Outcome 1 – Basic Differentiation

Bronze examples

Examples...

1. Bring the power down and multiply
2. Subtract '1' from the power

$f(x) = ax^n$

$f'(x) = nax^{n-1}$

Differentiate with respect to x...

$f(x) = 9x^6$ $\quad y = 5x^2$ $\quad f(x) = 4x$

$f'(x) = 54x^5$ $\quad \frac{dy}{dx} = 10x$ $\quad f'(x) = 9$

$f(x) = 7$ $\quad y = 9x^3 + 9x^2 - 12x + 5$

$f'(x) = 0$ $\quad \frac{dy}{dx} = 27x^2 + 18x - 12$

Bronze questions

Differentiate the following with respect to x...

1. $f(x) = x^{11}$
2. $y = x^{-1}$
3. $f(x) = 3x^9$
4. $f(x) = x^3 - 2x^2 + 5x + 18$
5. $f(x) = 15x$
6. $f(x) = 2x^3 + 8x^2 - 4x - 11$
7. $y = 20$
8. $y = 5x^3 - x + 7$
9. $f(x) = 7x^{-2}$
10. $f(x) = 3x^5 + 6x^3 - 10x + 1$

Outcome 2 – Differentiation with fractions and indices

Silver examples

Examples... **Rules of Indices...**

$\frac{1}{x} = x^{-1}$ $\quad \sqrt{x} = x^{\frac{1}{2}}$

$\sqrt[3]{x} = x^{\frac{1}{3}}$ $\quad \sqrt[5]{x^4} = x^{\frac{4}{5}}$

Differentiate with respect to x...

$f(x) = \frac{2}{3}x^{18}$ $\quad y = \sqrt[4]{x} = x^{\frac{1}{4}}$

$f'(x) = 12x^{17}$ $\quad \frac{dy}{dx} = \frac{1}{4}x^{-\frac{3}{4}}$

$(\frac{2}{3} \times 18 = \frac{36}{3} = 12)$ $(\frac{1}{4} - 1 = \frac{1}{4} - \frac{4}{4} = -\frac{3}{4})$

Silver questions

Differentiate the following with respect to x...

1. $f(x) = x^{\frac{3}{5}}$
2. $f(x) = \frac{5}{6}x^{12}$
3. $y = \frac{1}{3}x^{15}$
4. $f(x) = \frac{1}{10}x^{\frac{1}{3}}$
5. $f(x) = \sqrt[7]{x}$
6. $f(x) = \sqrt[10]{x}$
7. $y = 5\sqrt[3]{x}$
8. $f(x) = \sqrt{x^9}$
9. $y = \frac{6}{\sqrt{x}}$
10. $f(x) = \frac{4}{\sqrt[4]{x}}$

Outcome 3 – Harder Differentiation!

Gold examples

Examples...

Differentiate with respect to x...

$f(x) = (x+5)^2$ $\quad = x^2 + 10x + 25$

1. Square the first
2. Times and double
3. Square the last

$f'(x) = 2x + 10$

$f(x) = \frac{x^2 + 8}{x}$

Split up as separate fractions!

$f'(x) = 1 - 8x^{-2}$ $\quad = \frac{x^2}{x} + \frac{8}{x}$

$= 1 - \frac{8}{x^2}$ $\quad = x + 8x^{-1}$

Gold questions

Differentiate the following with respect to x...

1. $f(x) = 4(x+11)$
2. $f(x) = 3x(x-9)$
3. $f(x) = (x+5)^2$
4. $y = (3x-2)^2$
5. $f(x) = (x+9)(x-2)$
6. $f(x) = 2x(x-4)^2$
7. $y = \frac{x^9 - 3}{x}$
8. $f(x) = \frac{x^6 + 1}{x^2}$
9. $f(x) = \frac{x^8 + 10}{\sqrt{x}}$
10. $y = \frac{x^2 + x}{\sqrt[7]{x}}$

Bronze Answers

1. $f'(x) = 11x^{10}$
2. $\frac{dy}{dx} = -x^{-2}$
3. $f'(x) = 27x^{8}$
4. $f'(x) = 3x^2 - 4x + 5$
5. $f'(x) = 15$
6. $f'(x) = 6x^2 + 16x - 4$
7. $\frac{dy}{dx} = 0$
8. $\frac{dy}{dx} = 15x^2 - 1$
9. $f'(x) = -14x^{-3}$
10. $f'(x) = 15x^4 + 18x^2 - 10$

Silver Answers

1. $f'(x) = \frac{3}{5}x^{-\frac{2}{5}}$
2. $f'(x) = 10x^{11}$
3. $\frac{dy}{dx} = 5x^{14}$
4. $f'(x) = \frac{1}{30}x^{-\frac{2}{3}}$
5. $f'(x) = \frac{1}{7}x^{-\frac{6}{7}}$
6. $f'(x) = \frac{1}{10}x^{-\frac{9}{10}}$
7. $\frac{dy}{dx} = \frac{5}{3}x^{-\frac{2}{3}}$
8. $f'(x) = \frac{9}{2}x^{\frac{7}{2}}$
9. $\frac{dy}{dx} = -3x^{-\frac{3}{2}}$
10. $f'(x) = -x^{-\frac{5}{4}}$

Gold Answers

1. $f'(x) = 4$
2. $f'(x) = 6x - 27$
3. $f'(x) = 2x + 10$
4. $\frac{dy}{dx} = 18x - 12$
5. $f'(x) = 2x + 7$
6. $f'(x) = 6x^2 - 32x + 32$
7. $\frac{dy}{dx} = 8x^7 + 3x^{-2}$
8. $f'(x) = 4x^3 - 2x^{-3}$
9. $f'(x) = \frac{15}{2}x^{\frac{13}{2}} - 5x^{-\frac{3}{2}}$
10. $\frac{dy}{dx} = \frac{13}{7}x^{\frac{6}{7}} + \frac{6}{7}x^{-\frac{1}{7}}$