

Thursday 21st May 2020

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18/ENCO6/053

Mechanical Engineering (ENG234)

9) Since $V = ds/dt$ the V-t graph can be determined by differentiating the equation

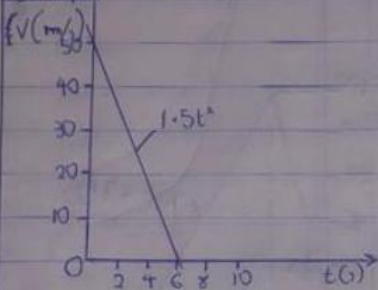
$$0 \leq t < 6s, s = 0.5t^2$$

$$V = ds/dt = 54 \text{ m/s}$$

$$6 \leq t < 10s, s = 108$$

$$V = ds/dt = 0 \text{ m/s}$$

Graph

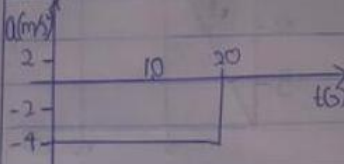


a-t Graph - The a-t graph is determined by differentiating the equation

$$0 \leq t < 20s, V = -4t + 80$$

$$a = dv/dt = -4$$

Graph



10) With the values of V and dv/ds known, the value of "a" can be calculated

$$0 \leq s < 40$$

$$V = 0.25s$$

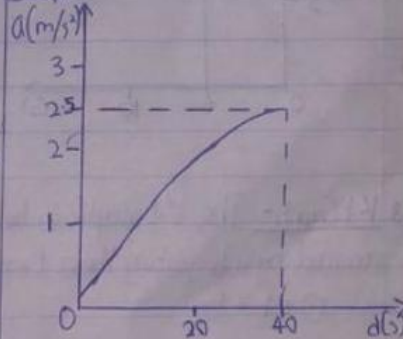
$$dv/ds = 0.25$$

$$V = 10 \text{ m/s}$$

$$a = V \times dv/ds$$

$$a = 10 \times 0.25 = 2.5 \text{ m/s}^2$$

Graph



10) s-t Graph - The s-t graph is

determined by integrating the equation

$$0 \leq t < 20s, V = -4t + 80$$

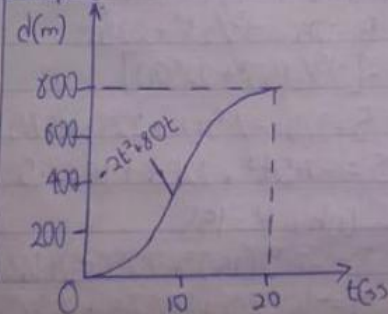
$$\int ds = \int_0^t (-4t + 80) dt$$

$$s = -2t^2 + 80t$$

$$\text{when } t = 20$$

$$= -2(20)^2 + 80 \times 20 = -800 + 1600 = 800 \text{ m}$$

Graph



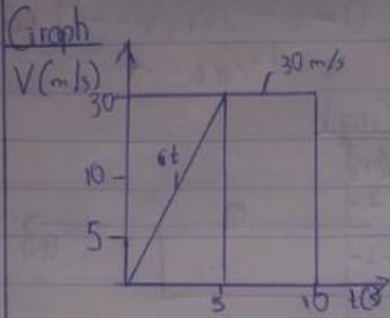
11) V-t Graph - The V-t graph can be constructed by differentiating the equations:

$$0 \leq t < 5, s = 3t^2$$

$$V = \frac{ds}{dt} = 6t - 6(5) = 30 \text{ m/s}$$

$$5 \leq t < 10, s = 30t - 75$$

$$V = \frac{ds}{dt} = 30 \text{ m/s}$$



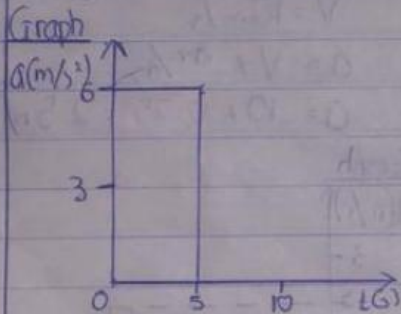
a-t Graph: The a-t graph can be determined by differentiating the v-t equations

$$0 \leq t < 5, V = 6t$$

$$a = \frac{dv}{dt} = 6 \text{ m/s}^2$$

$$5 \leq t < 10, V = 30 \text{ m/s}$$

$$a = \frac{dv}{dt} = 0 \text{ m/s}^2$$



13) v-t Graph: The v-t graph can be determined by integrating the a-t equations

$$0 \leq t < 5s$$

$$a = 20$$

$$\int_0^5 dv = \int_0^5 20 dt$$

$$\text{when } t = 5s, V = 20 \times 5 = 100 \text{ m/s}$$

Using this as the initial condition for the next time period, we have

$$5 \leq t < t'$$

$$a = -10 \text{ m/s}^2$$

$$\int_{100}^v dv = \int_5^{t'} -10 dt$$

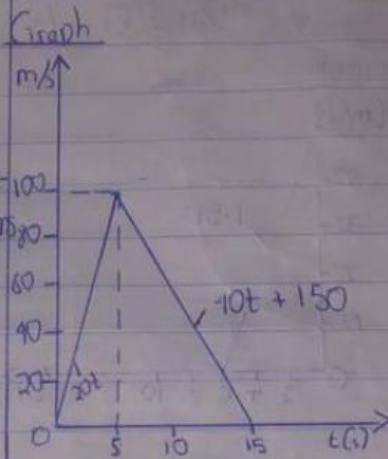
$$V - 100 = -10t + 50$$

$$V = -10t + 150$$

$$\text{when } t = t', V = 0$$

$$0 = -10t + 150$$

$$10t = 150, t = 15$$



s-t Graph: The s-t graph can be determined by integrating the equations

$$0 \leq t < 5s, V = 30t$$

$$\int_0^s ds = \int_0^5 30t dt$$

$$s = 15t^2 \text{ m}$$

$$\text{when } t = 5s, s = 15(5)^2 = 375 \text{ m}$$

Using this initial Conditions:

$$5s \leq t < 15s$$

$$\int_{375}^s ds = \int_5^{t'} (-15t + 225) dt$$

$$s - 375 = -15/2 t^2 + 225t$$

$$-[-15/2 (5)^2 + 225(5)]$$

$$s - 375 = -7.5t^2 + 225t + 1875 + 1125$$

$$s = -7.5t^2 + 225t + 1687.5$$

$$\text{When } t' = 15s$$

$$s = -7.5(15)^2 + 225(15) + 1687.5$$

$$s = -1687.5 + 1687.5 + 3157.5$$

$$S = 3,375 \text{ m}$$

