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Mechatronics Engineering

$$\textcircled{1} \quad v = 4t - 3t^2$$
$$\therefore s = \int v \cdot dt$$
$$\therefore s = \int (4t - 3t^2) \cdot dt$$

$$s = \int 4t \cdot dt - \int 3t^2 \cdot dt$$
$$= \frac{4t^2}{2} - \frac{3t^3}{3} + c$$

$$s = 2t^2 - t^3 + c$$

Recall that $s = 0$ when $t = 0$

$$0 = 2(0)^2 - (0)^3 + c$$

$$c = 0$$

$$s = 2t^2 - t^3$$

At $t = 4s$

$$s = 2(4)^2 - (4)^3$$
$$= -32m$$

$$\textcircled{9} \quad a = 4t^2 - 2$$

$$v = \int a \, dt \\ = \int [4t^2 - 2] \, dt$$

$$= \int 4t^2 \, dt - \int 2 \, dt$$

$$v = \frac{4t^3}{3} - 2t + C$$

$$s = \int v \, dt$$

$$= \int \left[\frac{4t^3}{3} - 2t + C \right] \, dt$$

$$= \int \frac{4t^3}{3} \, dt - \int 2t \, dt + \int C \, dt$$

$$= \frac{4t^4}{3 \times 4} - \frac{2t^2}{2} + Ct + \pi$$

$$s = \frac{t^4}{3} - t^2 + Ct + \pi$$

Recall that $s = -2$, when $t = 0$

$$-2 = \frac{(0)^4}{3} - (0)^2 + C(0) + \pi$$

$$\therefore \pi = -2$$

Also, $s = -20$, when $t = 2$

$$-20 = \frac{(2)^4}{3} - 2^2 + 2C + \pi \quad (\pi = -2)$$

$$-20 = \frac{16}{3} - 4 + 2C - 2$$

$$2C = -19\frac{2}{3}$$

$$C = -9.67$$

$$\therefore s = \frac{t^4}{3} - t^2 - 9.67t - 2$$

11. ~~20 - 0.05s^2~~

$$v = \frac{ds}{dt} = 20 - 0.1s$$
$$v = 0 \Rightarrow 20 - 0.1s = 0$$

12. ~~20 - 0.05s^2~~

$$v = 20 - 0.05s^2$$
$$v = \frac{ds}{dt}$$
$$\frac{ds}{dt} = 20 - 0.05s^2$$

$$a = \frac{dv}{dt} = \frac{d}{dt}(20 - 0.05s^2)$$
$$= -2s + 0.005s^3$$

Find when $s = 15m$

$$a = -2(15) + 0.005(15)^3$$
$$= -30 + 11.25$$
$$= -18.75 \text{ ms}^{-2}$$