EXPRESSWALA ACADEMY

Maths 1A: Functions

MCQ Test, Set 01

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 $A = \{6, 8\}$ and $B = \{s, t, u\}$, how many elements does $A \times B$ have?

A. 64 **B.** 6 **C.** 9 **D.** 5

2. For $f(x) = 3x - 4$ on the domain $A = \{-3, 1, 2, 3\}$, find the pre-image of 5.

A. 3 **B.** $\frac{1}{3}$ **C.** -3 **D.** 11

3. Find the point where the line $y = 3x - 7$ meets the y-axis.

A. $(\frac{7}{3}, 0)$ **B.** $(0, -7)$ **C.** $(0, 7)$ **D.** $(-7, 0)$

4. Find the maximum value of $f(x) = -3x^2 + 12x - 15$.

A. 2 **B.** -15 **C.** 3 **D.** -3

5. Find the discriminant of $-x^2 - 5x - 6 = 0$ and state the nature of its roots.

A. 49 **B.** -29 **C.** 1 **D.** -1

6. Solve $x^2 - 8x + 16 > 0$.

A. $\mathbb{R} - \{4\}$ **B.** $\{4\}$ **C.** $\mathbb{R}$ **D.** $\mathbb{R} - \{-4\}$

7. Solve $-x^2 + 7x - 12 \geq 0$.

A. $(-\infty, 3) \cup (4, \infty)$ **B.** $(-\infty, 3] \cup [4, \infty)$

C. $(3, 4)$ **D.** $[3, 4]$

8. Solve $|x + 7| \geq 5$.

A. $(-12, -2)$ **B.** $(-\infty, -12] \cup [-2, \infty)$

C. $[-12, -2]$ **D.** $(-\infty, -12) \cup (-2, \infty)$

9. Find all real x with $|x - 7| = x - 7$.

A. $(-\infty, 7]$ **B.** $[7, \infty)$ **C.** $[-7, \infty)$ **D.** $(7, \infty)$

10. Find $\lceil -3.9 \rceil - [3.4]$.

A. -7 **B.** -5 **C.** -6 **D.** -8

11. The solution set of $[x] < -2$ is

A. $(-\infty, -2)$ **B.** $(-\infty, -1)$ **C.** $[-1, \infty)$ **D.** $[-2, \infty)$

12. Find $\operatorname{sgn}(x^2 + 2x - 8)$ at $x = \frac{11}{2}$.

A. 1 **B.** -1 **C.** 0 **D.** $\frac{133}{4}$

13. The domain of $f(x) = 7^x$ is

A. $(0, \infty)$ **B.** $[0, \infty)$ **C.** $\mathbb{R} - \{0\}$ **D.** $\mathbb{R}$

14. Are $f(x) = \operatorname{sgn}(x^2 + 6)$ and $g(x) = 1$ equal functions?

A. equal only for $x > 0$ **B.** not equal: $D_f \neq D_g$

C. equal: $x^2 + 6 > 0$, so $f(x) = 1$ for all x **D.** not equal: sgn can be -1

15. The function $f(x) = x|x| + 2x \cos x$ is

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

C. even **D.** odd

16. The fundamental period of $\tan\left(\frac{4x}{3}\right)$ is

A. $\frac{3\pi}{2}$ **B.** $\frac{3\pi}{8}$ **C.** $\frac{4\pi}{3}$ **D.** $\frac{3\pi}{4}$

17. If $f(x) = x + 3$ and $g(x) = x^2 - 8x + 15$, find the domain of $\frac{f}{g}$.

A. $\mathbb{R} - \{-5, -3\}$ **B.** $\mathbb{R} - \{3, 5\}$ **C.** $\mathbb{R} - \{-3\}$ **D.** $\mathbb{R}$

18. f satisfies $f(x + y) = f(x)\, f(y)$ for all real x, y, and $f(1) = 2$. Find $f(4)$.

A. 32 **B.** 8 **C.** 16 **D.** 6

19. How many bijections are there from $A = \{1, 5, 7\}$ to $B = \{b, e, f\}$?

A. 9 **B.** 27 **C.** 6 **D.** 8

20. How many onto functions are there from $A = \{3, 5, 8\}$ to $B = \{b, d, e\}$?

A. 19 **B.** 3 **C.** 27 **D.** 6

21. If $f : \mathbb{R} \to \mathbb{R}$ is $f(x) = 3x - 2$, find $f^{-1}(-8)$.

A. $-\frac{1}{26}$ **B.** -26 **C.** 2 **D.** -2

22. Find the domain of $f(x) = \sqrt{x^2 - 7x}$.

A. $(-\infty, 0] \cup [7, \infty)$ **B.** $(-\infty, 0) \cup (7, \infty)$

C. $[0, 7]$ **D.** $(-\infty, -7] \cup [0, \infty)$

23. Find the range of $f(x) = 5 \sin x - 12 \cos x + 2$.

A. $[-11, 15]$ **B.** $[-13, 13]$ **C.** $[-15, 19]$ **D.** $[1, 3]$

24. Find the range of $f(x) = |x| + |x - 4|$.

A. $(4, \infty)$ **B.** $[4, \infty)$ **C.** $[0, \infty)$ **D.** $[5, \infty)$

25. The point $(8, 5)$ lies on $y = f(x)$. Which point must lie on $y = -f(x)$?

A. $(8, -5)$ **B.** $(5, 8)$ **C.** $(-8, -5)$ **D.** $(-8, 5)$

Key sheet

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

Solutions

1. If $A = \{6, 8\}$ and $B = \{s, t, u\}$, how many elements does $A \times B$ have?

$n(A) = 2,\ n(B) = 3$

$n(A \times B) = n(A) \cdot n(B) = 6$

Ans: (B) 6

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2. For $f(x) = 3x - 4$ on the domain $A = \{-3, 1, 2, 3\}$, find the pre-image of 5.

$f(x) = 5 \Rightarrow 3x - 4 = 5$

$\Rightarrow x = 3$

$3 \in A$, so the pre-image is 3.

Ans: (A) 3

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3. Find the point where the line $y = 3x - 7$ meets the y-axis.

$x = 0 \Rightarrow y = -7$

The point is $(0, -7)$.

Ans: (B) $(0, -7)$

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4. Find the maximum value of $f(x) = -3x^2 + 12x - 15$.

$\frac{4ac - b^2}{4a} = \frac{4(-3)(-15) - (12)^2}{4(-3)} = -3$

It occurs at $x = -\frac{b}{2a} = 2$.

Ans: (D) -3

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5. Find the discriminant of $-x^2 - 5x - 6 = 0$ and state the nature of its roots.

$\Delta = b^2 - 4ac = (-5)^2 - 4(-1)(-6) = 1$

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

Ans: (C) 1

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6. Solve $x^2 - 8x + 16 > 0$.

$x^2 - 8x + 16 = (x - 4)^2$

$\Delta = 0$: the expression has the sign of $a = 1$ except at $x = 4$, where it is 0.

Solution set: $\mathbb{R} - \{4\}$

Ans: (A) $\mathbb{R} - \{4\}$

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7. Solve $-x^2 + 7x - 12 \geq 0$.

$-x^2 + 7x - 12 = -(x - 4)(x - 3)$

The roots are 3 and 4, and $a = -1 < 0$.

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

Solution set: $[3, 4]$

Ans: (D) $[3, 4]$

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8. Solve $|x+7| \geq 5$.

$x+7 \geq 5$ or $x+7 \leq -5$

Solution set: $(-\infty, -12] \cup [-2, \infty)$

Ans: (B) $(-\infty, -12] \cup [-2, \infty)$

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9. Find all real x with $|x-7| = x-7$.

$|u| = u \iff u \geq 0$.

$x - 7 \geq 0 \Rightarrow x \geq 7$

So $x \in [7, \infty)$.

Ans: (B) $[7, \infty)$

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10. Find $\lceil -3.9 \rceil - [3.4]$.

$\lceil -3.9 \rceil = -3,\ [3.4] = 3$

$\lceil -3.9 \rceil - [3.4] = -6$

Ans: (C) -6

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11. The solution set of $[x] < -2$ is

$[x] < k \Rightarrow x \in (-\infty, k)$ with $k = -2$.

So $x \in (-\infty, -2)$.

Ans: (A) $(-\infty, -2)$

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12. Find $\operatorname{sgn}(x^2 + 2x - 8)$ at $x = \frac{11}{2}$.

$x^2 + 2x - 8 = \frac{133}{4}$ at $x = \frac{11}{2}$

This is positive, so sgn is 1.

Ans: (A) 1

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13. The domain of $f(x) = 7^x$ is

a^x is defined for every real x.

Ans: (D) $\mathbb{R}$

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14. Are $f(x) = \operatorname{sgn}(x^2 + 6)$ and $g(x) = 1$ equal functions?

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

So they are equal: $x^2 + 6 > 0$, so $f(x) = 1$ for all x.

Ans: (C) equal: $x^2 + 6 > 0$**, so** $f(x) = 1$ **for all** x

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15. The function $f(x) = x|x| + 2x\cos x$ is

$f(-x) = -2x\cos x - x\,|x|$

$f(-x) = -f(x)$, so f is odd.

Ans: (D) odd

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16. The fundamental period of $\tan\left(\frac{4x}{3}\right)$ is

$\tan x$ has period π.

$\tan(kx)$ has period $\frac{\pi}{k} = \frac{3\pi}{4}$

Ans: (D) $\frac{3\pi}{4}$

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17. If $f(x) = x + 3$ and $g(x) = x^2 - 8x + 15$, find the domain of $\frac{f}{g}$.

$D_f = D_g = \mathbb{R}$, and $\frac{f}{g}$ needs $g(x) \neq 0$.

$(x - 5)(x - 3) = 0 \Rightarrow x = 3, 5$

Domain $= \mathbb{R} - \{3, 5\}$

Ans: (B) $\mathbb{R} - \{3, 5\}$

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18. f satisfies $f(x + y) = f(x)\, f(y)$ for all real x, y, and $f(1) = 2$. Find $f(4)$.

$f(4) = f(1 + 1 + \cdots + 1) = f(1)^4$

$= (2)^4 = 16$

Ans: (C) 16

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19. How many bijections are there from $A = \{1, 5, 7\}$ to $B = \{b, e, f\}$?

$n(A) = n(B) = 3$

$\text{Number of bijections} = 3! = 6$

Ans: (C) 6

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20. How many onto functions are there from $A = \{3, 5, 8\}$ to $B = \{b, d, e\}$?

$3^3 - {}^3C_1\, 2^3 + {}^3C_2\, 1^3$

$= 27 - 24 + 3 = 6$

Ans: (D) 6

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21. If $f : \mathbb{R} \to \mathbb{R}$ is $f(x) = 3x - 2$, find $f^{-1}(-8)$.

$f^{-1}(-8) = x \iff f(x) = -8$

$3x - 2 = -8 \Rightarrow x = -2$

Ans: (D) -2

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22. Find the domain of $f(x) = \sqrt{x^2 - 7x}$.

We need $x^2 - 7x \geq 0$.

$x^2 - 7x = x\,(x - 7)$

Domain $= (-\infty, 0] \cup [7, \infty)$

Ans: (A) $(-\infty, 0] \cup [7, \infty)$

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23. Find the range of $f(x) = 5\sin x - 12\cos x + 2$.

$\sqrt{a^2 + b^2} = \sqrt{144 + 25} = 13$

$\text{Range} = [c - \sqrt{a^2 + b^2},\ c + \sqrt{a^2 + b^2}] = [-11, 15]$

Ans: (A) $[-11, 15]$

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24. Find the range of $f(x) = |x| + |x - 4|$.

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

Here $b - a = 4 - (0) = 4$, so the range is $[4, \infty)$.

Ans: (B) $[4, \infty)$

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25. The point $(8, 5)$ lies on $y = f(x)$. Which point must lie on $y = -f(x)$?

The graph of $y = -f(x)$ is obtained by reflection in the x-axis: $(x, y) \to (x, -y)$.

So $(8, 5) \to (8, -5)$.

Ans: (A) $(8, -5)$
