One Dimensional Motion TUTORIAL.

Pg 44 3, 11, 21

Pg 45 25, 30, 36, 37

Pg 46 1, 5

Pg 47 11, 16, 17, 18

Pg 48 20, 21, 25, 27, 28

Pg 49 31, 34, 35

Pg 50 38, 39, 42

Pg 51 44, 46, 47, 50, 51

Pg 52 57, 58, 59

Pg 53 6, 7

Pg 54 11, 12

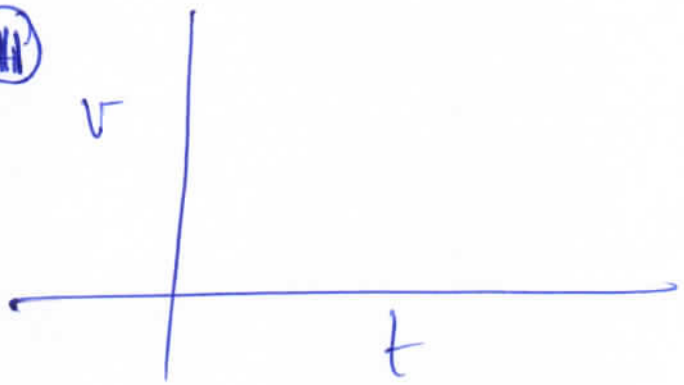
Pg 55 13, 15, 17

Pg 57-59 Comp 1, 3, 4.

Pg 44

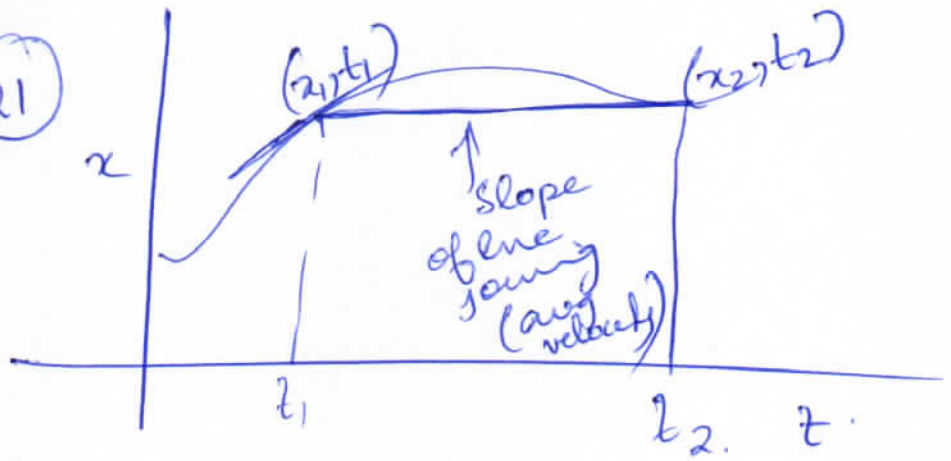
(3) No

(11)



displacement.

(21)



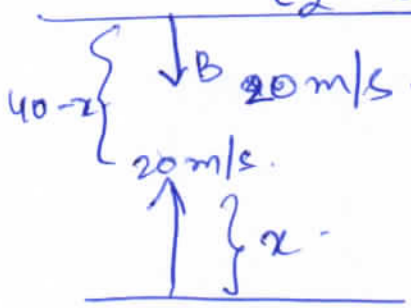
Slope at any point $= \frac{dx}{dt}$.

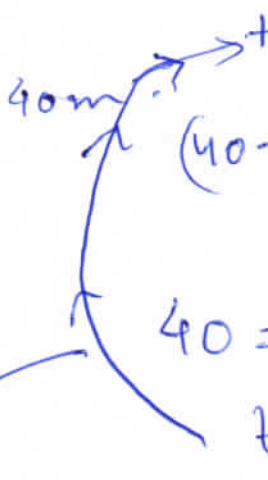
= instantaneous velocity.

$$\frac{x_2 - x_1}{t_2 - t_1}$$

Pg 45

(25)





$$+x = 20t - \frac{1}{2}gt^2$$

$$(40 - x) = 20t + \frac{1}{2}gt^2.$$

$$40 = 40t$$

$$t = 1\,s.$$

$$x = 20(1) - \frac{1}{2}(9.8)(1)^2$$

$$= 20 - 4.9 = 15.1\,m.$$

(30) $a = (3t^2 + 2t + 2)\ m/s^2$

$v_0(t=0) = 2\ m/s$.

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

$$\int_2^v dv = \int_0^2 a\, dt.$$

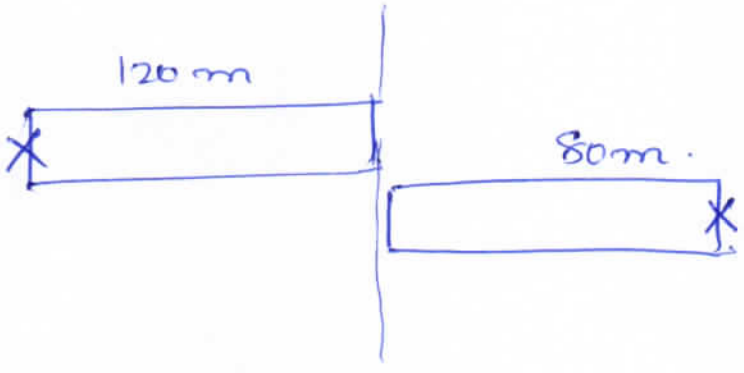
$$v\Big]_2^v = \int_0^2 (3t^2 + 2t + 2)\, dt$$

$$v - 2 = \frac{3t^3}{3} + \frac{2t^2}{2} + 2t \Big]_0^2$$

$$v = 2 + \left(8 + 4 + 4 \right)$$

$$= 2 + 16 = 18\ m/s$$

(36)



$$\frac{200\ m}{472 \times \frac{5}{18}} = 10\ s$$

(37)

$$s = 1200 + 720 = 1920 \text{ m}.$$

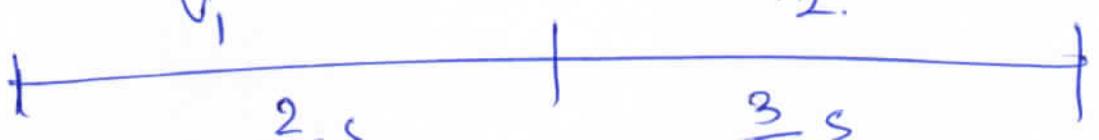
$$v_{avg} = \frac{s}{t_{tot}} = \frac{1920}{420} = \frac{32}{7} \text{ m/s}.$$

Pg 46

(1) (D)

Pg

(5)



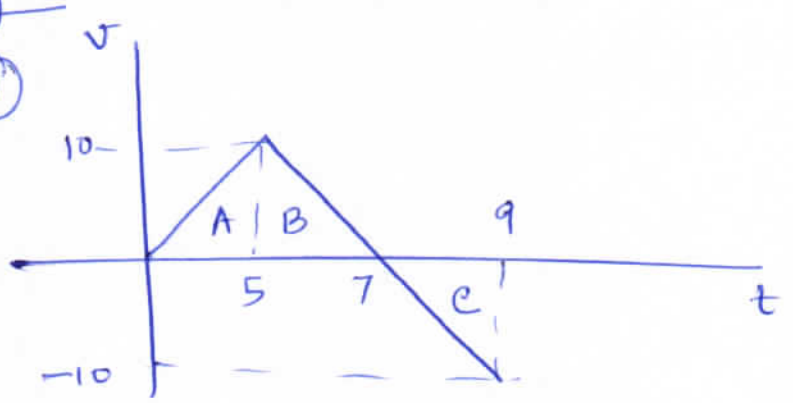
$$t_1 = \frac{2s}{5v_1} \qquad t_2 = \frac{3s}{5v_2}.$$

$$v_{avg} = \frac{s}{t_1 + t_2} = \frac{s}{\frac{2s}{5v_1} + \frac{3s}{5v_2}} = \frac{s}{\frac{2sv_2 + 3sv_1}{5v_1v_2}}$$

(D) $\frac{5v_1v_2}{2v_2 + 3v_1}$ $\Longleftarrow$ $= \frac{5v_1v_2 s}{s(2v_2 + 3v_1)}$

Pg 47

(11)



$A = \frac{1}{2} \times 5 \times 10 = 25\ m$

$B = \frac{1}{2} \times 2 \times 10 = 10\ m$

$C = \frac{1}{2} \times 2 \times 10 = -10\ m$

displacement = A + B + C

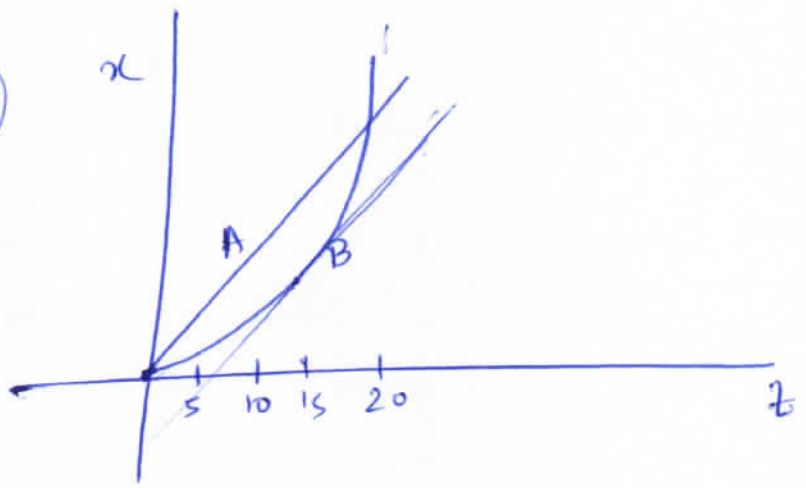
distance = |A| + |B| + |C|

= 25 + 10 + 10

= 45 m

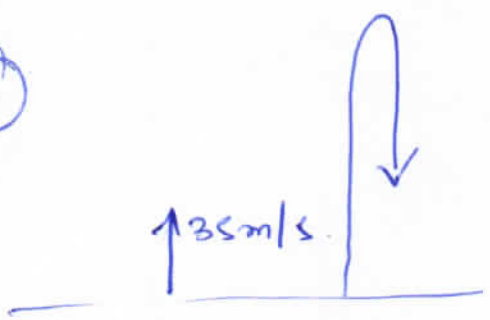
(D)

(16)



(B) 12 s.

(17)



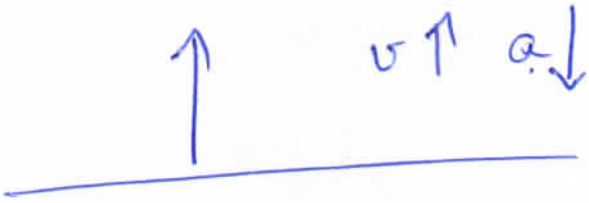
$v = u + at$.

$v = 35 + (-10)(5)$

$= -15\ m/s$.

(B) is downwards.

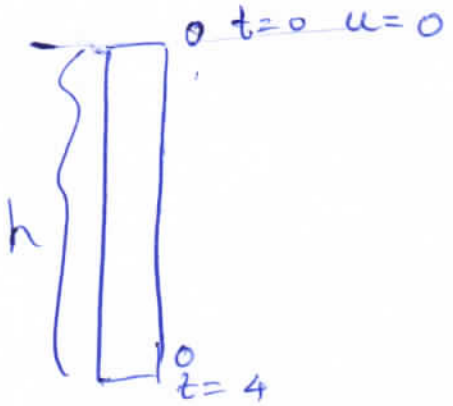
(18)



(D)

Pg 48

(20)

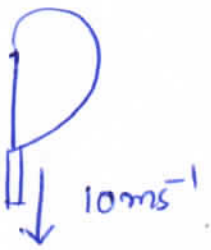


↓ +ve.

$+h = 0 \times 4 + \frac{1}{2}(10) \times 4^2$

$h = 80\ m$ (A)

(21)



$u = 10\ ms^{-1}$ ↓ +ve.

$a = +10\ m/s^2$

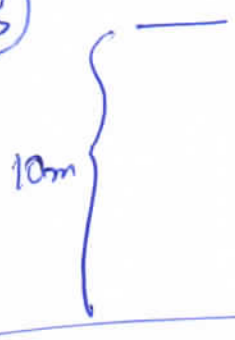
$t = 20\ s$.

$v = u + at$

$= +10 + (10)(20)$

$= 210\ ms^{-1}$ (B)

(23)



Concept of Impulse.

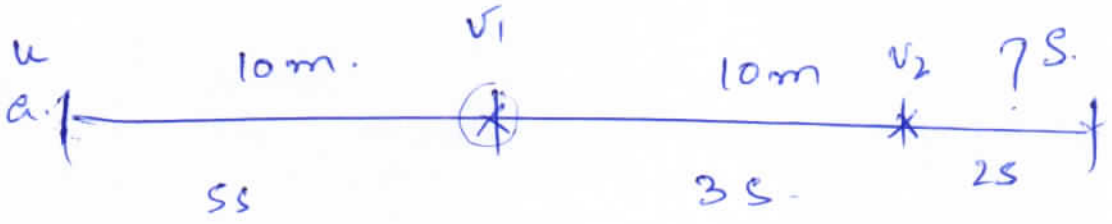
(27)

$u = 0 \quad a = 5 m/s^2 \quad v = ? \quad$ at $t = 10s$

$v = u + at$

$= 0 + 5 \times 10 = 50 m/s$ (A)

(28)



$S = ut + \frac{1}{2}at^2$

$10 = 5u + \frac{25a}{2}$ ⟶ $20 = 10u + 25a$ ⟶ $4 = 2u + 5a$

$20 = 8u + \frac{64a}{2}$ ⟶ $20 = 8u + 32a$

$5 = 2u + 8a$

$\frac{1.33}{3} = \frac{4}{3 \times 3} \frac{4}{9}$

$a = \frac{1}{3} m/s^2$

$u = 7/6 m/s$

$8 + 20 = 10u + \frac{100a}{2}$

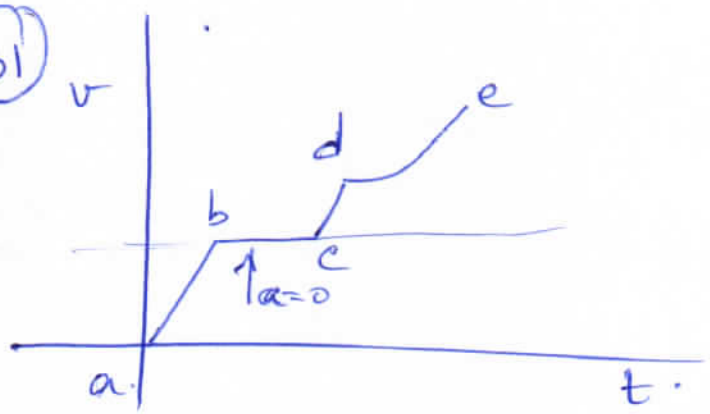
$S = (10u + 50a - 20)$

$= 10\left(\frac{7}{6}\right) + 50\left(\frac{1}{3}\right) - 20$

$= \frac{85 - 60}{3} = \frac{25}{3} m \quad 8.3 m$ (A)

Pg 49

(31)



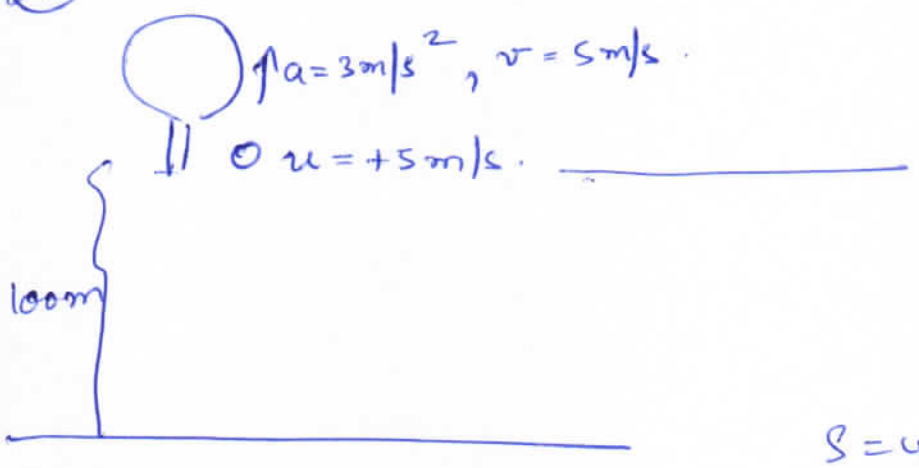
No Force ⟹ No accelerat.

⇓

const velocity

bc (B)

(34)



$$s = ut + \frac{1}{2}at^2$$

$$-100 = 5t + \frac{1}{2}(-10)t^2$$

$$-100 = 5t - 5t^2$$

$$5t^2 - 5t - 100 = 0$$

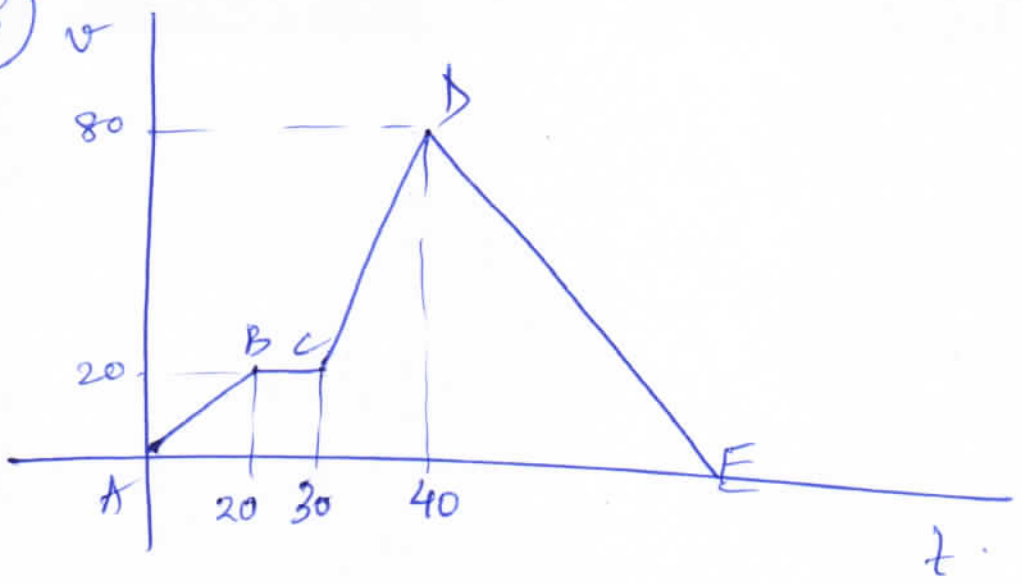
$$t^2 - t - 20 = 0$$

$$t^2 - 5t + 4t - 20 = 0$$

$$t(t-5) + 4(t-5) = 0$$

$$t = 5s \qquad t = -4$$

35



greatest slope. CD. $= \frac{80-20}{40-30}$

(D) $= \frac{60}{10} = 6 \text{ cm/s}^2$

Pg 50

38 $x = (2t^2 + t + 5)\text{m}$ $\quad a\,(t=2s)$

$v = \frac{dx}{dt} = (4t+1)\text{ m/s}$.

$a = \frac{dv}{dt} = 4 \text{ m/s}^2 \quad \forall\, t$

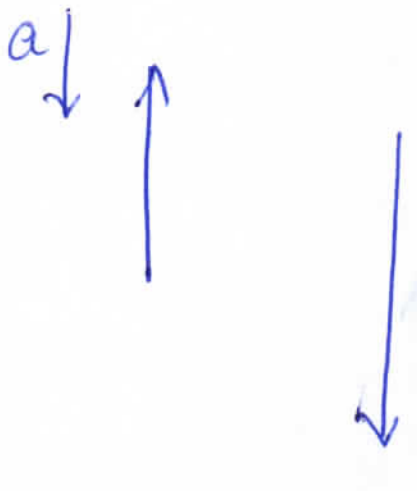
$a(t=2s) = 4 \text{ m/s}^2$ (A)

39 $v = 4t^2 + 3t + 6$ $\quad a\,(t=2s)$.

$a = \frac{dv}{dt} = 8t + 3$

$a(t=2) = 8(2) + 3 = 19 \text{ m/s}^2$ (C)

(42)



accelerat upwards $= (a+g)\downarrow$

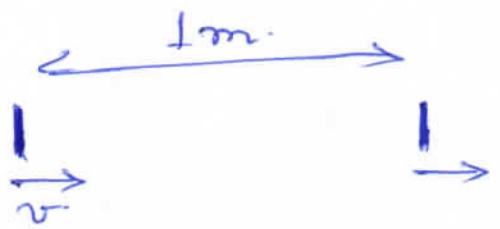
acceleration downward moher $= (g-a)\downarrow$

$S = ut + \frac{1}{2}at^2$

$S \propto at$

$a\uparrow \; t\downarrow$

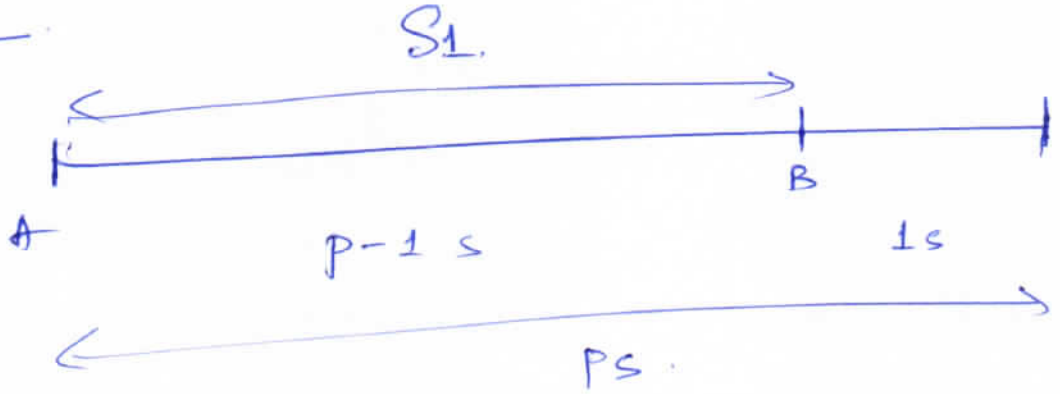
$a\downarrow \; t\uparrow$



(B)

Pg 51

(44)



$S_1 = u(p-1) + \frac{1}{2}a(p-1)^2 \quad \Rightarrow S_1 = \frac{1}{2}a(p-1)^2$

$S_2 = u(p) + \frac{1}{2}a p^2 \quad \Rightarrow S_2 = \frac{1}{2}a p^2$

$S_2 - S_1 = u + \frac{1}{2}a(2p-1)$

$(p^2-p+1)^{th}$ s.

$= S(p^2-p+1) - S(p^2-p)$

$= \left[u(p^2-p+1) + \frac{1}{2}a(p^2-p+1)^2\right] - \left[u(p^2-p) + \frac{1}{2}a(p^2-p)^2\right]$

$= u + \frac{1}{2}a(1)(2(p^2-p)+1)$

$S = \underset{0}{u} + \frac{1}{2}a(2p^2-2p+1)$

$S = \frac{1}{2}a(p^2-2p+1+p^2)$

$= \frac{1}{2}a((p-1)^2 + p^2)$

$= \frac{1}{2}a(p-1)^2 + \frac{1}{2}ap^2$

$= S_1 + S_2$

$S_{(p^2-p+1)} = u + \frac{1}{2}a(2(p^2-p+1)-1)$

$= u + \frac{1}{2}a(2p^2-2p+1)$

(46)

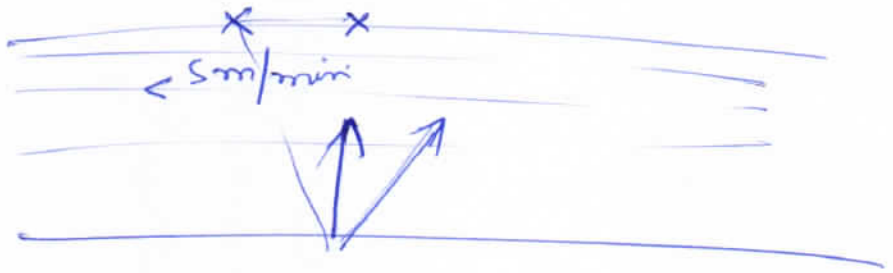
$V_B = 3i + 4j$

$V_R = -3i - 4j$

$V_{BR} = \vec{V_B} - \vec{V_R} = (3i+4j) - (-3i-4j)$

$= \underline{6i + 8j}$ (C)

(47)



due North

(A)

(50) $x = (t^2 - 6t^3 + 6)\,m.$

$v = \frac{dx}{dt} = (6t - 18t^2 + 0)\,m.$

$= 6(t - 3t^2)$

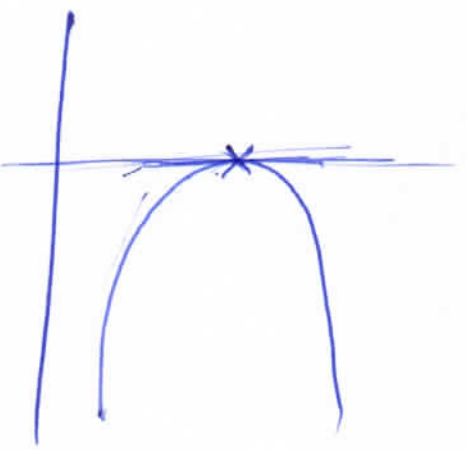
$= 6(-3t^2 + t)$

$= 18\left(-t^2 + \frac{t}{3}\right)$

$\frac{dv}{dt} = 6 - 36t$

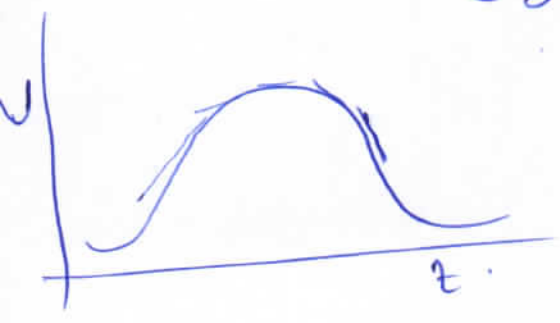
$t = \frac{1}{6}\,s.$

$v = 18\left(\frac{1}{36} - \left(t - \frac{1}{6}\right)^2\right)$



$t^2 - 2\left(\frac{1}{6}\right)t + \left(\frac{1}{6}\right)^2$

$-t^2 + \frac{t}{3} - \frac{1}{36} + \frac{1}{36}$



$t = \frac{1}{6}\,s$

(51) $a > 0$

$x_1 \longrightarrow \frac{d^2x_1}{dt^2} = 0 - 3(2.7)t^2$

$a_1 = \frac{d^2x_1}{dt^2} = -6(2.7)t$

$t > 0 \quad a_1 < 0$

$x_2 \quad a_2 \quad \frac{d^2x_2}{dt^2} = +6(2.7)t$

$t > 0 \quad a_2 > 0$

$x_3 \quad a_3 = \frac{d^2x_3}{dt^2} = -2(2.7)$

$t > 0 \quad a_3 < 0$

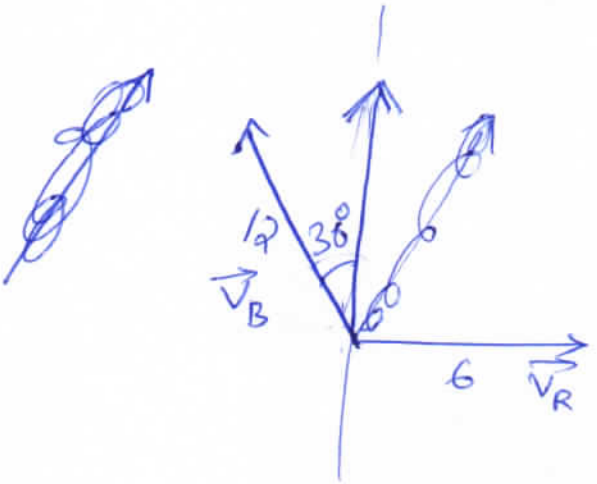
$x_4 \quad a_4 = \frac{d^2x_4}{dt^2} = -2(2.7)$

$t > 0 \quad a_4 < 0$

only 2 ...

Pg 52

57

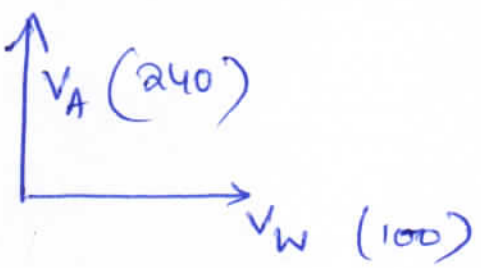


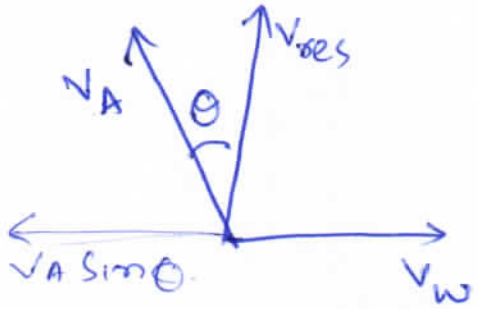
$$\vec{V}_S = \vec{V}_B + \vec{V}_R$$

$$= (12\cos 30\, j - 12\sin 30\, i) + 6i$$

$$= \underline{6\sqrt{3}\, j} \qquad (B)$$

58



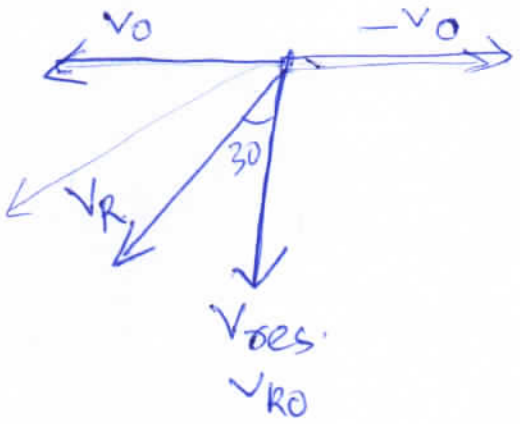


$$V_A \sin\theta = V_W$$

$$\sin\theta = \frac{V_W}{V_A} = \frac{5}{12}$$

$$\theta = \sin^{-1}\frac{5}{12} \qquad (A)$$

(59)



$V_{RO} = V_R - V_0$

$= (V_R \cos 30(-j)$

$+ V_R \sin 30(-i)$

$+ 10\,i$

~~$V_R \sin 30 \neq V_0$~~

$V_{RO} = (-V_R \cos 30\, j + (10 - V_R \sin 30) i$

$\downarrow$

0

$10 = V_R \sin 30$

$V_R = \frac{10}{\sin 30} = 20 \text{ km/hr}$

Pg 53

(6) ~~A~~ B D

(7) A B C D.

Pg 54

(11) $x = \frac{a}{b}(1 - e^{-bt})$

$v = \frac{dx}{dt} = \frac{a}{b}(0 + be^{-bt})$

$= ae^{-bt}.$

$a = \frac{dv}{dt} = -abe^{-bt}$

$\frac{de^x}{dx} = e^x$

$\frac{de^{ax}}{dx} = ae^{ax}$

$$x\left(t=\frac{1}{b}\right) \Rightarrow \frac{a}{b}\left(1-e^{-b/b}\right) = \frac{a}{b}\left(1-e^{-1}\right)$$

$$= \frac{a}{b}\left(1-\frac{1}{3}\right)$$

$$= \frac{2a}{3b} \quad (A)$$

$$v(t=0) = ae^{-0} = a$$

$$a(t=0) = -abe^{-0} = -ab \quad \Big\} (B)$$

(C) ✓ $\quad \therefore x = \frac{a}{b}\left(1-\underbrace{e^{-bt}}_{>0}\right)$

$$x < \frac{a}{b}.$$

$$x(t=0) \Rightarrow x = 0$$

$$x(t=\infty) \Rightarrow x = \frac{a}{b}\left(1-e^{-b\infty}\right) \quad \text{ABC} \checkmark$$

$$= \frac{a}{b}\left(1-\frac{1}{e^{b\infty}}\right)$$

$$x \to \frac{a}{b}.$$

(12)

$u = v_0$

$a = -\alpha v$

$$\frac{dv}{dt} = -\alpha v$$

$$\int_{v_0}^{v} \frac{dv}{v} = \int_{0}^{t} -\alpha \, dt$$

$$\int x^n dx = \frac{x^{n+1}}{n+1}$$

$$\int \frac{1}{x} dx = \ln x$$

$$\ln v \Big]_{v_0}^{v} = -\alpha t \Big]_0^t$$

$$\ln v - \ln v_0 = -\alpha t$$

$$\ln A - \ln B = \ln \left(\frac{A}{B}\right)$$

$$\ln \left(\frac{v}{v_0}\right) = -\alpha t$$

$$\log A + \log B = \log AB.$$

$$\log_e \left(\frac{v}{v_0}\right) = -\alpha t$$

$$\frac{v}{v_0} = e^{-\alpha t}$$

$$\log_{10} x = y$$

$$x = 10^y$$

$$\log_b a = x$$

$$a = b^x$$

$$\boxed{v = v_0 e^{-\alpha t}}$$

$$a = -\alpha v$$

$$\boxed{a = -\alpha v_0 e^{-\alpha t}}$$

$$v = v_0 e^{-\alpha t}$$

$$\frac{dx}{dt} = v_0 e^{-\alpha t}$$

$$dx = v_0 e^{-\alpha t}\, dt$$

$$x = \int_{t=0}^{t=\infty} v_0 e^{-\alpha t}\, dt$$

$$\int e^x dx = e^x$$

$$\int e^{ax} dx = \frac{e^{ax}}{a}$$

$$= v_0 \left[\frac{e^{-\alpha t}}{-\alpha} \right]_0^{\infty}$$

$$= 0 - \left(v_0 \times \frac{1}{-\alpha} \right)$$

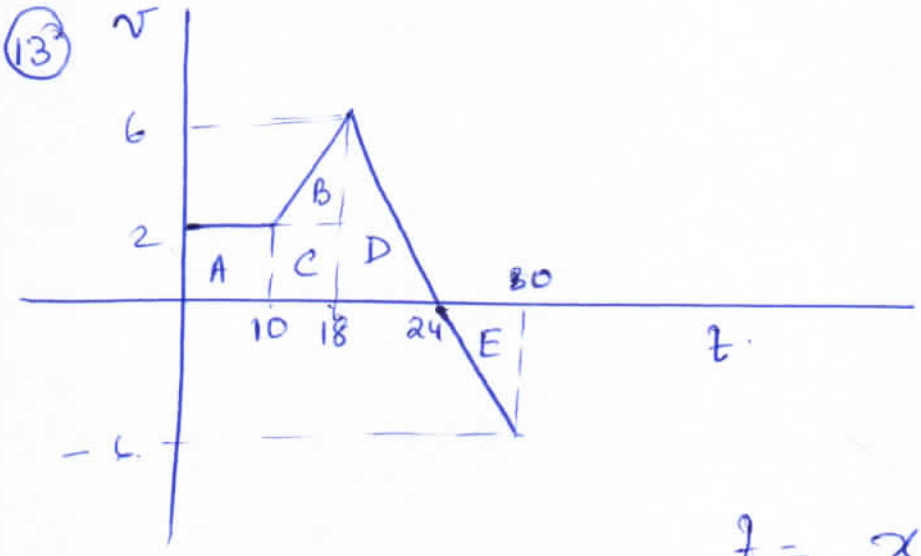
$$= \frac{v_0}{\alpha} \checkmark$$

B ✗

C ✓

Pg 55

(13)



$$\begin{cases} A = +20 \\ B = \frac{1}{2} \times 8 \times 4 = +16 \\ C = 2 \times 8 = +16 \\ D = \frac{1}{2} \times 6 \times 6 = +18 \\ E = -\frac{1}{2} \times 6 \times 6 = -18 \end{cases}$$

$t =$ $x = -16m$
$+70$

$+54m$

A ✓

$t = 18$

$x = -16$ $\quad t = 0$

$A+B+C = +52$ $\quad t = 18$

36

B ✓

$t = 30$

$x = -16$ $\quad t = 0$

$A+B+C+D+E = +52$ $\quad t = 30$

36

D ✓

(15) $\vec{v_1}$ & $\vec{v_2}$

$\vec{v_2} - \vec{v_1}$

v_{rel}

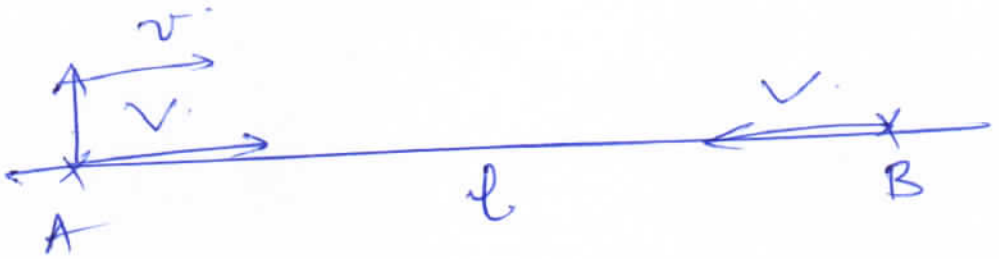
$|v_{rel}| = \sqrt{v_1^2 + v_2^2}$  A)

$|v_{rel}| = v_1 + v_2$ ✓ B)

$|v_{rel}| = v_1 - v_2$ ✓

$|v_{rel}| = 0$ ✓ C)

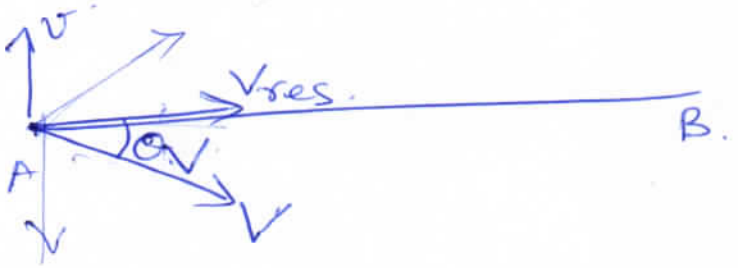
$v_{rel} > c$ ← speed of light ✗

(17) 

A) $t = \frac{l}{V+v} + \frac{l}{V-v}$

$t = \frac{2lV}{V^2 - v^2}$ A).

B) 



$V \sin\theta = v$

$\sin\theta = \frac{v}{V}$

$V_{res} = V \cos\theta$

$t = \frac{2l}{V\cos\theta}$

$\sin^2\theta + \cos^2\theta = 1$

$\cos\theta = \sqrt{1 - \sin^2\theta}$

$= \sqrt{1 - \frac{v^2}{V^2}} = \frac{\sqrt{V^2 - v^2}}{V}$

$t = \frac{2l}{V\frac{\sqrt{V^2-v^2}}{V}} = \frac{2l}{\sqrt{V^2-v^2}}$

e) $t = \frac{2l}{1 - \frac{v^2}{V}}$ $\quad t = \frac{2l}{V \times 1}$

$\frac{2l}{\sqrt{V^2-v^2}} = \frac{2l}{V\sqrt{\frac{V^2-v^2}{V^2}}}$

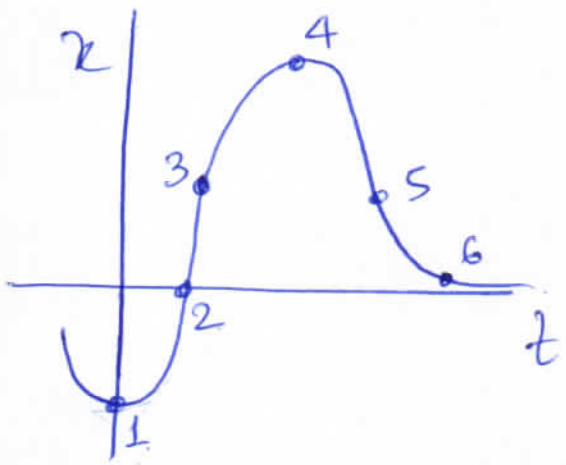
$= \frac{2l}{V\sqrt{1 - \frac{v^2}{V^2}}}$

D) ✓

A, B, C, D ✓

Pg 57

Comp 1.



1) D

2) A

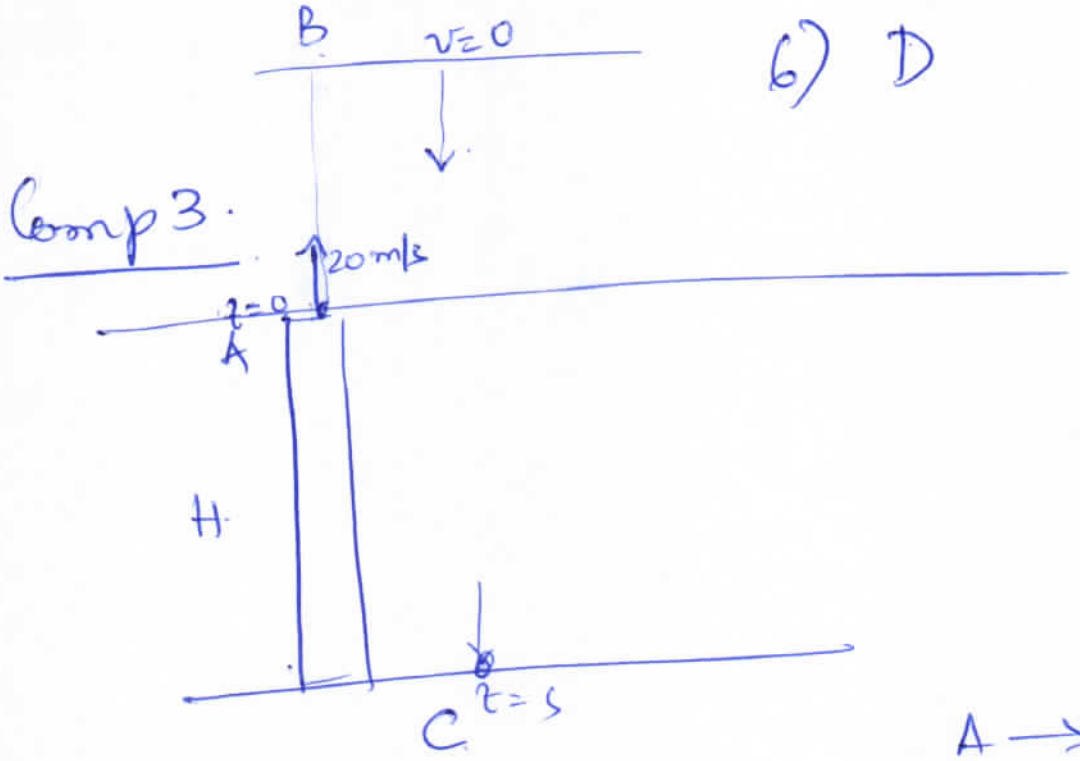
3) C

4) A

5) C

6) D

Comp 3.



A → B

$u = +20$

$v = 0$

$a = -10$

$v^2 - u^2 = 2as$

$0^2 - 20^2 = 2(-10)s$

$s = +20\ m$

10) $-25j$ D)

11) $-\frac{25}{5}.j = -5j$ B)

A → C

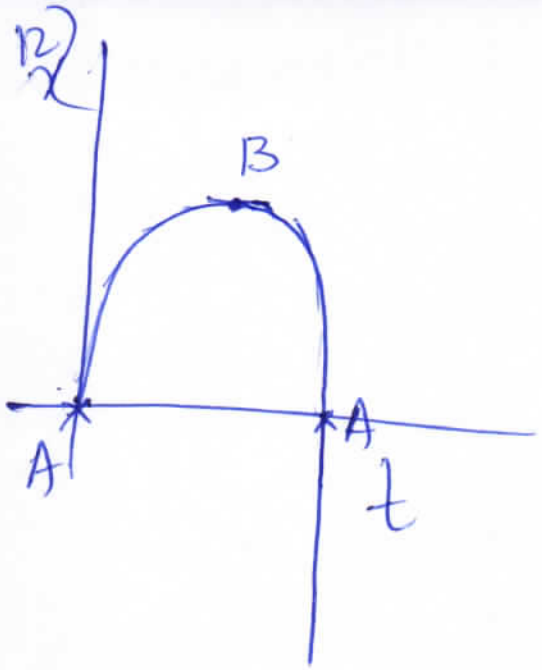
$s = ut + \frac{1}{2}at^2$

$-H = 20(5) + \frac{1}{2}(-10)(25)$

$-H = 100 - 125$

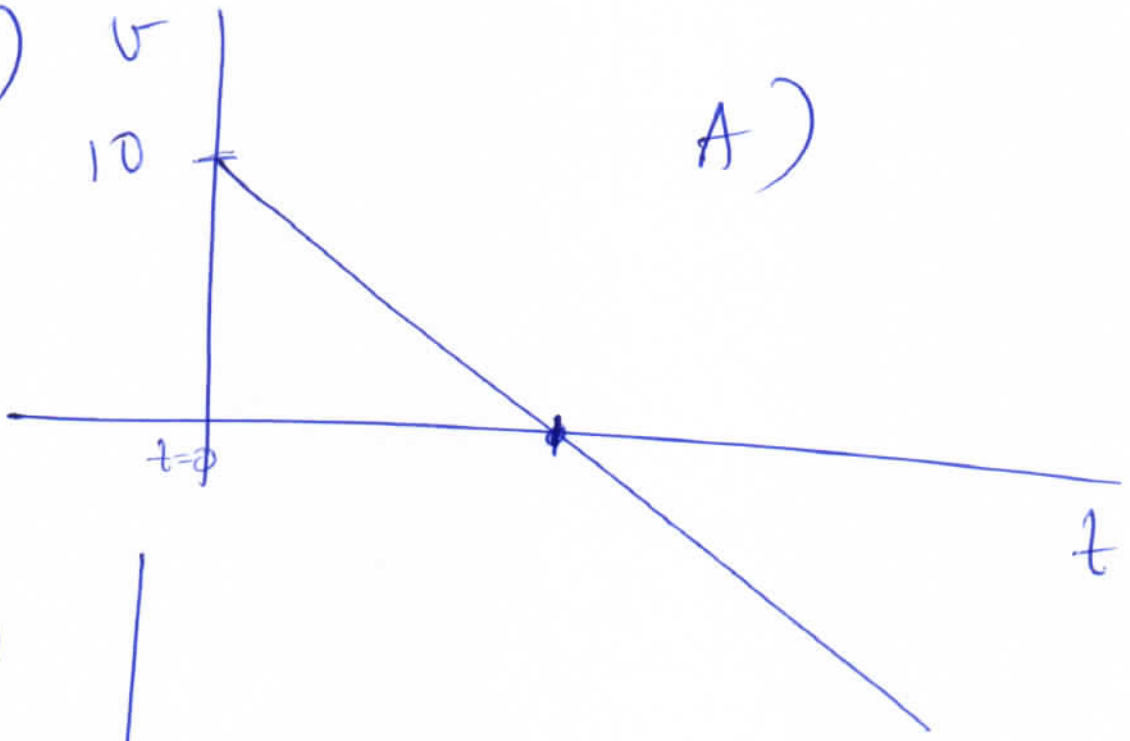
$H = 25$

12)



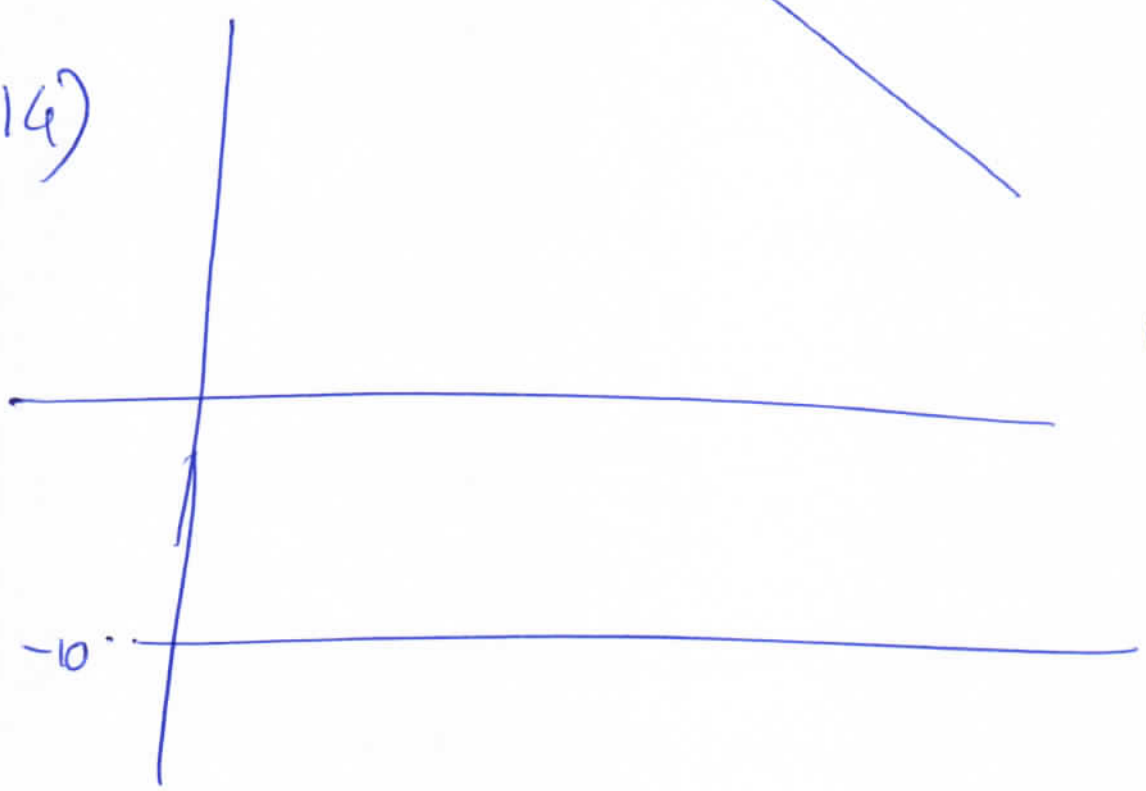
A) ~ .

13)



A)

14)

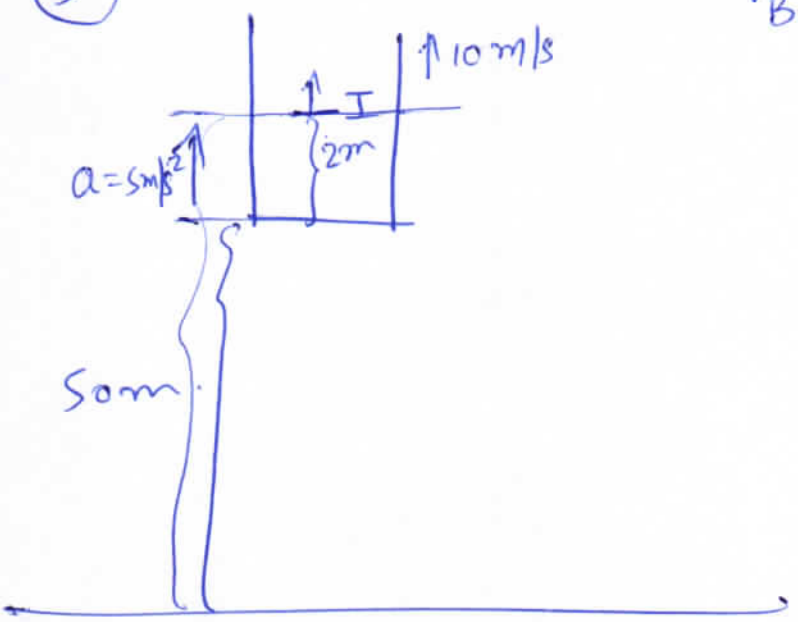


C) ~ .

Comp 4

M

(5)



$V_{BG} = V_B + V_E = 10 + 15 = 25 m/s$

I → M

$u = 25$	$v = u + at$
$a = -10$	$t = \frac{v-u}{a}$
$v = 0$	$= \frac{0-25}{-10}$
	$= 2.5 s$

$v^2 - u^2 = 2as$

$0^2 - 25^2 = 2(-10)s$

$\frac{125}{\cancel{625}\ \cancel{20}_4} = s$

$s = \frac{125}{4}$

$= 31.25 m$

(16)

$31.25 + 52 = 83.25$

(C)

let ball & elevator meet in time t

$S_E - S_B = +2$

$\left(10t + \frac{1}{2} \times 5t^2\right) - \left(25t - \frac{1}{2} \times 10t^2\right)$ (16)

$= 2$

$-15t + \frac{15}{2}t^2 = 2 \Rightarrow 15t^2 - 30t - 4 = 0$

$t = \frac{30 \pm \sqrt{900 + 240}}{30}$

$\frac{1 \pm \sqrt{1140}}{30}$

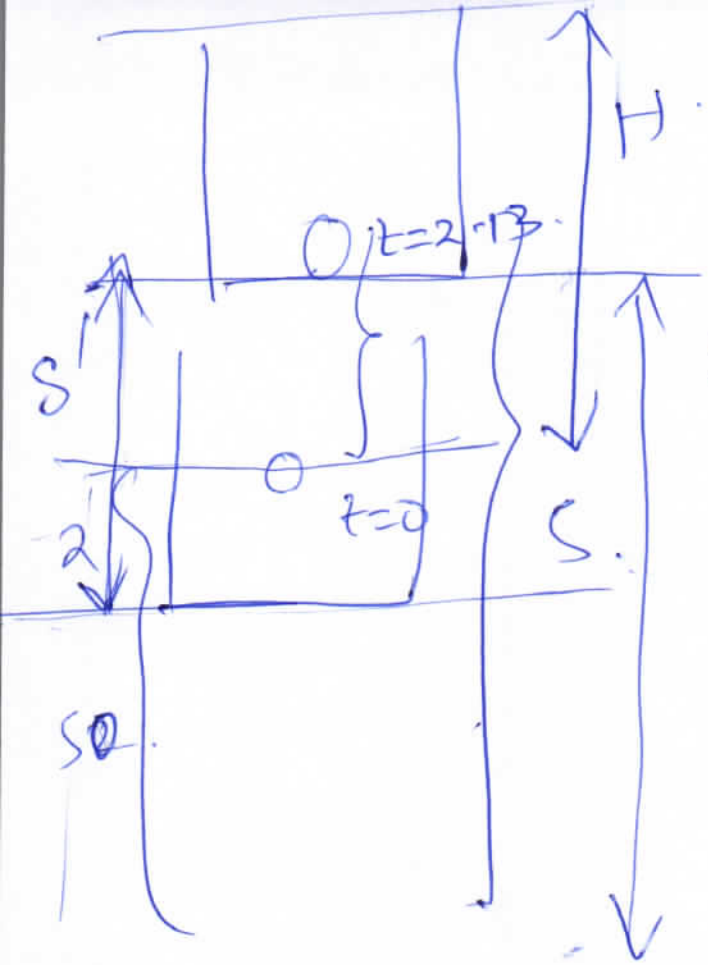
$\frac{1 \pm 33.7}{30}$

$= 1 + 1.1$

$= 2.1$ (A)

$3\overline{)1140.00}$ (9) $63\overline{)240}$ (189) $66\overline{)5100}$

$30\overline{)33.7}$ (30) (3) 1.1



$$S' = 10(2\cdot13) + \frac{1}{2} \times 5 (2\cdot13)^2$$

$$= 21\cdot3 + 2\cdot5(4\cdot5)$$

$$= 21\cdot3 + 11\cdot25$$

$$= 32\cdot55$$

2·13

$$S = S' - 2.$$

$$= 32\cdot55 - 2 = \underline{30\cdot55}$$

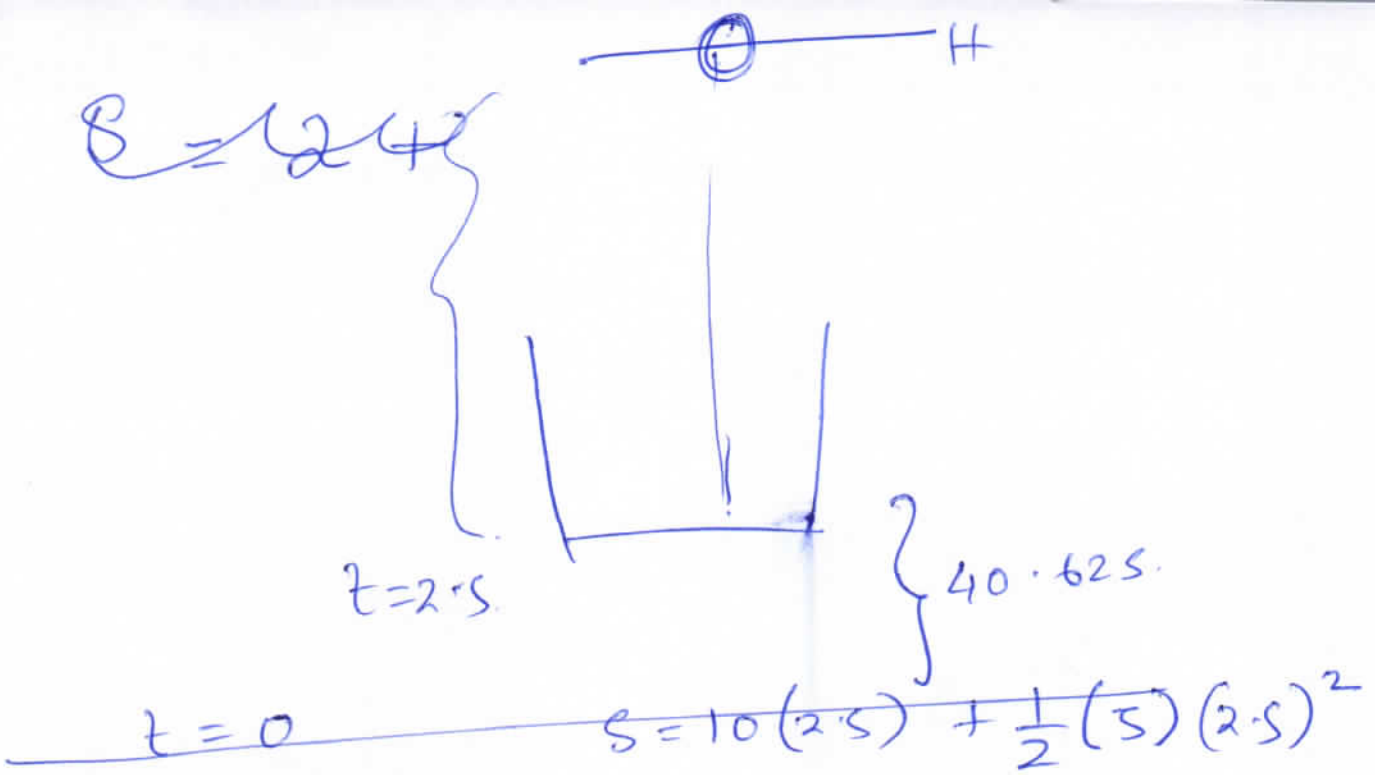
(D)

$2H - 30\cdot64.$

$2(31\cdot25) - 30\cdot64$

$62\cdot5 - 30\cdot64 = 31\cdot86m$

(B)



$V_B = 25 - 10t$]
$V_E = 10 + 5t$]

$25 - 10t = 10 + 5t$

$15 = 15t$

$t = \underline{1\ s}$

$S_B = 25(1) - \frac{1}{2} \times 10 \times 1^2 = 20$

$S_E = 10(1) + \frac{1}{2}(5)(1)^2 = 12.5$

7·5 9·5