Ex 21.1

i) $S = 10 + 2t - t^2$

a) $V = \frac{ds}{dt} = \frac{d}{dt}(10) + \frac{d}{dt}(2t) - \frac{d}{dt}(t^2)$

$V = 0 + 2 - 2t = 2 - 2t$

$a = \frac{dv}{dt} = -2$

b) for initial Position and velocity, $t = 0$.

$S(0) = 10 + 2(0) - (0)^2 = 10\,m$

$V(0) = 2 - 2(0) = 2\,ms^{-1}$

c) $V = 2 - 2t$

Put $V = 0$

$2 - 2t = 0 \Rightarrow t = 1$.

Put $t = 1$ in 'S' expression

$S(1) = 10 + 2(1) - (1)^2 = 11$.

ii) $S = -4t + t^2$

a) $V = -4 + 2t$

b) $S(0) = -4(0) + 0^2 = 0$

$V(0) = -4 + 2(0) = -4$

c) $V = -4 + 2t \Rightarrow -4 + 2t = 0 \Rightarrow t = 2$.

$S(2) = -4(2) + 2^2 = -4$.

iii) $x = t^3 - 5t^2 + 4$

a) $V = 3t^2 - 10t$

b) $x(0) = 0^3 - 5(0)^2 + 4 = 4$

$V(0) = 3(0)^2 - 10(0) = 0$

c) $V = 3t^2 - 10t \Rightarrow 3t^2 - 10t = 0$

$t(3t - 10) = 0$

$t_1 = 0 \quad t_2 = \frac{10}{3} = 3\frac{1}{3}$

$x(t_1) = 0^3 - 5(0)^2 + 4 = 4$

$V(t_1) = 3(0)^2 - 10(0) = 0$

$x(t_2) = \left(\frac{10}{3}\right)^3 - 5\left(\frac{10}{3}\right)^2 + 4 = -14$

$V(t_2)$

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Q# 15

Q2

i) $v = 4t + 3$

a) $v = 4t + 3$ b) $v(0) = 3$

$a = 4$ $a(0) = 4$

ii) $v = 6t^2 - 2t + 1$

a) $a = 12t - 2$

b) $v(0) = 6(0)^2 - 2(0) + 1 = 1$

$a(0) = 12(0) - 2 = -2$

iii) $v = 7t - 5$

a) $a = 7$

b) $v(0) = 7(0) - 5 = -5$

$a(0) = 7$

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Q3 $s = 4t + 0.5t^2$

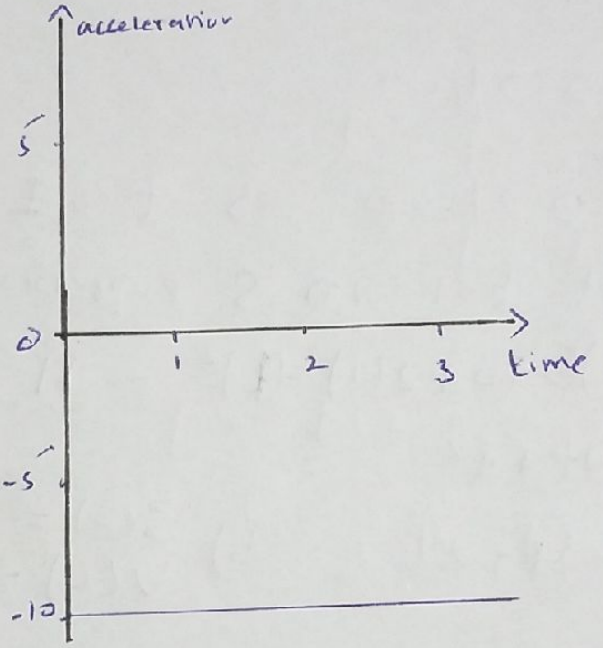
$\frac{ds}{dt} = v = 4 + 2(0.5)t = 4 + t$

$a = \frac{dv}{dt} = \frac{d}{dt}(4) + \frac{d}{dt}(t) = 0 + 1 = 1$

Q4 i) $x = 15t - 5t^2$

$\frac{dx}{dt} = v = 15 - 10t \Rightarrow \frac{dv}{dt} = a = -10$

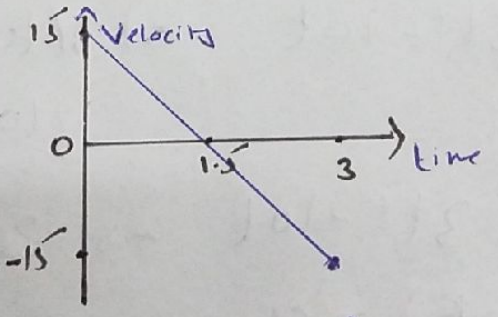
ii) as acceleration is constant



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

$t = 1.5$, $v = 0$

$t = 3$, $v = -15$



iii) The acceleration is the gradient of velocity time graph

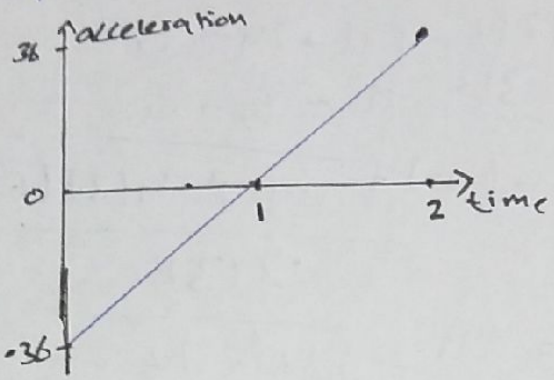
iv) The acceleration is constant, the velocity decrease at constant rate

Q5 i) $x = 6t^3 - 18t^2 - 6t + 3$

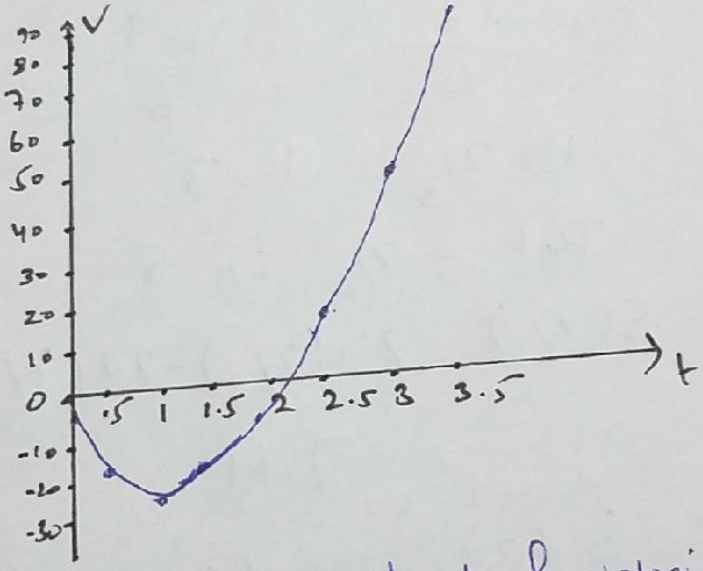
$v = 18t^2 - 36t - 6$, $a = 36t - 36$

ii)

t	0	1	2
a	-36	0	36



t	0	0.5	1	1.5	2	2.5	3	3.5
v	-6	-19.5	-24	-19.5	-6	16.5	48	88.5



iii) The acceleration is the gradient of velocity time graph, the velocity is minimum when the acceleration is zero.

iv) It starts in the negative direction, V is initially -6 and decrease to -24 when t=1, before increasing rapidly to zero, where object turns round to move in the positive direction.

Pg#4 Q6

i) $S = 24t - 22t^2 + 4t^3$

$V = 24 - 44t + 12t^2 \Rightarrow V(2) = 24 - 44(2) + 12(2)^2 = -16$

$a = -44 + 24t = a(2) = -44 + 24(2) = 4\ ms^{-2}$

ii)

$V = 24 - 44t + 12t^2$

$V = 0$

$12t^2 - 44t + 24 = 0$

$3t^2 - 11 + 6 = 0$

$$t = \frac{-(-11) \pm \sqrt{(-11)^2 - 4(3)(6)}}{2(3)}$$

$$= \frac{11 \pm \sqrt{121 - 72}}{6}$$

$$= \frac{11 \pm 7}{6}$$

$t = \frac{11+7}{6}$, $\frac{11-7}{6}$

$t = 2/3$ $t = 3$

Put $t = 2/3$ in S

$S(2/3) = 24(2/3) - 22(2/3)^2 + 4(2/3)^3$

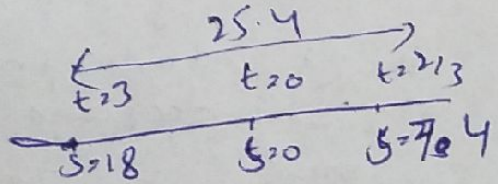
$= 7.4$

Now $t = 3$

$S(3) = 24(3) - 22(3)^2 + 4(3)^3$

$= -18$

distance covered



NOTE: distance always positive

$= 7.4 + 18$

$= 25.4$

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Pg#5

Q7

$x = 21 - 15t + 9t^2 - t^3$

$V = -15 + 18t - 3t^2$

at rest, $V = 0$

$-3t^2 + 18t - 15 = 0$

$3t^2 - 18t + 15 = 0$

$$t = \frac{-(-18) \pm \sqrt{(-18)^2 - 4(3)(15)}}{2(3)}$$

$$= \frac{18 \pm \sqrt{324 - 180}}{6}$$

$$= \frac{18 \pm \sqrt{144}}{6}$$

$$t = \frac{18 \pm 12}{6}$$

$t_2 = \frac{18+12}{6} = 5$, $t_1 = \frac{18-12}{6}, 1$

$a = \frac{dv}{dt} = 18 - 6t$

$a(t_1) = 18 - 6(1)$, $a(t_2) = 18 - 6(5)$

$a(1) = +12\ ms^{-2}$, $a(5) = -12\ ms^{-2}$

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