Differentiation practice questions and answers pdf

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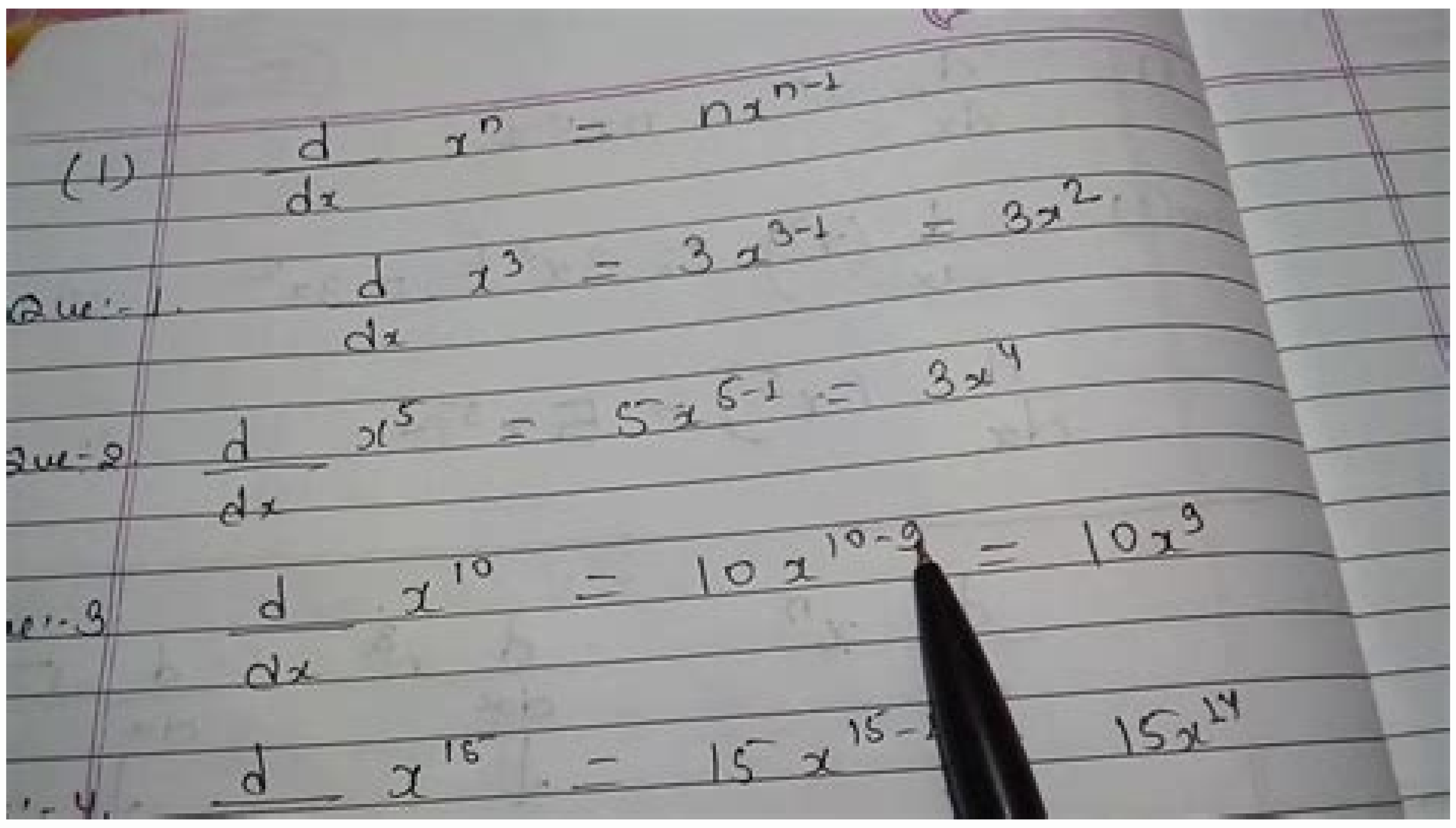

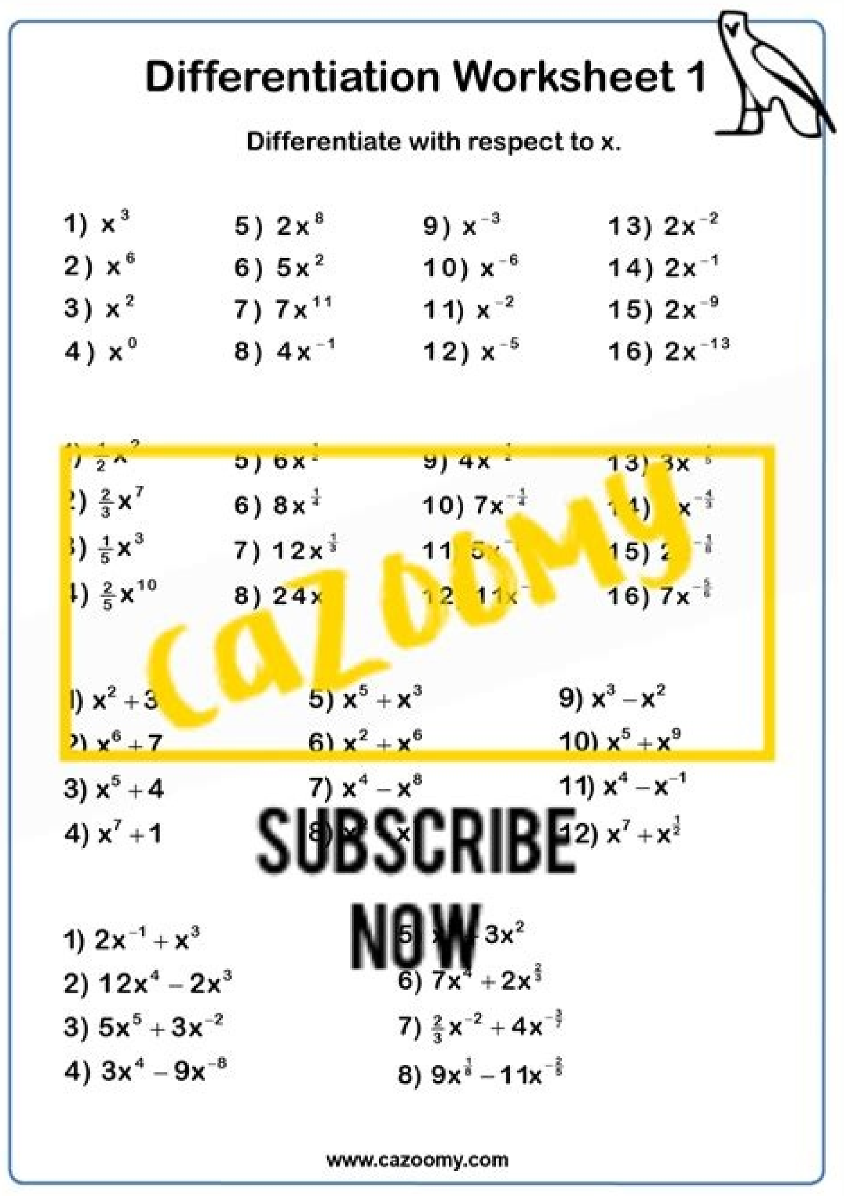

Differentiation Worksheet 1

Differentiate with respect to x.

1) x^3	5) $2x^8$	9) x^{-3}	13) $2x^{-2}$
2) x^6	6) $5x^2$	10) x^{-6}	14) $2x^{-1}$
3) x^2	7) $7x^{11}$	11) x^{-2}	15) $2x^{-9}$
4) x^0	8) $4x^{-1}$	12) x^{-5}	16) $2x^{-13}$

1) $\frac{1}{2}x^2$	5) $6x$ [illegible]	9) $4x$ [illegible]	13) $3x$ [illegible]
2) $\frac{2}{3}x^7$	6) $8x^{\frac{1}{4}}$	10) $7x^{-\frac{1}{4}}$	14) $x^{-\frac{4}{3}}$
3) $\frac{1}{5}x^3$	7) $12x^{\frac{1}{3}}$	11) [illegible]	15) [illegible]
4) $\frac{2}{5}x^{10}$	8) $24x$ [illegible]	12) $11x$ [illegible]	16) $7x^{-\frac{5}{6}}$

1) x^2+3	5) x^5+x^3	9) x^3-x^2
2) x^6+7	6) x^2+x^6	10) x^5+x^9
3) x^5+4	7) x^4-x^8	11) x^4-x^{-1}
4) x^7+1	8) [illegible]	12) $x^7+x^{\frac{1}{2}}$

1) $2x^{-1}+x^3$	5) [illegible] $3x^2$
2) $12x^4-2x^3$	6) $7x^4+2x^{\frac{2}{3}}$
3) $5x^5+3x^{-2}$	7) $\frac{2}{3}x^{-2}+4x^{-\frac{3}{7}}$
4) $3x^4-9x^{-8}$	8) $9x^{\frac{1}{8}}-11x^{-\frac{3}{8}}$

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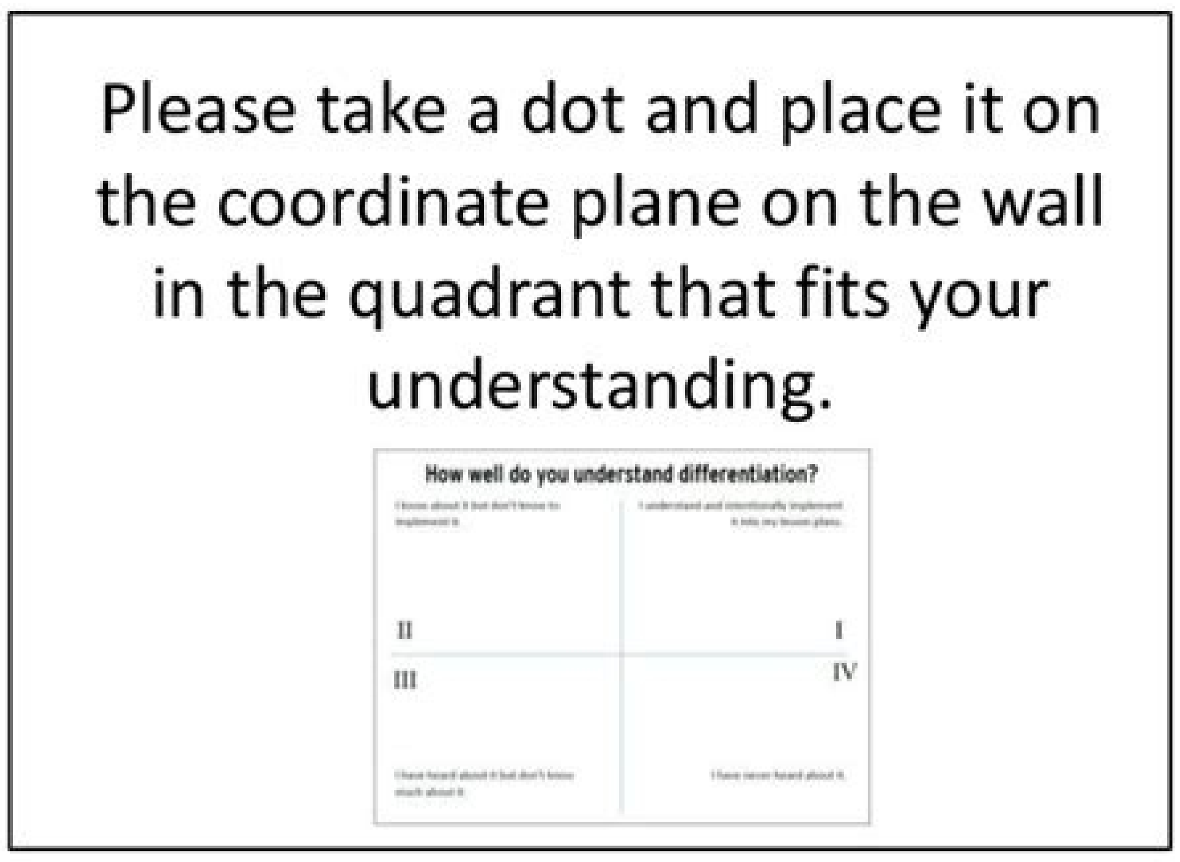

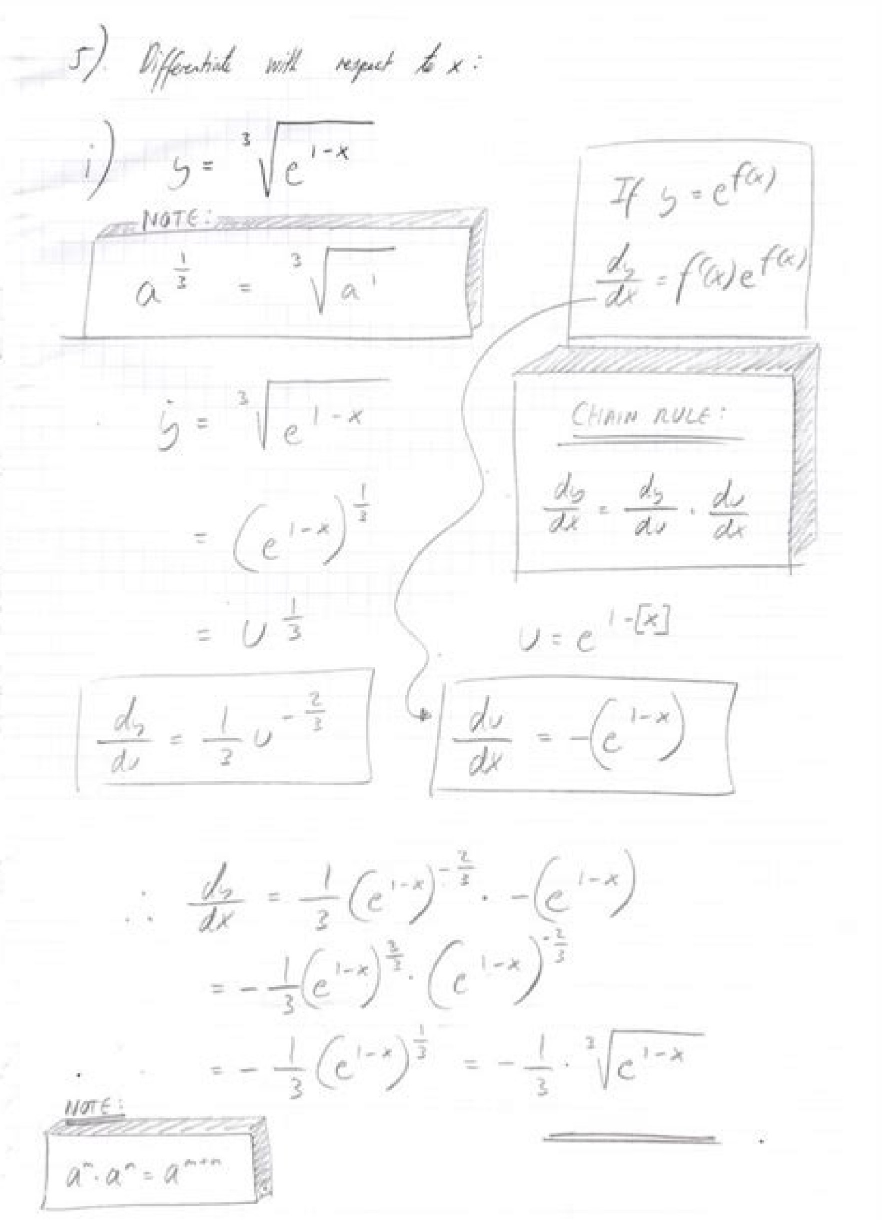

(0,0) and (1,2)	2	(4, −2) and (0,0)	$-\frac{1}{2}$
(0,0) and (2,1)	$\frac{1}{2}$	(5, −1) and (1,1)	$-\frac{1}{2}$
(2,1) and (0,0)	$\frac{1}{2}$	(10, −2) and (2,2)	$-\frac{1}{2}$
(−2,1) and (0,0)	$-\frac{1}{2}$	(10, −2) and (2,10)	$-\frac{3}{2}$
(−2, −1) and (0,0)	$\frac{1}{2}$	(10, −2) and (−2, −10)	$\frac{2}{3}$
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Basic differentiation practice questions. Differentiation practice questions and answers pdf.

Tutorial Contents / Maths / Exam Questions - Differentiation methods 1)View SolutionHelpful TutorialsThe product ruleChain rule: Polynomial to a rational power Click here to see the mark scheme for this question2)View SolutionHelpful TutorialsPart (a): Part (b): 3)View SolutionHelpful TutorialsChain rule: Trigonometric typesParts (a) and (b): Part (c): 4)View SolutionPart (i,a) Part (i,b) Part (ii) 5)View Solution 6)View SolutionPart (a)(i): Part (a)(ii): Part (b): 7)View SolutionPart (a): Part (b): 8)View SolutionPart (a): Part (b): 9)View SolutionPart (a): Part (b): 10)View SolutionPart (a): Part (b): Part (c): 11)View SolutionPart (i): Part (ii): 12)View SolutionPart (i)(a): Part (i)(b): Part (ii): 13)View SolutionPart (a): Part (b): 14)View SolutionPart (a)(i): Part (a)(ii): Part (b): Part (c): 15)View SolutionPart (i): Part (ii): 16)View Solution 17)View SolutionPart (a): Part (b): MichaelExamSolutionsKid2020-11-10T19:20:37+00:00 Are you working to calculate derivatives in Calculus? Let's solve some common problems step-by-step so you can learn to solve them routinely for yourself.Jump down this page to: [Power rule, x^n] [Exponential, e^x] [Trig derivatives] [Product rule] [Quotient rule] [Chain rule] CALCULUS SUMMARY: Derivatives and Rules You can always access our Handy Table of Derivatives and Differentiation Rules via the Key Formulas menu item at the top of every page. CLICK TO VIEW SUMMARY$$\frac{d}{dx}\text{(constant)} = 0 \quad \frac{d}{dx} \left(x\right) = 1 $$ $$\frac{d}{dx} \left(x^n\right) = nx^{n-1} $$Exponential Derivative\begin{align*} \frac{d}{dx}\left(e^x \right) &= e^x &&& \frac{d}{dx}\left(a^x \right) &= a^x \ln a \\ \\ \end{align*}Trigonometric Derivatives\begin{align*} \frac{d}{dx}\left(\sin x\right) &= \cos x &&& \frac{d}{dx}\left(\csc x\right) &= -\csc x \cot x \\ \\ \dfrac{d}{dx}\left(\cos x\right) &= -\sin x &&& \frac{d}{dx}\left(\sec x\right) &= \sec x \tan x \\ \\ \dfrac{d}{dx}\left(\tan x\right) &= \sec^2 x &&& \frac{d}{dx}\left(\cot x\right) &= -\csc^2 x \end{align*}Notice that a negative sign appears in the derivatives of the co-functions: cosine, cosecant, and cotangent.Constant Factor RuleConstants come out in front of the derivative, unaffected: $$\dfrac{d}{dx}\left[c f(x) \right] = c \dfrac{d}{dx}f(x) $$ For example, $\dfrac{d}{dx}\left(4x^3\right) = 4 \dfrac{d}{dx}\left(x^3 \right) =\, ... $Sum of Functions RuleThe derivative of a sum is the sum of the derivatives: $$\dfrac{d}{dx} \left[f(x) + g(x) \right] = \dfrac{d}{dx}f(x) + \dfrac{d}{dx}g(x) $$For example, $\dfrac{d}{dx}\left(x^2 + \cos x \right) = \dfrac{d}{dx}\left(x^2\right) + \dfrac{d}{dx}(\cos x) = \, ...$Product Rule for Derivatives\begin{align*} \dfrac{d}{dx}(fg)&= \left(\dfrac{d}{dx}f \right)g + f\left(\dfrac{d}{dx}g \right)\\[8px] &= \Big[\text{ (deriv of the 1st) } \times \text{ (the 2nd) }\Big] + \Big[\text{ (the 1st) } \times \text{ (deriv of the 2nd)}\Big] \end{align*} IV. Quotient Rule for Derivatives\begin{align*} \dfrac{d}{dx}\left(\dfrac{f}{g} \right) &= \dfrac{\left(\dfrac{d}{dx}f \right)g – f\left(\dfrac{d}{dx}g \right)}{g^2} \\[8px] &=\dfrac{ {\Big[\text{ (deriv of numerator) } \times \text{ (denominator)}\Big] – \Big[\text{ (numerator) } \times \text{ (deriv of denominator)}\Big]} {\text{all divided by [the denominator, squared]}} \end{align*}Many students remember the quotient rule by thinking of the numerator as "hi," the demoninator as "lo," the derivative as "d," and then singing "lo d-hi minus hi d-lo over lo-lo" [collapse] I. Power Rule \[\bbox[yellow,5px]{\dfrac{d}{dx}\left(x^n\right) = nx^{n-1}}\] For example, $\dfrac{d}{dx}\left(x^3\right) = 3x^2;$ $\dfrac{d}{dx}\left(x^{47}\right) = 47x^{46}.$Two specific cases you'll quickly remember: $$\dfrac{d}{dx}\text{(constant)} = 0$$ $$\dfrac{d}{dx}(x) = 1$$ Power Rule Differentiation Problem #1 Differentiate $f(x) = 2\pi$. Click to View Calculus Solution 2π is just a number: it's a constant. And the derivative of any constant is 0: \[\begin{align*} \dfrac{d}{dx}(2\pi) &= \dfrac{d}{dx}(\text{constant}) \\[8px] &= 0 \quad \cmark \end{align*} \] [collapse] Power Rule Differentiation Problem #2 Find the derivative of $f(x) = \dfrac{2}{3}x^9$. Click to View Calculus Solution We'll show more detailed steps here than normal, since this is the first time we're using the Power Rule. Recall that $\dfrac{d}{dx}\left(x^n\right) = nx^{n-1}.$ \[\begin{align*} \dfrac{d}{dx}\left(\frac{2}{3}x^9\right) &= \frac{2}{3} \dfrac{d}{dx}\left(x^9 \right) \\[8px] &= \frac{2}{3}\left(9 x^{9-1} \right) \\[8px] &= \frac{2}{3}(9) \left(x^8 \right) \\[8px] &= 6x^8 \quad \cmark \end{align*} \] [collapse] Power Rule Differentiation Problem #3 Calculate the derivative of $f(x) = 2x^3 – 4x^2 + x -33$. Click to View Calculus Solution Recall that $\dfrac{d}{dx}\left(x^n\right) = nx^{n-1}.$ We simply go term by term: \[\begin{align*} \dfrac{d}{dx}\left(2x^3 – 4x^2 + x -33 \right) &= \dfrac{d}{dx}\left(2x^3\right) – \dfrac{d}{dx}\left(4x^2\right) + \dfrac{d}{dx}(x) – \cancelto{0}{\dfrac{d}{dx}(33)} \\[8px] &= 2\dfrac{d}{dx}\left(x^3\right) – 4\dfrac{d}{dx}\left(x^2\right) + \dfrac{d}{dx}(x) \\[8px] &= 2 \left(3 x^2 \right) – 4 \left(2x^1 \right) + 1 \\[8px] &= 6x^2 -8x + 1 \quad \cmark \end{align*} \] [collapse] Power Rule Differentiation Problem #4 Differentiate $f(x) = \sqrt{x}$. Recall $\sqrt[n]{x} = x^{1/n}.$ Click to View Calculus Solution Recall that $\dfrac{d}{dx}\left(x^n\right) = nx^{n-1}.$ The rule also holds for fractional powers: \[\begin{align*} \dfrac{d}{dx}\left(\sqrt{x} \right) &= \dfrac{d}{dx}\left(x^{\frac{1}{2}} \right) \\[8px] &= \frac{1}{2}x^{\left(\frac{1}{2}\, – 1 \right)} \\[8px] &= \frac{1}{2}x^{-1/2} \quad \cmark \\[8px] &= \frac{1}{2}\frac{1}{\sqrt{x}} \quad \cmark \end{align*} \] Note that the last two lines are completely equivalent, and either would be acceptable as the answer. [collapse] Power Rule Differentiation Problem #5 Differentiate $f(x) = \dfrac{5}{x^3}$. Recall $\dfrac{1}{x^n} = x^{-n}.$ Click to View Calculus Solution Recall that $\dfrac{d}{dx}\left(x^n\right) = nx^{n-1}.$ The rule also holds for negative powers: \[\begin{align*} \dfrac{d}{dx} \left(\dfrac{5}{x^3} \right) &= 5 \dfrac{d}{dx} \left(x^{-3} \right) \\[8px] &= 5 \left((-3) x^{(-3-1)} \right) \\[8px] &= -15 x^{-4} \quad \cmark \\[8px] &= \frac{-15}{x^4} \quad \cmark \end{align*} \] Note that the last two lines are completely equivalent, and either would be acceptable as the answer. [collapse] Power Rule Differentiation Problem #6 Calculate the derivative of $f(x) = \sqrt[3]{x}\, – \dfrac{1}{\sqrt{x}}$. Click to View Calculus Solution Recall that $\dfrac{d}{dx}\left(x^n\right) = nx^{n-1}.$ \[\begin{align*} \dfrac{d}{dx}\left(\sqrt[3]{x}\, – \dfrac{1}{\sqrt{x}} \right) &= \dfrac{d}{dx} \left(x^{\frac{1}{3}} \right) – \dfrac{d}{dx} \left(x^{-\frac{1}{2}} \right) \\[8px] &= \left(\frac{1}{3}x^{\frac{1}{3}\, – 1} \right) – \left(-\frac{1}{2} x^{\left(-\frac{1}{2}\, – 1 \right)} \right) \\[8px] &= \frac{1}{3} x^{-\frac{2}{3}} + \frac{1}{2}x^{-\frac{3}{2}} \\[8px] &= \frac{1}{3}\frac{1}{\sqrt[3]{x^2}} + \frac{1}{2} \frac{1}{\sqrt{x^3}} \quad \cmark \end{align*} \] [collapse] Power Rule Differentiation Problem #7 Find the derivative of $f(x) = \sqrt{x}\left(x^2 – 8 + \dfrac{1}{x} \right)$. Click to View Calculus Solution We'll learn the "Product Rule" below, which will give us another way to solve this problem. For now, to use only the Power Rule we must multiply out the terms. Recall that $x^a x^b = x^{(a+b)}.$ \[\begin{align*} \sqrt{x}\left(x^2 – 8 + \frac{1}{x} \right) &= x^{\frac{1}{2}}x^2 – 8x^{\frac{1}{2}} + x^{\frac{1}{2}}x^{-1} \\[8px] &= x^{\frac{5}{2}}\, – 8x^{\frac{1}{2}}\, + x^{-\frac{1}{2}} \end{align*} \] We can now take the derivative: \[\begin{align*} \dfrac{d}{dx} \left(\sqrt{x}\left(x^2 – 8 + \frac{1}{x} \right) \right) &= \dfrac{d}{dx}\left(x^{\frac{5}{2}}\right) – 8\dfrac{d}{dx}\left(x^{\frac{1}{2}} \right) + \dfrac{d}{dx} \left(x^{-\frac{1}{2}} \right) \\[8px] &= \frac{5}{2} x^{\left(\frac{5}{2}\, – 1 \right)} – 8 \left(\frac{1}{2} x^{\left(\frac{1}{2}\, – 1 \right)} \right) + \left(-\frac{1}{2} \right)x^{\left(-\frac{1}{2}\, -1 \right)} \\[8px] &= \frac{5}{2}x^{\frac{3}{2}}\, – 4 x^{-\frac{1}{2}} \,- \frac{1}{2} x^{-\frac{3}{2}} \quad \cmark \end{align*} \] [collapse] Power Rule Differentiation Problem #8 Differentiate $f(x) = \left(2x^2 + 1 \right)^2$. Click to View Calculus Solution To use only the Power Rule to find this derivative, we must start by expanding the function so we can proceed term by term: \[\begin{align*} \left(2x^2 + 1 \right)^2 &= (2x^2)^2 + 2(2x^2)(1) + 1^2 \\[8px] &= 4x^4 + 4x^2 + 1 \end{align*} \] We can now take the derivative: \[\begin{align*} \dfrac{d}{dx}\left(2x^2 + 1 \right)^2 &= \dfrac{d}{dx}\left(4x^4 \right) + \dfrac{d}{dx} \left(4x^2 \right) + \cancelto{0}{\dfrac{d}{dx}(1)} \\[8px] &= 4(4)x^3 + 4(2)x \\[8px] &= 16x^3 + 8x \quad \cmark \end{align*} \] [collapse] II. Exponential Function Derivative $$\bbox[yellow,5px]{\dfrac{d}{dx}e^x = e^x}$$ This one's easy to remember! Exponential Differentiation Problem #1 Differentiate $f(x) = e^x + x$. Click to View Calculus Solution \[\begin{align*} \dfrac{d}{dx}\left(e^x + x \right) &= \dfrac{d}{dx}\left(e^x \right) + \dfrac{d}{dx}(x) \\[8px] &= e^x + 1 \quad \cmark \end{align*} \] [collapse] Exponential Differentiation Problem #2 Calculate the derivative of $f(x) = e^{1 + x}$. Click to View Calculus Solution Recall that $a^{n+m} = a^n a^m$. Hence $$e^{1 + x} = e \cdot e^x $$ And remember that e is just a number — a constant. Hence \[\begin{align*} \dfrac{d}{dx}\left(e^{1 + x} \right) &= \dfrac{d}{dx}\left(e \cdot e^x \right) \\[8px] &= e \dfrac{d}{dx}\left(e^x \right) \\[8px] &= e \left(e^x \right) \quad \cmark \\[8px] &= e^{x+1} \quad \cmark \end{align*} \] Note that the last two lines are completely equivalent. Either is correct as the answer. [collapse] III. Trig Function Derivatives \[\bbox[yellow,5px]{ \begin{align*} \frac{d}{dx}\left(\sin x\right) &= \cos x &&& \frac{d}{dx}\left(\csc x\right) &= -\csc x \cot x \\ \\ \dfrac{d}{dx}\left(\cos x\right) &= -\sin x &&& \frac{d}{dx}\left(\sec x\right) &= \sec x \tan x \\ \\ \dfrac{d}{dx}\left(\tan x\right) &= \sec^2 x &&& \frac{d}{dx}\left(\cot x\right) &= -\csc^2 x \end{align*}} \] Notice that a negative sign appears in the derivatives of the co-functions: cosine, cosecant, and cotangent. Trig Differentiation Problem #1 Differentiate $f(x) = \sin x – \cos x$. Click to View Calculus Solution Recall from the table that $\dfrac{d}{dx}(\sin x) = \cos x,$ and $\dfrac{d}{dx}(\cos x) = -\sin x.$ \[\begin{align*} \dfrac{d}{dx} \left(\sin x – \cos x \right) &= \dfrac{d}{dx}(\sin x) – \dfrac{d}{dx}(\cos x) \\[8px] &= \cos x – (-\sin x) \\[8px] &= \cos x + \sin x \quad \cmark \end{align*} \] [collapse] Trig Differentiation Problem #2 Calculate the derivative of $f(x) = 5x^3 – \tan x$. Click to View Calculus Solution Recall from the table that $\dfrac{d}{dx}(\tan x) = \sec^2 x.$ \[\begin{align*} \dfrac{d}{dx}\left(5x^3 – \tan x\right) &= 5\dfrac{d}{dx}\left(x^3 \right) – \dfrac{d}{dx}(\tan x) \\[8px] &= 5(3x^2) – \sec^2 x \\[8px] &= 15x^2 – \sec^2 x \quad \cmark \end{align*} \] [collapse] IV. Product Rule \[\bbox[yellow,5px]{ \begin{align*} \dfrac{d}{dx}(fg)&= \left(\dfrac{d}{dx}f \right)g + f\left(\dfrac{d}{dx}g \right)\\[8px] &= [{\small \text{ (deriv of the 1st) } \times \text{ (the 2nd) }}]\, + \,[{\small \text{ (the 1st) } \times \text{ (deriv of the 2nd)}}] \end{align*}}\] Product Rule Differentiation Problem #1 Differentiate $f(x) = x\sin x.$ Click to View Calculus Solution Since the function is the product of two separate functions, x and $\sin x$, we must use the Product Rule. Recall that $\dfrac{d}{dx}x = 1,$ and that $\dfrac{d}{dx}\sin x = \cos x.$ \[\begin{align*} \dfrac{d}{dx} \left(x\sin x\right)&= \left(\dfrac{d}{dx}x\right)\sin x + x \left(\dfrac{d}{dx}\sin x \right) \\[8px] &= (1)\sin x + x \,(\cos x) \\[8px] &= \sin x + x\cos x \quad \cmark \end{align*} \] [collapse] Product Rule Differentiation Problem #2 Calculate the derivative of $f(x) = \left(e^x +1 \right) \tan x.$ Click to View Calculus Solution Since the function is the product of two separate functions, $ \left(e^x +1 \right)$ and $\tan x$, we must use the Product Rule. Recall that $\dfrac{d}{dx}\left(e^x + 1 \right) = e^x,$ and that $\dfrac{d}{dx}\tan x = \sec^2 x.$ \[\begin{align*} \dfrac{d}{dx} \left[\left(e^x +1 \right) \tan x \right] &= \left[\dfrac{d}{dx} \left(e^x +1 \right) \right] \tan x + \left(e^x +1 \right)\left[\dfrac{d}{dx}\tan x \right] \\[8px] &= \left[e^x \right]\tan x + \left(e^x +1 \right)\left[\sec^2 x\right] \\[8px] &= e^x \tan x + \left(e^x +1 \right)\sec^2 x \quad \cmark \end{align*} \] [collapse] V. Quotient Rule \[\bbox[yellow,5px]{ \begin{align*} \dfrac{d}{dx}\left(\dfrac{f}{g} \right) &= \dfrac{\left(\dfrac{d}{dx}f \right)g – f\left(\dfrac{d}{dx}g \right)}{g^2} \\[8px] &=\dfrac{{[{\small \text{(derivative of the numerator) } \times \text{ (the denominator)}}]\\ \quad – \, [{\small \text{ (the numerator) } \times \text{ (derivative of the denominator)}}]}}{{\small \text{all divided by [the denominator, squared]}}} \end{align*}}\] Many students remember the quotient rule by thinking of the numerator as "hi," the demoninator as "lo," the derivative as "d," and then singing "lo d-hi minus hi d-lo over lo-lo"

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