INDIAN SCHOOL AL WADI AL KABIR
Dept. of Mathematics 2025 – 2026
Class XII – Mathematics
Work Sheet – Application of Derivatives

1	The edge of a cube is increasing at the rate of 0.3 cm/s, the rate of change of its surface area when edge is 3 cm is (a) 10.8cm (b) 10.8 cm^2 (c) 10.8 cm^2/s (d) 10.8 cm/s
2	The total revenue in ₹ received from the sale of x units of an article is given by $R(x) = 3x^2+36x+5$. The marginal revenue when x=15 is (in ₹) (a) 126 (b) 116 (c) 96 (d) 90
3	The point on the curve $y = x^2$ where the rate of change of x −coordinate is equal to the rate of change of y −coordinate is (a) $\frac{1}{2}$ (b) $\frac{1}{4}$ (c) $\left(\frac{1}{2},\frac{1}{4}\right)$ (d) (1,1)
4	The interval on which the function $f(x)=2x^3+9x^2+12x-1$ is decreasing ,is (a) $(-1,\infty)$ (b) $(-2,-1)$ (c) $(-\infty,-2)$ (d) $[-1,1]$
5	If at $x = 1$, the function $f(x) = x^4 - 62x^2 + ax + 9$ attains its maximum value on the interval $[0, 2]$. Then the value of a is (a) 124 b) −124 c) 120 d) −120
6	The function $f(x) = 4\sin^3 x - 6\sin^2 x + 12\sin x + 100$ is strictly (a) increasing in $\left(\pi,\frac{3\pi}{2}\right)$ b) decreasing in $\left(\frac{\pi}{2},\pi\right)$ c) decreasing in $\left(-\frac{\pi}{2},\frac{\pi}{2}\right)$ d) decreasing in $\left(0,\frac{\pi}{2}\right)$
7	Which of the following functions is decreasing in $(0, \pi/2)$. (a) $\sin 2x$ b) $\tan x$ c) $\cos x$ d) $\cos 3x$
8	The function $f(x)=2x^3-3x^2-12x+4$ has (a) two points of local maximum (c) one maximum and one minimum (b) two points of local minimum (d)no maximum, no minimum

9	A particle moves along the curve $y = \frac{2}{3}x^3 + 1$. The x-coordinates of the points on the curve at which y-coordinate is changing twice as fast as x-coordinate is (a) 1 b) ± 1 c) $\frac{5}{3}$ d) $\frac{1}{3}$
10	The rate of change of the area of a circle with respect to its radius r at $r = 6cm$ is: (a) 10π cm^2/cm (b) 12π cm^2/cm (c) 8π cm^2/cm (d)11π cm^2/cm
11	The total revenue in Rupees received from the sale of x units of a product is given by R(x) = $3x^2+36x+5$. The marginal revenue, when $x = 15$ is: (a) 116 b) 96 c) 90 d) 126
12	The maximum value of the function $f(x) = 5 + sin2x$ is (a) 1 b) 6 c) 4 d) -1
13	The function $f(x) = x - sin\, x$ decreases for (a) $all\ x$ (b) $x < \pi/2$ (c) $0 < x < \pi/4$ (d) $no\ value\ of\ x$
14	The absolute maximum value of $f(x) = x^3 - 3x + 2$ in $0 \le x \le 2$ is (a) 4 b) 6 c) 2 d) 0
15	For the function $y = x^3+21$, the value of x, when y increases 75 times as fast as x, is (a) ± 3 (b) $\pm 5\sqrt{3}$ c) ± 5 d) none of these
16	The maximum value of $\left(\frac{1}{x}\right)^x$ is (a) e (b) e^e c) $e^{\frac{1}{e}}$ d) $\left(\frac{1}{e}\right)^{\frac{1}{e}}$
17	The function f(x) = cos x -2px is monotonically decreasing for (a) $p < \frac{1}{2}$ b) $p > \frac{1}{2}$ c) $p < 2$ d) $p > 2$
18	The maximum value of xy, subject to x+y = 8 is (a) 8 b) 16 c) 20 d) 24
19	The interval on which the function $f(x)=x^3+6x^2+6$ is strictly increasing is (a) $(-\infty,-4) \cup (0, \infty)$ (b) $(-\infty,-4)$ (c) (-4,0) (d) $(-\infty,0) \cup (4, \infty)$

	Choose the correct answer out of the following choices. (a) Both(A) and (R) are true and (R) is the correct explanation of (A). (b) Both(A) and (R) are true and (R) is not the correct explanation of (A) (c) (A) is true and (R) is false (d) (A) is false and (R) is true
20	Let f(x) be a polynomial function in a degree 6 such that $\frac{d}{dx}(f(x)) = (x-1)^3(x-3)^2$, then **Assertion (A)**: $f(x)$ *has a minimum at* $x = 1$. **Reason (R)**: When $\frac{d}{dx}(f(x))<0, \forall\ x \in (a-h, a)$ and $\frac{d}{dx}(f(x))>0, \forall\ x \in (a, a+h)$; where 'h' is an infinitesimally small positive quantity, then f(x) has a minimum at x=a, provided f(x) is continuous at x=a.
21	Let C be the circumference and A be the area of a circle. **Assertion(A):** The rate of change of the area with respect to radius is equal to C. **Reason(R):** The rate of change of the area with respect to diameter is $\frac{C}{2}$.
22	Let the radius, surface area and volume of sphere be r, S and V respectively. **Assertion(A):** The rate of change of volume of sphere with respect to its radius is equal to S. **Reason(R):** The rate of change of volume of sphere with respect to S is $\frac{r}{2}$.
23	**Assertion(A):** If the area of a circle increases at a uniform rate, then its perimeter varies inversely as its radius. **Reason(R):** The rate of change of area of a circle with respect to its perimeter is equal to the radius.
24	Let $f(x) = 1-x^3-x^5$ **Assertion(A):** f(x) is an increasing function **Reason(R):** $3x^2+5x^4>0$, for all $x \neq 0$.
25	Let $f(x) = 2x^3-3x^2-12x+4$ **Assertion(A):** x = -1 is a point of local maximum **Reason(R):** f′ (-1) >0
26	*Let* $f(x) = x + cosx$ **Assertion(A):** f(x) is an increasing function on R **Reason(R):** $-1 \leq sinx \leq 1$
27	**Assertion(A) :** The function $f(x) = x^3+5x+1$, $x \in \mathbb{R}$ is always increasing **Reason(R):** f'(x)>0 for $x \in \mathbb{R}$, for increasing function

28	$Let\ f(x) = sinx$ **Assertion(A) : f**(x) is increasing in $\left(0,\frac{\pi}{2}\right)$ **Reason(R):** $\cos\theta$ is positive for all $\theta \in \left(0,\frac{\pi}{2}\right)$
29	Radius of variable circle is changing at the rate of 5cm/s. What is the radius of the circle at a time when its area is changing at the rate of $100\text{cm}^2/\text{s}$?
30	The side of an equilateral triangle is increasing at the rate of 0.5 cm/s. Find the rate of increase of its perimeter.
31	If the rate of change of volume of a sphere is equal to the rate of change of its radius, then find the radius.
32	A balloon which always remain spherical has a variable diameter $\frac{3}{2}(2x+1)$. Find the rate of change of its volume with respect to x.
33	x and y are the sides of two squares such that $y = x - x^2$. Find the rate of change of the area of Second Square with respect to the area of the first square.
34	Find the intervals in which $f(x) = x^2 - 2x + 15$ is strictly increasing or strictly decreasing.
35	Show that the function $f(x) = (x^3 - 6x^2 + 12x + 18)$ is an increasing function on R
36	Find the intervals on which the function $f(x) = (5 + 36x + 3x^2 - 2x^3)$ is increasing
37	Amongst all pairs of positive numbers with sum 24, find those whose product is maximum.
38	Find the local maxima and local minima, if any of the function f, given by f(x) = sin x + cos x, $0 < x < \frac{\pi}{2}$
39	Find the interval/s in which the function $f : \mathbb{R} \to \mathbb{R}$ defined by $(x) = xe^x$, is increasing.
40	If $f(x) = \frac{1}{4x^2+2x+1}; x \in \mathbb{R}$, then find the maximum value of $f(x)$.
41	Find two positive numbers whose sum is 16 and sum of whose cubes is minimum.

42.	The equation of the path traced by a roller-coaster is given by the polynomial $f(x) = a(x + 9)(x + 1)(x - 3)$. If the roller-coaster crosses y-axis at a point (0, 1), answer the following : (a) Find the value of a. (b) Find second derivative of f(x) at x=-1
43.	The traffic police has installed Over Speed Violation Detection (OSVD) system at various locations in a city. These cameras can capture a speeding vehicle from a distance of 300 m and even function in the dark. A camera is installed on a pole at the height of 5 m. It detects a car travelling away from the pole at the speed of 20 m/s. At any point, x m away from the base of the pole, the angle of elevation of the speed camera from the car C is θ. On the basis of the above information, answer the following questions : i) Express θ in terms of height of the camera installed on the pole and x. ii) Find $\frac{d\theta}{dx}$. iii) (a)Find the rate of change of angle of elevation with respect to time at an instant when the car is 50 m away from the pole. OR (c) If the rate of change of angle of elevation with respect to time of another car at a distance of 50 m from the base of the pole is $\frac{101}{3}$ rad/s, then find the speed of the car.
44.	A tank, formed using a combination of a cylinder and a cone, offers better drainage as compared to a flat bottomed tank. A tap is connected to such a tank whose conical part is full of water. Water is dripping out from a tap at the bottom at the uniform rate of 2 cm^3/s. The semi-vertical angle of the conical tank is 45^0 . On the basis of given information, answer the following questions : (i) Find the volume of water in the tank in terms of its radius r. (ii) Find rate of change of radius at an instant when r = $2\sqrt{2}$ cm. (iii) (a) Find the rate at which the wet surface of the conical tank is decreasing at an instant when radius r = $2\sqrt{2}$ cm. OR (b) Find the rate of change of height h at an instant when height is 4 cm.

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Answers

1	C
5	C
9	B
13	D
17	B
21	B
25	C

2	A
6	B
10	B
14	A
18	B
22	B
26	A

3	C
7	C
11	D
15	C
19	A
23	A
27	A

4	B
8	C
12	B
16	C
20	A
24	D
28	A

29	$r = \frac{10}{\pi}$cm.	30	1.5cm/s
31	$r = \frac{1}{2\sqrt{\pi}}$ units	32	$\frac{27}{8}\pi(2x+1)^2$
33	$1 - 3x - 2x^2$	34	$f(x)$ is decreasing on $(-1, \infty)$
36	$f(x)$ is increasing on$[-2,3]$	37	12 & 12
38	Local maximum value = f$(\frac{\pi}{4}) = sin\frac{\pi}{4} + cos\frac{\pi}{4} = \frac{1}{\sqrt{2}} + \frac{1}{\sqrt{2}} = \sqrt{2}$		
39	$f(x)$ increases in $[-1, \infty)$	40	maximum value of $f(x) = \frac{4}{3}$.
41	8 and 8	42	$\frac{-1}{27}, \frac{-8}{27}$
43	*i)* $\theta = tan^{-1}\left(\frac{5}{x}\right)$ *ii)* $\frac{d\theta}{dx} = \frac{-5}{x^2+25}$ *iii)* -0.0396 rad/s OR -170551.67m/s	44	i) V= $\frac{1}{3}\pi r^3$ ii) $\frac{-1}{4\pi}\ cm/s$ iii) a) -2cm^2/s OR b) $\frac{-1}{8\pi}$

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