



Indian School Al Wadi Al Kabir

Unit Test 2026 - 27

Sub: Mathematics (Marking Scheme)

Class: XII

Max. Marks: 30

Date: 18-05-2026

Time: 1 hour

	SECTION A	
1	(Answer: C) If A is a 3×3 matrix and $A = -2$ For a matrix of order n: $adj A = A ^{n-1}$ Therefore: $adj A = (-2)^2 = 4$ Again, adj A is also a 3×3 matrix. So: $adj(adj A) = adj A ^2 = 4^2 = 16$	1m
2	(Answer: D) The given matrix is skew-symmetric because: $a_{ij} = -a_{ji}$ and all diagonal entries are zero. For every skew-symmetric matrix of odd order: $A = 0$	1m
3	(Answer: B) $ A = \cos^2 x - \sin^2 x$ $ A = \cos 2x$ $\left(\frac{d A }{dx}\right) = -2 \sin 2x$ At $x = \pi/4$: $\left(\frac{d A }{dx}\right) = -2 \sin(\pi/2) = -2$	1m
4	(Answer: A) $f(x) = kx - \sin x$ $f'(x) = k - \cos x$ For strictly increasing function: $f'(x) > 0$ for all x Since $\cos x \in [-1, 1]$, minimum value of $k - \cos x$ is $k - 1$ So: $k - 1 > 0$ $k > 1$	1m

5	(Answer: C) $y = \log(\log(\log x^5))$ Using chain rule: $\frac{dy}{dx} = \frac{1}{\log(\log x^5)} \times \frac{1}{\log x^5} \times \frac{5}{x}$	1m
6	(Hence statement D is incorrect) Matrix multiplication is possible when: Number of columns of first matrix = Number of rows of second matrix. Matrices need not be of same order.	1m
7	(Answer: C) $f(x) = x+1 - x+2 + x+3 - x+4 $ Absolute value functions are continuous everywhere. So assertion is true. Reason is false because: Every differentiable function is continuous, but every continuous function need not be differentiable.	1m
	SECTION B	
8	$x = t + \frac{1}{t}$ $y = t - \frac{1}{t}$ $\frac{dx}{dt} = 1 - \frac{1}{t^2}, \frac{dy}{dt} = 1 + \frac{1}{t^2}$ $\frac{dy}{dx} = \frac{\frac{dy}{dt}}{\frac{dx}{dt}}$ At $t = 2$: $\frac{dy}{dx} = \frac{1 + \frac{1}{4}}{1 - \frac{1}{4}} = \frac{\frac{5}{4}}{\frac{3}{4}} = \frac{5}{3}$	$\frac{1}{2} + \frac{1}{2}$ m $\frac{1}{2}$ m $\frac{1}{2}$ m
9	(A) Volume of sphere: $V = \left(\frac{4}{3}\right)\pi r^3$ Surface area: $S = 4\pi r^2$ Given: rate of decrease of volume $\propto$ surface area	$\frac{1}{2}$ m $\frac{1}{2}$ m

	$\frac{dV}{dt} \propto 4\pi r^2$ $= -k(4\pi r^2)$ But: $\frac{dV}{dt} = 4\pi r^2 \left(\frac{dr}{dt} \right)$ Equating: $4\pi r^2 \left(\frac{dr}{dt} \right) = -k(4\pi r^2)$ $\left(\frac{dr}{dt} \right) = -k$ Thus radius decreases at a constant rate.	½ m ½ m
	(B) Let the numbers be x and y. Given: $xy = 256$ $y = \frac{256}{x}$ Sum: $S = x + \frac{256}{x}, \frac{dS}{dx} = 1 - \frac{256}{x^2}$ For minimum value: $1 - \frac{256}{x^2} = 0$ $x^2 = 256$ $x = 16$ $y = 16$ Therefore least sum occurs for 16 and 16	1m 1m
10	$A = \begin{bmatrix} 1 & 0 & -2 \\ 0 & -1 & 0 \end{bmatrix}, B = \begin{bmatrix} -1 \\ 0 \\ -1 \end{bmatrix}$ AB exists because order is $(2 \times 3)(3 \times 1) = 2 \times 1$ $AB = \begin{bmatrix} 1 \\ 1 \\ 0 \end{bmatrix}$ BA does not exist because multiplication $(3 \times 1)(2 \times 3)$ is not possible.	½ m 1m ½ m
	SECTION C	
11	$(\sin x)^y = y^{\cos x}$ Taking logarithm on both sides: $y \log(\sin x) = \cos x \cdot \log y$ Differentiating implicitly: $\left(\frac{dy}{dx} \right) \log(\sin x) + y \cot x = -\sin x \log y + \left(\frac{\cos x}{y} \right) \left(\frac{dy}{dx} \right)$ $\left(\frac{dy}{dx} \right) [\log(\sin x) - \cos x/y] = -\sin x \log y - y \cot x$	½ m 1m 1m

	Therefore: $\left(\frac{dy}{dx}\right) = \frac{[-\sin x \log y - y \cot x]}{[\log(\sin x) - \cos x/y]}$	½ m
12	$A = \begin{bmatrix} 0 & 4 & 2 \\ 1 & 2 & -5 \\ 6 & 0 & 1 \end{bmatrix}$ then $A = \frac{1}{2} (A + A^T) + \frac{1}{2} (A - A^T)$ $(A + A^T) = \begin{bmatrix} 0 & 4 & 2 \\ 1 & 2 & -5 \\ 6 & 0 & 1 \end{bmatrix} + \begin{bmatrix} 0 & 1 & 6 \\ 4 & 2 & 0 \\ 2 & -5 & 1 \end{bmatrix}$ $= \begin{bmatrix} 0 & 5 & 8 \\ 5 & 4 & -5 \\ 8 & -5 & 2 \end{bmatrix} \Rightarrow \frac{1}{2} (A + A^T) = \frac{1}{2} \begin{bmatrix} 0 & 5 & 8 \\ 5 & 4 & -5 \\ 8 & -5 & 2 \end{bmatrix}$ = Symmetric matrix $(A - A^T) = \begin{bmatrix} 0 & 4 & 2 \\ 1 & 2 & -5 \\ 6 & 0 & 1 \end{bmatrix} - \begin{bmatrix} 0 & 1 & 6 \\ 4 & 2 & 0 \\ 2 & -5 & 1 \end{bmatrix}$ $= \begin{bmatrix} 0 & 3 & -4 \\ -3 & 0 & -5 \\ 4 & 5 & 0 \end{bmatrix} \Rightarrow \frac{1}{2} (A - A^T) = \frac{1}{2} \begin{bmatrix} 0 & 3 & -4 \\ -3 & 0 & -5 \\ 4 & 5 & 0 \end{bmatrix}$ = Skew-symmetric matrix Therefore $A = \frac{1}{2} (A + A^T) + \frac{1}{2} (A - A^T)$	½ m 1m 1m ½ m
13	A) Given: $xy = e^{x-y}$ $\log(xy) = \log(e^{x-y})$ $\log x + \log y = x - y$ Differentiate both sides with respect to x: $\frac{d}{dx}(\log x) + \frac{d}{dx}(\log y) = \frac{d}{dx}(x - y)$ $\frac{1}{x} + \left(\frac{1}{y}\right)\left(\frac{dy}{dx}\right) = 1 - \frac{dy}{dx}$ Bring $\frac{dy}{dx}$ terms to one side: $\left(\frac{1}{y}\right)\left(\frac{dy}{dx}\right) + \frac{dy}{dx} = 1 - \frac{1}{x}$ $\frac{dy}{dx} \left[\frac{1}{y} + 1 \right] = \frac{x - 1}{x}$ $\frac{dy}{dx} \left[\frac{1 + y}{y} \right] = \frac{x - 1}{x}$ Therefore, $\frac{dy}{dx} = \left[\frac{x - 1}{x} \right] \times \left[\frac{y}{1 + y} \right]$ $\frac{dy}{dx} = \frac{y(x - 1)}{x(1 + y)}$ OR B) $x\sqrt{1+y} = y\sqrt{1+x}$ $x^2(1+y) = y^2(1+x)$ $x^2 + x^2y = y^2 + xy^2$	½ m 2m ½ m ½ m

	$(x^2 - y^2) + (x^2y - xy^2) = 0$ $(x - y)(x + y) + xy(x - y) = 0$ $(x - y)(x + y + xy) = 0$ Since $x \neq y$ for this branch of the function, $x + y + xy = 0$ $y(1 + x) = -x$ $y = -x/(1 + x)$ $\left(\frac{dy}{dx}\right) = \frac{[(1 + x)(-1) - (-x)(1)]}{(1 + x)^2}$ $\left(\frac{dy}{dx}\right) = \frac{[-1 - x + x]}{(1 + x)^2}$ Therefore, $\left(\frac{dy}{dx}\right) = -\frac{1}{(1 + x)^2}$	1m 1m ½ m
	SECTION D	
14	Volume condition: $x^2h = 250, x^2 = \frac{250}{h}$ Land cost = $500x^2$ $= 500\left(\frac{250}{h}\right) = \frac{125000}{h}$ Digging cost = $4000h^2$ Total cost function: $C(h) = \frac{125000}{h} + 4000h^2$ Differentiating: $C'(h) = -\frac{125000}{h^2} + 8000h$ Setting $C'(h) = 0$: $8000h^3 = 125000$ $h^3 = \frac{125}{8} \Rightarrow h = \frac{5}{2}m$ Second derivative: $C''(h) = \frac{250000}{h^3} + 8000 > 0$ Hence cost is minimum at $h = 5/2$ m. Minimum cost = ₹75,000 Also: $x^2 = \frac{250}{\frac{5}{2}} = 100$ $x = 10m$	1m 1m 2m

15	Let English typing charge = ₹x per page Let Hindi typing charge = ₹y per page Equations: $8x + 4y = 200$ $5x + 10y = 275$ Matrix form: $\begin{bmatrix} 8 & 4 \\ 5 & 10 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 200 \\ 275 \end{bmatrix}$ $A = (8)(10) - (5)(4) = 60$ If $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ then $\text{adj } A = \begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$ Therefore $\text{adj } A = \begin{bmatrix} 10 & -4 \\ -5 & 8 \end{bmatrix}$ OR Solving equations: $X = A^{-1}B$ $X = \frac{1}{ A } \text{adj } A$ $= \frac{1}{60} \begin{bmatrix} 10 & -4 \\ -5 & 8 \end{bmatrix} \begin{bmatrix} 200 \\ 275 \end{bmatrix}$ $\begin{bmatrix} x \\ y \end{bmatrix} = \frac{1}{60} \begin{bmatrix} 900 \\ 1200 \end{bmatrix} = \begin{bmatrix} 15 \\ 20 \end{bmatrix}$ *****	1m 1m 2m 2m
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