mel gichane

PHYS 1 50 — MIDTERM

Unit 0 →

1) ~11.0 g/cm^3 ⇒ $\boxed{C}$
as water's density
is 1 g/cm^3

2) LA ⟶ BAY
$x_0 = 0km$ $V = 60 \frac{km}{hr}$ $x_1 = 600km$
$t_0 = 0s$ $t_1 = ?$

$V = \frac{\Delta x}{\Delta t} \Rightarrow \Delta t = \frac{\Delta x}{V}$

$t_1 = \frac{(600\ km)}{(60\ km/hr)} = 10\ hr$

It takes 10 hrs to reach its destination $\boxed{C}$

3) 25 m/s ⟶ km/hr

$\frac{25\ \cancel{m}}{1\ \cancel{s}} \cdot \frac{3600\ \cancel{s}}{1\ hr} \cdot \frac{1\ km}{1000\ \cancel{m}}$

$= 90\ km/hr = \boxed{D}$

4)

$V_0 = 0 km/hr$ $\quad V_1 = 10 km/hr$
$t_0 = 0 s$ $\quad t_1 = 60s =$

$\vec{a} = \frac{\Delta v}{\Delta t} = \frac{(10\ km/hr)}{(60\ s)}$

$= 1/6\ km/hr/s \rightarrow \boxed{C}$

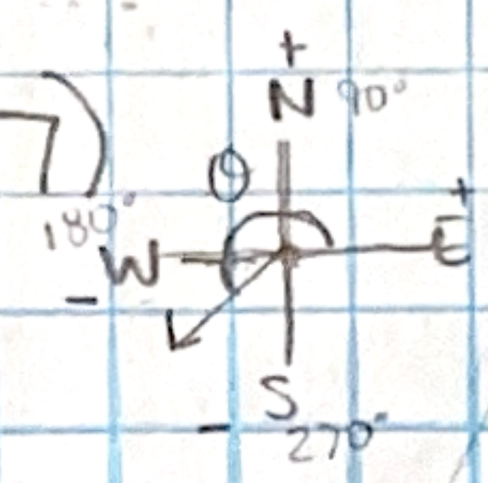
5) ~500 m^2 or $\boxed{C}$
(process of elimination & estimation)

6) bean vol. → 0.5 cm^3
bottle vol. → 2 L ?

$\frac{2L}{} \cdot \frac{1000\ cm^3}{1\ L} = 2000\ cm^3$

$\frac{2000\ cm^3}{0.5\ cm^3} = 4{,}000$ beans $= \boxed{C}$

7)



$\vec{V} = 10$ km/hr SW
$V_x = ?$ $V_y = ?$
θ → 225° exact
β → 45°

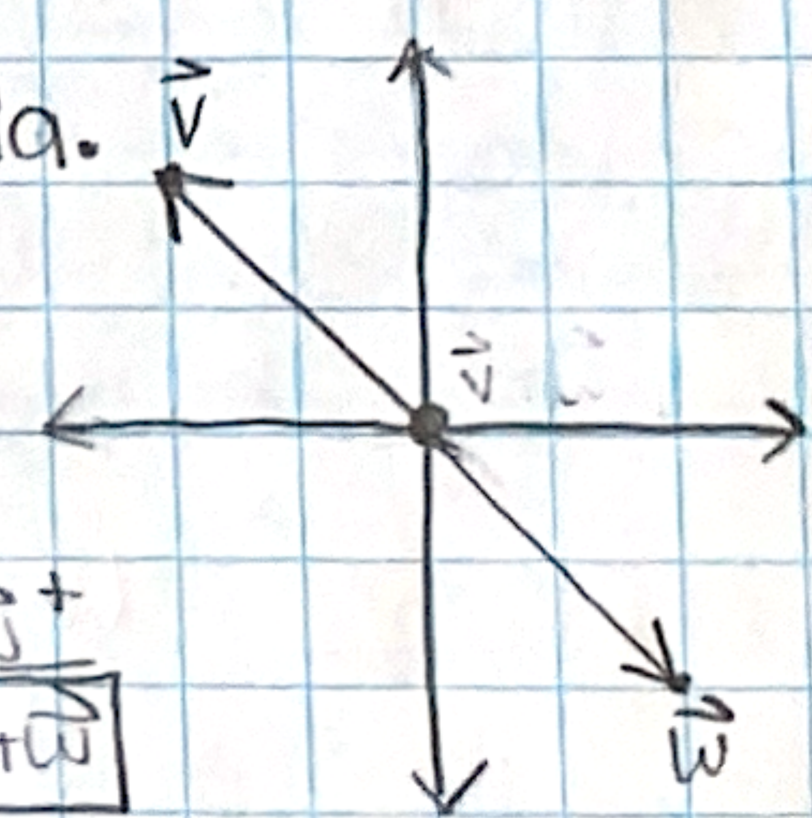
$\frac{V_x}{\vec{V}} = \cos\theta \rightarrow V_x = \frac{10\sqrt{2}}{2} = 5\sqrt{2}$

$\frac{V_y}{\vec{V}} = \sin\theta \rightarrow V_y = \frac{10\sqrt{2}}{2} = 5\sqrt{2}$

$\vec{V} = -5\sqrt{2}\hat{i} - 5\sqrt{2}\hat{j}$ km/hr
$= \boxed{D}$

8) 45° from −x horizontal
is $\boxed{225°}$ counter-clockwise from +x horizontal
$= \boxed{A}$

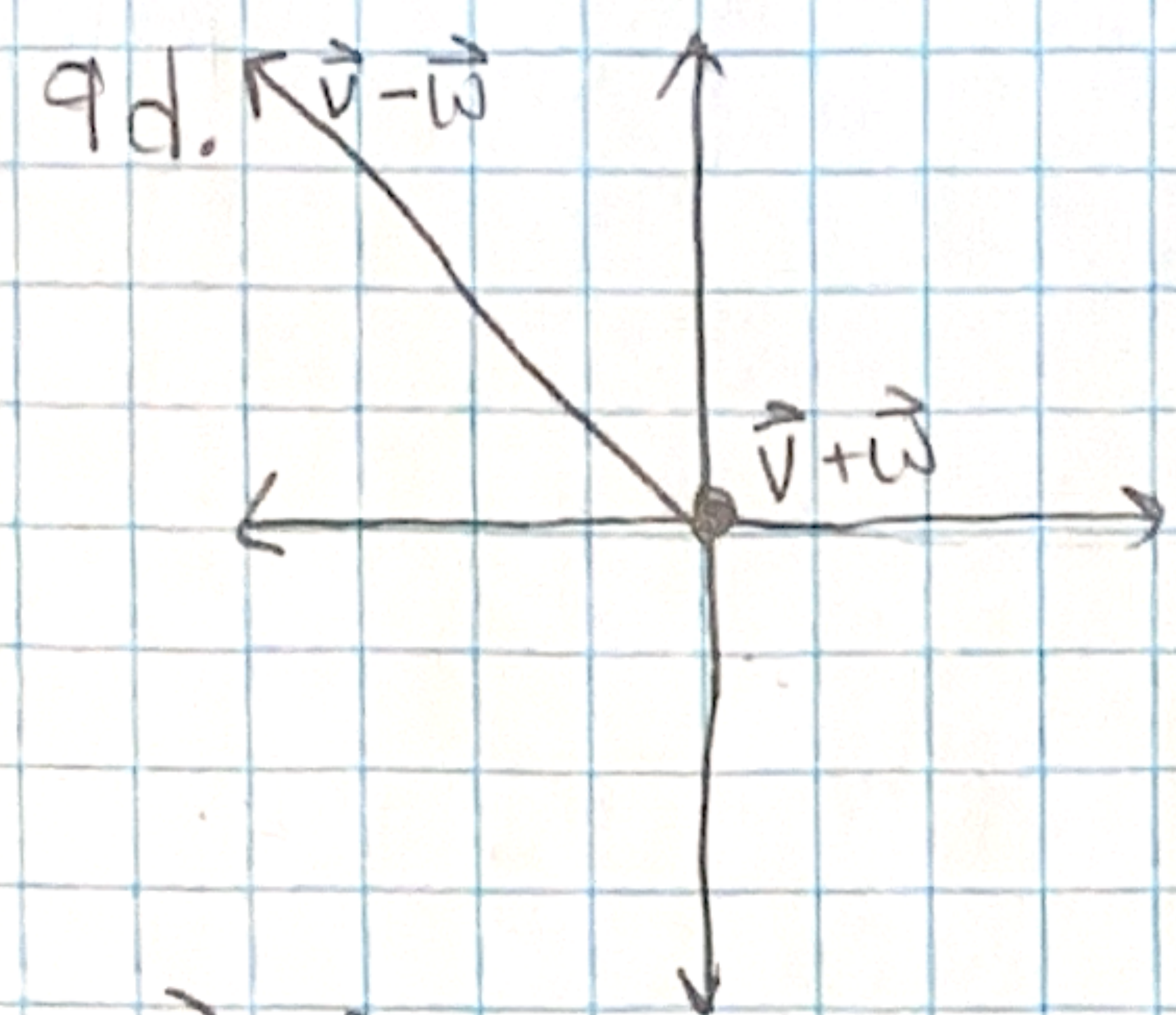
9) $\vec{V} = -2\hat{i} + 2\hat{j}$ 9a.
$\vec{W} = 2\hat{i} - 2\hat{j}$



9b. $-2\hat{i} + 2\hat{j} = \vec{V}$
$+\ 2\hat{i} - 2\hat{j} = \vec{W}\ +$
$\boxed{0\hat{i} - 0\hat{j} = \vec{V} + \vec{W}}$

9c. $-2\hat{i} + 2\hat{j} = \vec{V}$
$-\ \ 2\hat{i} - 2\hat{j} = \vec{W}\ -$
$\boxed{-4\hat{i} + 4\hat{j} = \vec{V} - \vec{W}}$

9d.



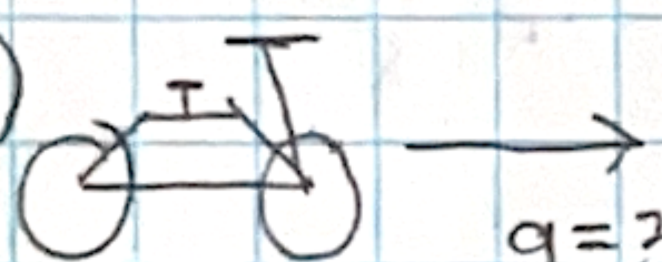
$\vec{v}+\vec{w} = 0\hat{i} + 0\hat{j}$
$\vec{v}-\vec{w} = -4\hat{i} + 4\hat{j}$

9e. $\vec{v}\cdot\vec{w} = ?$

$= V_x W_x \hat{i} + V_y W_y \hat{j}$
$= (-2)(2)\hat{i} + (2)(-2)\hat{j}$
$\vec{v}\cdot\vec{w}\ \boxed{= -4\hat{i} - 4\hat{j}}$

Unit 1 →

1)



$t = 0s$ $\quad a = 3\ m/s^2$
$V_0 = 15 m/s$ $\quad V(4) = ?$
$x_0 = 0m$ $\quad \Delta X = ?$
$t = 4$

1a. $V(4) = (15 m/s) + (3 m/s^2)(4s)$
$\boxed{V(4) = 27\ m/s}$

1b. $V_{x_1}^2 = V_{x_0}^2 + 2a_x(X_1 - X_0)$

$\frac{V_{x_1}^2 - V_{x_0}^2}{2a} = (X_1 - X_0)$

$\frac{(27 m/s)^2 - (15 m/s)^2}{2(3 m/s^2)} = \Delta X$

$\frac{729 m^2/s^2 - 225 m^2/s^2}{6 m/s^2} = \Delta X$

$\boxed{84\ m = \Delta X}$

1c. $V(4) = \frac{\Delta X}{\Delta t} = \frac{84m}{4s}$ 21 m/s

$V(0) = \frac{\Delta X}{\Delta t}$ 0 m/s

$\boxed{\text{diff. @ } t = 4s}$

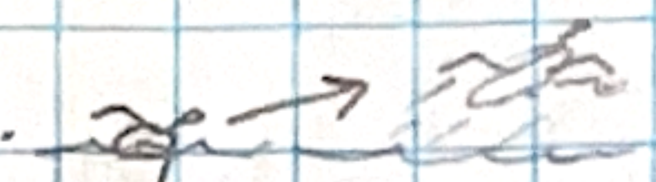
2) 2a. $P \rightarrow \frac{x_f - x_1}{t_f - t_1} \rightarrow \frac{988 - 338}{15 - 5} = \boxed{65\ m/s}$

$Q \rightarrow \frac{x_f - x_1}{t_f - t_1} \rightarrow \frac{2900 - 1500}{30 - 20} = \boxed{140\ m/s}$

2b. acceleration is positive as the parabolic figure is concave up signifying a pos. acceleration

$a = \frac{\Delta V}{\Delta t} \rightarrow \frac{140 - 65}{25 - 10} = \boxed{5\ m/s^2}$

3) 3a.



$V_0 = 0 m/s$ $\quad V_1 = 6 m/s$
$a = 0.8\ m/s^2$ $\quad \boxed{\Delta X = ?}$, $t = ?$

$\frac{V_{x_1}^2 - \cancel{V_{x_0}^2}}{2a_x} = \Delta X$

$\frac{(6 m/s)^2}{2(0.8 m/s^2)} = \boxed{\Delta X = 22.5\ m}$

3b. $\frac{V_{x_1} - \cancel{V_{x_0}}}{a_x} = t$

$\frac{6 m/s}{0.8 m/s^2} = \boxed{t = 7.5\ s}$

4) show R = 60 m w/ #'s selected & verify results

$R = 60m$
$\boxed{\theta = 45^\circ} \rightarrow \sin(2\theta) = 1$
$g = 9.8 m/s$
$v = ?$

$R = \frac{v^2 \sin(2\theta)}{g}$

$\sqrt{\frac{Rg}{\sin 2\theta}} = \sqrt{v^2}$

$\sqrt{\frac{(60 m)(9.8 m/s^2)}{(1)}} = \boxed{V_2 = 24.249\ m/s}$

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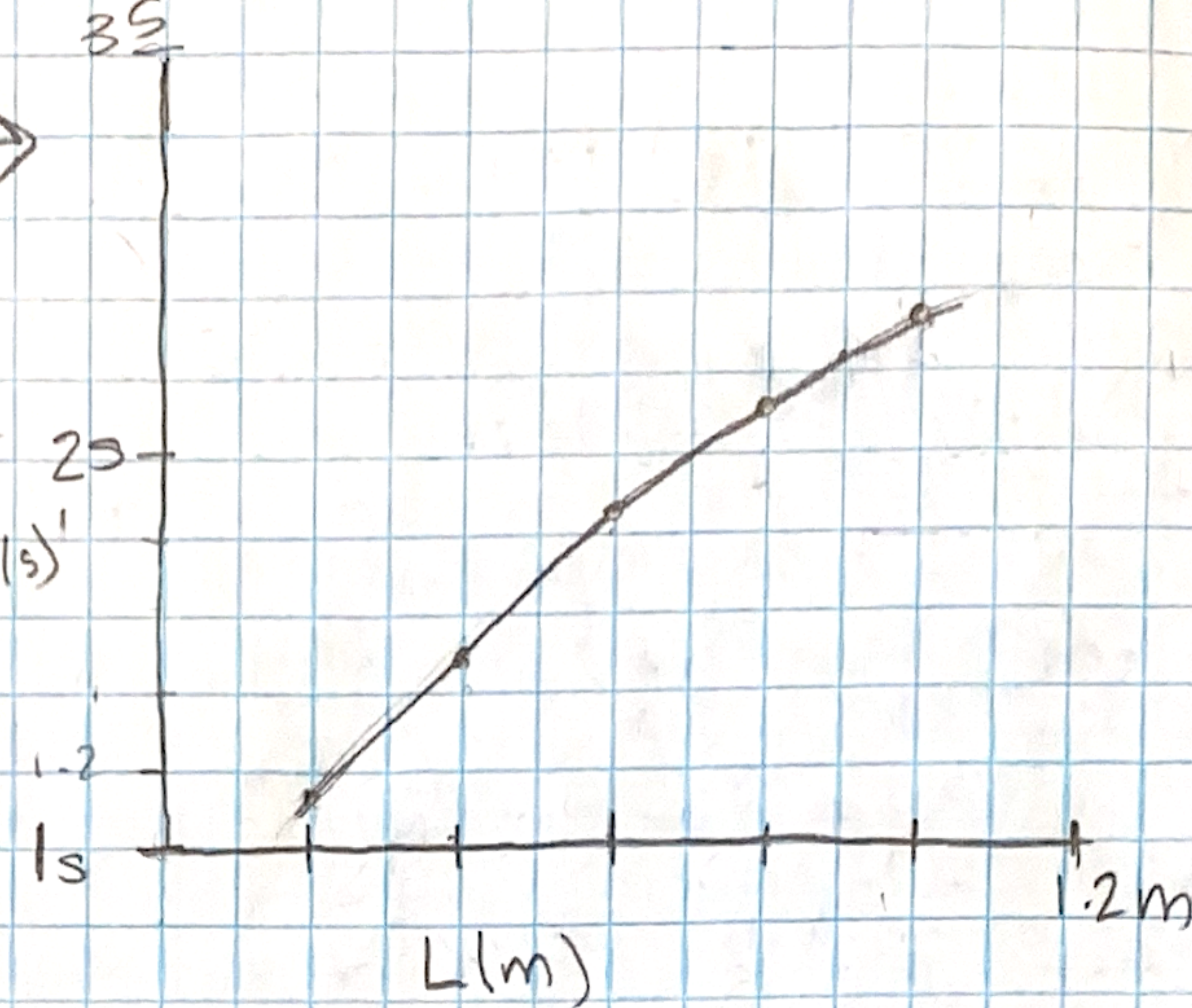
Unit 1 (cont.) →

5) $T = 2\pi\sqrt{L/g}$

show $g \rightarrow 9.8 m/s^2$

graph



T (s)	L (m)
1.140	0.2
1.498	0.4
1.834	0.6
2.118	0.8
2.368	1.0

$T = 2\pi\sqrt{L/g}$

$\left(\frac{T}{2\pi}\right)^2 = \frac{L}{g} \rightarrow \frac{T^2}{4\pi^2} = \frac{L}{g} \rightarrow g = \frac{4\pi^2 L}{T^2} \rightarrow$

ex. (0.2 m, 1.140 s)

$g = \frac{4\pi^2(0.2\,m)}{(1.140)^2}$

$[g = 6.075\, m/s^2$?????

ex.2 (0.6 m, 1.834 s)

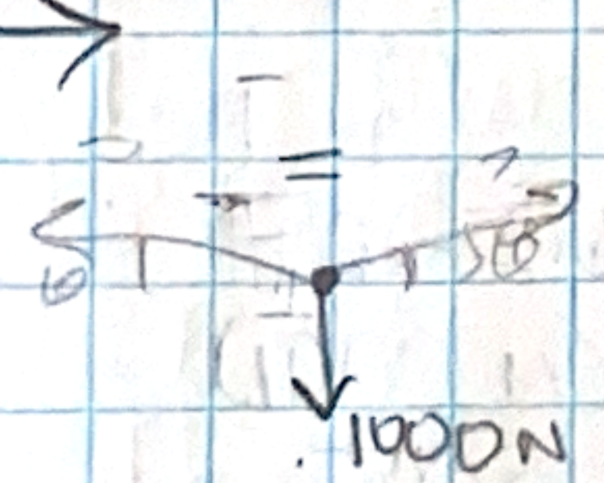
$g = \frac{4\pi^2(0.6m)}{(1.834)^2}$

$[g = 7.042\, m/s^2$???

I attempted to retake data but my #'s remained the same. I'm not exactly sure as to why it isn't proving 9.8 m/s² as g, since m is negligable, the periods were measured 3x per length & my calculations were double checked.

Unit 2 →

1) 1a. $F_\perp = 1000 N$
$\theta = 7°$
$\mu = .05$

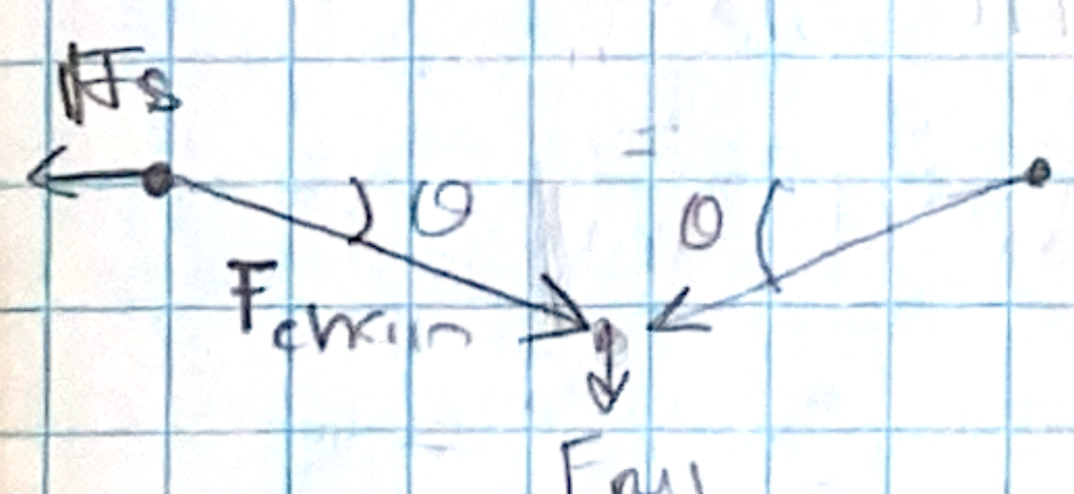


$\Sigma F_y = (-1000\,N) + 2(F_{T_y}) = 0$

$F_{T_y} = 500 N$

$\sin\theta = \frac{F_{T_y}}{F_T} \rightarrow \frac{F_{T_y}}{\sin\theta} = \boxed{F_T = 4{,}102.75}$

$\cos\theta = \frac{F_{T_x}}{F_T}$



1b. $F_s = \mu|F_N|$
$= (.05)(900\,kg \cdot 9.8\,m/s^2)$
$= 441\,N$

$\Sigma F_x = -441\,N + F_T\cos\theta = 3{,}631.17$

$\Sigma F_y = (+500\,N$

$\frac{F}{m} = a$

$\frac{(3{,}665.43N)}{(900\,kg)}$

$\boxed{a = 4.07\, m/s^2}$

Unit 2 →

2) $V_0 = \frac{120{,}000\,m}{hr} \cdot \frac{1\,hr}{3{,}600\,s} = 33.33\,m/s$

$V_1 = 0\,m/s$

$\Delta x = 100\,m$

$a = ?$

$V_1^2 = V_0^2 + 2a(\Delta x)$

$\frac{\cancel{V_1^2} - V_0^2}{2\Delta x} = a$

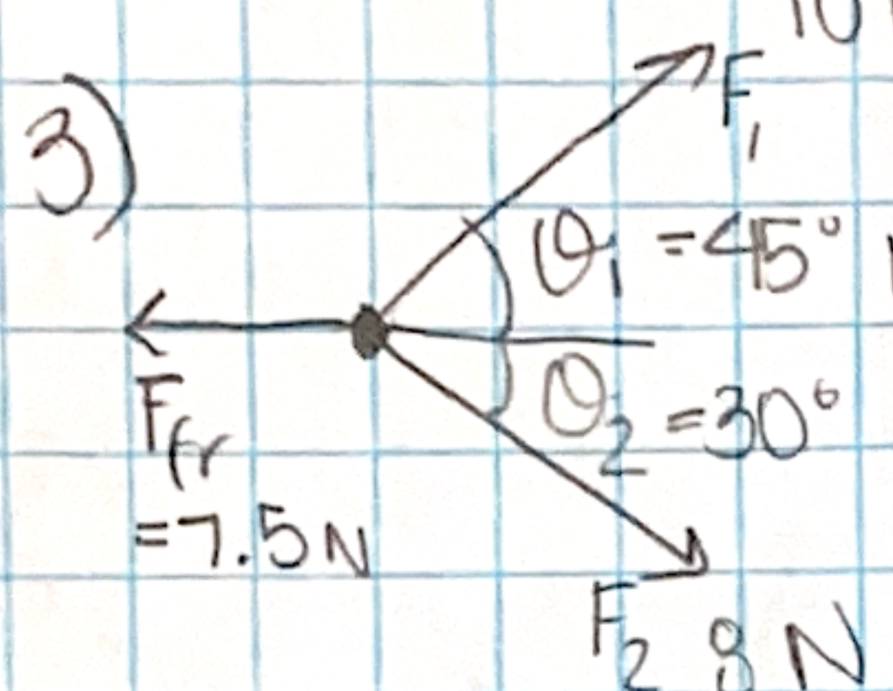
$\frac{-(33.33\,m/s)^2}{(200\,m)} = \boxed{a = -5.55\,m/s^2}$

2b. $F = ma$

$= (20{,}000\,kg)(-5.55\,m/s^2)$

$\boxed{F = -111{,}111\,N}$

3)



$m = 50\,kg$

$\Sigma F_x = F_1\cos\theta_1 + F_2\cos\theta_2 - F_{fr}$

$= \frac{\sqrt{2}}{2}F_1 + \frac{\sqrt{3}}{2}F_2 - F_{fr}$

$= 5\sqrt{2} + 4\sqrt{3} - 7.5\,N$

$\Sigma F_x = 6.50\,N$

$\Sigma F_y = F_1\sin\theta_1 - F_2\sin\theta_2$

$= 5\sqrt{2} - 4$

$\Sigma F_y = 3.07\,N$

$|F| = \sqrt{F_x^2 + F_y^2}$

$= \sqrt{(6.5\,N)^2 + (3.07\,N)^2}$

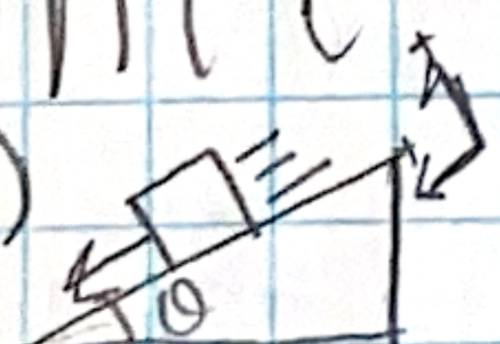
$|F| = 7.189\,N$

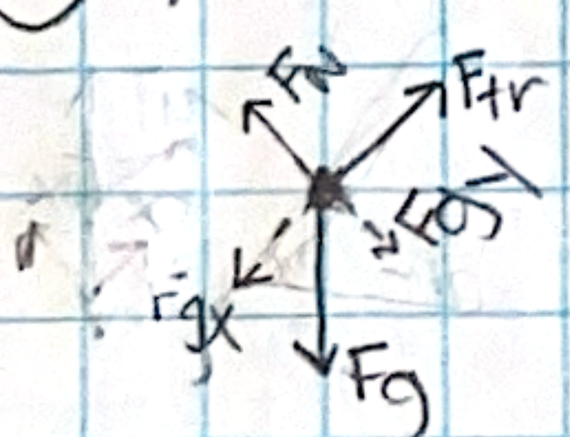
$\frac{F}{m} = a = \frac{(7.189\,N)}{(50\,kg)} = \boxed{.14\,m/s^2 = a}$

$\tan^{-1}(3.07\,N / 6.50\,N) = \boxed{\theta = 25.3°}$

Unit 3 →

1)





1b. $\mu \to 0$

$\boxed{a_x = g\sin\theta}$

$\Sigma F_x = F_{gx} - F_{fr}$

$\Sigma F_x = mg\sin\theta - mg\cos\theta\,\mu$

$\frac{\Sigma F_x}{m} = a_x$

$\frac{\cancel{m}g(\sin\theta - \mu\cos\theta)}{\cancel{m}} = a_x$

$\boxed{g(\sin\theta - \mu\cos\theta) = a_x}$

2) a. $\mu_{kws} = .1$, $\theta = 10°$

$a_x = 9.8(\sin(10) - .1\cos(10))$

$= 9.8(.075167)$

$a_x = .737\,m/s^2$

b. $V_{x_1} = \cancel{V_{x_0}} + a_x t$

$\boxed{V_{x_1} = 22.099\,m/s}$

$V_{x_1}^2 = V_{x_0}^2 + 2a_x(\Delta x)$

$\frac{V_{x_1}^2 - \cancel{V_{x_0}^2}}{2a_x} = \Delta x$

$\frac{(22.1\,m/s)^2}{2(.737\,m/s^2)} = \boxed{\Delta x = 331.3\,m}$

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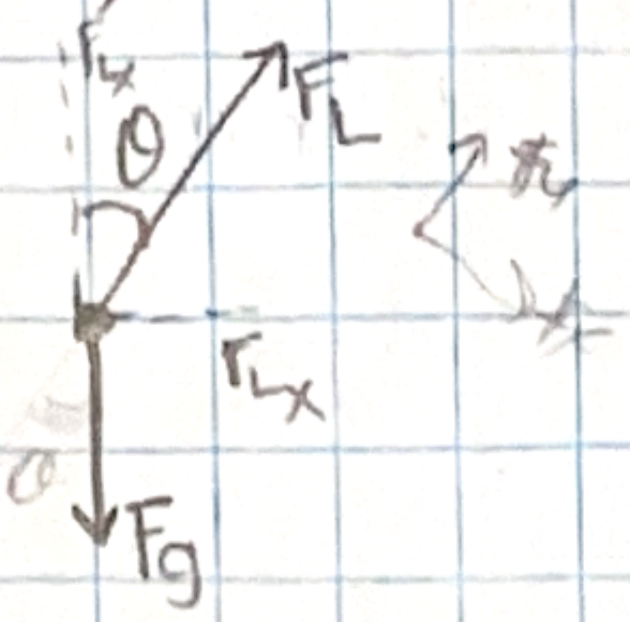
Unit 3 (cont.) →

3) $m = 6{,}000\ kg$
$\theta = 30°$
$F_L = 80{,}000\ N$



a. $F_c = \frac{mv^2}{r}$

$F_{Lx} = F_L \sin\theta$

$F_c = F_{Lx}$

$\frac{mv^2}{r} = F_L \sin\theta$

$F_c = F_L \sin\theta$
$= (80{,}000)\sin(30°)$

$\boxed{F_c = 40{,}000\ N}$

b. $V = \frac{600\ km}{hr} \cdot \frac{1000\ m}{1\ km} \cdot \frac{1\ hr}{3600\ s} = 166.67\ m/s$

$F_c = \frac{mv^2}{r} \Rightarrow r = \frac{mv^2}{F_c}$

$r = \frac{(6{,}000\ kg)(166.67\ m/s)^2}{(40{,}000\ N)}$

$\boxed{r = 4{,}166.67\ m}$

c. ½ circle → $\pi \cdot r$
$= 13{,}089.97\ m$

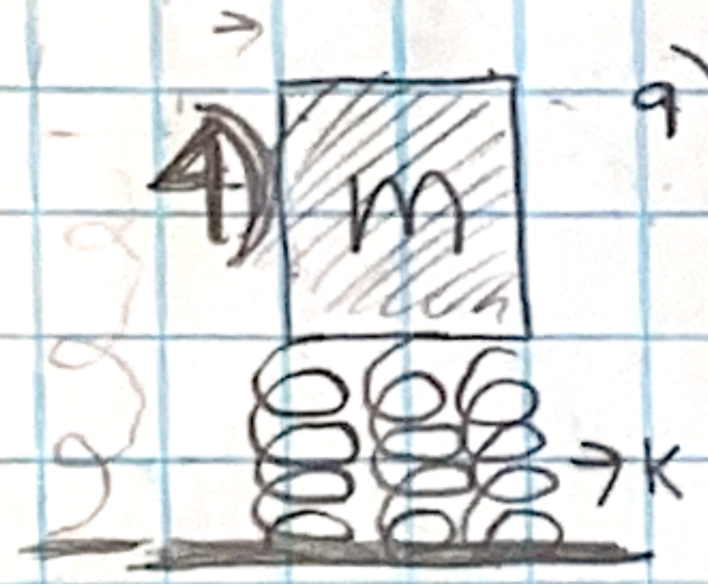
$\frac{\pi r}{v} = t \rightarrow \frac{(13{,}089.97 m)}{(166.67\ m/s)}$
$= 78.54\ s$

$\boxed{t = 79\ s}$

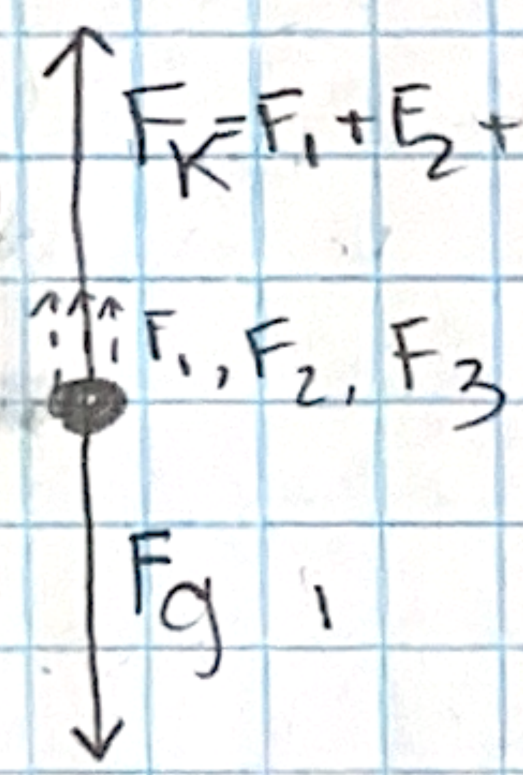
5) Unit analysis

$\sqrt{\frac{kg \cdot m}{s^2} \cdot \frac{m^3 \cdot 1}{kg\ m^2}} \cdot \sqrt{\frac{m^2}{s^2}} = m/s$

4)



a)



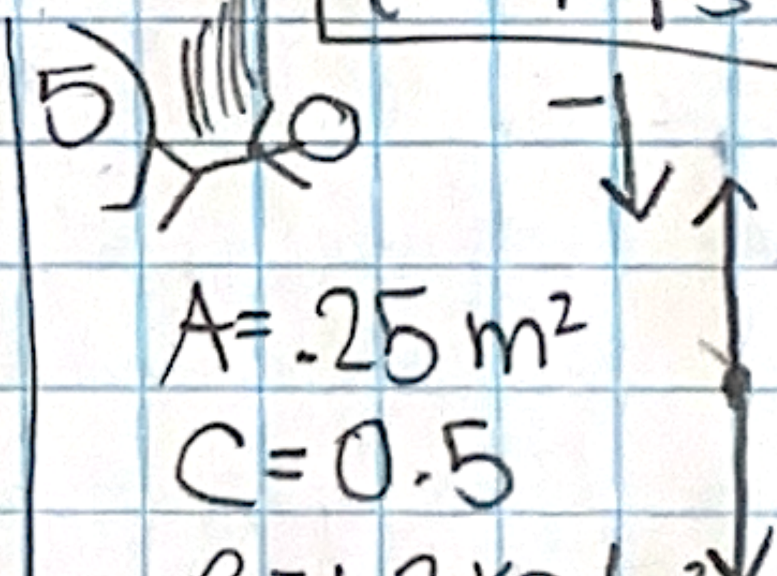
b) $\Sigma F_y = F_K - F_g$
$0 = (F_1 + F_2 + F_3) - F_g$
$F_g = F_1 + F_2 + F_3$
$mg = K(\Delta x) + K(\Delta x) + K(\Delta x)$
$mg = 3K(\Delta x)$

$\boxed{\frac{mg}{3K} = \Delta x}$

c) $\lim_{K \to \infty} \frac{mg}{3K}$
$= \frac{mg}{3(\infty)}$

$\boxed{\Delta x = 0}$

5)



$A = .25\ m^2$
$C = 0.5$
$\rho = 1.2\ kg/m^3$
$m = 60\ kg$
$\boxed{V_t = ?}$

$\Sigma F_y = F_D - mg = 0$
$mg = F_D$
$mg = \frac{1}{2} C \rho A V_t^2$
$\sqrt{\frac{2mg}{C\rho A}} = -V$ direction

$\sqrt{\frac{2(60 kg)(9.8 m/s^2)}{(.5)(1.2 kg/m^3)(.25 m^2)}}$

$\boxed{V_t = 88.5\ m/s}$

b) $\sqrt{2mg} \cdot \frac{1}{\sqrt{C\rho A \cdot 100}} = \sqrt{\frac{2mg}{C\rho A}} \cdot \frac{1}{\sqrt{100}}$
$= \frac{1}{10} \cdot \sqrt{\frac{2mg}{C\rho A}}$

$\boxed{V_t = -8.85\ m/s}$

(6)

$F = 10{,}000\,N$

$Y = 4.5\times10^{9}\,N/m^2$

$\boxed{\Delta x = ?}$

$d = 0.2\,m$

$L = 10\,m$

$A = \pi r^2$
$= \pi(.1\,m)^2$
$= .0314\,m^2$

a) $Y = K\frac{L}{A}$

$\frac{X}{L} = \frac{F}{YA}$

$X = \frac{FL}{YA} = \frac{(10{,}000\,N)(10\,m)}{(4.5\times10^{9}\,N/m^2)(.0314\,m^2)}$

$X = .000707\,m$

$\boxed{X = 7.077\times10^{-5}\,m}$

unit analysis

$\frac{\cancel{N}\cdot m}{1} \times \frac{\cancel{m^2}}{\cancel{N}} \cdot \frac{1}{\cancel{m^2}} = m$

b) $Y = \frac{1}{2}Y$

$X = \frac{FL}{\frac{1}{2}YA} = \frac{FL}{YA}\cdot\frac{2}{1} = \frac{2FL}{YA} = \boxed{X = 1.41\times10^{-4}\,m}$