1)

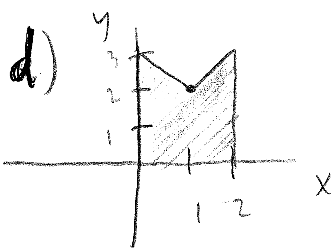
a) $\int (5x^4 + 8x^3 - x - 3 - 1/x^2)\,dx = \boxed{x^5 + 2x^4 - \frac{1}{2}x^2 - 3x + 1/x + C}$

b) $\int \frac{\cos^3 x + 1}{\cos^2 x}\,dx = \int \left(\cos x + \frac{1}{\cos^2 x}\right)dx = \int (\cos x + \sec^2 x)\,dx = \boxed{\sin(x) + \tan(x) + C}$

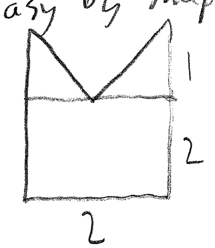
c) Shaded Area $= \int_0^3 ((2 - 2x^2) - (-16))\,dx = \int_0^3 (18 - 2x^2)\,dx = 18x - \frac{2}{3}x^3 \Big|_0^3 = 18(3) - \frac{2}{3}(3)^3$

(Top − Bottom)

$= \boxed{36}$

d) 

Easy by shapes



Area of Rectangle $= 2 \times 2 = 4$

Area of a triangle $= \frac{1}{2}(1)(1) = \frac{1}{2}$

Total area $=$ Area of Rectangle $+ 2$(Area of Triangle)

$= 4 + 2(\frac{1}{2}) = \boxed{5}$

or

$\int_0^1 (-(x-1) + 2)\,dx + \int_1^2 ((x-1) + 2)\,dx$

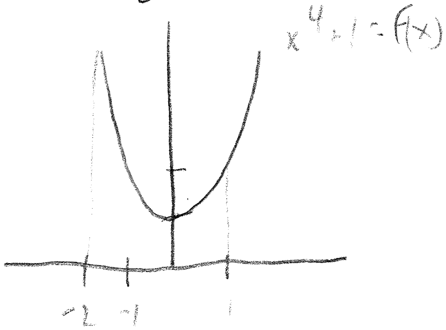
$= \int_0^1 (-x + 3)\,dx + \int_1^2 (x + 1)\,dx$

$= (-\frac{1}{2}x^2 + 3x)\Big|_0^1 + (\frac{1}{2}x^2 + x)\Big|_1^2$

$-\frac{1}{2} + 3 \quad + 2 + 2 - (\frac{1}{2} + 1)$

$\frac{5}{2} + \frac{5}{2} = \boxed{5}$

2) $\int_{-2}^{1} (x^4+1)\,dx$



a) $\text{Sum} = (1)f(-2) + (1)f(-1) + (1)(f(0))$

$= (16+1) + (2) + (1)$

$= \boxed{20}$

Note width $= \frac{1--2}{3} = \frac{3}{3} = 1$

b) $\text{Trap} = \frac{1}{2}\left(f(-2) + 2f(-1) + 2f(0) + f(1)\right)$

$= \frac{1}{2}(17 + 2(2) + 2(1) + 2)$

$= \frac{1}{2}(17 + 4 + 2 + 2)$

$= \frac{1}{2}(25)$

$= \boxed{25/2 = 12.5}$

c) $\int_{-2}^{1} (x^4+1)\,dx = \frac{1}{5}x^5 + x \Big|_{-2}^{1}$

$= \frac{1}{5} + 1 - \left(\frac{1}{5}(-32) - 2\right)$

$= \frac{1}{5} + 1 + \frac{32}{5} + 2$

$= 3 + \frac{33}{5} = \boxed{\frac{48}{5} = 9.8}$

d) $h = \frac{b-a}{n}$

$|E_T| \le \frac{b-a}{12}\left(\frac{b-a}{n}\right)^2 M < .0108$

$\frac{(b-a)^3}{12n^2} M < .0108$

$f(x) = x^4 + 1$

$f'(x) = 4x^3$

$f''(x) = 12x^2 \rightarrow$ Largest $|12x^2|$ on $[-2,1]$ is $12(-2)^2 = 48 = M$

$\frac{(1--2)^3}{12n^2}(48) < .0108$

$\frac{4(27)}{n^2} < .0108$

$\frac{108}{n^2} < .0108$

$n^2 > 10000$

$n > 100$

$\boxed{n = 101}$

3 ~~2~~

$$f(x) = \begin{cases} \sqrt{x} & x \geq 0 \\ \sqrt{-x} & x < 0 \end{cases}$$

Newton's Method

$$x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$$

$f(x) = \sqrt{x}$

$f'(x) = \dfrac{1}{2\sqrt{x}}$

$$x_{n+1} = x_n - \frac{\sqrt{x_n}}{\frac{1}{2\sqrt{x_n}}} =$$

$$x_{n+1} = x_n - 2x_n$$

$$\boxed{x_{n+1} = -x_n}$$

so $x_0 = h$

$x_1 = -h$

$f(x) = \sqrt{-x}$

$f'(x) = \dfrac{-1}{2\sqrt{-x}}$

$$x_{n+1} = x_n - \frac{\sqrt{-x_n}}{\frac{-1}{2\sqrt{x_n}}}$$

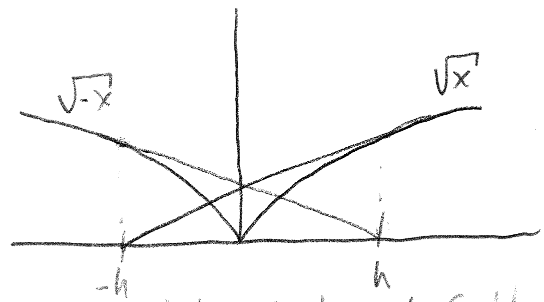
$$x_{n+1} = x_n - (-2)(-x_n)$$

$$x_{n+1} = x_n - 2x_n$$

$$\boxed{x_{n+1} = -x_n}$$

so $x_0 = -h$

$x_1 = h$



Oscillates back and forth from h to -h with no convergence

4

$$\begin{array}{l} D \\ \uparrow \int \text{integrate} \\ V \\ \uparrow \int \text{integrate} \\ A \end{array} \qquad \begin{array}{l} a(0) = -15 \\ v(0) = 60 \\ d(0) = 0 \end{array}$$

$a(t) = -15$

$v(t) = \int -15\,dt = -15t + C$

$v(0) = 60 = -15(0) + C$

$C = 60$

$v(t) = -15t + 60$

$d(t) = \int (-15t + 60)\,dt = \frac{-15t^2}{2} + 60t + C$

$d(0) = 0 = C$

$d(t) = -\frac{15}{2}t^2 + 60t$

How long does it take Jones to stop?

$v(t) = -15t + 60 = 0$

$15t = 60$

$\boxed{t = 4 \text{ sec}}$

How far did he travel in those 4 seconds?

$d(4) = \frac{-15}{2}(4)^2 + 60(4)$

$= \frac{-15}{2}(16) + 240$

$= -15(8) + 240$

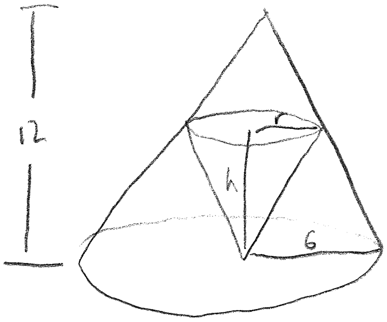
$= -120 + 240$

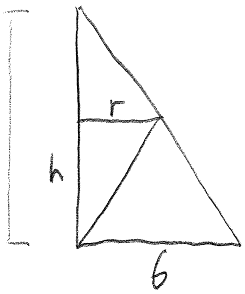
$= \boxed{120 \text{ ft}}$

The cliff was 125 feet away, so Jones stops the carriage safely with 5 feet to spare!!

<u>He lives!!</u>

5) Max $V_{cone} = \frac{1}{3}\pi r^2 h$





$$\frac{6}{12} = \frac{r}{12-h}$$

$$\frac{1}{2} = \frac{r}{12-h}$$

$$12-h = 2r$$

$$\boxed{h = 12-2r}$$

$$V_{cone} = \frac{1}{3}\pi r^2 h$$
$$= \frac{1}{3}\pi r^2 (12-2r)$$
$$= \frac{2}{3}\pi r^2 (6-r)$$
$$V = 4\pi r^2 - \frac{2}{3}\pi r^3$$
$$V'(r) = 8\pi r - 2\pi r^2 = 0$$
$$8\pi r = 2\pi r^2$$
$$4r = r^2$$
$$r = 4$$

Check to see if max by 2nd Derivative

$$V''(r) = 8\pi - 4\pi r$$
$$V''(4) = 8\pi - 4\pi(4) = -8\pi < 0$$ Concave Down so a max

Check Endpts

$r = 0$ $V(0) = 0$ no radius

$r = 6$ $V(6) = 0$ no height

$$\boxed{\text{Max volume when } r = 4,\quad h = 12-2(4) = 12-8 = 4}$$