50 multiple-choice questions

Question 1 (Level 1) — *Power rule: x*
Find $\frac{d}{dx}(x^4)$.

(A) $4x^3$

(B) $4x^4$

(C) $3x^4$

(D) x^3

Question 2 (Level 1) — *Constant multiple rule*
Find $\frac{d}{dx}(7x^3)$.

(A) $21x^2$

(B) $7x^2$

(C) $21x^3$

(D) $3x^2$

Question 3 (Level 1) — *Sum rule basics*
Find $\frac{d}{dx}(x^3 + x^2)$.

(A) $3x^2 + 2x$

(B) $3x^2 + x^2$

(C) $5x^4$

(D) $3x + 2$

Question 4 (Level 1) — *Derivative of 2x*
Find $f'(x)$ if $f(x) = 2x^5$.

(A) $10x^4$

(B) $10x^5$

(C) $5x^4$

(D) $2x^4$

Question 5 (Level 1) — *Difference rule*
Find $\frac{d}{dx}(x^4 - x^2)$.

(A) $4x^3 - 2x$

(B) $4x^3 - x^2$

(C) $4x - 2x$

(D) $4x^3 + 2x$

Question 6 (Level 1) — *Derivative with constant term*
Find $\frac{d}{dx}(3x^2 + 5)$.

(A) $6x$

(B) $6x + 5$

(C) $3x$

(D) 6

Question 7 (Level 1) — *Power rule: x*
Find $\frac{d}{dx}(x^6)$.

(A) $6x^5$

(B) $5x^6$

(C) $6x^6$

(D) x^5

Question 8 (Level 1) — *Three-term polynomial*
Find $\frac{d}{dx}(x^3 + 2x^2 + x)$.

(A) $3x^2 + 4x + 1$

(B) $3x^2 + 2x + 1$

(C) $3x^2 + 4x$

(D) $x^2 + 4x + 1$

Question 9 (Level 1) — *Negative coefficient*
Find $\frac{d}{dx}(-4x^3)$.

(A) $-12x^2$

(B) $12x^2$

(C) $-4x^2$

(D) $-12x^3$

Question 10 (Level 1) — *Evaluate derivative at x=1*
If $f(x) = x^4$, find $f'(1)$.

(A) 4

(B) 1

(C) 3

(D) 0

Question 11 (Level 2) — *Chain rule introduction*
Find $\frac{d}{dx}(2x+1)^3$ using the chain rule.

(A) $6(2x+1)^2$

(B) $3(2x+1)^2$

(C) $6(2x+1)^3$

(D) $2(2x+1)^2$

Question 12 (Level 2) — *Chain rule with square*
Find $\frac{d}{dx}(3x-4)^2$.

(A) $6(3x-4)$

(B) $2(3x-4)$

(C) $6(3x-4)^2$

(D) $3(3x-4)$

Question 13 (Level 2) — *Product rule introduction*
If $y = x \cdot x^2$, which equals x^3, verify using the product rule that $y' = 3x^2$.

(A) $3x^2$

(B) $2x^2$

(C) $2x^3$

(D) x^2

Question 14 (Level 2) — *Chain rule with fourth power*
Find $\frac{d}{dx}(x+5)^4$.

(A) $4(x+5)^3$

(B) $4(x+5)^4$

(C) $3(x+5)^4$

(D) $(x+5)^3$

Question 15 (Level 2) — *Quotient as negative power*
Find $\frac{d}{dx}\left(\frac{1}{x^3}\right)$ by writing it as x^{-3}.

(A) $-\frac{3}{x^4}$

(B) $\frac{3}{x^4}$

(C) $-\frac{3}{x^2}$

(D) $-\frac{1}{3x^4}$

Question 16 (Level 2) — *Chain rule with coefficient*
Find $\frac{d}{dx}(5x-1)^3$.

(A) $15(5x-1)^2$

(B) $3(5x-1)^2$

(C) $5(5x-1)^2$

(D) $15(5x-1)^3$

Question 17 (Level 2) — *Simple product rule*
Find $\frac{d}{dx}[x(x+1)]$ using the product rule.

(A) $2x+1$

(B) $x+1$

(C) $2x$

(D) 1

Question 18 (Level 2) — *Chain rule with square root*
Find $\frac{d}{dx}\sqrt{x+3}$.

(A) $\frac{1}{2\sqrt{x+3}}$

(B) $\frac{1}{\sqrt{x+3}}$

(C) $2\sqrt{x+3}$

(D) $\frac{1}{2}\sqrt{x+3}$

Question 19 (Level 2) — *Which rule to use?*
To differentiate $y = (x^2+1)^5$, which rule is most appropriate?

(A) Chain rule

(B) Product rule

(C) Quotient rule

(D) Power rule only

Question 20 (Level 2) — *Chain rule evaluated*
If $f(x) = (x-2)^4$, find $f'(3)$.

(A) 4

(B) 1

(C) 12

(D) 32

Question 21 (Level 3) — *Product rule with polynomials*
Find $\frac{d}{dx}[(x^2)(x^3+1)]$ using the product rule.

(A) $5x^4 + 2x$

(B) $2x^4 + 3x^4$

(C) $6x^4 + 2x$

(D) $5x^4 + 1$

Question 22 (Level 3) — *Quotient rule basics*
Find $\frac{d}{dx}\left(\frac{x}{x+1}\right)$ using the quotient rule.

(A) $\frac{1}{(x+1)^2}$

(B) $\frac{x}{(x+1)^2}$

(C) $\frac{-1}{(x+1)^2}$

(D) $\frac{1}{x+1}$

Question 23 (Level 3) — *Chain rule with exponential*
Find $\frac{d}{dx}(e^{3x})$.

(A) $3e^{3x}$

(B) e^{3x}

(C) $3xe^{3x}$

(D) e^{3x-1}

Question 24 (Level 3) — *Chain rule with ln*
Find $\frac{d}{dx}[\ln(2x)]$.

(A) $\frac{1}{x}$

(B) $\frac{2}{x}$

(C) $\frac{1}{2x}$

(D) $\ln(2)$

Question 25 (Level 3) — *Product rule with exponential*
Find $\frac{d}{dx}(xe^{x})$.

(A) $e^{x}(1+x)$

(B) xe^{x}

(C) e^{x}

(D) $e^{x}(x-1)$

Question 26 (Level 3) — *Chain rule with trig*
Find $\frac{d}{dx}[\sin(2x)]$.

(A) $2\cos(2x)$

(B) $\cos(2x)$

(C) $-2\cos(2x)$

(D) $2\sin(2x)$

Question 27 (Level 3) — *Quotient rule with quadratic*
Find $\frac{d}{dx}\left(\frac{x^2}{x-1}\right)$.

(A) $\dfrac{x(x-2)}{(x-1)^2}$

(B) $\dfrac{x^2}{(x-1)^2}$

(C) $\dfrac{2x}{x-1}$

(D) $\dfrac{x^2+2x}{(x-1)^2}$

Question 28 (Level 3) — *Chain rule with negative exponent*
Find $\dfrac{d}{dx}\left(\dfrac{1}{2x+3}\right)$.

(A) $-\dfrac{2}{(2x+3)^2}$

(B) $\dfrac{2}{(2x+3)^2}$

(C) $-\dfrac{1}{(2x+3)^2}$

(D) $\dfrac{-2}{2x+3}$

Question 29 (Level 3) — *Chain rule with cos*
Find $\dfrac{d}{dx}[\cos(3x+1)]$.

(A) $-3\sin(3x+1)$

(B) $3\sin(3x+1)$

(C) $-\sin(3x+1)$

(D) $-3\cos(3x+1)$

Question 30 (Level 3) — *Product rule with trig*
Find $\dfrac{d}{dx}[x\sin(x)]$.

(A) $\sin(x)+x\cos(x)$

(B) $x\cos(x)$

(C) $\cos(x)+x\sin(x)$

(D) $\sin(x)-x\cos(x)$

Question 31 (Level 4) — *Chain rule with e(quadratic)*
Find $\dfrac{d}{dx}(e^{x^2})$.

(A) $2xe^{x^2}$

(B) e^{x^2}

(C) $x^2e^{x^2}$

(D) $2e^{x^2}$

Question 32 (Level 4) — *Product rule with e and polynomial*
Find $\dfrac{d}{dx}(x^2e^x)$.

(A) $e^x(x^2+2x)$

(B) $2xe^x$

(C) $e^x(x^2-2x)$

(D) x^2e^x

Question 33 (Level 4) — *Chain rule with ln(quadratic)*
Find $\dfrac{d}{dx}[\ln(x^2+1)]$.

(A) $\dfrac{2x}{x^2+1}$

(B) $\dfrac{1}{x^2+1}$

(C) $\dfrac{2x}{x^2}$

(D) $\dfrac{x}{x^2+1}$

Question 34 (Level 4) — *Quotient rule with exponential*
Find $\dfrac{d}{dx}\left(\dfrac{e^x}{x}\right)$.

(A) $\dfrac{e^x(x-1)}{x^2}$

(B) $\dfrac{e^x}{x^2}$

(C) $\dfrac{e^x(x+1)}{x^2}$

(D) $e^x-\dfrac{e^x}{x}$

Question 35 (Level 4) — *Chain rule with sin*
Find $\dfrac{d}{dx}[\sin^2(x)]$.

(A) $2\sin(x)\cos(x)$

(B) $2\sin(x)$

(C) $\cos^2(x)$

(D) $2\cos(x)$

Question 36 (Level 4) — *Product of trig functions*
Find $\dfrac{d}{dx}[\sin(x)\cos(x)]$.

(A) $\cos^2(x) - \sin^2(x)$

(B) $-\sin^2(x)$

(C) $\cos^2(x) + \sin^2(x)$

(D) $-\cos(x)\sin(x)$

Question 37 (Level 4) — *Quotient rule with trig*
Find $\dfrac{d}{dx}\left(\dfrac{\sin(x)}{x}\right)$.

(A) $\dfrac{x\cos(x) - \sin(x)}{x^2}$

(B) $\dfrac{\cos(x)}{x}$

(C) $\dfrac{x\cos(x) + \sin(x)}{x^2}$

(D) $\dfrac{\cos(x) - \sin(x)}{x^2}$

Question 38 (Level 4) — *Chain rule with e(trig)*
Find $\dfrac{d}{dx}(e^{\sin(x)})$.

(A) $\cos(x)e^{\sin(x)}$

(B) $\sin(x)e^{\sin(x)}$

(C) $e^{\cos(x)}$

(D) $-\cos(x)e^{\sin(x)}$

Question 39 (Level 4) — *Product rule with ln*
Find $\dfrac{d}{dx}[x\ln(x)]$.

(A) $\ln(x) + 1$

(B) $\ln(x)$

(C) $\dfrac{1}{x} + 1$

(D) $\ln(x) - 1$

Question 40 (Level 4) — *Chain rule with ln(trig)*
Find $\dfrac{d}{dx}[\ln(\cos(x))]$.

(A) $-\tan(x)$

(B) $\tan(x)$

(C) $-\dfrac{1}{\cos(x)}$

(D) $\dfrac{\cos(x)}{\sin(x)}$

Question 41 (Level 5) — *Combined product and chain*
Find $\dfrac{d}{dx}[x^2 \sin(3x)]$.

(A) $2x\sin(3x) + 3x^2\cos(3x)$

(B) $2x\cos(3x) + 3x^2\sin(3x)$

(C) $6x^2\cos(3x)$

(D) $2x\sin(3x) + x^2\cos(3x)$

Question 42 (Level 5) — *Quotient with chain rule*
Find $\dfrac{d}{dx}\left(\dfrac{e^{2x}}{x+1}\right)$.

(A) $\dfrac{e^{2x}(2x+1)}{(x+1)^2}$

(B) $\dfrac{2e^{2x}}{(x+1)^2}$

(C) $\dfrac{e^{2x}(2x+2)}{(x+1)^2}$

(D) $\dfrac{e^{2x}(2x-1)}{(x+1)^2}$

Question 43 (Level 5) — *Double chain rule*
Find $\dfrac{d}{dx}\left[e^{\cos(2x)}\right]$.

(A) $-2\sin(2x)e^{\cos(2x)}$

(B) $2\cos(2x)e^{\cos(2x)}$

(C) $-\sin(2x)e^{\cos(2x)}$

(D) $2\sin(2x)e^{\cos(2x)}$

Question 44 (Level 5) — *Implicit differentiation basics*
If $x^2 + y^2 = 25$, find $\dfrac{dy}{dx}$.

(A) $-\dfrac{x}{y}$

(B) $\dfrac{x}{y}$

(C) $-\dfrac{y}{x}$

(D) $-\dfrac{2x}{y}$

Question 45 (Level 5) — *Product of three functions*
Find $\dfrac{d}{dx}[xe^x \sin(x)]$.

(A) $e^x[(1+x)\sin(x) + x\cos(x)]$

(B) $e^x[x\sin(x) + x\cos(x)]$

(C) $e^x \sin(x) + xe^x \cos(x)$

(D) $xe^x[\sin(x) + \cos(x)]$

Question 46 (Level 5) — *Implicit with product*
If $xy = e^x$, find $\dfrac{dy}{dx}$.

(A) $\dfrac{e^x - y}{x}$

(B) $\dfrac{e^x}{x}$

(C) $\dfrac{e^x + y}{x}$

(D) $e^x - \dfrac{y}{x}$

Question 47 (Level 5) — *Chain rule with inverse trig*
Find $\dfrac{d}{dx}[\sin^{-1}(2x)]$.

(A) $\dfrac{2}{\sqrt{1-4x^2}}$

(B) $\dfrac{1}{\sqrt{1-4x^2}}$

(C) $\dfrac{2}{\sqrt{1-2x^2}}$

(D) $\dfrac{1}{\sqrt{1-x^2}}$

Question 48 (Level 5) — *Logarithmic differentiation*
Find $\dfrac{d}{dx}(x^x)$ for $x > 0$.

(A) $x^x(\ln x + 1)$

(B) $x \cdot x^{x-1}$

(C) $x^x \ln x$

(D) x^x

Question 49 (Level 5) — *Complex quotient rule*
Find $\dfrac{d}{dx}\left(\dfrac{\ln(x)}{x^2}\right)$.

(A) $\dfrac{1-2\ln(x)}{x^3}$

(B) $\dfrac{1+2\ln(x)}{x^3}$

(C) $\dfrac{\ln(x)}{x^3}$

(D) $\dfrac{1-\ln(x)}{x^2}$

Question 50 (Level 5) — *Implicit with trig*
If $\sin(x+y) = y$, find $\dfrac{dy}{dx}$.

(A) $\dfrac{\cos(x+y)}{1-\cos(x+y)}$

(B) $\dfrac{\cos(x+y)}{1+\cos(x+y)}$

(C) $\dfrac{-\cos(x+y)}{1+\cos(x+y)}$

(D) $\cos(x+y)$

Solutions

Q1: (A)
$\frac{d}{dx}(x^4) = 4x^3$.
Q2: (A)
$7 \cdot 3x^2 = 21x^2$.
Q3: (A)
$3x^2 + 2x$.
Q4: (A)
$f'(x) = 2 \cdot 5x^4 = 10x^4$.
Q5: (A)
$4x^3 - 2x$.
Q6: (A)
$6x + 0 = 6x$.
Q7: (A)
$6x^5$.
Q8: (A)
$3x^2 + 4x + 1$.
Q9: (A)
$-4 \cdot 3x^2 = -12x^2$.
Q10: (A)
$f'(x) = 4x^3$. $f'(1) = 4(1)^3 = 4$.
Q11: (A)
$3(2x+1)^2 \cdot 2 = 6(2x+1)^2$.
Q12: (A)
$2(3x-4) \cdot 3 = 6(3x-4)$.
Q13: (A)
$u = x,\ v = x^2$. $y' = x \cdot 2x + x^2 \cdot 1 = 2x^2 + x^2 = 3x^2$. ✓
Q14: (A)
$4(x+5)^3 \cdot 1 = 4(x+5)^3$.
Q15: (A)
$-3x^{-4} = -\frac{3}{x^4}$.
Q16: (A)
$3(5x-1)^2 \cdot 5 = 15(5x-1)^2$.
Q17: (A)
$1 \cdot (x+1) + x \cdot 1 = x + 1 + x = 2x + 1$.
Q18: (A)
$\frac{1}{2}(x+3)^{-1/2} \cdot 1 = \frac{1}{2\sqrt{x+3}}$.
Q19: (A)
This is a composite function (function of a function), so we use the chain rule.
Q20: (A)
$f'(x) = 4(x-2)^3$. $f'(3) = 4(1)^3 = 4$.
Q21: (A)
$2x(x^3+1) + x^2(3x^2) = 2x^4 + 2x + 3x^4 = 5x^4 + 2x$.
Q22: (A)
$\frac{1 \cdot (x+1) - x \cdot 1}{(x+1)^2} = \frac{1}{(x+1)^2}$.
Q23: (A)

$e^{3x} \cdot 3 = 3e^{3x}$.

Q24: (A)

$\dfrac{1}{2x} \cdot 2 = \dfrac{1}{x}$.

Q25: (A)

$1 \cdot e^x + x \cdot e^x = e^x(1 + x)$.

Q26: (A)

$\cos(2x) \cdot 2 = 2\cos(2x)$.

Q27: (A)

$\dfrac{2x(x-1) - x^2 \cdot 1}{(x-1)^2} = \dfrac{2x^2 - 2x - x^2}{(x-1)^2} = \dfrac{x^2 - 2x}{(x-1)^2} = \dfrac{x(x-2)}{(x-1)^2}$.

Q28: (A)

$-1(2x+3)^{-2} \cdot 2 = -\dfrac{2}{(2x+3)^2}$.

Q29: (A)

$-\sin(3x+1) \cdot 3 = -3\sin(3x+1)$.

Q30: (A)

$1 \cdot \sin(x) + x \cdot \cos(x) = \sin(x) + x\cos(x)$.

Q31: (A)

$e^{x^2} \cdot 2x = 2xe^{x^2}$.

Q32: (A)

$2xe^x + x^2e^x = e^x(x^2 + 2x) = xe^x(x+2)$.

Q33: (A)

$\dfrac{1}{x^2+1} \cdot 2x = \dfrac{2x}{x^2+1}$.

Q34: (A)

$\dfrac{e^x \cdot x - e^x \cdot 1}{x^2} = \dfrac{e^x(x-1)}{x^2}$.

Q35: (A)

$2\sin(x) \cdot \cos(x) = \sin(2x)$.

Q36: (A)

$\cos(x)\cos(x) + \sin(x)(-\sin(x)) = \cos^2(x) - \sin^2(x) = \cos(2x)$.

Q37: (A)

$\dfrac{x\cos(x) - \sin(x)}{x^2}$.

Q38: (A)

$e^{\sin(x)} \cdot \cos(x) = \cos(x)e^{\sin(x)}$.

Q39: (A)

$1 \cdot \ln(x) + x \cdot \dfrac{1}{x} = \ln(x) + 1$.

Q40: (A)

$\dfrac{1}{\cos(x)} \cdot (-\sin(x)) = -\dfrac{\sin(x)}{\cos(x)} = -\tan(x)$.

Q41: (A)

$2x\sin(3x) + x^2 \cdot 3\cos(3x) = 2x\sin(3x) + 3x^2\cos(3x)$.

Q42: (A)

$\dfrac{2e^{2x}(x+1) - e^{2x}}{(x+1)^2} = \dfrac{e^{2x}(2x+1)}{(x+1)^2}$.

Q43: (A)

$e^{\cos(2x)} \cdot (-\sin(2x)) \cdot 2 = -2\sin(2x)e^{\cos(2x)}$.

Q44: (A)

$2x + 2y\frac{dy}{dx} = 0 \Rightarrow \frac{dy}{dx} = -\frac{x}{y}$.

Q45: (A)

$e^x \sin(x) + xe^x \sin(x) + xe^x \cos(x) = e^x[\sin(x) + x\sin(x) + x\cos(x)] = e^x[(1+x)\sin(x) + x\cos(x)]$.

Q46: (A)

$y + x\frac{dy}{dx} = e^x \Rightarrow \frac{dy}{dx} = \frac{e^x - y}{x}$.

Q47: (A)

$\frac{1}{\sqrt{1-(2x)^2}} \cdot 2 = \frac{2}{\sqrt{1-4x^2}}$.

Q48: (A)

$\ln y = x \ln x$. $\frac{1}{y}\frac{dy}{dx} = \ln x + 1$. $\frac{dy}{dx} = x^x(\ln x + 1)$.

Q49: (A)

$\frac{\frac{1}{x} \cdot x^2 - \ln(x) \cdot 2x}{x^4} = \frac{x - 2x\ln(x)}{x^4} = \frac{1 - 2\ln(x)}{x^3}$.

Q50: (A)

$\cos(x+y)(1+y') = y' \Rightarrow \cos(x+y) + y'\cos(x+y) = y' \Rightarrow y'[1 - \cos(x+y)] = \cos(x+y) \Rightarrow y' = \frac{\cos(x+y)}{1-\cos(x+y)}$.