CUET (UG) – MATHEMATICS

Chapter Test - Relations and Functions

SOLUTIONS

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Solutions

1. **Correct Option: (A).** R contains $(1,1),(2,2),(3,3)$, making it reflexive. $(1,2) \in R \implies (2,1) \in R$ and $(2,3) \in R \implies (3,2) \in R$, so it is symmetric. However, $(1,2) \in R$ and $(2,3) \in R$ but $(1,3) \notin R$, so it is not transitive.

2. **Correct Option: (B).** The number of one-one functions from a set of n elements to itself is $n!$. For $n = 3$, $3! = 3 \times 2 \times 1 = 6$.

3. **Correct Option: (D).** $f(1) = 1$ and $f(-1) = 1$, so it is many-one. The range is $[0, \infty)$, while the codomain is R, so it is not onto.

4. **Correct Option: (B).** By definition, the principal value branch of $\sec^{-1} x$ is $[0, \pi] - \{\frac{\pi}{2}\}$.

5. **Correct Option: (D).** $a - a = 0$ is divisible by 5 (Reflexive). If $5|(a-b)$, then $5|(b-a)$ (Symmetric). If $5|(a-b)$ and $5|(b-c)$, then $5|(a-c)$ (Transitive). Hence, it is an equivalence relation.

6. **Correct Option: (A).** For $g(f(x_1)) = g(f(x_2)) \implies x_1 = x_2$ (given). Since $f(x_1) = f(x_2) \implies g(f(x_1)) = g(f(x_2))$, the injective property of $g \circ f$ forces $x_1 = x_2$, proving f is injective.

7. **Correct Option: (B).** $\cos^{-1}(\cos \frac{7\pi}{6}) = \cos^{-1}(\cos(2\pi - \frac{5\pi}{6})) = \cos^{-1}(\cos \frac{5\pi}{6}) = \frac{5\pi}{6}$, as $\frac{5\pi}{6} \in [0, \pi]$.

8. **Correct Option: (B).** Set $-1 \le 2x - 3 \le 1$. Adding 3 gives $2 \le 2x \le 4$. Dividing by 2 gives $1 \le x \le 2$. Domain is $[1, 2]$.

9. **Correct Option: (B).** A line is not perpendicular to itself (not reflexive). If $L_1 \perp L_2$, then $L_2 \perp L_1$ (Symmetric). If $L_1 \perp L_2$ and $L_2 \perp L_3$, then $L_1 \parallel L_3$ (not transitive).

10. **Correct Option: (B).** $f(f(x)) = \frac{\frac{x-1}{x+1} - 1}{\frac{x-1}{x+1} + 1} = \frac{(x-1)-(x+1)}{(x-1)+(x+1)} = \frac{-2}{2x} = -\frac{1}{x}$.

11. **Correct Option: (B).** $\tan^{-1}(\sqrt{3}) = \frac{\pi}{3}$. $\sec^{-1}(-2) = \pi - \sec^{-1}(2) = \pi - \frac{\pi}{3} = \frac{2\pi}{3}$. $\frac{\pi}{3} - \frac{2\pi}{3} = -\frac{\pi}{3}$.

12. **Correct Option: (C).** Equivalence relations correspond to Bell numbers. For $n = 3$, $B_3 = 5$.

13. **Correct Option: (B).** The standard range (principal value branch) of $\sin^{-1} x$ is $[-\frac{\pi}{2}, \frac{\pi}{2}]$.

14. **Correct Option: (A).** $3x_1 = 3x_2 \implies x_1 = x_2$ (one-one). For any $y \in R$, $x = y/3 \in R$ exists (onto).

15. **Correct Option: (B).** $(1,2) \in R$ and $(2,1) \in R$ makes it symmetric. Since $(1,1) \notin R$, it is neither reflexive nor transitive.

16. **Correct Option: (B).** The principal value branch of $\tan^{-1} x$ is the open interval $(-\frac{\pi}{2}, \frac{\pi}{2})$.

17. **Correct Option: (C).** $\sin^{-1} \frac{1}{5} + \cos^{-1} x = \sin^{-1}(1) = \frac{\pi}{2}$. Using the identity $\sin^{-1} x + \cos^{-1} x = \frac{\pi}{2}$, we get $x = \frac{1}{5}$.

18. **Correct Option: (A).** By definition, a function is onto (surjective) if the Range equals the Codomain Y.

19. **Correct Option: (B).** $\sin^{-1}(\sin \frac{3\pi}{5}) = \sin^{-1}(\sin(\pi - \frac{2\pi}{5})) = \sin^{-1}(\sin \frac{2\pi}{5}) = \frac{2\pi}{5}$, since $\frac{2\pi}{5} \in [-\frac{\pi}{2}, \frac{\pi}{2}]$.

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20. **Correct Option: (A)**. For reflexivity, we need $(1,1), (2,2), (3,3)$. For symmetry, we need $(2,1)$ and $(3,1)$. Adding $(2,3)$ would force $(3,2)$ and make it transitive. Thus, only 1 such relation exists.