EXPRESSWALA ACADEMY

Maths 1A: Functions

MCQ Test, Set 05

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 $A = \{1, 2, 3, 5, 6\}$ and $B = \{q, s, t, w\}$, find the number of relations from A to B.

A. 512 **B.** 20 **C.** 1024 **D.** 1048576

2. If $f : A \to \mathbb{Z}$ is defined by $f(x) = x^2 - 1$ where $A = \{1, 2, 3, 4\}$, find the range of f.

A. $\{0, 3, 8, 15, 16\}$ **B.** $\{0, 3, 8, 15\}$ **C.** $\{1, 2, 3, 4\}$ **D.** $\{2, 5, 10, 17\}$

3. Find the point where the line $y = x - 8$ meets the y-axis.

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

4. Find the minimum value of $f(x) = x^2 + 6x + 5$.

A. -3 **B.** 5 **C.** -4 **D.** 4

5. Find the discriminant of $-x^2 + 4x + 1 = 0$ and state the nature of its roots.

A. 20 **B.** -20 **C.** 12 **D.** 8

6. Solve $2x^2 - 16x + 24 \leq 0$.

A. $(-\infty, 2] \cup [6, \infty)$ **B.** $[2, 6]$
C. $(-\infty, 2) \cup (6, \infty)$ **D.** $(2, 6)$

7. Solve $x^2 + 4x + 3 < 0$.

A. $(-3, -1)$ **B.** $(-\infty, -3) \cup (-1, \infty)$
C. $[-3, -1]$ **D.** $(-\infty, -3] \cup [-1, \infty)$

8. Solve $|3x - 2| < 4$.

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

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 $\lceil -5.7 \rceil - [-2.9]$.

A. -2 **B.** -4 **C.** -3 **D.** -1

11. The solution set of $[x] = 6$ is

A. $(-\infty, 7)$ **B.** $[7, \infty)$ **C.** $[6, 7)$ **D.** $[6, \infty)$

12. Find $\operatorname{sgn}(x^2 - 3x - 10)$ at $x = \frac{15}{2}$.

A. 0 **B.** $\frac{95}{4}$ **C.** -1 **D.** 1

13. The range of $f(x) = \left(\frac{1}{5}\right)^x$ is

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

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

A. equal: $\frac{4x}{x} = 4$ **B.** equal: both are constant

C. not equal: $D_f = \mathbb{R} - \{0\}$, $D_g = \mathbb{R}$ **D.** not equal: $R_f \neq R_g$

15. The function $f(x) = x \cos x - 4x^3$ is

A. both even and odd **B.** even

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

16. If $f(x) = \sin x$ and $g(x) = x^2$, then $f \circ g$ is

A. a constant function **B.** odd

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

17. If $f(x) = \sqrt{x - 1}$ and $g(x) = \sqrt{7 - x}$, find the domain of $f + g$.

A. $(1, 7)$ **B.** $(-\infty, 1] \cup [7, \infty)$

C. $[1, 7]$ **D.** $[-7, -1]$

18. f satisfies $f(xy) = f(x) + f(y)$ for all positive x, y, and $f(2) = a$. Find $f(8)$.

A. $3a$ **B.** $a + 3$ **C.** $8a$ **D.** a^3

19. How many bijections are there from $A = \{1, 2, 4, 7, 8\}$ to $B = \{b, c, d, f, g\}$?

A. 25 **B.** 3125 **C.** 120 **D.** 32

20. How many onto functions are there from $A = \{2, 4, 5, 6, 7, 9, 11\}$ to $B = \{c, h\}$?

A. 128 **B.** 127 **C.** 49 **D.** 126

21. Find the inverse of $f : \mathbb{R} \to \mathbb{R}$, $f(x) = \frac{3x-7}{3}$.

A. $x + \frac{7}{3}$ **B.** $\frac{3}{3x-7}$ **C.** $x - \frac{7}{3}$ **D.** $-x - \frac{7}{3}$

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

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

23. Find the range of $f(x) = 8 \sin x + 6 \cos x + 8$.

A. $[-10, 10]$ **B.** $[7, 9]$ **C.** $[-6, 22]$ **D.** $[-2, 18]$

24. Find the range of $f(x) = -2x^2 + 4x - 1$ on $[-1, 4]$.

A. $[-17, 1]$ **B.** $[-1, 4]$ **C.** $[-17, -7]$ **D.** $(-\infty, 1]$

25. The graph of $y = f(x - 6)$ is obtained by

A. shifting the graph of $y = f(x)$ down by 6 units

B. shifting the graph of $y = f(x)$ to the left by 6 units

C. shifting the graph of $y = f(x)$ to the right by 6 units

D. shifting the graph of $y = f(x)$ up by 6 units

Key sheet

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

Solutions

1. If $A = \{1, 2, 3, 5, 6\}$ and $B = \{q, s, t, w\}$, find the number of relations from A to B.

$n(A \times B) = 5 \times 4 = 20$

Every subset of $A \times B$ is a relation.

$\text{Number of relations} = 2^{20} = 1048576$

Ans: (D) 1048576

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2. If $f : A \to \mathbb{Z}$ is defined by $f(x) = x^2 - 1$ where $A = \{1, 2, 3, 4\}$, find the range of f.

$f(1) = 0$, $f(2) = 3$, $f(3) = 8$, $f(4) = 15$

Range $= \{0, 3, 8, 15\}$

Ans: (B) $\{0, 3, 8, 15\}$

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3. Find the point where the line $y = x - 8$ meets the y-axis.

$x = 0 \Rightarrow y = -8$

The point is $(0, -8)$.

Ans: (B) $(0, -8)$

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4. Find the minimum value of $f(x) = x^2 + 6x + 5$.

$\frac{4ac - b^2}{4a} = \frac{4(1)(5) - (6)^2}{4(1)} = -4$

It occurs at $x = -\frac{b}{2a} = -3$.

Ans: (C) -4

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5. Find the discriminant of $-x^2 + 4x + 1 = 0$ and state the nature of its roots.

$\Delta = b^2 - 4ac = (4)^2 - 4(-1)(1) = 20$

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

Ans: (A) 20

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6. Solve $2x^2 - 16x + 24 \leq 0$.

$2x^2 - 16x + 24 = 2\,(x - 6)\,(x - 2)$

The roots are 2 and 6, and $a = 2 > 0$.

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

Solution set: $[2, 6]$

Ans: (B) $[2, 6]$

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7. Solve $x^2 + 4x + 3 < 0$.

$x^2 + 4x + 3 = (x + 1)\,(x + 3)$

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

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

Solution set: $(-3, -1)$

Ans: (A) $(-3, -1)$

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8. Solve $|3x - 2| < 4$.

$-4 < 3x - 2 < 4$

Solution set: $(-\frac{2}{3}, 2)$

Ans: (B) $(-\frac{2}{3}, 2)$

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

$|x| = -x$ exactly when $x \leq 0$.

Ans: (C) $(-\infty, 0]$

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10. Find $\lceil -5.7 \rceil - [-2.9]$.

$\lceil -5.7 \rceil = -5,\ [-2.9] = -3$

$\lceil -5.7 \rceil - [-2.9] = -2$

Ans: (A) -2

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11. The solution set of $[x] = 6$ is

$[x] = k \iff k \leq x < k + 1$ with $k = 6$.

So $x \in [6, 7)$.

Ans: (C) $[6, 7)$

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12. Find $\operatorname{sgn}(x^2 - 3x - 10)$ at $x = \frac{15}{2}$.

$x^2 - 3x - 10 = \frac{95}{4}$ at $x = \frac{15}{2}$

This is positive, so sgn is 1.

Ans: (D) 1

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13. The range of $f(x) = \left(\frac{1}{5}\right)^x$ is

$a^x > 0$ for all x and takes every positive value.

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

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

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

So they are not equal: $D_f = \mathbb{R} - \{0\}$, $D_g = \mathbb{R}$.

Ans: (C) not equal: $D_f = \mathbb{R} - \{0\}$, $D_g = \mathbb{R}$

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15. The function $f(x) = x \cos x - 4x^3$ is

$f(-x) = 4x^3 - x \cos x$

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

Ans: (C) odd

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16. If $f(x) = \sin x$ and $g(x) = x^2$, then $f \circ g$ is

f is odd and g is even.

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

Ans: (D) even

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17. If $f(x) = \sqrt{x-1}$ and $g(x) = \sqrt{7-x}$, find the domain of $f+g$.

$D_f = [1, \infty),\ D_g = (-\infty, 7]$

$D_{f+g} = D_f \cap D_g = [1, 7]$

Ans: (C) $[1, 7]$

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18. f satisfies $f(xy) = f(x) + f(y)$ for all positive x, y, and $f(2) = a$. Find $f(8)$.

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

$f(8) = f(2^3) = 3\, f(2) = 3a$

Ans: (A) $3a$

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19. How many bijections are there from $A = \{1, 2, 4, 7, 8\}$ to $B = \{b, c, d, f, g\}$?

$n(A) = n(B) = 5$

$\text{Number of bijections} = 5! = 120$

Ans: (C) 120

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20. How many onto functions are there from $A = \{2, 4, 5, 6, 7, 9, 11\}$ to $B = \{c, h\}$?

$n(A) = 7,\ n(B) = 2$

$\text{Number of onto functions} = 2^n - 2 = 2^7 - 2 = 126$

Ans: (D) 126

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21. Find the inverse of $f : \mathbb{R} \to \mathbb{R}$, $f(x) = \frac{3x-7}{3}$.

$y = \frac{3x-7}{3} \Rightarrow 3x - 7 = 3y$

$x = y + \frac{7}{3}$

$f^{-1}(x) = x + \frac{7}{3}$

Ans: (A) $x + \frac{7}{3}$

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

From the table of standard domains: $(-1, 1)$.

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

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23. Find the range of $f(x) = 8 \sin x + 6 \cos x + 8$.

$\sqrt{a^2 + b^2} = \sqrt{36 + 64} = 10$

$\text{Range} = [c - \sqrt{a^2+b^2},\ c + \sqrt{a^2+b^2}] = [-2, 18]$

Ans: (D) $[-2, 18]$

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24. Find the range of $f(x) = -2x^2 + 4x - 1$ on $[-1, 4]$.

$f(-1) = -7$, $f(4) = -17$; the vertex $x = 1$ lies in the interval, $f(1) = 1$.

Least value -17, greatest value 1, so the range is $[-17, 1]$.

Ans: (A) $[-17, 1]$

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25. The graph of $y = f(x - 6)$ is obtained by

Rule: shifting the graph of $y = f(x)$ to the right by 6 units.

Ans: (C) shifting the graph of $y = f(x)$ to the right by 6 units

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