal functions?

A. equal: same domain $\mathbb{R}$ **B.** not equal: $D_g = [0, \infty)$

C. not equal: $g(x) = 2|x|$, so $g(-1) \neq f(-1)$ **D.** equal: $\sqrt{4x^2} = 2x$

15. The function $f(x) = 3x^4 - 2x^5$ is

A. odd **B.** neither even nor odd

C. both even and odd **D.** even

16. The fundamental period of $\tan(4x)$ is

A. 4π **B.** $\frac{\pi}{4}$ **C.** $\frac{\pi}{8}$ **D.** $\frac{\pi}{2}$

17. If $f(x) = \sqrt{6 - x}$ and $g(x) = \sqrt{x + 1}$, find the domain of $\frac{g}{f}$.

A. $[-1, 6)$ **B.** $(-1, 6)$ **C.** $[-1, 6]$ **D.** $(-1, 6]$

18. f satisfies $f(xy) = f(x) + f(y)$ for all positive x, y, and $f(3) = a$. Find $f(81)$.

A. $a + 4$ **B.** a^4 **C.** $4a$ **D.** $81a$

19. How many onto functions are there from $A = \{1, 2, 8, 9, 10, 11\}$ to $B = \{e, f\}$?

A. 63 **B.** 36 **C.** 64 **D.** 62

20. How many onto functions are there from $A = \{4, 5, 7, 8, 10\}$ to $B = \{f, h\}$?

A. 31 **B.** 30 **C.** 25 **D.** 32

21. If $f(x) = x - 3$ and $g(x) = 2x$ are functions from $\mathbb{R}$ to $\mathbb{R}$, find $(g \circ f)^{-1}(-7)$.

A. $-\frac{1}{2}$ **B.** -2 **C.** -20 **D.** -11

22. Find the domain of $f(x) = \log_e(-x^2 - x + 20)$.

A. $(-5, 4)$ **B.** $[-5, 4]$

C. $(-\infty, -5) \cup (4, \infty)$ **D.** $(-4, 5)$

23. Find the range of $f(x) = 4\sin x + 3\cos x + 6$.

A. $[-5, 5]$ **B.** $[-1, 13]$ **C.** $[1, 11]$ **D.** $[5, 7]$

24. Find the range of $f(x) = |x + 8| + |x - 5|$.

A. $[0, \infty)$ **B.** $[3, \infty)$ **C.** $(13, \infty)$ **D.** $[13, \infty)$

25. The point $(4, -8)$ lies on $y = f(x)$. Which point must lie on $y = -f(-x)$?

A. $(-8, 4)$ **B.** $(-4, 8)$ **C.** $(-4, -8)$ **D.** $(4, 8)$

Key sheet

1. A	**2.** D	**3.** B	**4.** D	**5.** A
6. B	**7.** C	**8.** C	**9.** B	**10.** A
11. D	**12.** B	**13.** A	**14.** C	**15.** B
16. B	**17.** D	**18.** C	**19.** D	**20.** B
21. A	**22.** A	**23.** C	**24.** D	**25.** B

Solutions

1. If $A = \{3, 4\}$ and $B = \{p, q, s, t, u\}$, how many elements does $A \times B$ have?

$n(A) = 2,\ n(B) = 5$

$n(A \times B) = n(A) \cdot n(B) = 10$

Ans: (A) 10

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2. If $f : A \to \mathbb{Z}$ is defined by $f(x) = x^2 + 5$ where $A = \{-3, 1, 2, 3\}$, find the range of f.

$f(-3) = 14,\ f(1) = 6,\ f(2) = 9,\ f(3) = 14$

Range $= \{6, 9, 14\}$

Ans: (D) $\{6, 9, 14\}$

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3. Find the point where the line $y = 4x + 2$ meets the y-axis.

$x = 0 \Rightarrow y = 2$

The point is $(0, 2)$.

Ans: (B) $(0, 2)$

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4. Find the vertex of the parabola $y = 2x^2 - 8x + 5$.

$x = -\frac{b}{2a} = -\frac{-8}{2(2)} = 2$

$y = \frac{4ac - b^2}{4a} = -3$

Vertex $= (2, -3)$

Ans: (D) $(2, -3)$

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5. Find the discriminant of $-x^2 + 4x - 2 = 0$ and state the nature of its roots.

$\Delta = b^2 - 4ac = (4)^2 - 4(-1)(-2) = 8$

$\Delta > 0$, so the roots are real and distinct.

Ans: (A) 8

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6. Solve $-x^2 - 2x \geq 0$.

$-x^2 - 2x = -x\,(x + 2)$

The roots are -2 and 0, and $a = -1 < 0$.

The expression has the sign opposite to a between the roots.

Solution set: $[-2, 0]$

Ans: (B) $[-2, 0]$

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7. Solve $-3x^2 + 10x - 8 \geq 0$.

$-3x^2 + 10x - 8 = -\,(x - 2)\,(3x - 4)$

The roots are $\frac{4}{3}$ and 2, and $a = -3 < 0$.

The expression has the sign opposite to a between the roots.

Solution set: $[\frac{4}{3}, 2]$

Ans: (C) $[\frac{4}{3}, 2]$

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8. Solve $|4x - 1| > 1$.

$4x - 1 > 1$ or $4x - 1 < -1$

Solution set: $(-\infty, 0) \cup (\frac{1}{2}, \infty)$

Ans: (C) $(-\infty, 0) \cup (\frac{1}{2}, \infty)$

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9. The set of all real x with $|x| = x$ is

$|x| = x$ exactly when $x \geq 0$.

Ans: (B) $[0, \infty)$

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10. Find the value of $[4.6] + [-4.5]$, where $[x]$ is the greatest integer function.

$[4.6] = 4,\ [-4.5] = -5$

$[4.6] + [-4.5] = -1$

Ans: (A) -1

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11. Using $[x] + \left[x + \frac{1}{n}\right] + \cdots + \left[x + \frac{n-1}{n}\right] = [nx]$, evaluate $[0.33] + \left[0.33 + \frac{1}{2}\right]$.

Here $x = 0.33$, $n = 2$.

$\text{Sum} = [2 \times 0.33] = [0.66] = 0$

Check: the terms are 0, 0.

Ans: (D) 0

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12. Solve $\log_4 x > -2$.

The base 4 is more than 1, so $\log_4 x$ is increasing.

$x > 0$ and $x > 4^{-2} = 0.0625$

So $x \in (\frac{1}{16}, \infty)$.

Ans: (B) $(\frac{1}{16}, \infty)$

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13. The graph of $y = 6^x$ passes through

$a^0 = 1$, so $(0, 1)$ lies on every graph $y = a^x$.

Ans: (A) $(0, 1)$

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14. Are $f(x) = 2x$ and $g(x) = \sqrt{4x^2}$ equal functions?

Equal functions need the same domain and the same value at every point of it.

So they are not equal: $g(x) = 2|x|$, so $g(-1) \neq f(-1)$.

Ans: (C) not equal: $g(x) = 2|x|$, so $g(-1) \neq f(-1)$

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15. The function $f(x) = 3x^4 - 2x^5$ is

$f(-x) = 2x^5 + 3x^4$

$f(-x)$ is neither $f(x)$ nor $-f(x)$, so f is neither even nor odd.

Ans: (B) neither even nor odd

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16. The fundamental period of $\tan(4x)$ is

$\tan x$ has period π.

$\tan(kx)$ has period $\frac{\pi}{k} = \frac{\pi}{4}$

Ans: (B) $\frac{\pi}{4}$

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17. If $f(x) = \sqrt{6-x}$ and $g(x) = \sqrt{x+1}$, find the domain of $\frac{g}{f}$.

$D_f = [-1, \infty),\ D_g = (-\infty, 6]$

We also need $f(x) \neq 0$, which removes $x = -1$.

Domain $= (-1, 6]$

Ans: (D) $(-1, 6]$

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18. f satisfies $f(xy) = f(x) + f(y)$ for all positive x, y, and $f(3) = a$. Find $f(81)$.

$f(xy) = f(x) + f(y) \Rightarrow f(x) = k \log_e x$.

$f(81) = f(3^4) = 4\, f(3) = 4a$

Ans: (C) $4a$

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19. How many onto functions are there from $A = \{1, 2, 8, 9, 10, 11\}$ to $B = \{e, f\}$?

$n(A) = 6,\ n(B) = 2$

$\text{Number of onto functions} = 2^n - 2 = 2^6 - 2 = 62$

Ans: (D) 62

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20. How many onto functions are there from $A = \{4, 5, 7, 8, 10\}$ to $B = \{f, h\}$?

$n(A) = 5,\ n(B) = 2$

$\text{Number of onto functions} = 2^n - 2 = 2^5 - 2 = 30$

Ans: (B) 30

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21. If $f(x) = x - 3$ and $g(x) = 2x$ are functions from $\mathbb{R}$ to $\mathbb{R}$, find $(g \circ f)^{-1}(-7)$.

$(g \circ f)^{-1} = f^{-1} \circ g^{-1}$

$g^{-1}(x) = \frac{x}{2},\ f^{-1}(x) = x + 3$

$(g \circ f)^{-1}(-7) = f^{-1}\left(\frac{-7}{2}\right) = -\frac{1}{2}$

Ans: (A) $-\frac{1}{2}$

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22. Find the domain of $f(x) = \log_e(-x^2 - x + 20)$.

$-x^2 - x + 20 > 0$

$\Rightarrow (x+5)(x-4) < 0$

Domain $= (-5, 4)$

Ans: (A) $(-5, 4)$

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23. Find the range of $f(x) = 4\sin x + 3\cos x + 6$.

$\sqrt{a^2 + b^2} = \sqrt{9 + 16} = 5$

$\text{Range} = [c - \sqrt{a^2+b^2},\ c + \sqrt{a^2+b^2}] = [1, 11]$

Ans: (C) $[1, 11]$

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24. Find the range of $f(x) = |x + 8| + |x - 5|$.

For $b > a$, the range of $|x - a| + |x - b|$ is $[b - a, \infty)$.

Here $b - a = 5 - (-8) = 13$, so the range is $[13, \infty)$.

Ans: (D) $[13, \infty)$

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25. The point $(4, -8)$ lies on $y = f(x)$. Which point must lie on $y = -f(-x)$?

The graph of $y = -f(-x)$ is obtained by half turn about the origin: $(x, y) \to (-x, -y)$.

So $(4, -8) \to (-4, 8)$.

Ans: (B) $(-4, 8)$
