EXPRESSWALA ACADEMY

Maths 1A: Functions

MCQ Test, Set 10

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 $A = \{3, 6, 7, 9\}$ and $B = \{q, r, t, u, v\}$, how many functions are there from B to A?

A. 1024 **B.** 20 **C.** 625 **D.** 1048576

2. For $f(x) = 4 - 4x$ on the domain $A = \{-3, 0, 1, 2, 4\}$, find the pre-image of 16.

A. -5 **B.** 3 **C.** -3 **D.** -60

3. How many constant functions are there from a set with 2 elements to a set with 7 elements?

A. 7 **B.** 2 **C.** 14 **D.** 49

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

A. -5 **B.** 5 **C.** 6 **D.** 0

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

A. 17 **B.** -17 **C.** -13 **D.** 33

6. Solve $2x^2 - 4x - 48 \leq 0$.

A. $(-4, 6)$ **B.** $[-4, 6]$
C. $(-\infty, -4) \cup (6, \infty)$ **D.** $(-\infty, -4] \cup [6, \infty)$

7. Solve $-x^2 - 5x + 6 < 0$.

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

8. Solve $|4x + 4| < 9$.

A. $[-\frac{13}{4}, \frac{5}{4}]$ **B.** $(-\frac{13}{4}, \frac{5}{4})$
C. $(-\infty, -\frac{13}{4}) \cup (\frac{5}{4}, \infty)$ **D.** $(-\infty, -\frac{13}{4}] \cup [\frac{5}{4}, \infty)$

9. Find the domain of $f(x) = \dfrac{x + 2}{x^2 + 2x - 15}$.

A. $\mathbb{R}$ **B.** $\mathbb{R} - \{-2\}$ **C.** $\mathbb{R} - \{-5, 3\}$ **D.** $\mathbb{R} - \{-3, 5\}$

10. Find $\lceil 6.2 \rceil - [3.8]$.

A. 5 **B.** 2 **C.** 4 **D.** 3

11. The solution set of $[x] = 5$ is

A. $[6, \infty)$ **B.** $[5, 6)$ **C.** $[5, \infty)$ **D.** $(-\infty, 6)$

12. Solve $\log_{10} x > 2$.

A. $(100, \infty)$ **B.** $(0, 20)$ **C.** $(0, 100)$ **D.** $(-\infty, 100)$

13. The graph of $y = 3^x$ passes through

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

14. If $f(x) = 4x + 5$, find $(f \circ f)(x)$.

A. $16x + 5$ **B.** $16x^2 + 40x + 25$ **C.** $8x + 10$ **D.** $16x + 25$

15. The function $f(x) = x \sin x + 4 \tan x$ is

A. even **B.** odd

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

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

A. 3π **B.** $\frac{2\pi}{3}$ **C.** 2π **D.** 6π

17. If $f(x) = x - 5$ and $g(x) = x^2 - 9$, find $(fg)(1)$ and $\left(\frac{f}{g}\right)(4)$.

A. $-32,\ -\frac{1}{7}$ **B.** $32,\ -\frac{1}{7}$ **C.** $-12,\ -\frac{1}{7}$ **D.** $32,\ -7$

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

A. $\frac{9}{2}$ **B.** $\frac{1}{8}$ **C.** 2 **D.** $\frac{1}{16}$

19. How many many-one functions are there from $A = \{10, 11\}$ to $B = \{d, e, f\}$?

A. 3 **B.** 6 **C.** 9 **D.** 2

20. How many bijections are there from $A = \{2, 4, 8, 9\}$ to $B = \{b, c, f, g\}$?

A. 12 **B.** 16 **C.** 24 **D.** 256

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

A. 9 **B.** -9 **C.** $\frac{1}{3}$ **D.** 3

22. Find the domain of $f(x) = \log_e(-x^2 - 2x + 3)$.

A. $[-3, 1]$ **B.** $(-3, 1)$

C. $(-1, 3)$ **D.** $(-\infty, -3) \cup (1, \infty)$

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

A. $[-8, 20]$ **B.** $[5, 7]$ **C.** $[-10, 10]$ **D.** $[-4, 16]$

24. Find the range of $f(x) = |x + 2| + |x - 5|$.

A. $[3, \infty)$ **B.** $[0, \infty)$ **C.** $[7, \infty)$ **D.** $(7, \infty)$

25. The graph of $y = f(x + 8)$ is obtained by

A. shifting the graph of $y = f(x)$ down by 8 units

B. shifting the graph of $y = f(x)$ to the right by 8 units

C. shifting the graph of $y = f(x)$ up by 8 units

D. shifting the graph of $y = f(x)$ to the left by 8 units

Key sheet

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

Solutions

1. If $A = \{3, 6, 7, 9\}$ and $B = \{q, r, t, u, v\}$, how many functions are there from B to A?

$n(B) = 5,\ n(A) = 4$

Number of functions from B to $A = \{n(A)\}^{n(B)} = 4^5 = 1024$

Ans: (A) 1024

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2. For $f(x) = 4 - 4x$ on the domain $A = \{-3, 0, 1, 2, 4\}$, find the pre-image of 16.

$f(x) = 16 \Rightarrow 4 - 4x = 16$

$\Rightarrow x = -3$

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

Ans: (C) -3

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3. How many constant functions are there from a set with 2 elements to a set with 7 elements?

A constant function sends every element to the same value k.

There is one constant function for each element of the co-domain: 7.

Ans: (A) 7

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

$\frac{4ac-b^2}{4a} = \frac{4(1)(5)-(0)^2}{4(1)} = 5$

It occurs at $x = -\frac{b}{2a} = 0$.

Ans: (B) 5

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

$\Delta = b^2 - 4ac = (-5)^2 - 4(-2)(-1) = 17$

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

Ans: (A) 17

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6. Solve $2x^2 - 4x - 48 \leq 0$.

$2x^2 - 4x - 48 = 2\,(x - 6)\,(x + 4)$

The roots are -4 and 6, and $a = 2 > 0$.

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

Solution set: $[-4, 6]$

Ans: (B) $[-4, 6]$

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7. Solve $-x^2 - 5x + 6 < 0$.

$-x^2 - 5x + 6 = -\,(x - 1)\,(x + 6)$

The roots are -6 and 1, and $a = -1 < 0$.

The expression has the sign of a outside the roots.

Solution set: $(-\infty, -6) \cup (1, \infty)$

Ans: (A) $(-\infty, -6) \cup (1, \infty)$

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8. Solve $|4x + 4| < 9$.

$-9 < 4x + 4 < 9$

Solution set: $(-\frac{13}{4}, \frac{5}{4})$

Ans: (B) $(-\frac{13}{4}, \frac{5}{4})$

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9. Find the domain of $f(x) = \dfrac{x+2}{x^2+2x-15}$.

The denominator must not be zero.

$x^2 + 2x - 15 = (x-3)(x+5) = 0 \Rightarrow x = -5, 3$

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

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

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10. Find $\lceil 6.2 \rceil - [3.8]$.

$\lceil 6.2 \rceil = 7,\ [3.8] = 3$

$\lceil 6.2 \rceil - [3.8] = 4$

Ans: (C) 4

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11. The solution set of $[x] = 5$ is

$[x] = k \iff k \le x < k+1$ with $k = 5$.

So $x \in [5, 6)$.

Ans: (B) $[5, 6)$

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12. Solve $\log_{10} x > 2$.

The base 10 is more than 1, so $\log_{10} x$ is increasing.

$x > 0$ and $x > 10^2 = 100$

So $x \in (100, \infty)$.

Ans: (A) $(100, \infty)$

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13. The graph of $y = 3^x$ passes through

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

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

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14. If $f(x) = 4x + 5$, find $(f \circ f)(x)$.

$(f \circ f)(x) = f(4x+5) = 4(4x+5) + 5$

$= 16x + 25$

Ans: (D) $16x + 25$

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15. The function $f(x) = x \sin x + 4 \tan x$ is

$f(-x) = x \sin x - 4 \tan x$

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

Ans: (C) neither even nor odd

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

$\sin x$ has period 2π.

$\sin(kx)$ has period $\frac{2\pi}{k} = 6\pi$

Ans: (D) 6π

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17. If $f(x) = x - 5$ and $g(x) = x^2 - 9$, find $(fg)(1)$ and $\left(\frac{f}{g}\right)(4)$.

$(fg)(1) = f(1)\,g(1) = (-4)(-8) = 32$

$\left(\frac{f}{g}\right)(4) = \frac{f(4)}{g(4)} = \frac{-1}{7} = -\frac{1}{7}$

Ans: (B) $32,\ -\frac{1}{7}$

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

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

$= \left(\frac{1}{2}\right)^4 = \frac{1}{16}$

Ans: (D) $\frac{1}{16}$

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19. How many many-one functions are there from $A = \{10, 11\}$ to $B = \{d, e, f\}$?

$\text{All functions} = 3^2 = 9$

$\text{One-one} = {}^3P_2 = 6$

$\text{Many-one} = 9 - 6 = 3$

Ans: (A) 3

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20. How many bijections are there from $A = \{2, 4, 8, 9\}$ to $B = \{b, c, f, g\}$?

$n(A) = n(B) = 4$

$\text{Number of bijections} = 4! = 24$

Ans: (C) 24

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

$f^{-1}(-3) = x \iff f(x) = -3$

$\frac{3-x}{2} = -3 \Rightarrow x = 9$

Ans: (A) 9

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22. Find the domain of $f(x) = \log_e(-x^2 - 2x + 3)$.

$-x^2 - 2x + 3 > 0$

$\Rightarrow (x+3)(x-1) < 0$

Domain $= (-3, 1)$

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

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

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

$\text{Range} = [c - \sqrt{a^2+b^2},\ c + \sqrt{a^2+b^2}] = [-4, 16]$

Ans: (D) $[-4, 16]$

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24. Find the range of $f(x) = |x+2| + |x-5|$.

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

Here $b - a = 5 - (-2) = 7$, so the range is $[7, \infty)$.

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

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25. The graph of $y = f(x+8)$ is obtained by

Rule: shifting the graph of $y = f(x)$ to the left by 8 units.

Ans: (D) shifting the graph of $y = f(x)$ to the left by 8 units

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