

CLASS 12

MATHEMATICS

EXTRA QUESTIONS

Class 12 Mathematics Chapter 6 Applications of Derivatives – Extra Questions with Answers

Applying derivatives to real curves means finding tangent and normal slopes, locating critical points, and using the second derivative test, all of which this question set covers.

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Applying derivatives to real curves means finding tangent and normal slopes, locating critical points, and using the second derivative test, all of which this question set covers.

Very Short Answer Questions (1 mark)

Q1. What is the slope of the tangent to $y=f(x)$ at $x=x_0$?

Ans: $f'(x_0)$.

Q2. What is the slope of the normal at the same point?

Ans: $-1/f'(x_0)$.

Q3. State the condition for a critical point.

Ans: $f'(x)=0$ or $f'(x)$ does not exist.

Q4. If $f''(c)<0$ at a critical point c , what does this indicate?

Ans: c is a point of local maximum.

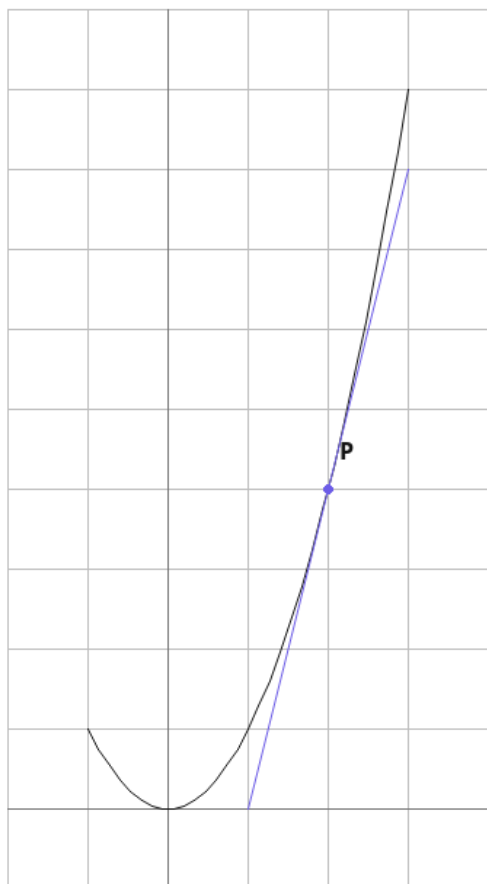
Q5. Write the formula for approximating Δy using differentials.

Ans: $\Delta y \approx f'(x)\Delta x = dy$.

Short Answer Questions (2–3 marks)

Q6. Find the equation of the tangent to $y=x^2$ at the point (2,4).

Ans: $dy/dx=2x$, so slope at $x=2$ is 4. Tangent: $y-4=4(x-2)$, i.e., $y=4x-4$.



Tangent to $y=x^2$ at $(2,4)$: slope=4, line $y=4x-4$.

Q7. Show that $f(x)=3x+7$ is strictly increasing on $\mathbb{R}$.

Ans: $f'(x)=3>0$ for all x , so f is strictly increasing everywhere on $\mathbb{R}$.

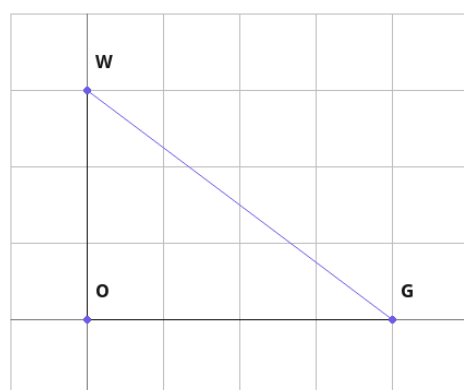
Q8. Use differentials to approximate $\sqrt{25.3}$.

Ans: Let $f(x)=\sqrt{x}$, $x=25$, $\Delta x=0.3$. $f'(x)=1/(2\sqrt{x})$, $f'(25)=1/10$. $\Delta y \approx (1/10)(0.3)=0.03$. So $\sqrt{25.3} \approx 5+0.03=5.03$.

Higher-Order Thinking / Application Questions

Q9. A ladder 5 m long is leaning against a wall. The bottom of the ladder is pulled along the ground away from the wall at 2 cm/s. Find the rate at which the top of the ladder is sliding down when the bottom is 4 m from the wall.

Ans: Let x =distance of bottom from wall, y =height of top on wall. By Pythagoras, $x^2+y^2=25$ (constant, since ladder length=5). Differentiating both sides with respect to time t : $2x(dx/dt)+2y(dy/dt)=0$, so $dy/dt=-(x/y)(dx/dt)$. Given $dx/dt=2$ cm/s and $x=4$ m=400 cm (keeping consistent units, or working in metres: $x=4$, $dx/dt=0.02$ m/s). When $x=4$, $y^2=25-16=9$, so $y=3$. Then $dy/dt=-(4/3)(0.02)=-0.0267$ m/s (using metres throughout), or equivalently $-8/3$ cm/s if $dx/dt=2$ cm/s is used directly with x,y in metres converted consistently: $dy/dt=-(x/y)(dx/dt)=-(4/3)(2)=-8/3$ cm/s. The negative sign indicates the top is sliding DOWN at a rate of $8/3$ cm/s (≈ 2.67 cm/s) at that instant. This is a classic related-rates problem showing how differentiating a constraint equation (constant ladder length) connects the rates of change of two related



Ladder 5m: wall 3m, base 4m (3-4-5); $dy/dt=-8/3$ cm/s.

quantities.

Q10. Find two positive numbers whose sum is 24 and whose product is maximum, proving your answer using the second derivative test.

Ans: Let the two numbers be x and $24-x$ (so their sum is fixed at 24), with $x>0$ and $24-x>0$, i.e., $0<x<24$. Let $P(x)=x(24-x)=24x-x^2$ be their product. To maximize P , differentiate: $P'(x)=24-2x$. Setting $P'(x)=0$ gives $24-2x=0$, so $x=12$, which is a critical point within the valid domain $(0,24)$. To confirm this is a maximum (not minimum), apply the second derivative test: $P''(x)=-2$, which is negative for all x , confirming that $x=12$ gives a local (and here, global, since P is a downward parabola) maximum. At $x=12$, the second number is $24-12=12$, so the two numbers are 12 and 12, and their maximum product is $12 \times 12=144$. This result makes intuitive sense: for a fixed sum, the product of two positive numbers is maximized when the numbers are equal, illustrating a general principle in optimization (AM-GM-related) that calculus confirms rigorously here.

For complete step-by-step answers and a quick summary, check the [Class 12 Mathematics Chapter 6 Solutions](#) and [Class 12 Mathematics Chapter 6 Revision Notes](#).

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Practice more: [Chapter 1](#) | [Chapter 2](#) | [Chapter 3](#) | [Chapter 4](#) | [Chapter 5](#)

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