## 2.0 Find constant

### *Solving Differential Equations*

**Warm up – finding derivatives, forward thinking.**

1. Find the slope function (derivative) for any point on the given curves:

a) $y = x^2 + 2x - 3$ b) $y = 3e^{2x}$ c) $y = \sin^2 x$

$\frac{dy}{dx} = 2x + 2$

$y' = 3e^{2x}(2)$

$y' = 6e^{2x}$

$\frac{d}{dx}(\sin x)$

$\frac{dy}{dx} = 2\sin x(\cos x)$

$\frac{dy}{dx} = \sin(2x)$

2. Find the slope of the above curve at the point where

a) $x = 3$ b) $x = 3$ c) $x = \frac{\pi}{4}$

$f'(3) = 2(3) + 2$

$m = 8$

$P(3, 12)$

$f'(3) = 6e^6$

$f'(x) = \sin\left(2 \cdot \frac{\pi}{4}\right)$

$= \sin \frac{\pi}{2}$

$= 1$

**Outcome: Find the equation for the anitderivative given initial conditions.**

**SKILL: Work backwards. Solve for C given a point on the function.**

**Examples:**

1. A curve has a general slope described by $2x - 5$. If the original curve passes through the point (2,17), then what is the equation of the original curve?

$f(x) = 2x - 5$

$F(x) = \frac{2x^2}{2} - \frac{5x^1}{1} + c$

$F(x) = x^2 - 5x + c$

Point $(2, 17)$ $x = 2$ $y = 17$

$17 = (2)^2 - 5(2) + c$

$c = 23$

$F(x) = x^2 - 5x + 23$

2. Find the equation of each curve:

a) $f(x) = \frac{6}{x^2} =$ and passing through (-1, 6).

$f(x) = 6x^{-2}$

$F(x) = \frac{6x^{-1}}{-1} + c$

$F(x) = -\frac{6}{x} + c$

$P(-1, 6)$

$6 = -\frac{6}{-1} + c$

$6 = 6 + c$

$c = 0$

$F(x) = -\frac{6}{x}$

b) $f(x) = 3\sqrt{x}$ and passing through (4, 5)

$f(x) = 3x^{1/2}$

$F(x) = \frac{3x^{3/2}}{3/2} + c$

$F(x) = \frac{2}{3}(3x^{3/2}) + c$

$F(x) = 2x^{3/2} + c$ $P(4, 5)$

$5 = 2(\sqrt{4})^3 + c$

$5 = 2(2)^3 + c$

$5 = 16 + c$

$c = -11$

## 2.0 Find constant

$y = 4\sin x$

c) $f(x) = 4sin$ and passing through $\left(\frac{\pi}{2}, 6\right)$

$F(x) = -4\cos x + C$

$6 = -4\left[\cos\frac{\pi}{2}\right] + C$

$6 = -4(0) + C$

$C = 6$

$F(x) = -4\cos x + 6$

2. Find the displacement function for an object moving on a horizontal line given the velocity function: $\frac{ds}{dt} = 2t$, with the initial condition: $s = 3$ when $t = 0$.

$s'(t) = 2t$

$s(t) = \frac{2t^2}{2} + C$

$s(t) = t^2 + C$

$3 = (0)^2 + C$

$C = 3$

$s(t) = t^2 + 3$

3. Find the curve $y = F(x)$ that passes through ( -1, 0) and satisfies $\frac{dy}{dx} = 6x^2 + 6x$

$F(x) = \frac{6x^3}{3} + \frac{6x^2}{2} + C$

$F(x) = 2x^3 + 3x^2 + C$

$P(-1, 0)$

$0 = 2(-1)^3 + 3(-1)^2 + C$

$0 = -2 + 3 + C$

$C = -1$

$F(x) = 2x^3 + 3x^2 - 1$

4. For the graph G at every point $\frac{dy}{dx} = e^{-x}$ Find the equation of a graph parallel to G that passes through the origin.

$F(x) = \frac{e^{-x}}{-1}$

$y = -e^{-x} + C$

$P(0, 0)$

$0 = -e^{(-0)} + C$

$0 = -(e^0) + C$

$0 = -1 + C$

$C = 1$

$y = -\frac{1}{e^x} + 1$

**Homework:** Page 411 #1, 2, 3, 4abc, 5, 6