(10) $\frac{1}{3}t^3 \ln t - \frac{t^3}{9} + C$

(16) $\frac{4}{3}x(x+2)^{3/2} - \frac{8}{15}(x+2)^{5/2} + \frac{28}{15}$

(16) $\int dy = \int 2x\sqrt{x+2}\,dx$ $\quad u = 2x \quad dv = \sqrt{x+2}$

$du = 2\,dx \quad v = \frac{2}{3}(x+2)^{3/2}$

$y = 2x \cdot \frac{2}{3}(x+2)^{3/2} - \int \frac{2}{3}(x+2)^{3/2} \cdot 2\,dx$

$= \frac{4}{3}x(x+2)^{3/2} - \frac{4}{3}\int (x+2)^{3/2}\,dx$

$= \frac{4}{3}x(x+2)^{3/2} - \frac{4}{3} \cdot \frac{2}{5}(x+2)^{5/2} + C$

$y = \frac{4}{3}x(x+2)^{3/2} - \frac{8}{15}(x+2)^{5/2} + C$

$0 = \frac{4}{3}(-1)(1)^{3/2} - \frac{8}{15}(1)^{5/2} + C$

$\frac{28}{15} = C$

or do tabular!

$f(x)$		$g(x)$
$2x$	+	$\sqrt{x+2}$
2	−	$\frac{2}{3}(x+2)^{3/2}$
0		$\frac{8}{15}(x+2)^{5/2}$

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$u = e^{2x}$ $\quad dv = \cos 3x\,dx$

$du = 2e^{2x}dx$ $\quad v = \frac{1}{3}\sin 3x$

$$\int e^{2x}\cos 3x\,dx = e^{2x}\cdot\frac{1}{3}\sin 3x - \int \frac{1}{3}\sin 3x \cdot 2e^{2x}dx$$

$$\int e^{2x}\cos 3x\,dx = \frac{1}{3}e^{2x}\sin 3x - \frac{2}{3}\int e^{2x}\sin 3x\,dx$$

$u = e^{2x}$ $\quad dv = \sin 3x\,dx$

$du = 2e^{2x}dx$ $\quad v = -\frac{1}{3}\cos 3x$

$$\int e^{2x}\cos 3x\,dx = \frac{1}{3}e^{2x}\sin 3x - \frac{2}{3}\left[e^{2x}\cdot -\frac{1}{3}\cos 3x - \int -\frac{1}{3}\cos 3x\cdot 2e^{2x}dx\right]$$

$$\int e^{2x}\cos 3x\,dx = \frac{1}{3}e^{2x}\sin 3x + \frac{2}{9}e^{2x}\cos 3x - \frac{4}{9}\int e^{2x}\cos 3x\,dx$$

$$+\frac{4}{9}\int e^{2x}\cos 3x\,dx \qquad\qquad +\frac{4}{9}\int e^{2x}\cos 3x\,dx$$

$$\frac{13}{9}\int e^{2x}\cos 3x\,dx = \frac{1}{3}e^{2x}\sin 3x + \frac{2}{9}e^{2x}\cos 3x$$

$$\int e^{2x}\cos 3x\,dx = \frac{9}{13}\left[\frac{1}{3}e^{2x}\sin 3x + \frac{2}{9}e^{2x}\cos 3x\right]_{-2}^{3}$$

$$= \frac{1}{13}e^{2x}\left[3\sin 3x + 2\cos 3x\right]_{-2}^{3}$$

$$= \frac{1}{13}e^{6}\left[3\sin 9 + 2\cos 9\right] - \frac{1}{13}e^{-4}\left[3\sin(-6) + 2\cos(-6)\right]$$

$$\approx -18.186$$

More 6.4 Separable Diff. Eq

$$\frac{dy}{dx} = f(y) \cdot g(x)$$

$$\int \frac{dy}{f(y)} = \int g(x) \cdot dx$$

Ex) $\frac{dy}{dx} = x^2 y^2$ $y=1$ when $x=1$.

$$\int \frac{dy}{y^2} = \int x^2 dx$$

$$-\frac{1}{y} = \frac{x^3}{3} + c$$

Solve for c:

$$-\frac{1}{1} = \frac{1^3}{3} + c$$

$$-\frac{4}{3} = c$$

$$-\frac{1}{y} = \frac{x^3}{3} - \frac{4}{3}$$

$$-\frac{1}{y} = \frac{x^3-4}{3}$$

$$-y = \frac{3}{x^3-4}$$

$$y = \frac{3}{4-x^3}$$

D: $4-x^3=0$

$4=x^3$

$\sqrt[3]{4}=x$

D: $(-\infty, \sqrt[3]{4}) \cup (\sqrt[3]{4}, \infty)$

Exponential Change

rate of change of an amount is proportional to the amount present.

y = initial amount

$$\boxed{\frac{dy}{dt} = k \cdot y}$$

$$\int \frac{dy}{y} = \int k \cdot dt$$

$$e^{\ln|y|} = e^{kt+c}$$

$$y = e^{kt+c}$$

$$y = e^{kt} \cdot e^{c}$$

$$y = Ae^{kt}$$

$$y = y_0 e^{kt}$$

Pe^{rt}

Radioactive Decay

$$\frac{dy}{dt} = -k \cdot y$$

$$\downarrow$$

$$y = y_0 e^{-kt}$$

To find half life

given: $\frac{dy}{dt} = -k \cdot y$ (tell you k)

$\frac{1}{2} y_0 = y_0 e^{-kt}$ after time t

$$\frac{1}{2} = e^{-kt}$$

$$\ln \frac{1}{2} = -kt$$

$$\frac{\ln \frac{1}{2}}{-k} = t = \frac{\ln 2}{k}$$

Newton's Law of Cooling

T = temp of object after time t

T_s = surrounding temperature

T_0 = initial

$$\frac{dT}{dt} = -k\,(T_0 - T_s) \qquad y = y_0 e^{kt}$$

$$\frac{d(T-T_s)}{dt} = -k\,(T_0 - T_s) \Rightarrow T - T_s = (T_0 - T_s)e^{-kt}$$

Ex) Hard boiled egg at 98°C. Pan of H_2O at 18°C. After 5 min, cools to 38°C. How much longer to cool to 20°C?

p 357 #1–13 odds, 21–27 odds, 39, 42

Graded HW due after break.