EXPRESSWALA ACADEMY

Maths 1A: Functions

MCQ Test, Set 07

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 $A = \{5, 9\}$ and $B = \{q, s, u\}$, how many functions are there from A to B?

A. 64 **B.** 6 **C.** 8 **D.** 9

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

A. $\{-2, 1, 6, 7\}$ **B.** $\{-2, 1, 6\}$ **C.** $\{-3, -2, -1, 2, 3\}$ **D.** $\{4, 7, 12\}$

3. If $f(x) = ax + b$ with $f(5) = 1$ and $f(-1) = 7$, find a and b.

A. $a = 1,\ b = 6$ **B.** $a = -1,\ b = -6$ **C.** $a = -1,\ b = 6$ **D.** $a = 6,\ b = -1$

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

A. -4 **B.** 3 **C.** 4 **D.** 1

5. Find the discriminant of $-2x^2 + 6x + 3 = 0$ and state the nature of its roots.

A. -60 **B.** 60 **C.** 30 **D.** 12

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

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

C. $(-\infty, -4] \cup [3, \infty)$ **D.** $(-4, 3)$

7. Solve $-x^2 + 4x - 4 > 0$.

A. $\mathbb{R}$ **B.** $\{2\}$ **C.** ϕ **D.** $\mathbb{R} - \{2\}$

8. Solve $|x - 2| \geq 9$.

A. $[-7, 11]$ **B.** $(-\infty, -7) \cup (11, \infty)$

C. $(-7, 11)$ **D.** $(-\infty, -7] \cup [11, \infty)$

9. Find the domain of $f(x) = \dfrac{x + 1}{x^2 - 7x + 6}$.

A. $\mathbb{R} - \{1, 6\}$ **B.** $\mathbb{R}$ **C.** $\mathbb{R} - \{-6, -1\}$ **D.** $\mathbb{R} - \{-1\}$

10. Find $\lceil -1.8 \rceil - [6.1]$.

A. -9 **B.** -6 **C.** -7 **D.** -8

11. The solution set of $[x] \geq 8$ is

A. $[8, \infty)$ **B.** $[9, \infty)$ **C.** $(-\infty, 8)$ **D.** $(-\infty, 9)$

12. Solve $\log_4 x > 2$.

A. $(-\infty, 16)$ **B.** $(0, 8)$ **C.** $(0, 16)$ **D.** $(16, \infty)$

13. The domain of $f(x) = 2^x$ is

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

14. If $f(x) = 2x - 2$ and $g(x) = 2x^2 - 1$, find $(f \circ g)(2)$.

A. 12 **B.** 14 **C.** 7 **D.** 9

15. The function $f(x) = 3x^4 + 4x|x|$ is

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

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

16. If $f(x) = x^4$ and $g(x) = |x| + 1$, then $f \circ g$ is

A. even **B.** a constant function

C. odd **D.** neither even nor odd

17. If $f(x) = x + 1$ and $g(x) = x^2 - 5$, find $(fg)(0)$ and $\left(\frac{f}{g}\right)(0)$.

A. $5,\ -\frac{1}{5}$ **B.** $-5,\ -5$ **C.** $-4,\ -\frac{1}{5}$ **D.** $-5,\ -\frac{1}{5}$

18. A polynomial f satisfies $f(x)f\left(\frac{1}{x}\right) = f(x) + f\left(\frac{1}{x}\right)$ and $f(4) = -63$. Find $f(5)$.

A. -624 **B.** -124 **C.** -125 **D.** 126

19. How many onto functions are there from $A = \{1, 4, 8\}$ to $B = \{d, f\}$?

A. 8 **B.** 6 **C.** 9 **D.** 7

20. How many onto functions are there from $A = \{1, 5, 9, 12\}$ to $B = \{c, f, h\}$?

A. 81 **B.** 33 **C.** 64 **D.** 36

21. If $f : \mathbb{R} \to \mathbb{R}$ is $f(x) = \frac{6-2x}{2}$, find $f^{-1}(9)$.

A. $-\frac{1}{6}$ **B.** -6 **C.** 6 **D.** -5

22. The domain of $f(x) = \operatorname{sech}^{-1} x$ is

A. $(0, 1]$ **B.** $[1, \infty)$ **C.** $\mathbb{R}$ **D.** $[0, 1]$

23. Find the range of $f(x) = 2x^2 - 12x + 24$ on $[2, 7]$.

A. $[6, \infty)$ **B.** $[6, 38]$ **C.** $[8, 38]$ **D.** $[2, 7]$

24. Find the range of $f(x) = x^2 + 8x + 17$ on $[-5, -1]$.

A. $[2, 10]$ **B.** $[1, 10]$ **C.** $[-5, -1]$ **D.** $[1, \infty)$

25. The point $(3, -7)$ lies on $y = f(x)$. Which point must lie on $y = f^{-1}(x)$?

A. $(3, 7)$ **B.** $(-3, -7)$ **C.** $(-7, 3)$ **D.** $(-3, 7)$

Key sheet

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

Solutions

1. If $A = \{5, 9\}$ and $B = \{q, s, u\}$, how many functions are there from A to B?

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

Number of functions $= \{n(B)\}^{n(A)} = 3^2 = 9$

Ans: (D) 9

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

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

Range $= \{-2, 1, 6\}$

Ans: (B) $\{-2, 1, 6\}$

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3. If $f(x) = ax + b$ with $f(5) = 1$ and $f(-1) = 7$, find a and b.

$5a + b = 1,\ -a + b = 7$

$\Rightarrow 6a = -6 \Rightarrow a = -1$

$b = 6$

Ans: (C) $a = -1,\ b = 6$

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

$\frac{4ac - b^2}{4a} = \frac{4(-1)(3) - (2)^2}{4(-1)} = 4$

It occurs at $x = -\frac{b}{2a} = 1$.

Ans: (C) 4

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5. Find the discriminant of $-2x^2 + 6x + 3 = 0$ and state the nature of its roots.

$\Delta = b^2 - 4ac = (6)^2 - 4(-2)(3) = 60$

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

Ans: (B) 60

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

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

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

The expression has the sign of a outside the roots.

Solution set: $(-\infty, -4] \cup [3, \infty)$

Ans: (C) $(-\infty, -4] \cup [3, \infty)$

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7. Solve $-x^2 + 4x - 4 > 0$.

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

$\Delta = 0$: the expression has the sign of $a = -1$ except at $x = 2$, where it is 0.

Solution set: ϕ

Ans: (C) ϕ

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8. Solve $|x-2| \geq 9$.

$x-2 \geq 9$ or $x-2 \leq -9$

Solution set: $(-\infty, -7] \cup [11, \infty)$

Ans: (D) $(-\infty, -7] \cup [11, \infty)$

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9. Find the domain of $f(x) = \dfrac{x+1}{x^2-7x+6}$.

The denominator must not be zero.

$x^2 - 7x + 6 = (x-6)(x-1) = 0 \Rightarrow x = 1, 6$

Domain $= \mathbb{R} - \{1, 6\}$

Ans: (A) $\mathbb{R} - \{1, 6\}$

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10. Find $\lceil -1.8 \rceil - [6.1]$.

$\lceil -1.8 \rceil = -1,\ [6.1] = 6$

$\lceil -1.8 \rceil - [6.1] = -7$

Ans: (C) -7

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11. The solution set of $[x] \geq 8$ is

$[x] \geq k \Rightarrow x \in [k, \infty)$ with $k = 8$.

So $x \in [8, \infty)$.

Ans: (A) $[8, \infty)$

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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 $x > 4^2 = 16$

So $x \in (16, \infty)$.

Ans: (D) $(16, \infty)$

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13. The domain of $f(x) = 2^x$ is

a^x is defined for every real x.

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

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14. If $f(x) = 2x - 2$ and $g(x) = 2x^2 - 1$, find $(f \circ g)(2)$.

$g(2) = 7$

$(f \circ g)(2) = f(7) = 12$

Ans: (A) 12

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15. The function $f(x) = 3x^4 + 4x|x|$ is

$f(-x) = 3x^4 - 4x\,|x|$

$f(-x)$ 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. If $f(x) = x^4$ and $g(x) = |x| + 1$, then $f \circ g$ is

f is even and g is even.

From the table, $f \circ g$ is even.

Ans: (A) even

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17. If $f(x) = x + 1$ and $g(x) = x^2 - 5$, find $(fg)(0)$ and $\left(\frac{f}{g}\right)(0)$.

$(fg)(0) = f(0)\, g(0) = (1)(-5) = -5$

$\left(\frac{f}{g}\right)(0) = \frac{f(0)}{g(0)} = \frac{1}{-5} = -\frac{1}{5}$

Ans: (D) $-5,\ -\frac{1}{5}$

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18. A polynomial f satisfies $f(x)f\left(\frac{1}{x}\right) = f(x) + f\left(\frac{1}{x}\right)$ and $f(4) = -63$. Find $f(5)$.

So $f(x) = 1 \pm x^n$.

$1 - 4^n = -63 \Rightarrow 4^n = 64 \Rightarrow n = 3$

$f(x) = 1 - x^3$

$f(5) = 1 - (5)^3 = -124$

Ans: (B) -124

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19. How many onto functions are there from $A = \{1, 4, 8\}$ to $B = \{d, f\}$?

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

$\text{Number of onto functions} = 2^n - 2 = 2^3 - 2 = 6$

Ans: (B) 6

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20. How many onto functions are there from $A = \{1, 5, 9, 12\}$ to $B = \{c, f, h\}$?

$3^4 - {}^3C_1\, 2^4 + {}^3C_2\, 1^4$

$= 81 - 48 + 3 = 36$

Ans: (D) 36

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21. If $f : \mathbb{R} \to \mathbb{R}$ is $f(x) = \frac{6-2x}{2}$, find $f^{-1}(9)$.

$f^{-1}(9) = x \iff f(x) = 9$

$\frac{6-2x}{2} = 9 \Rightarrow x = -6$

Ans: (B) -6

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22. The domain of $f(x) = \text{sech}^{-1}\, x$ is

From the table of standard domains: $(0, 1]$.

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

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23. Find the range of $f(x) = 2x^2 - 12x + 24$ on $[2, 7]$.

$f(2) = 8$, $f(7) = 38$; the vertex $x = 3$ lies in the interval, $f(3) = 6$.

Least value 6, greatest value 38, so the range is $[6, 38]$.

Ans: (B) $[6, 38]$

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24. Find the range of $f(x) = x^2 + 8x + 17$ on $[-5, -1]$.

$f(-5) = 2$, $f(-1) = 10$; the vertex $x = -4$ lies in the interval, $f(-4) = 1$.

Least value 1, greatest value 10, so the range is $[1, 10]$.

Ans: (B) $[1, 10]$

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25. The point $(3, -7)$ lies on $y = f(x)$. Which point must lie on $y = f^{-1}(x)$?

The graph of $y = f^{-1}(x)$ is obtained by reflection in $y = x$: $(x, y) \to (y, x)$.

So $(3, -7) \to (-7, 3)$.

Ans: (C) $(-7, 3)$
