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① $V = \frac{ds}{dt}$

$V = \frac{d}{dt} (0.5t^3)$

$V = 1.5t^2$

at $t=0$
 $V = 1.5(0)^2 = 0$

at $t=6$
 $V = 1.5(6)^2 = 54$

$V = \frac{d}{dt} (108)$

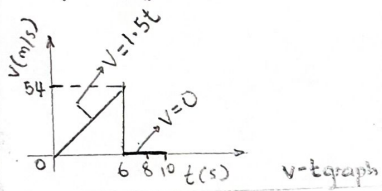
$V = 0$

at $t=8$

$V = 0$

at $t=10$

$V = 0$



③ $V = \frac{ds}{dt}$

$a = \frac{dv}{dt}$

using Chain rule

$\frac{dv}{dt} = \frac{ds}{dt} \times \frac{dv}{ds}$

$a = 0.25s \times 0.25$
 $= 0.0625s$

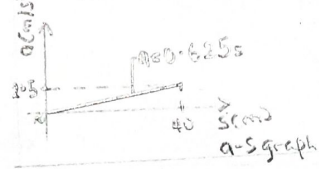
when $s=0$

$a=0$

when $s=40$

$a = 0.0625 \times 40$

$= 2.5$



④ $s = 3t^2$

$V = \frac{ds}{dt} \quad a = \frac{dv}{dt}$

$V = 6t \quad a = 6$

when $t=0$

$V=0$

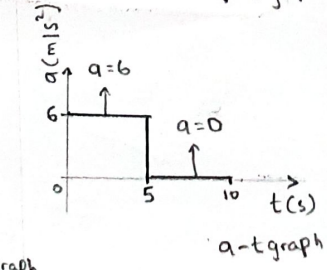
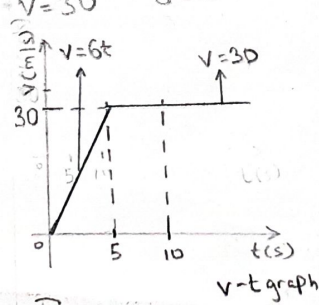
when $t=5$

$V=30$

$s = 30t - 75$

$V = \frac{ds}{dt} \quad a = \frac{dv}{dt}$

$V = 30 \quad a = 0$



② $\int v dt = s$

$\int -4t + 80 = \frac{-4t^2}{2} + 80t + c$

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

$s=0$ when $t=0$

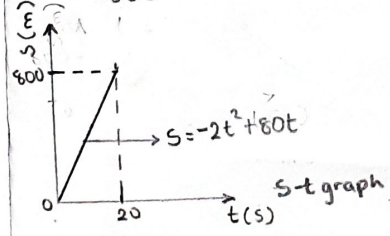
$0 = -2(0)^2 + 80(0) + c$

$0 = c$

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

at $t=20$

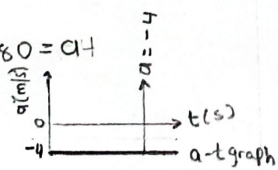
$s = -2(20)^2 + 80(20)$
 $= 800$



$\frac{d}{dt} v = a$

$\frac{d}{dt} -4t + 80 = a$

$a = -4$



⑤ $a = \frac{dv}{dt}$

$0 \leq t < 5$

$\int_0^v dv = \int_0^t 20 dt$

$v = 20t$

at $t=5$

$v = 20(5)$
 $= 100$

$5 \leq t < 15$

$\int_{100}^v dv = \int_5^t -10 dt$

$v - 100 = -10t + 50$

$v = -10t + 150$

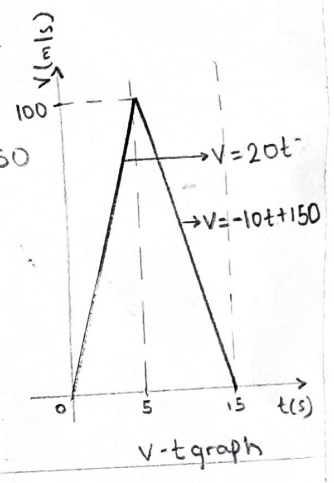
at $t=15, a=0, v=0$

$\therefore v = 0$

$0 = -10t + 150$

$-150 = -10t$

$t = 15s$



⑥ $V = 30t$

$0 \leq t < 5$

$V = \frac{ds}{dt}$

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

$s = \frac{30t^2}{2}$

$= 15t^2$

at $t=5$

$s = 15(5)^2 = 375$

$5 \leq t < 15$

$v = -15t + 225$

$\int_{375}^s ds = \int_5^{15} -15t + 225 dt$

$s - 375 = \left[-\frac{15t^2}{2} + 225t \right]_5^{15}$

$s = 1687.5 - 937.5 + 375$

$s = 1125$

Total distance can be calculated as area under the v-t graph

$\frac{1}{2} bh = \frac{1}{2} \times 150 \times 15$

$= 1125m$

