حلول الأوت لاين
فيزياء 141
شابترز (1 - 10)

* أصدقائي بإمكانكم التأكد من إجاباتكم على الأسئلة ذات الأرقام الفردية (1،3،5...) بالرجوع للملحق الموجود في نهاية الكتاب..

♡ فيزياء سعيدة .. وسلامات زهيدة ^^
صديقتكم وزميلتكم سجود حمايل

* الأصدقاء المتعاونون في هذا الإنجاز :-

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محمد السويطي ..

Chapter 1

Q_3 :

$$\frac{1 \text{ mile}}{1 \text{ houre}} = \frac{1609}{60*60} = \frac{1609}{3600} = 0.45 \text{ m/s}$$

Q_5 :

24 frames → 1 s

?? ← → 2 hour = (2×3600) s

$= 172800$

$= 1.7 * 10^5$ frames

Q_7 :

$$S = \frac{d}{t} \Rightarrow 70 \text{ mi/h} = \frac{d}{1 \text{ year}}$$

$$\frac{70 \text{ mil}}{60*60 \text{ s}} = \frac{d}{365*60*60*24 \text{ s}}$$

$\Rightarrow d = 613200$

$= 6.1 * 10^5$ mi

Q_9 :

$$\text{number of cubical} = \frac{\text{big cubical Volume}}{\text{small cubical Volume}}$$

small Cabical Volume $* 6.02 * 10^{23}$ = big Cubical Volume

$1 \text{ cm} * 6.02 * 10^{23} = V_b \Rightarrow 6.02 * 10^{17} \text{ m}^3$

$V_b = L_b^3 \Rightarrow \sqrt[3]{L^3 = 6.02 * 10^{17}}$

$l = 8.4 * 10^2$ Km

Q_{12}:

$$10^{10}\ \cancel{year} \longrightarrow 10^{6}\ \cancel{year}$$
$$1\ day \longrightarrow ??$$
$$= 10^{-4}\ day$$

Q_{14}:

a) $1\ microcentury = \underbrace{100 * 10^{-6}}_{microcentury} * \underbrace{365}_{\text{day in year}} * \underbrace{24}_{\text{hour in day}} * \underbrace{60}_{\text{min in hour}}$

$$= 52.6\ min$$

b) $\text{percentage difference} = \left(\frac{actual - approximation}{actual}\right) * 100\%$

$$= \left(\frac{52.6 - 50}{52.6}\right) * 100\%$$

$$= 4.87\ \%$$

Q_{18}:

$\Delta t = 30 * (0.001)s = 0.03\ s/century$

$\text{average increase in the length of a day} = \frac{(0 + 0.03)}{2}$

$$= 0.015\ s$$

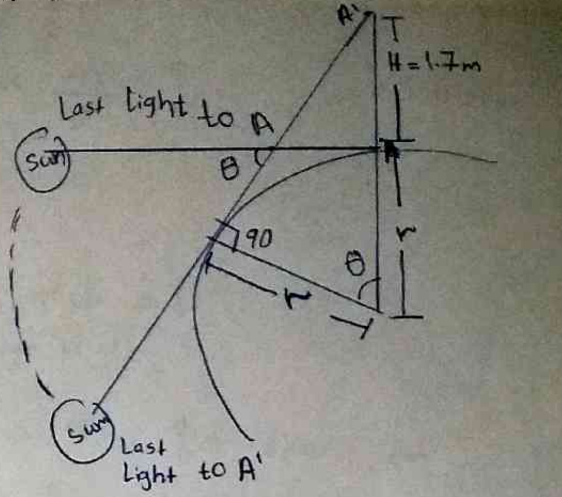
$T = (\text{averege increase in the length of a day}) \cdot (\text{number of day})$

$$= \left(\frac{0.015 s}{\cancel{day}}\right) \cdot \left(3000\ \cancel{year}\right) \cdot \left(\frac{365.25\ \cancel{day}}{\cancel{year}}\right)$$

$$= 16436.25 s$$

$$= 4.56\ h$$

Q19



$$\frac{\theta}{360^\circ} = \frac{1}{24h}$$

$$\frac{\theta}{360} = \left(\frac{11.1s}{24h}\right)\left(\frac{1h}{60min}\right)\left(\frac{1min}{60s}\right)$$

$$\theta = 1.28 * 10^{-4} * 360^\circ$$
$$= 0.0462^\circ$$

$$\cos\theta = \frac{r}{r+H}$$

$$r = \frac{H\cos\theta}{1-\cos\theta} \Rightarrow r = \frac{(1.7m)(\cos 0.0462)}{1 - \cos 0.0462} = 5.21 * 10^6 m$$

Q21:

$$d = \frac{m}{V} = \frac{9.05g}{3.5cm^3} = \frac{9.05 * 10^{-3} Kg}{3.5 * (10^{-2})^3 m^3}$$

$$= 2.6 * 10^3 kg/m^3$$

Q22: A) 29.34 g of gold $= 29.34 g \left(\frac{1 cm^3}{19.32g}\right)$
$= 1.518633 cm^3$

thickness $= 1 \mu m = 1.0 * 10^{-4} cm$

Area of the leaf * thickness = 1.518633

$A * 10^{-4} = 1.518633 \Rightarrow A = 1.5 * 10^4 cm^2$

B) Area of circular base * Length = 1.5

$\pi r^2 * L = 1.5$

$$L = \frac{1.5}{\pi (2.5 * 10^{-4})^2} = 7.7 * 10^6 cm$$

Q24:

$$\rho = \frac{m}{V} \Rightarrow m = V\rho$$
$$= \frac{4}{3}\pi(60*10^{-6})^3(2600)$$
$$= 2.35*10^{-9}\ kg$$

$$a = 4\pi r^2$$
$$= 4\pi(60*10^{-6})^2 = 4.5\times10^{-8}$$

→ mass of $4.5*10^{-8}$ is $2.35*10^{-9}$

⇒ length (a) of side of cube = 1 m

Surface area (A) of a cube $= 6a^2$
$$= 6 * 1m^2$$
$$= 6m^2$$

$$M = \frac{2.35*10^{-9} * 6}{4.5*10^{-8}} = 0.3\ kg$$

Q31:

$$\rho = \frac{m}{V} = \frac{0.02\,g\left(\frac{10^{-3}\,kg}{g}\right)}{(50\,mm^3)\left(\frac{10^{-3}\,cm^3}{1\,mm^3}\right)} = 4.0*10^{-4}\ kg/cm^3$$

The total volume of the candies is expressed as follows:..

$$V' = Ah$$

$$M = \rho V'$$
$$M = \rho A h \Rightarrow \frac{dM}{dt} = \rho A\frac{dh}{dt}$$

$$A = (14.0\,cm)(17.0\,cm) = 238\ cm^3$$

$$\frac{dM}{dt} = \rho A\frac{dh}{dt} \Rightarrow = (4.0*10^{-4}\,kg/cm^3)(238\,cm^3)(0.250\,cm/s)$$
$$= (238*10^{-4}\,kg/s)\left(\frac{60\,s}{1\,min}\right)$$
$$= 1.43\ kg/min$$

②

Chapter 2

(a)

$$V = \frac{d}{t} \rightarrow 1,22 = \frac{73.2}{t_1}$$

$$t_1 = \frac{73.2}{1.22} = 60\,s$$

$$\rightarrow t_2 = \frac{73.2}{2.85} = 25.65$$

$$= (26)(5)$$

$$\vec{V}_{avg} = \frac{\Delta x}{\Delta t} = \frac{73.2 + 73.2}{60 + 26} = 1.7\ m/s$$

(b)

1 min — 1 min

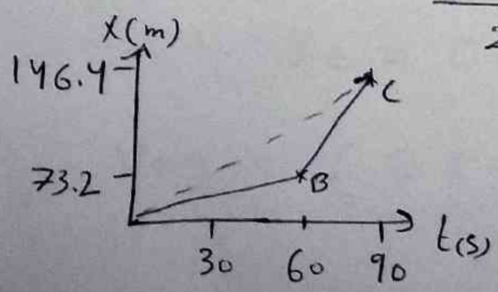
1.22 m/s — 3.05 m/s

d_1

$$d_1 = t \times v = 1 \times 60 \times 1.22 = 73.2\,m$$

$$d_2 = t \times v = 1 \times 60 \times 3.05 = 183\,m$$

$$\bar{V}_{avg} = \frac{73.2 + 183}{2 \times 60} = 2.135\ m/s$$



V_{avg} = slope of AC

$$= \frac{146.4\,m}{84\,s}$$

$$= 1.74\ m/s$$

(27)

$v_0 = 0$

$\left.\begin{array}{l} \Delta x = 2\ cm = 0.02\ m \\ t = 5\ ms = 5 \times 10^{-3}\ s \end{array}\right\} a = ?$

$\Delta x = v_0 t + \frac{1}{2} a t^2$

$0.02 = \frac{1}{2}\ a\ (25)(10^{-6})$

$\frac{0.04}{9 \times 25 \times 10^{-6}} = 17 \times 10^{-04} \times 10^{6} =$

$1,7 \times 10^{2}\ m/s^2$

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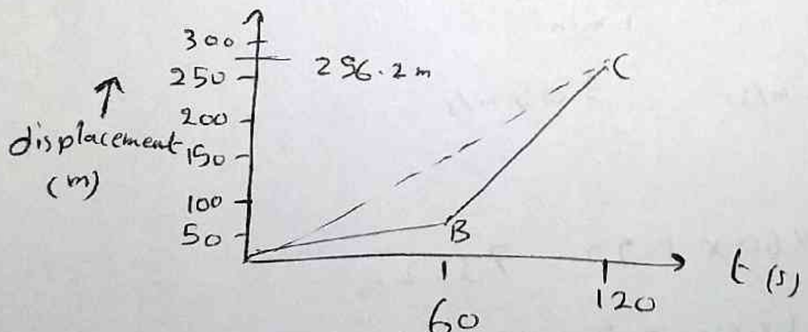
(2) [illegible]

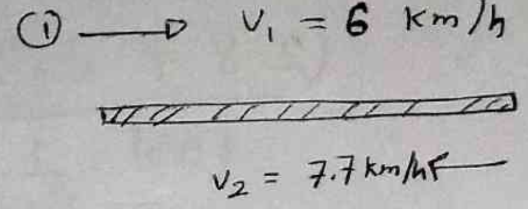


V_{avg} = slope of AC

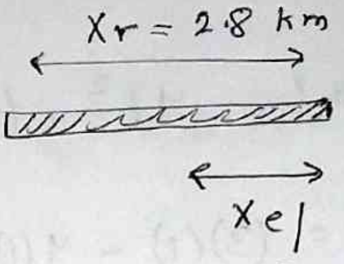
$= \frac{256.2\,m}{120\,s}$

$= 2.135\ m/s$

③



Find : ⓐ V_{avg} ⓑ S_{avg} in the interval (0-35) min



ⓐ $$V_{avg} = \frac{X_f - X_i}{\Delta t}$$

$$= \frac{(X_r - X_e) - X_i}{\Delta t}$$

→ to find X_f : we need to find $\boxed{t_e}$

* $v_1 = \dfrac{d}{t_r}$

$6 = \dfrac{2.8}{t_r} \longrightarrow t_r = 0.467$ h

* $v_2 = \dfrac{d}{t_2}$

$7.7 = \dfrac{2.8}{t_2}$

$t_2 = 0.364$ h

$t_e = 35$ min $- t_r$

$= 35$ min $- 0.467$ h

$= 0.583$ h $- 0.467$ h

$= 0.116$ h

*** then $v_2 = \dfrac{X_e}{t_e} \longrightarrow 7.7 = \dfrac{X_e}{0.116}$

$X_e = 0.893$ km

$$V_{avg} = \frac{(2.8 - 0.893) - 0}{(35) \cdot \frac{1}{(60)}} = 3.269 \text{ Km/h}$$

(g) Graph

(b) $S_{avg} = \frac{X_{tot}}{t_{tot}} = \frac{(2.8 + 0.893)}{(35) \cdot \frac{1}{(60)}}$

$= 6.3 \text{ km/h}$

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

(a) $x(1) = (3)(1) - 4(1)^2 + (1)^3$

$= 0$

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

$= -2 \text{ m}$

(c) $x(3) = (3)(3) - (4)(3)^2 + (3)^3$

$= 0$

(d) $x(4) = (3)(4) - (4)(4)^2 + (4)^3$

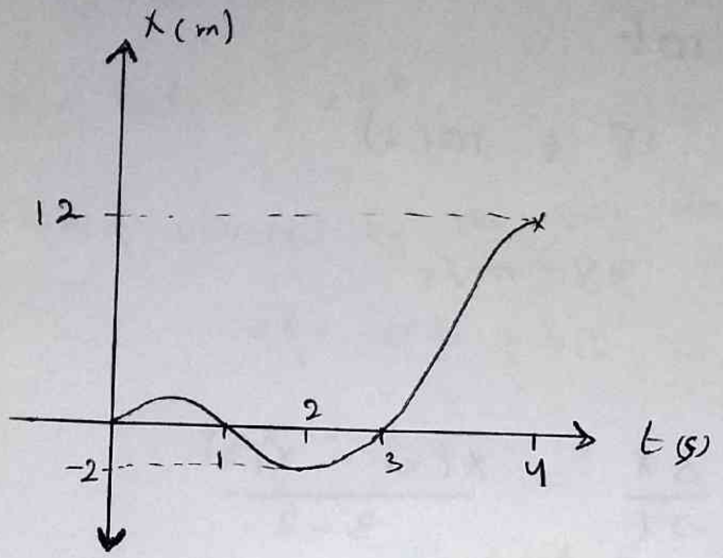
$= 12 \text{ m}$

(e) Δx between $t = 0_s$ and $t = 4_s$

$12 - 0 = 12 \text{ m}$

(f) $V_{avg} = \frac{x(4) - x(2)}{4 - 2} = 7 \text{ m/s}$

(9) Graph x



(14) $X = 16 t e^{-t}$

$X(0) = 0$

$V_f = 0$

$\Delta X = ??$

$\rightarrow v = -16 t e^{-t} + 16 e^{-t}$

$V(0) = 0 + 16$

$= 16$

$V_f = \frac{0}{16} = -\frac{16}{16} t e^{-t} + \frac{16}{16} e^{-t}$

$0 = e^{-t}(-t + 1)$

$e^{-t} = 0$ or $-t + 1 = 0$

impossible then نعوض في معادلة X

$\boxed{t = 1_s} \longrightarrow X(1) = \frac{16}{e}$

$\Delta X = X_2 - X_1$

$= \frac{16}{e}$ m

15

$$X = 18t + 5t^2$$
$$V = 18 + 10t$$

ⓐ $V_{inst}\big|_{t=2} = 18 + 10(2)$

$= 38 \ m/s$

ⓑ $V_{avg} = \dfrac{\Delta X}{\Delta t} = \dfrac{X(3) - X(2)}{3-2}$

$X(3) = 18 \times 3 + 5 \times 3^2 = 99 \ m$

$X(2) = 18 \times 2 + 5 \times 4 = 56 \ m$

$V_{avg} = \dfrac{99 - 56}{1} = 43 \ m/s$

19

$V_0 = 18 \ m/s$

$V_1 = -30 \ m/s$

$t = 2.4 \ s$

$\vec{a}_{avg} = \dfrac{\Delta V}{\Delta t} = \dfrac{-30 - 18}{2.4} = -20 \ m/s$

20

$$X = 25t - 6t^3$$

ⓐ $V(t) = 25 - 18t^2$

$V(t) = 0$

$25 - 18t^2 = 0$

$\sqrt{\dfrac{25}{18}} = t$

$1.178 \ s = t$

23

$V_0 = 0$

$$\Delta X = V_0 t + \frac{1}{2} a t^2$$

the distance covered by the body during the 5^{th} s :-

$$\Delta X_1 = 0 + \frac{1}{2} a (1)^2$$

$$\Delta X_1 = \frac{1}{2} a$$

ΔX coverded in the first 5s :-

$$\Delta X_2 = 0 + \frac{1}{2} a (5)^2$$

$$\Delta X_2 = \frac{1}{2} a \; 25$$

$$\frac{\Delta X_1}{\Delta X_2} = \frac{\cancel{\frac{1}{2} a}}{\frac{1}{2} a (25)} = \boxed{\frac{1}{25}}$$

30 (a) $V_1 = 146 \text{ km/h} = \frac{146 \times 1000}{3600} = 40.6 \text{ m/s}$

$V_2 = 90 \text{ km/h} = \frac{90 \times 1000}{3600} = 25 \text{ m/s}$

$$V_2 = V_1 + at \rightarrow t = \frac{V - V_0}{a}$$

$$t = \frac{25 - 40.6}{-5.2} = \boxed{3 S}$$

the minimum time of the car

(b) $a(t) = -36t$

$a(t) = 0 = -36t$

then $\boxed{t = 0}$

(c) $a(t) = -36t = 0$

$a(t)$ — $+a$ | 0 | $-a$

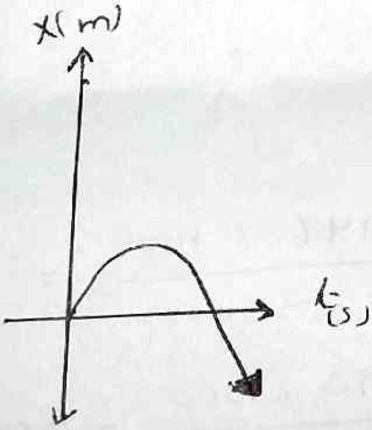
when $t > 0$ then a is negative.

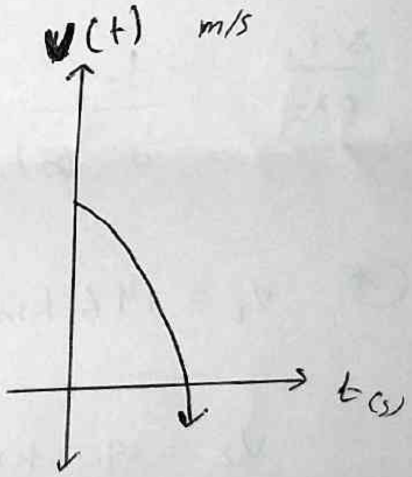
when $t < 0$ then a is positive.

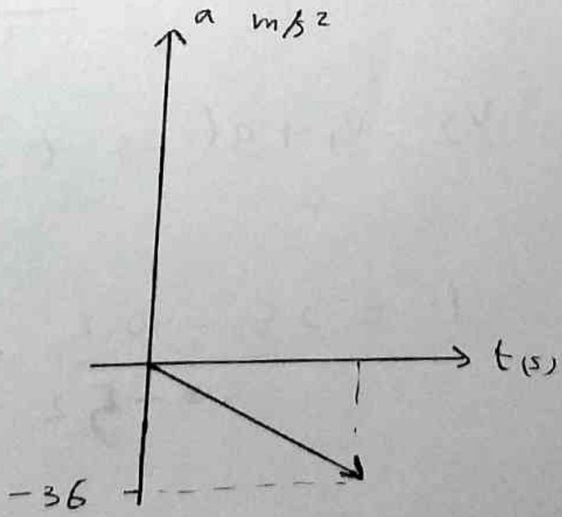
(d)

~~d~~

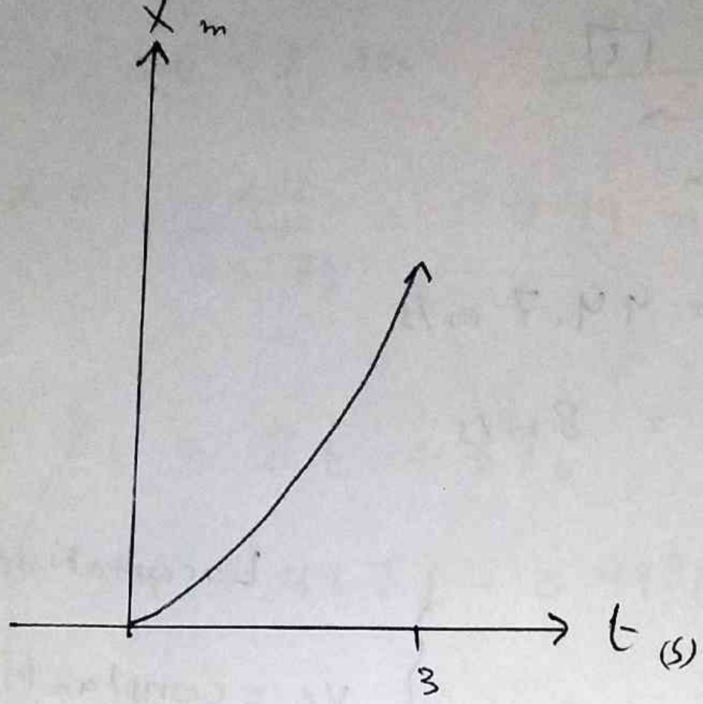
(e)

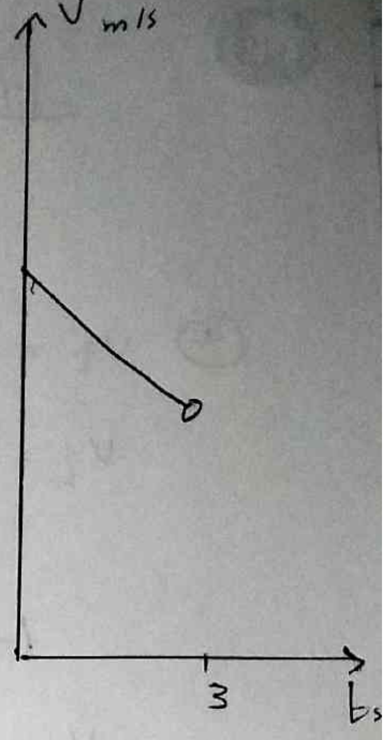






(b)





33

$$\Delta x = v_0 t + \frac{1}{2} a t^2$$

$$-60 = -20 \times t - \frac{1}{2} \times 10 \times t^2$$

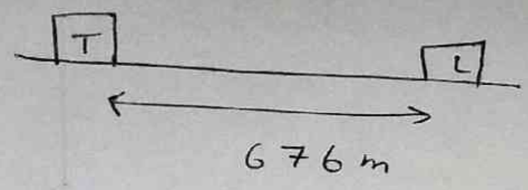
$$\frac{60 = 20t + 5t^2}{5}$$

$$t^2 + 4t - 12 = 0 \rightarrow (t-2)(t+6) = 0$$

$$t = -6 \,,\, 2$$

$$\boxed{t = 2\,s}$$

43



(a) $V_t = 161\ km/h = 44.7\ m/s$

$V_L = 29\ km/h = 8\ m/s$

train

$V_{ft} = V_0 + at$

$V_{ft} = 44.7 + at$

$x_{ft} = V_{0t}\, t + \frac{1}{2} a t^2$

$X_{ft} = 44.7 t + \frac{1}{2} a t^2$

Locomotive

$V_f = \text{constant}$

$X_{fL} - X_{0f} = V_f t$

$X_{fL} - 676 = 8t$

$X_{fL} = 8t + 676$

$\boxed{V_{fL} = V_f}$

$V_{ft} = 44.7 + at$

$8 = 44.7 + at$

$a = -\frac{36.7}{t}$

$\boxed{X_{f,t} = X_{f.L}}$

$X_{f,t} = 44.7 t + \frac{1}{2} a t^2$

$X_{f,t} = 44.7 t + \frac{1}{2}\left(\frac{-36.7}{t}\right) t^2$

$\boxed{X_{f,t} = 26.4\ t}$

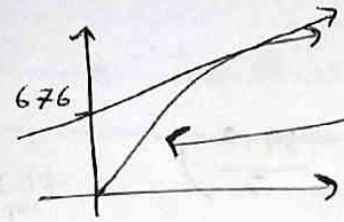
$X_{f,t} = X_{f,L} \longrightarrow 26.4 t = 8t + 676$

$\rightarrow t = 36.73 \text{ sec}$

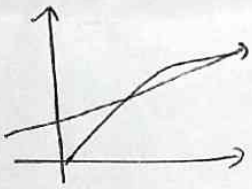
$$\rightarrow a = -\frac{36.7}{36.73} = -0.99 \text{ m/s}^2$$

(b) $x_L = 8t + 676$

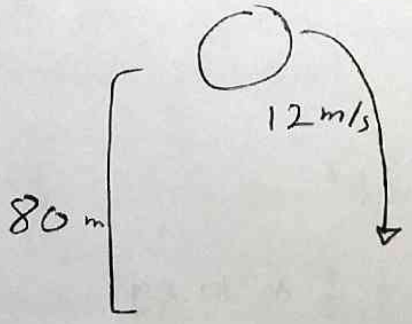
$x_t = 44.7t - 0.495t^2$



لو فيه تصادم



49



(a) $x = v_0 t + \frac{1}{2} a t^2$

$-80 = 12t - 5t^2$

$5t^2 - 12t - 80 = 0$

$t = 5.4 \text{ sec}$

(b) $V = V_0 + at$

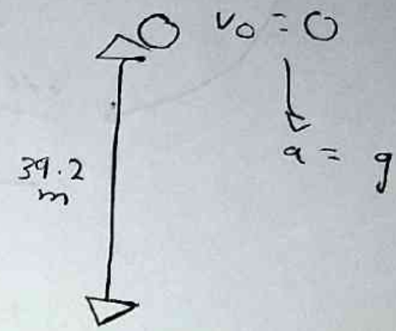
$V = 12 - 10 \times 5.4$

$12 - 54$

$|v| = |-42| = 42 \ m/s$

51

$V^2 - \underset{\text{zero}}{V_0^2} = 2a\Delta y$



$V^2 = (2)(-9.8)\left(-\frac{39.2}{2}\right)$

$V = 19.6 \ m/s$

64

$V_0 = 10 \ m/s$

$\Delta y = ?$, $t = 3 s$

$\Delta y = V_0 t + \frac{1}{2} a t^2$

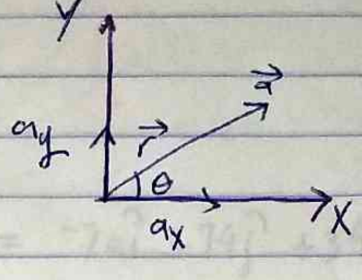
$\Delta y = -10 \times 3 + \frac{1}{2} \times -10 \times 9$

$\Delta y = -75 \ m$

Chapter 3 "Vectors"

Lecture questions. (1, 11, 15, 38)

q(1) $a_x = .5a$



$\tan\theta = \frac{a_y}{a_x}$

$\cos\theta = \frac{a_x}{a} = \frac{.5a}{a} = .5$

$\theta = 60 \longrightarrow \tan\theta = \sqrt{3}$

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(11) $\vec{a} + \vec{b}$

$\vec{a} = (4.0m)\hat{i} + (3.0m)\hat{j}$

$\vec{b} = (-13.0m)\hat{i} + (7.0m)\hat{j}$

a) $\vec{a} + \vec{b} = (4-13)\hat{i} + (3+7)\hat{j} = -9m\hat{i} + 10m\hat{j}$

b) magnitude of $(\vec{a}+\vec{b}) = \sqrt{(-9)^2 + (10)^2} = 13.45m$

c) $\tan\theta = \frac{-10}{9}$

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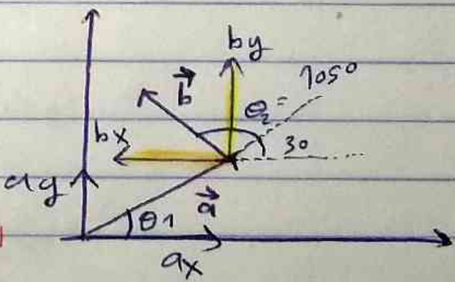
(15) $a = 10.0m \quad \theta_1 = 30°$

$b = 10.0m \quad \theta_2 = 105°$



a) $r_x = a_x + b_x$

c) $r = \sqrt{(12.07)^2 + (1.59)^2} = 12.2m$

$\theta = \tan^{-1}\left(\frac{12.07}{1.59}\right) = 82.5°$

$a_x = a\cos 30 = 10 \times .866 = 8.66m$

$b_x = b\cos 135 = 10 \times (-0.707) = -7.07m$

$r_x = 8.66 - 7.07 = 1.59m \longrightarrow$ x component of $\vec{r}$

$r_y = a_y + b_y \qquad a_y = a\sin 30 = 5 \qquad b_y = b\sin 135 = 7.07m$

$r_y = 12.07m \longrightarrow$ y component of $\vec{r}$

(38) $3\vec{C}\cdot(2\vec{A}\times\vec{B})$

$\vec{A} = 2.00\hat{i} + 3.00\hat{j} - 4.00\hat{k} \rightarrow 2\vec{A} = 4.00\hat{i} + 6.00\hat{j} - 8.00\hat{k}$

$\vec{B} = -3.00\hat{i} + 4.00\hat{j} + 2.00\hat{k}$

$\vec{C} = 7.00\hat{i} - 8.00\hat{j}$

$3\vec{C} = 21\hat{i} - 24\hat{j}$

$$(2\vec{A}\times\vec{B}) = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 4 & 6 & 8 \\ -3 & 4 & 2 \end{vmatrix} = -20\hat{i} - 14\hat{j} + 34\hat{k}$$

$$3\vec{C}\cdot(2\vec{A}\times\vec{B}) = (21\hat{i} - \overset{24}{\cancel{8}}\hat{j})\cdot(20\hat{i} - 14\hat{j} + 34\hat{k})$$

$$= (21\times -20) + (-24\times -14) + (0\times 34) = -420 + 336 = -84$$

Discussion questions. (2, 7, 18, 34, 41, 43)

(2) $|\vec{r}| = 12\,m \quad \theta = 30^\circ$

$X_{component} = 12\cos 30 = 10.32\ m$

y component $= 12\sin 30 = 6\ m$

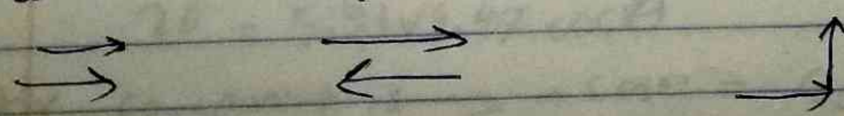
(7) first vector = 3m

2nd vector = 4m

a) 7m → parallel متوازيين

b) 1m → antiparallel (متعاكسين)

c) 5m → perpendicular متعامدين



(18)

a) ~~magin~~ magnitude of $\vec{B}$?

$\vec{A} + \vec{B} = \vec{C}$

$B_x = C_x - A_x$

$B_y = C_y - A_y$

الربع الثالث

$A_x = A\cos 40 = 9.19\,m$ | $C_x = C\cos 20 = -15.04$

$A_y = A\sin 40 = 7.71\,m$ | $C_y = C\sin 20 = -5.47$

$B_x = -15.04 - 9.19 = -24.23$

$B_y = -5.47 - 7.71 = -13.18$

$\vec{B} = 24.23\hat{i} - 13.18\hat{j}$ unit vector notation

$|\vec{B}| = \sqrt{(-24.23)^2 + (-13.18)^2} = 27.58\,m$

b) $\theta_B = \tan^{-1}\left(\frac{13.18}{24.23}\right) = 28.540$ (ccw) with $-x$ axis. counter clock wise

(34) $\vec{a} = 3.0\hat{i} + 5.0\hat{j} + 0\hat{k}$

$\vec{b} = 2.0\hat{i} + 4.0\hat{j} + 0\hat{k}$

a) $\vec{a} \times \vec{b} = \begin{vmatrix} i & j & k \\ 3 & 5 & 0 \\ 2 & 4 & 0 \end{vmatrix} = 2\hat{k}$

b) $\vec{a} \cdot \vec{b} = a_x b_x + a_y b_y + a_z b_z = (3\times2) + (5\times4) = 26$

c) $(\vec{a} + \vec{b}) \cdot \vec{b} = (3\hat{i} + 2\hat{i} + 5\hat{j} + 4\hat{j}) \cdot (2\hat{i} + 4\hat{j}) = 46$

d) component of $\vec{a}$ along the diection of $\vec{b}$.

$a = \sqrt{(3)^2 + (5)^2}$

$b = \sqrt{(2)^2 + (4)^2}$

$\theta = ?$ $\vec{a} \cdot \vec{b} = ab\cos\theta$

$\theta = \cos^{-1}\left(\frac{26}{5.83\times4.47}\right)$

$26 = 5.83 \times 4.47 \cos\theta$

the component is $\rightarrow$ $a\cos\theta = \frac{\cancel{5.83}\times 26}{\cancel{5.83}\times4.47} = \boxed{5.816}$

41) $\vec{a}\cdot\vec{b} = (4\times3)+(4\times2)+(4\times4) = 36$

$a = \sqrt{4^2+4^2+4^2} = 4\sqrt{3} = 6.92$

$b = \sqrt{(3)^2+(2)^2+(4)^2} = 5.38$

$\vec{a}\cdot\vec{b} = ab\cos\theta$

$36 = 6.92\times5.38\times\cos\theta$

$\theta = \cos^{-1}\left(\frac{36}{6.92\times5.38}\right) = 14.76^\circ$

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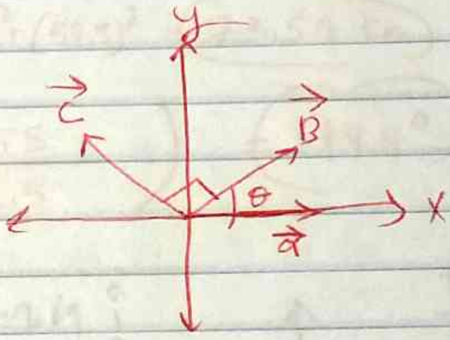
43)



a) $a_y = 0$ $a_x = 3$

b) $b_y = b\sin30 = 2$

$b_x = b\cos30 = 3.46$

c) $c_y = 10\sin120 = 5\sqrt{3}$

$c_x = 10\cos(90+30) = -5$

d) $\vec{c} = p\vec{a} + q\vec{b}$ — $p = ?$ $q = ?$

$\vec{c} = p(a_x\hat{i} + a_y\hat{j}) + q(b_x\hat{i} + b_y\hat{j})$

$\vec{c} = \underbrace{(pa_x + qb_x)\hat{i}}_{c_x} + \underbrace{(pa_y + qb_y)\hat{j}}_{c_y}$

(1) $-5 = 3p + 3.46q \rightarrow$ $p = -6.67$

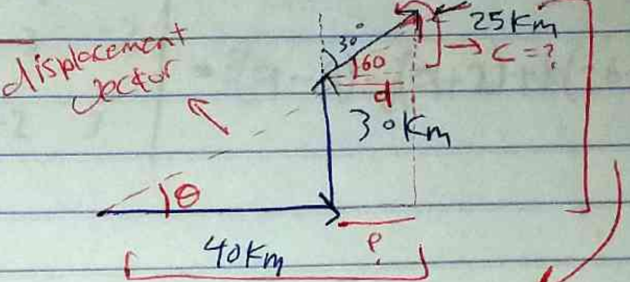
(2) $5\sqrt{3} = 0 + 2q \rightarrow q = 2.5\sqrt{3} \approx 4.33$

تعويض في الأولى

quiz questions (3, 12, 26, 37, 44)

(3) magnitude $= \sqrt{(15)^2 + (15)^2 + (10)^2} = 23.45$ m

(12)



$\sin 60 = \frac{c}{25} = .86$

$c = 21.5$

$\cos 60 = \frac{d}{25} = \frac{1}{2} \Rightarrow d = 12.5$ km

$21.5 + 30 = 51.5$ km

$40 + 12.5 = 52.5$ Km

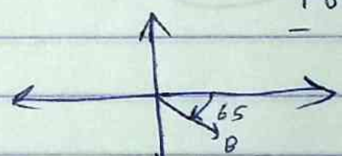
magnitude of vector $= \sqrt{(51.5)^2 + (52.5)^2} = 73.54$ Km

$= \theta = \tan\theta^{-1}\left(\frac{51.5}{52.5}\right) = 44.4°$

(26) $\vec{B}$ → $B_x = B\cos 65 = 1.69\,\hat{i}$

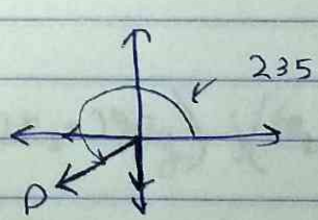
→ $B_y = B\sin 65 = -3.62\,\hat{j}$

+ of c
− &



$\vec{D}$ → $D_x = D\cos 235 = -2.86\,\hat{i}$

→ $D_y = D\sin 235 = -4.09\,\hat{j}$



(a) the sum in unit vector notation.

$\underbrace{\vec{A} + \vec{B} + \vec{C} + \vec{D}}_{\vec{H}} = \underbrace{(2 + 1.69 + -4 + -2.86)}_{H_x}\hat{i} + \underbrace{(3 + -3.62 + -6 + -4.09)}_{H_y}\hat{j}$

b) $\sqrt{(H_x)^2 + (H_y)^2}$

c) $\tan^{-1}\left(\frac{H_y}{H_x}\right)$

$$\vec{b} + \vec{c} = 1\hat{i} + {-2}\hat{j} + 3\hat{k}$$

37

c) $$\vec{a} \times (\vec{b} + \vec{c}) = \begin{vmatrix} i & j & k \\ 3 & 3 & -2 \\ 1 & -2 & 3 \end{vmatrix} = i(9-4) - j(9+2) + k(-6-3)$$

$$= 5\hat{i} - 11\hat{j} - 9\hat{k}$$

---

(44) $\vec{F} = q\vec{v} \times \vec{B}$ $\quad q = 3$

$\vec{v} = 2\hat{i} + 4\hat{j} + 6\hat{k}$ $\quad F = 4\hat{i} - 20\hat{j} + 12\hat{k}$

$3\vec{v} = 6\hat{i} + 12\hat{j} + 18\hat{k}$

$\vec{B} = ?$ $\quad B_x = B_y$

$B\cos\theta = B\sin\theta \rightarrow \theta = \frac{\pi}{4} = 45°$ X

$\vec{F} = 3\vec{v} \times \vec{B}$

$|F| = 23.6$

$|3v| = 22.4$

$$23.6 = \begin{vmatrix} i & j & k \\ 6 & 12 & 18 \\ B_x & B_y & B_z \end{vmatrix} = i(12B_z - 18B_y) - j(6B_z - 18B_x) + k(6B_y - 12B_x)$$

$4\hat{i} - 20\hat{j} + 12\hat{k}$

$4 = 12\vec{B}_z - 18\vec{B}_y$ $\qquad B_x = B_y$ طب

$-20 = -6\vec{B}_z + 18\vec{B}_x$

$12 = 6\vec{B}_y - 12\vec{B}_x\ B_y \rightarrow 12 = -6\vec{B}_y$

و نعوض في المعادلات لإيجاد المركبات الأخرى $\quad \boxed{B_y = -2\hat{j}}$ $\quad \boxed{\cancel{B_x = -2\hat{i}}}$

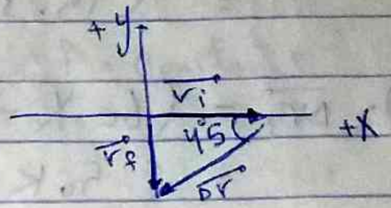
Chapter 4

P3 : $\vec{\Delta r} = \vec{r_f} - \vec{r_i} \longrightarrow \vec{r_i} = \vec{r_f} - \vec{\Delta r}$

$\vec{r_i} = (4\hat{j} - 5\hat{k}) - (2\hat{i} - 4\hat{j} + 8\hat{k})$

$= -2\hat{i} + 8\hat{j} - 13\hat{k}$

P4 : ⓐ $\vec{\Delta r} = \vec{r_f} - \vec{r_i}$



$= (12)(-\hat{j}) - 12(+\hat{i})$

$\vec{\Delta r} = -12\hat{j} - 12\hat{i}$

$|\vec{\Delta r}| = \sqrt{(12)^2 + (12)^2}$

$= \sqrt{288}$

ⓑ $\theta = \tan^{-1}\left(\frac{-12\ cm}{-12\ cm}\right) = -135°$ (because it's in 3^{rd})

ⓒ $\vec{r_1} = (-12\ cm)\hat{j}$ and $\vec{r_2} = (12\ cm)\hat{j}$

$\vec{\Delta r} = (24\ cm)\hat{j}$

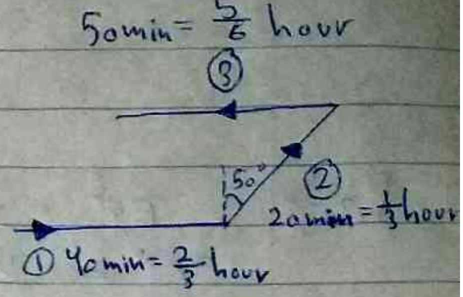
$|\vec{\Delta r}| = 24\ cm$

ⓓ $\theta = \tan^{-1}\left(\frac{20\ cm}{0}\right) = 90°$

ⓔ It returns to the starting position so $\vec{\Delta r} = 0$

ⓕ $\theta = 0$

P5: Constant Velocity = 60 Km/h



①: $\overrightarrow{\Delta r_1} = \left(60 \times \frac{2}{3}\ Km\right)\hat{i}$
$= (40\ Km)\hat{i}$

②: $\overrightarrow{\Delta r_2} = \left(60 \times \frac{1}{3} \times \sin 50\ Km\right)\hat{i} + \left(60 \times \frac{1}{3} \times \cos 50\ Km\right)\hat{j}$
$= (15.3\ Km)\hat{i} + (12.9\ Km)\hat{j}$

③: $\overrightarrow{\Delta r_3} = \left(60 \times \frac{5}{6} \times \cos 180\ Km\right)\hat{i}$
$= (-50\ Km)\hat{i}$

* $\overrightarrow{\Delta r} = \overrightarrow{\Delta r_1} + \overrightarrow{\Delta r_2} + \overrightarrow{\Delta r_3}$
$= (40\ Km)\hat{i} + (15.3\ Km)\hat{i} + (12.9\ Km)\hat{j} + (-50\ Km)\hat{i}$
$= (5.3\ Km)\hat{i} + (12.9\ Km)\hat{j}$

* $\Delta t = \Delta t_1 + \Delta t_2 + \Delta t_3 = \frac{1}{3} + \frac{2}{3} + \frac{5}{6} = 1.83$ hour.

* $\overrightarrow{V_{avg}} = \frac{\overrightarrow{\Delta r}}{\Delta t} = \frac{(5.3\ Km)\hat{i} + (12.9\ Km)\hat{j}}{1.83\ hour}$

$= \left(2.9\ \frac{Km}{h}\right)\hat{i} + \left(7\ \frac{Km}{h}\right)\hat{j}$

$|V_{avg}| = \sqrt{(2.9)^2 + (7)^2} = 7.58\ Km/h$

$\tan\theta = \frac{7}{2.9} = 2.4$

$\tan^{-1}(2.4) = 67^\circ$

the angle is 67° north of east

P7 : $\vec{r_1} = (6\hat{i} - 7\hat{j} + 3\hat{k})$ m

$\Delta t = 10$ sec

$\vec{r_2} = (-3\hat{i} + 9\hat{j} - 3\hat{k})$ m

$$\vec{V}_{avg} = \frac{\Delta \vec{r}}{\Delta t} = \frac{-3\hat{i} - 6\hat{i}}{10} + \frac{9\hat{j} + 7\hat{j}}{10} + \frac{-3\hat{k} - 3\hat{k}}{10}$$

$$= (-0.9\hat{i} + 1.6\hat{j} - 0.6\hat{k}) \text{ m/s}$$

P10 : $r(t) = (5t)\hat{i} + (et + ft^2)\hat{j}$ / e, f = constants

$$v(t) = \frac{dr}{dt} = 5\hat{i} + (e + 2ft)\hat{j}$$

$\tan\theta = \frac{V_y}{V_x}$, where $V_y = e + 2ft$ and $V_x = 5$

at $t = 0 \rightarrow \theta = 35°$

$$\tan 35 = \frac{e + 0}{5} \rightarrow \boxed{e = 5\tan 35 = 3.5}$$

at $t = 14$ sec $\rightarrow \theta = 0$

$$\tan 0 = \frac{3.5 + 2f(14)}{5} = 0 \rightarrow 3.5 + 28f = 0$$

$$\boxed{f = -0.125}$$

P11 : $\vec{r} = (3t^3 - 6t)\hat{i} + (7 - 8t^4)\hat{j}$

a) $\vec{r}(3) = (3(3)^3 - 6(3))\hat{i} + (7 - 8(3)^4)\hat{j} = (63\text{ m})\hat{i} - (641\text{ m})\hat{j}$

b) $\vec{v} = \frac{d\vec{r}}{dt} = (9t^2 - 6)\hat{i} - (32t^3)\hat{j}$

$\vec{v}(3) = (75 \text{ m/s})\hat{i} - (864 \text{ m/s})\hat{j}$

c) $\vec{a} = (18t)\hat{i} - (96t^2)\hat{j} \Rightarrow \vec{a}(3) = 54\hat{i} - 864\hat{j}$

d) slope of tanget $= \frac{dy}{dx} = \frac{\frac{dy}{dt}}{\frac{dx}{dt}} = \frac{-32t^3}{9t^2 - 6}$

when $t = 3$s $\Rightarrow m = \frac{-288}{25} = \tan\theta \Rightarrow \theta = 275°$ with +X

[illegible]

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③ [illegible]

② [illegible]

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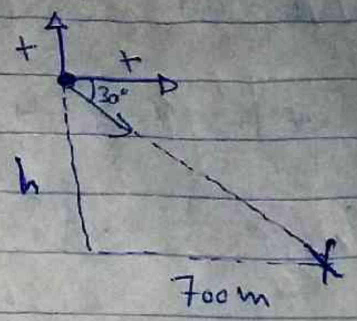
P27 : (a) time to flight.

$X = V_0 \cos\theta \, t$

$700 = \left(\frac{290000}{3600}\right)(\cos 30)(t)$

$t = 10$ sec.



(b) $h = ?$

$y_f = y_i + V_{0y} t - \frac{1}{2} g t^2$

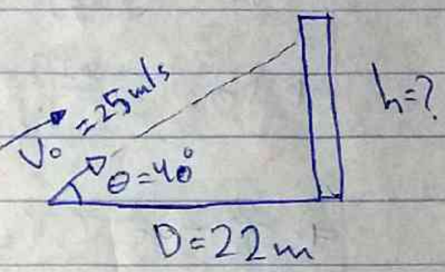
$h = 0 + \left(\frac{290000}{3600}\right)(\sin 30) t + 5t^2$

$h = 903$ m

P32 : (a) $D = V_x t = 25 \cos 40 \, t$

$22 = 25 \times (0.77)(t)$

$t = 1.14$ sec.



$y = y_0 + V_{0y} t + \frac{1}{2} a t^2$

$h = 0 + (25)(\sin 40)(1.14) + \frac{1}{2}(-10)(1.14)^2$

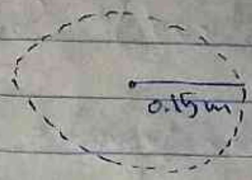
$= 18.3 - 6.5 = 11.8$ m.

(b) $V_x = V_{0x} = 19.25$ m/s

(c) $V_y = V_{0y} + at = 16 - 10(1.14) = 4.6$ m/s

(d) No, the ball hasn't because $V_{fy} > 0$

P58: 1100 rev. Per min
$R = 0.15$ m



ⓐ in one revolution :○
Circurference $= 2\pi R = 2\pi(0.15) = 0.942$ m

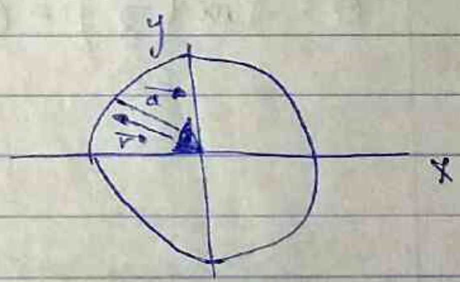
ⓑ Distance traveled in all revolutions :○
$1100 \text{ rev.} \times 2\pi R = 1100(0.942)$
$= 1036.2$ m

$$\text{Speed} = \frac{\text{distance}}{\text{time}} = \frac{1036.2 \text{ m}}{60 \text{ sec.}} = 17.27 \text{ m/sec}$$

ⓒ $a = \frac{V^2}{R} = \frac{(17.27)^2}{0.15} = 1988 \text{ m/s}^2$.

ⓓ Period of revolution
$(1100 \text{ rev/min})^{-1} = 9.1 \times 10^{-4}$ min
$T = 9.1 \times 10^{-4} \times 60 = 0.0546$ sec.

P60: $T = 2$ sec $\quad |r = 3.5$ m
$\vec{a} = 6\hat{i} - 4\hat{j}$

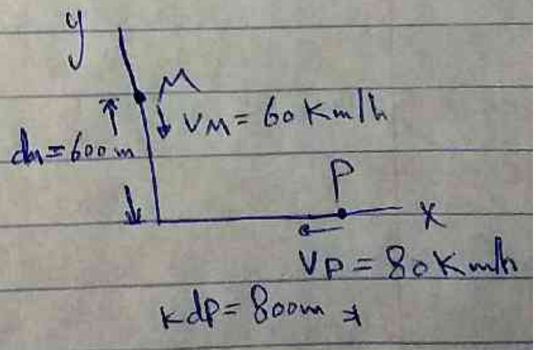


ⓐ $\vec{v} \cdot \vec{a} =$ Zero
ⓑ $\vec{r} \times \vec{a} = |\vec{r}||\vec{a}| \sin 180 =$ Zero

P62: $V = 10$ m/s , $R = 20$ m

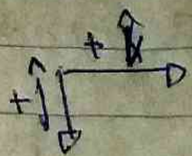
$$|\vec{a}| = \frac{V^2}{R} = \frac{100}{20} = 5 \text{ m/s}^2$$

P73: ⓐ $\vec{V} = \vec{V_M} - \vec{V_P} = (-60\hat{j} \text{ Km/h}) - (-80\hat{i} \text{ Km/h})$
$= (80 \text{ Km/h})\hat{i} - (60 \text{ Km/h})\hat{j}$



ⓑ $\vec{r} = \vec{d_P} - \vec{d_m} = (800 \text{ m})\hat{i} - (600 \text{ m})\hat{j}$
ⓒ No, they don't change.

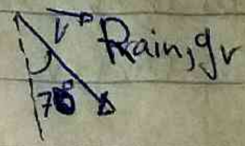
P75: train travels South 30 m/s (relative to ground)



"مزمن"

$\vec{V}_{train,ground} = 30\,\hat{i}$

Velocity of rain relative to ground:



$$\vec{V}_{rain,gr} = \left(|\vec{V}_{r,g}| \sin 70\right)\hat{i} + \left(|\vec{V}_{r,g}| \cos 70\right)\hat{j}$$

$$\vec{V}_{rain,train} = |\vec{V}_{r,t}|\,\hat{j} \quad , \quad \text{find } |\vec{V}_{r,g}| = ?$$

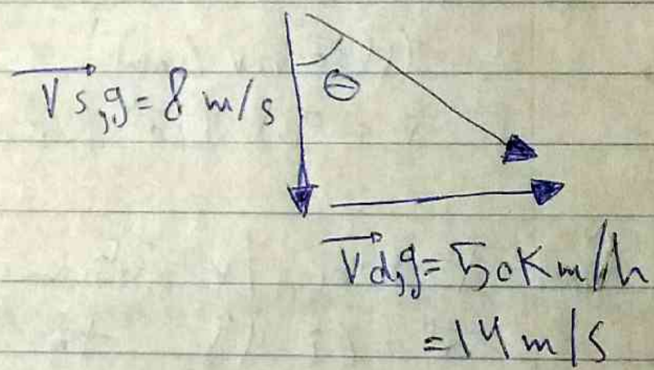
$$\vec{V}_{r,g} = \vec{V}_{r,t} + \vec{V}_{t,g} \Rightarrow \left(|\vec{V}_{r,g}| \sin 70\right)\hat{i} + \left(|\vec{V}_{r,g}| \cos 70\right)\hat{j} = |\vec{V}_{r,t}|\,\hat{j} + 30\,\hat{i}$$

$$|\vec{V}_{r,g}| \sin 70 = 30$$

$$|\vec{V}_{r,g}| = \frac{30}{0.94} = 32 \text{ m/s}$$

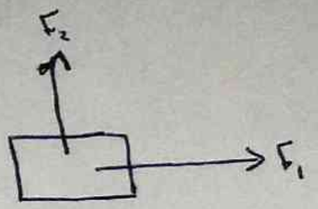
P77: $\tan\theta = \frac{14}{8}$

$$\theta = \tan^{-1}\left(\frac{14}{8}\right) = 60^\circ$$



Chapter 5

Q. 1



mass = 6 kg

$F_1 = 9N$

$F_2 = 7N$

$\sum F_x = m a_x \Rightarrow 9 + 0 = 6 a_x \Rightarrow a_x = \frac{9}{6} = 1.5 \ m/s^2$

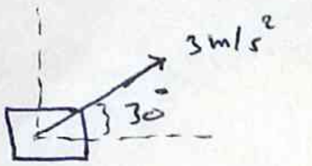
$\sum F_y = m a_y \Rightarrow 0 + 7 = 6 a_y \Rightarrow a_y = \frac{7}{6} = 1.17 \ m/s^2$

$|a| = \sqrt{(1.17)^2 + (1.5)^2} = 1.9 \ m/s^2$

$\tan\theta = \frac{\frac{7}{6}}{\frac{9}{6}} = \frac{7}{9} = .78$

$\tan^{-1}(.78) \approx 38^\circ$

Q.3.



$m = 2kg$

$|a| = 3 m/s^2$

$\theta = 30^\circ$

$\sum F_x = m a_x = 2 \times 3 \times \cos 30 = 5.2 \ N$

$\sum F_y = m a_y = 2 \times 3 \times \sin 30 = 3 \ N$

$F = 5.2 \hat{i} + 3 \hat{j}$

Q.4

Constant Velocity $\Rightarrow a = 0$

$v = 2 (m/s) \hat{i} - 5 (m/s) \hat{j}$

$F_1 = 2\hat{i} - 5\hat{j}$ $\qquad F_2 = F_x \hat{i} + F_y \hat{j} + F_z \hat{k}$

$$\left.\begin{aligned}
&\sum F_x = m a_x \\
&2 + F_x = 0 \Rightarrow F_x = -2 \\
&\sum F_y = m a_y \\
&-5 + F_y = 0 \Rightarrow F_y = 5 \\
&\sum F_z = m a_z \\
&F_z + 0 = 0 \Rightarrow F_z = 0
\end{aligned}\right\} \Rightarrow \begin{aligned} &F_2 = F_x \hat{i} + F_y \hat{j} + F_z \hat{k} \\ &F_2 = -2\hat{i} + 5\hat{j} \end{aligned}$$

Q.9 $x_{(t)} = -16 + 3t - 5t^3$ $m = ,45\ kg$ $y_{(t)} = 26 + 8t - 10t^2$

$r_{(t)} = x_{(t)}\hat{i} + y_{(t)}\hat{j} \Rightarrow r_{(t)} = (-16 + 3t - 5t^3)\hat{i} + (26 + 8t - 10t^2)\hat{j}$

$a = \frac{dv}{dt} = \frac{d^2r}{dt^2} \Rightarrow$ $v = (3 - 15t^2)\hat{i} + (8 - 20t)\hat{j}$

$a = \frac{dv}{dt} \Rightarrow a = -30t\,\hat{i} + 20\hat{j}$

at $t = ,8$ $\sum F_x = ma_x$ $a_x\big|_{t=,8} = -30 \times ,8 = -24$

$F_x = ,45 \times -24 = -10,8\ N$

$\sum F_y = ma_y \Rightarrow F_y = ,45 \times -20 = 9\ N$

$F = -10,8\,\hat{i} - 9\,\hat{j}$ $\Bigg\}$ $\tan\theta = \frac{-9}{-10,8} = ,833$

$\theta = 320^\circ$ or $\theta = 39,8$

320° $39,8$

Q.6 $a = \frac{dv}{dt} = \frac{d^2x}{dt}$ $x_{(t)} = -13 + 2t + 4t^2 - 3t^3$

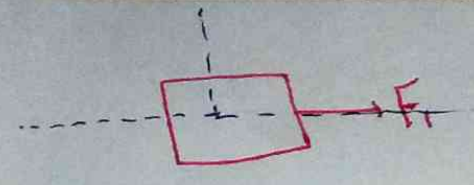
mass $= ,15$

$v = \frac{dx}{dt} = 2 + 8t - 9t^2$ $\rightarrow$ $a = \frac{dv}{dt} = 8 - 18t$

$a\big|_{t=2,6} = 8 - 18 \times 2,6 = -38,8\ m/s^2$

$F_{net} = ma = ,15 \times -38,8 = -5,82\ N$

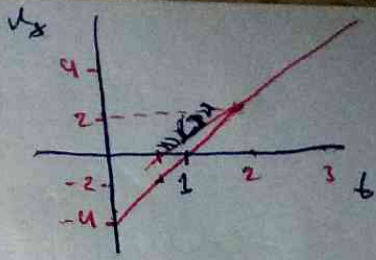
Q.12



$F_1 = 7N$ x^+

$F_2 = 9N$??

$m = 4kg$



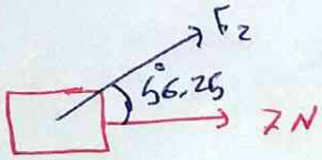
$$a_{x\,avg} = \frac{\Delta v_x}{\Delta t} = \frac{2-4}{2-0} = 3\ m/s^2$$

$$F_{net\,x} = m a_x \Rightarrow F_{x_1} + F_{x_2} = 4 \times 3$$

$$7 + 9\cos\theta = 12$$

$$9\cos\theta = 5$$

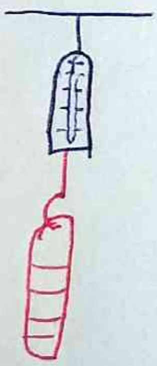
$$\cos\theta = ,\overline{55} \Rightarrow \theta = 56,25$$



Q.15

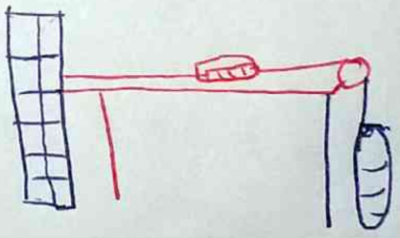
$m_{salmi} = 11$ kg

(a)



The spring reading ⇒ 11kg $W = 11 \times 9.8 = 107,8\ N$

b)

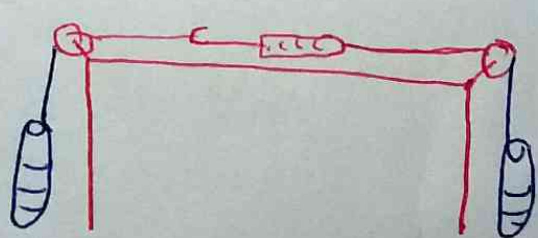


the spring reading 11kg

$W = 11 \times 9.8$

$= 107,8\ N$

c)

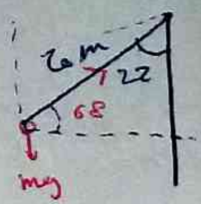


the spring reading 11 kg

$W = 11 \times 9,8$

$= 107,8\ N$

Q.23 $|T| = 760\,N$ $W = 860\,N$



$~~T = T\cos 68\,\hat{i}~~$

$m = \frac{860}{10} = 86$

$T = T\sin 22\,\hat{i} + T\cos 22\,\hat{j}$

$T = 284.7\,\hat{i} + 704.65\,\hat{j}$

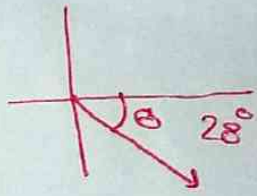
$F_{net} = T + \text{Weight}$

$= (284.7\,\hat{i} + 704.65\,\hat{j}) + (-860\,\hat{j})$

$F = 284.7\,\hat{i} - 155.35\,\hat{j}$

$|F| = \sqrt{(284.7)^2 + (-155.35)^2} = 324.33\ N$

$\tan\theta = \frac{-155.35}{284.7} = -.55 \Rightarrow \theta = -28^\circ$ clock wise

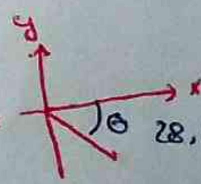


$F = ma \Rightarrow a = \frac{F}{m} \Rightarrow a = \frac{284.7}{86}\,\hat{i} - \frac{155.35}{86}\,\hat{j}$

$a = 3.31\,\hat{i} - 1.8\,\hat{j}$

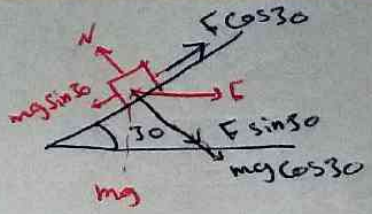
$|a| = \sqrt{(3.31)^2 + (-1.8)^2} = 3.77\ m/s^2$

$\tan\theta = \frac{-1.8}{3.31} = .54 \Rightarrow \theta = -28.5$ clock wise



Q.34 $m = 115$ kg

Constant speed $\Rightarrow a = 0$



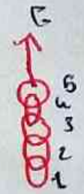
a) $mg\sin 30 - F\cos 30 = 0$

$mg\sin 30 = F\cos 30$

$F = mg\tan\theta = 115 \times 9.8 \times \cos 30 = 650.67\ N$

b) $F_n - (mg\cos 30 + F\sin 30) = 0$

$F_n = mg\cos 30 + F\sin 30 = 976.01 + 325.34 = 1301.39\ N$



Q.43

For link 1

$T_1 - mg = ma$

$T_1 = m(a+g) = 1.23\ N$

$\boxed{\text{For link 2}}$

$T_2 - (T_1 + mg) = ma$

$T_2 = (T_1 + mg) + ma$

$= 1.23 + .98 + .25 = 2.46\ N$

$\boxed{\text{For link 3}}$ $T_3 - (T_2 + mg) = ma$

$T_3 = T_2 + mg + ma = 2.46 + .1 \times 9.8 + .1 \times 2.5 = 3.69\ N$

$\boxed{\text{For link 4}}$ $T_4 - (T_3 + mg) = ma$

$T_4 = T_3 + mg + ma = 4.92\ N$

$\boxed{\text{For link 5}}$ $T_5 - (T_4 + mg) = ma \Rightarrow T_5 = 6.15\ N$

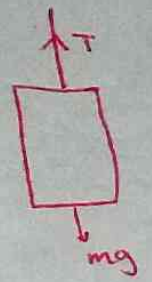
F

f) For each link the same acceleration and the same mass

$F = ma = .1 \times 2.5 = .25\ N$

Q.45

a) $T \Rightarrow$ is $a = 1.5\ m/s^2$



$mg = 29\ kN$

$= 29 \times 10^3\ N$

$m = \frac{29000}{10} = 2900\ kg$

$T - mg = ma$

$T = 29000 + 2900 \times 1.5 = 33.35 \times 10^3\ N$

b) T is $a = -1.5$

$T - mg = ma \Rightarrow T = mg + ma$

$= 29000 + {}^{-}1.5 \times 2900 = 24650\ N$

Q.46 $m = 2000\ kg$ $a_{\text{relative to the Cup}} = 8.3$

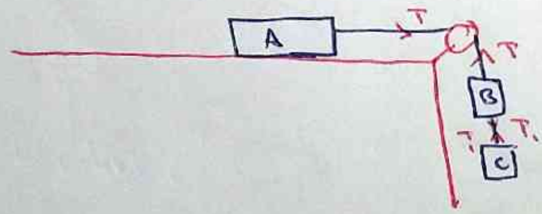
$$\overset{-9.8}{a_{og\,c\to g}} = \overset{-8.3}{a_{o\to c}} + a_{c\to g}$$

$a_{cg} = -9.8 + 8.3 = -1.5$

$T - mg = ma$

$T = mg + ma \Rightarrow T = m(g + a) = 2000(9.8 - 1.5) = 16600\ N$

Q.50



$m_a = m_B = 30\ kg$

$m_c = 10\ kg$

$m_c g - T_1 = m_c a$

$T_1 + m_B g - T = m_B a$

$T = m_a a$

$m_c g + m_B g = m_{total}\, a$

$100 + 300 = 70\, a$

$a = \frac{400}{70} = 5.7\ m/s^2$

a) $m_c g - T_1 = \cancel{m_c}\ m_c a$

$100 - T_1 = 57$

$T_1 = 43\ N$

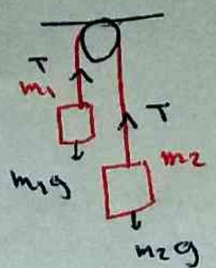
b) $\Delta x = \cancel{u_0 t} + \frac{1}{2} a t^2$

$\Delta x = \frac{1}{2} \times 5.7 \times 0.25^2$

$= .178\ m$

$m_1 = 1{,}3\ kg \qquad m_2 = 2{,}8\ kg$

Q.51



a)

$m_2 g - T = m_2 a$

$T - m_1 g = m_1 a$

$m_2 g - m_1 g = m_{total}\, a$

$28 - 13 = (1{,}3 + 2{,}8)\, a$

$\Downarrow$

$a = 3{,}66\ m/s^2$

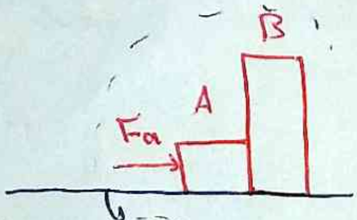
b)

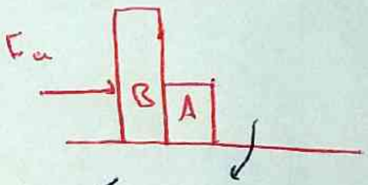
$m_2 g - T = m_2 a$

$28 - T = (2{,}8 \times 3{,}66)$

$T = 17{,}75\ N$

Q.56





$F_{net} = 15\ N$ ← عند الجسم B لوحده

$F_{net} = 10\ N$ ← عند الجسم A لوحده

$F_{net} = m_B a$

$15 = m_B a \quad \cdots (1)$

$10 = m_A a \quad \cdots (1)$

(1) + (2)

$25 = a\,(m_B + m_A)$

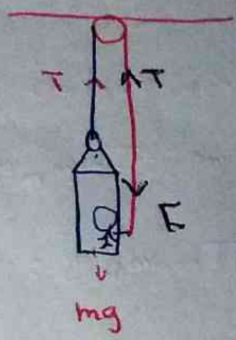
$25 = 12\, a \Rightarrow a = 2{,}08\ m/s^2$

$F_a = \underset{\text{للجسمين}}{F_{net}} = m_{total}\, a$

$= \cancel{24}\ 12 \times 2{,}08 = 25\ N$

$\boxed{F_a = 25\ N}$

Q.58 $m_{total} = 103\ kg$



a) with a constant velocity $\Rightarrow a = 0$

$F - T = m\cancel{a}$ Zero

$F = T$

$T - mg = m\cancel{a}$ Zero

$T = mg \Rightarrow F = mg = 103 \times 9.8 = 1009.4\ N$

b) $a = 1.3$

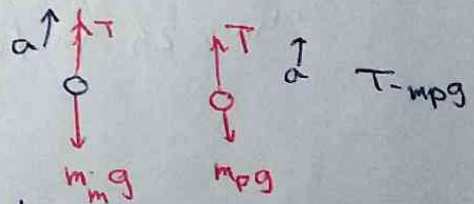
$$\left.\begin{aligned} F - T &= m_{\cancel{total}}\, a \\ T - mg &= ma \end{aligned}\right\} \Rightarrow F - mg = 2ma$$

$F = mg + 2ma$

$= 1009.4 + 2 \times 103 \times 1.3 = 1277.2N$

$\boxed{F = 1277.2\ N}$

Q.59 $m_m = 10\ kg$ $m_p = 15\ kg$



(a) the least a for monkey it is mean the least force to move the package $\Rightarrow$ أقل قوة لتحريك الصندوق
لأن تسارع الصندوق = صفر

$T - m_m g = m_m a_m$

~~$m_p g - T = m_p a_p$~~ Zero

$T - m_p g = m_p \cancel{a}$ Zero

~~$m_p g - m_m g = m_m a_m$~~

$T = m_p g$

$T = 15 \times 10 = 150\ N$

$150 - 100 = 10\ a_m$

$\boxed{a_m = 5\ m/s^2}$

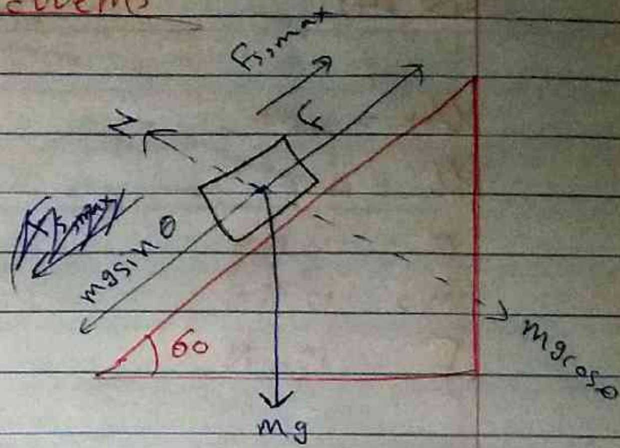
$\Leftarrow$ يتبع مطلوب B

1

chapter 6

Lecture Problems

Q1)



m = 6 Kg
$\mu_s = 0.6$
θ = 60

$F_{s,max} = \mu_s N$

$= 0.6(mg\cos\theta)$

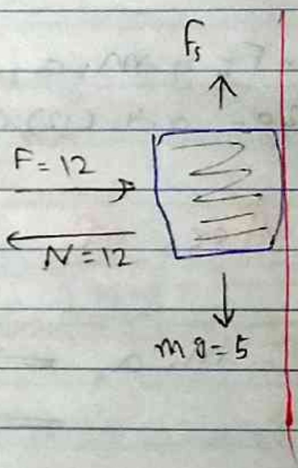
$F_{s,max} = 17.64$ N

$mg\sin\theta = 6(9.8)\sin 60$

$= 50.9$ N

$F = F_{s,max} \cancel{+} - mg\sin\theta = \cancel{68.56\ N}\ 33$ N

Q19)



a) Will the block move?

$\cancel{F_{s,max} = \mu_s N}$

$\cancel{= \mu_s (N)}$

$\cancel{= 0.4(12) = 4.8}$

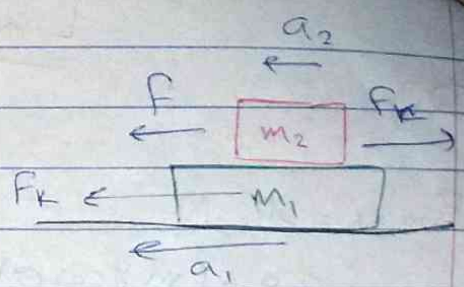
$F_{s,max} = \mu_s N$

$= 0.6(12) = 7.2$ N

b) Force in unit-vector notation?

$F = -12\hat{i} + 5\hat{j}$

Q34)



$\mu_k = 0.4$

$\mu_s = 0.6$

$m_1 = 40\,kg$

$m_2 = 12\,kg$

$F = 120\,N$

~~$F_{s,max}$~~ in unit vector notation,

a) Acc ~~of~~ for ~~m_2~~ m_2 ~~and m_2~~

$$F_{s,max} = \mu_s N \Rightarrow 0.6(m_2 g)$$

$$\Rightarrow 0.6(12)(9.8) = 72\,N$$

$$F - F_k = m_2 a_2$$

$$120 - 0.4(12)(9.8) = 12 a_2 \Rightarrow a_2 = 6\,m/s^2$$

b) Acc of m_1?

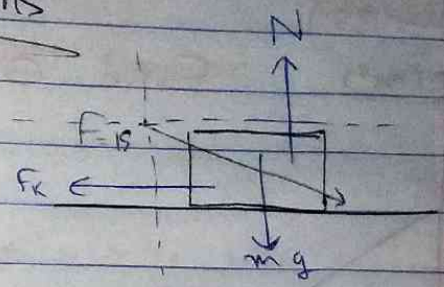
$$F_k = m_1 a_1 \Rightarrow \mu_k (m_2 g) = m_1 a_1$$

$$\Rightarrow (0.4)(120) = 40 a_1$$

$$\Rightarrow a_1 = 1.2\,m/s^2$$

Quiz Problems

Q9)



$m = 3.5\,kg$
$|\vec{F}| = 15\,N$
$\mu_K = 0.25$

a) Frictional force?

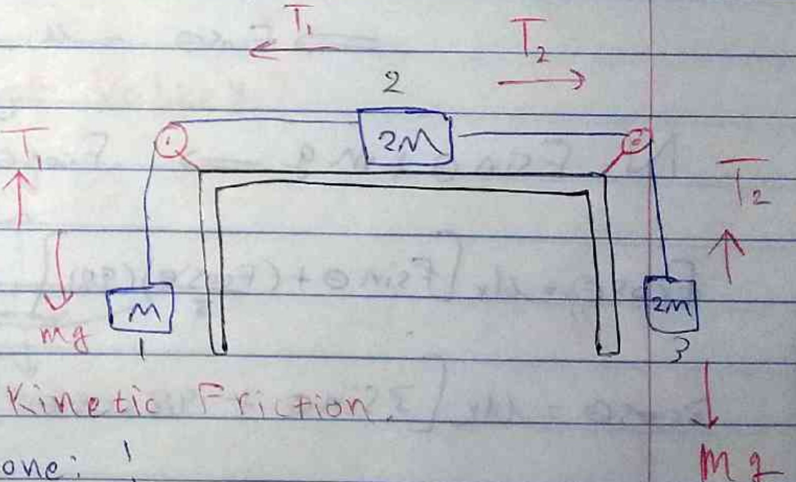
$F_K = \mu_K N \longrightarrow F_K = 0.25\,(43.9)$
$= 10.98\,N$

Note:
$N - F\sin 40 - mg = 0$
$N = F\sin 40 + mg$
$N = 15\sin 40 + 3.5\,(9.8)$
$N = 43.94$

b) block's acceleration?

$F\cos\theta - F_K = ma \Longrightarrow 15\cos 40 - 10.98 = 3.5\,a$
$\Longrightarrow a = 0.145\ m/s^2$

Q23)



$a = 0.9\ m/s^2$

Find coefficient of Kinetic Friction.

First we look at block one:

$T_1 - mg = Ma \ldots (1)$
$T_1 = Mg + Ma$

block (2):

$T_2 - F_K - T_1 = 2Ma \ldots (2)$

block (3):

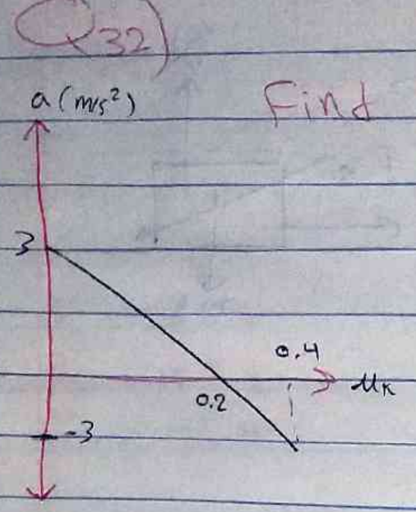
$2mg - T_2 = 2Ma \ldots (3)$
$T_2 = 2Mg - 2Ma$

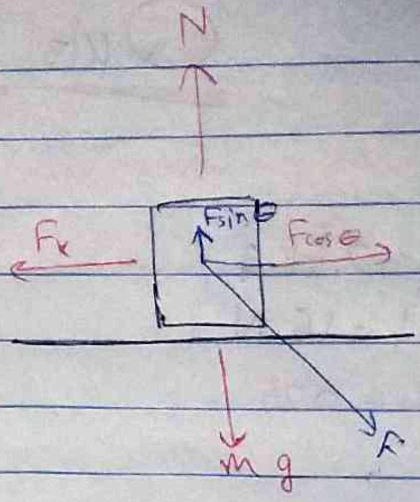
Substitute both (1) and (3) in (2)

$F_K = T_2 - T_1 - 2Ma$
$\mu_K(2Mg) = 2Mg - 2Ma - Mg - Ma - 2M$
$\mu_K = 0.37$

Q32)

Find θ?





When acceleration = 3 m/s² ;

$F\cos\theta - F_k = ma \Rightarrow F\cos\theta = 3m \ldots$ (1)

$m = \frac{F\cos\theta}{3}$

When acceleration equals zero :

$F\cos\theta - F_k = 0 \Rightarrow F\cos\theta = F_k$

$\Rightarrow F\cos\theta = \mu_k(N) \Rightarrow \cancel{F\cos\theta = \mu_k mg \ldots (2)}$

$N = F\sin\theta + mg \Rightarrow F\cos\theta = \mu_k(F\sin\theta + mg) \ldots$ (2)

$F\cos\theta = \mu_k\left[F\sin\theta + \left(\frac{F\cos\theta}{3}\right)(9.8)\right] \Rightarrow \cos\theta = \mu_k\left[\sin\theta + \frac{\cos\theta}{3}(9.8)\right]$

$3\cos\theta = \mu_k\left[3\sin\theta + 9.8\cos\theta\right] \Rightarrow 1.04\cos\theta = 0.6\sin\theta$

$\theta = \tan^{-1}\left(\frac{1.04}{0.6}\right) = \boxed{60.01^\circ}$

Q42)

$\mu_s = 0.6$

$R = 32\,m$

Velocity that will make the car almost lose control?

$$F_c = ma_c \Longrightarrow F_s = \frac{mv^2}{r} \Longrightarrow \mu_s(mg) = \frac{mv^2}{R}$$

$$\Longrightarrow V = \sqrt{\mu_s (g)(R)}$$

$$V = 13.7\ m/s$$

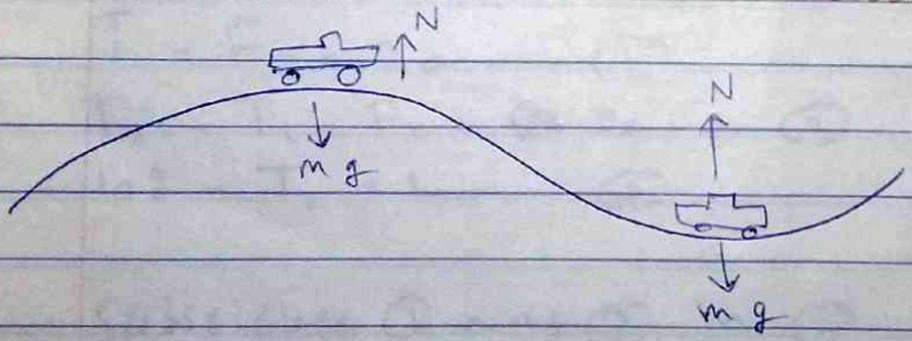
Q49)

Constant speed $\longrightarrow$ acceleration $= 0$

Normal Force on top of hill $= 0$

$m = 80\,kg$

Normal force in bottom of Valley?



on top of hill:

$$mg = \frac{mv^2}{R}$$

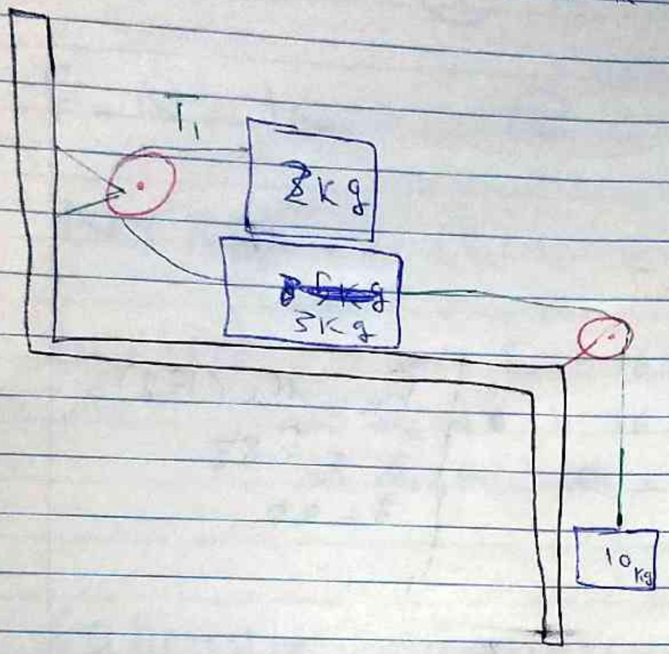
on bottom of Valley:

$$N - mg = \frac{mv^2}{R} \Longrightarrow N = mg + mg \Longrightarrow N = 1568\ N$$

Discussion Problems Ch.6

Q3)

$\mu_k = 0.3$



a) Find Acceleration?

$T_1 - F_k = 2a$ ... (1)

$T_2 - T_1 - F_k = 3a$ ... (2)

$10g - T_2 = 10a$ ... (3)

$F_k = \mu_k (2g)$

$= 5.88$ N

$g = 9.8$

Substitute (1) and (3) in (2):

$10g - 10a - 2a - F_k - F_k = 3a \Rightarrow a = 5.7\ m/s^2$

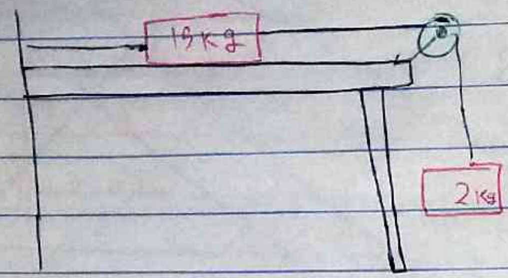
b) Find T_1?

$T_1 - F_k = 2a \Rightarrow T_1 = 17.28$ N

c) Find T_2?

$10g - T_2 = 10a \Rightarrow T_2 = 41$ N

Q 21) $\mu_K = 0.04$



a) Find Accoleration?

$T - F_K = 15a \; \cdots$ ①

$2g - T = 2a \; \cdots$ ②

$F_K = \mu_K (15g)$
$= 5.88$
$g = 9.8$

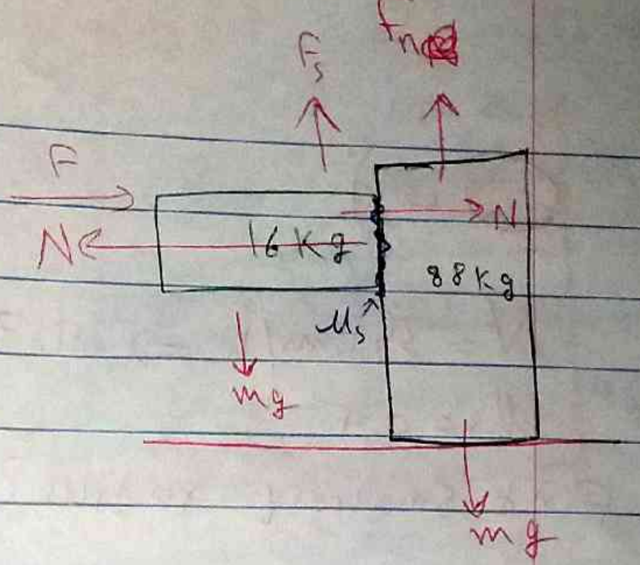
sabstitute ① in ②

$2g - F_K = 17a \Rightarrow a = 0.8 \, m/s^2$

b) Tension?

$T - F_K = 15a \Rightarrow T = 15a + F_K \Rightarrow T = 15(0.8)(5.88) = 17.98$

Q35) $\mu_s = 0.33$



$\vec{F} = 104a$ ... (1)

$F - N = 16a$ ... (2)

$N = 88a$ ... (3)

Find minimum force?

$F_s - 16g = 0 \Rightarrow F_s = 16g$

$\Rightarrow \mu_s N = 16g$

$\Rightarrow \mu_s (88a) = 16g \Rightarrow a = \frac{16(9.8)}{\mu_s (88)} \Rightarrow 5.4\ m/s^2$

Substitute acceleration in (1):

$F = 104(5.4) \Rightarrow F = 561.6\ N$

~~Q39) $V_1 = 1200\ km/h$ $\rho = 0.38\ kg/m^3$ at $h = 10\ km$~~

~~$h_1 = 15\ km$ $\rho = 0.67\ kg/m^3$ at $h = 5\ km$~~

~~$V_2 = 600\ km/h$~~

~~$h_2 = 7.5\ km$ Find ratio between D_1 and D_2.~~

Q 43)

$V = 35\ Km/h \Rightarrow 9.72\ m/s$

$\mu_s = 0.4$

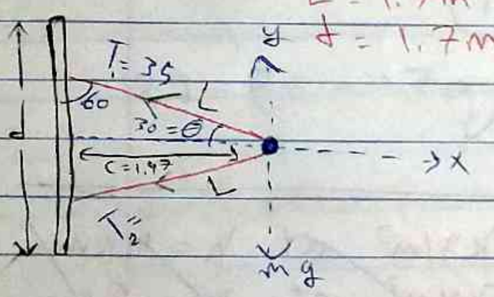
Find smallest radius?

$F_c = \frac{mV^2}{R} \Rightarrow \mu_s m g = \frac{m V^2}{r} \Rightarrow \frac{V^2}{\mu_s g} = r$

$r = 24\ m.$

Q 59) $m = 1.34\ Kg$
$L = 1.7m$
$d = 1.7m$

a) Tension in lower string?



$T_1 \sin\theta = 1.34g + T_2 \sin 30$

$35 \sin 60 = 1.34(g) + T_2 \sin 30$

$T_2 = 8.2\ N$

b) Net force on object?

$F_{net} = T_1 \cos 30 + T_2 \cos 30$

$= 37.4\ N$

c) speed of object?

$F_{net} = \frac{mv^2}{c} \Rightarrow 37.4 = \frac{1.34\ V^2}{1.47} \Rightarrow V = 6.4\ m/s$

d) direction of F_{net}?

towards center.