~~Unit~~ 0. $^{\text{r in}}$

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1) Physics 1 midterm #1 10/11/2a →

1. Density of Lead is about $11.3\ g/cm^3$

$\boxed{C}$: $11.0\ g/cm^3$

2. $V = 60\ km/hr$, $d = 600\ km$, $t = ?$

$d = v \cdot t \rightarrow t = d/v \rightarrow \frac{\cancel{600}^{10}\ km}{\cancel{60}\ km/hr}$

$t = \frac{10\ km}{km/hr} \rightarrow 10\ \cancel{km} \cdot \frac{hr}{\cancel{km}} \rightarrow \boxed{10\ hr}$

$\boxed{C}$ ← C

3. $25\ m/s \rightarrow km/hr$

$25\ \frac{\cancel{m}}{s} \cdot \frac{1\ km}{1000\ \cancel{m}} \rightarrow 0.025\ \frac{km}{\cancel{s}} \cdot \frac{3600\ \cancel{s}}{1\ hr}$

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

4. $a = \frac{\Delta V}{\Delta t} \rightarrow \frac{10\ km/hr - 0}{60\ s}$

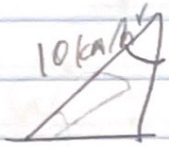
$\frac{10\ km/hr}{60\ s} \rightarrow \frac{1\ km/hr}{6\ s}$ $a =$

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

5. $\boxed{C: 500m^2}$

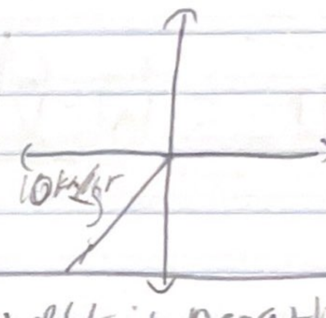
6. $\boxed{C}$

7.



$\sin = \frac{opp}{hyp}$

$\sin = \frac{opp}{10}$

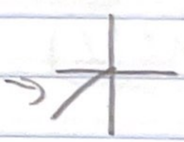


D. South is negative and west is negative

8. ~~$\tan^{-1} z$~~ $\tan\theta = \frac{-7.1}{-7.1}$

$\theta = \tan^{-1}\left(\frac{-7.1}{-7.1}\right)$

$\theta = 45$

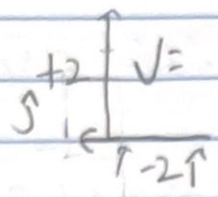


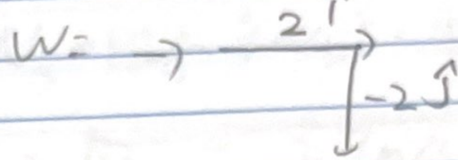
$\theta = 225^{\circ}$

A

9. $\vec{V} = -2\hat{\imath} + 2\hat{\jmath}$, and $\vec{w} = 2\hat{\imath} - 2\hat{\jmath}$

a.





b. $\vec{V} + \vec{w} =$

$$\begin{array}{r} -2\hat{\imath} + 2\hat{\jmath} \\ +\ \ 2\hat{\imath} - 2\hat{\jmath} \\ \hline 0\hat{\imath} \quad 0\hat{\jmath} \end{array}$$

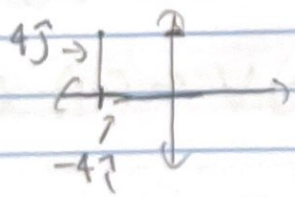
$\boxed{\vec{V} + \vec{w} = 0}$

c. $\vec{V} - \vec{w} =$

$$\begin{array}{r} -2\hat{\imath} + 2\hat{\jmath} \\ -\ \ 2\hat{\imath} + 2\hat{\jmath} \\ \hline -4\hat{\imath} + 4\hat{\jmath} \end{array}$$

$\boxed{\vec{V} - \vec{w} = -4\hat{\imath} + 4\hat{\jmath}}$

d.



e. $\vec{V} \cdot \vec{w}$

$$\begin{array}{r} -2\hat{\imath} + 2\hat{\jmath} \\ \cdot\ \ 2\hat{\imath} + 2\hat{\jmath} \\ \hline -4\hat{\imath} + 4\hat{\jmath} \end{array}$$

$\vec{V} \cdot \vec{w} = -4\hat{\imath} + 4\hat{\jmath}$

s at the back

unit 1: kinematics II, III 10/11

1. 15 m/s at t=0. a = 3 m/s^2

a. $\Delta v = a \cdot t \rightarrow v_f - 15\,m/s = 3\,m/s^2 \cdot 4s$

$v_f = 12\,m/s + 15\,m/s \rightarrow \boxed{v_f = 27\,m/s}$

b. $\Delta x = \frac{\Delta v}{\Delta t} \rightarrow \Delta x = \frac{27\,m/s - 15\,m/s}{4s}$

$\frac{12\,m/s}{4s} \rightarrow \boxed{\Delta x = 3m}$

c. The instantaneous velocity at 4 seconds is greater than at t=1 due to acceleration

2. $x(t) = 10t - 2t^2. \rightarrow 10(2) - 2(2)^2 = 12, 10(3) - 2(3)^2 =$

a. $x'(t) \rightarrow v(t) = 10 - 4t \quad t = 2, 3s$

$10 - 4(2) = 2\,m/s, \; 10 - 4(3) = -2\,m/s$

b. $\Delta v = \frac{\Delta d}{\Delta t} \rightarrow \frac{12 - 12}{3 - 2} = \frac{0}{1} = 0$

$\boxed{\Delta v = 0}$

c. $v'(t) \rightarrow \boxed{a(t) = -4}$

unit 1

3. a. $V_f = 6.00 m/s$ $a = 0.8 m/s^2$

Δx? $V_f^2 = V_i^2 + 2a\Delta x \rightarrow \frac{V_f^2 - V_i^2}{2a} = \Delta x$

$\Delta x = \frac{(6.00 m/s)^2 - 0}{2(0.8 m/s^2)} \rightarrow \boxed{\Delta x = 22.5 m}$

b. t? $\Delta x = \cancel{V_i t} + \frac{1}{2} a t^2$ $V_i = 0$

$\cancel{2(\Delta x)}$ $\cancel{2(\Delta x) = 2(\frac{1}{2} a t^2) \rightarrow \frac{2(\Delta x)}{a} = \frac{a t^2}{a}}$

$\cancel{\sqrt{\frac{2(\Delta x)}{a}} = t = \sqrt{\frac{2(22.5 m)}{0.8 m/s^2}} = \boxed{7.5 s}}$

$\cancel{V}$ $d/t = V$ $\frac{d}{V} = t$ $\cancel{d = \Delta t}$

$d = 22.5 m$, $V_f = 6.00 m/s$ $\frac{22.5 m}{6.00 m/s} = \boxed{3.75 s}$

right answer

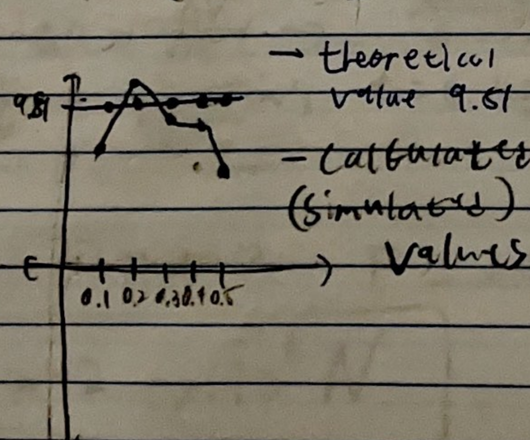
4. Design Problem

For the simulation, we can use projectile motion we can make a graph from the simulation and one that uses the equation (theory). We keep the velocity constant but change the angles. If we gather the data from both the simulation and the theory, we can put it in a graph that is a range vs degree graph and compare the two. Because of human error, the graph from the simulation compared to theory will be a bit off.

5. Design Problem $T = 2\pi\sqrt{L/g}$

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

g vs L graph



$$g = \frac{0.1}{\left(\frac{0.7}{2\pi}\right)^2} \approx 8.05$$

$$g = \frac{0.2}{\left(\frac{0.89}{2\pi}\right)^2} \approx 9.96$$

$$g = \frac{0.3}{\left(\frac{1.1}{2\pi}\right)^2} \approx 9.78$$

$$g = \frac{0.4}{\left(\frac{1.30}{2\pi}\right)^2} \approx 9.34$$

$$g = \frac{0.5}{\left(\frac{1.42}{2\pi}\right)^2} \approx 7.83$$

Unit 2 ; forces I and III

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

$T = \frac{F}{(2(\sin\theta))}$ $T = \frac{1000}{(2(\sin(7)))}$

$\boxed{T = 4102.75\ N}$

b. $m = 900 kg$ $\mu_k = 0.05$

$F_k = 0.05 \cdot (900 \cdot 9.81)$ $F_k = 441.45$

$\frac{F_T - F_k = ma}{m}$ $\frac{4102.75N - 441.45N}{900 kg}$

$\boxed{a = 4.068\ m/s^2}$

2\. $m = 20,000 kg$. $V = 120 km/hr \rightarrow 33.33 m/s$

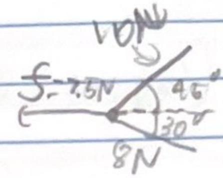
a. $\Delta a = \frac{\Delta V}{\Delta t} \rightarrow \frac{0 - 33.33 m/s}{0.3333 - 0}$ $\boxed{a = -101\ m/s^2}$

$\frac{d}{V} = t$ $\frac{33.33 m/s}{100 m}$ $t = 0.3333 s$

b. $F = ma$ $F = 20,000 kg \cdot -101 m/s^2$

$\boxed{F = -2.02 \cdot 10^6\ N}$

3.



$10(\cos(45)) + 8(\cos(30))$

≈ 14

$10(\sin(45)) - 8(\sin(30))$

≈ 3

$\sqrt{14^2 + 3^2} \approx 14.3\ N$

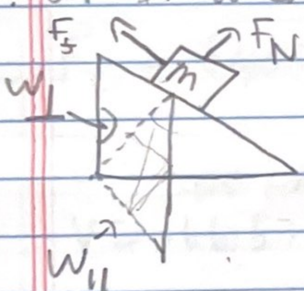
$14.3N - 7.5N = 6.8N$

unit 3 F II, IV

$\frac{6.8N}{50} = \frac{50kg\ a}{50}$

$\boxed{a = 0.136 m/s^2}$

1. a. Show that $a = g(\sin\theta - \mu\cos\theta)$



$W_{\parallel} - f = ma$

$W_{\parallel} - \mu N = ma$

$W_{\parallel} = mg\sin$

$W_{\perp} = mg\cos\mu$

$W_{\parallel} - \mu W_{\perp} = ma$

$\cancel{m}g\sin\theta - \mu \cancel{m}g\cos\theta = \cancel{m}a$

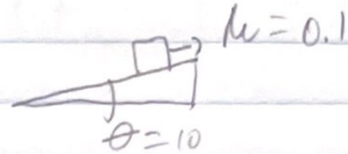
$g(g\sin\theta - \mu g\cos\theta) = a$

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

b. If $\mu = 0$ then acceleration would equal $g(\sin\theta)$ since there is no coefficient of friction to cause a frictional force.

2. a. $a = 9.8\,m/s^2\,(\sin(10) - 0.1\cos(10))$

$\boxed{a = 0.74\,m/s^2}$



b. $t = 30\,sec$ $\quad \Delta x = ?\ \Delta V = ?$

$\Delta V = a\Delta t \rightarrow V = 0.74\,m/s^2 \cdot 30s$

$\boxed{V = 22.2\,m/s}$ $\quad \Delta x = \frac{\Delta V}{\Delta t} \rightarrow \Delta x = \frac{22.2\,m/s}{30s}$

$\boxed{\Delta x = 0.74}$

3. $m = 6000\,kg$ $\quad \theta = 30^\circ$ $\quad F_L = 80{,}000\,N$

a. $F_c = F_L \cdot \sin(\theta)$,

$F_c = 80{,}000\,N \cdot \sin(30^\circ) \rightarrow F_c = 40{,}000\,N$

b. $V = 600\,km/hr$ $\quad F_c = \frac{mv^2}{r} \rightarrow r = \frac{mv^2}{F_c}$

$V = 166.67\,m/s$

$r = \frac{6000\,kg \cdot (166.67\,m/s)^2}{40{,}000\,N}$

$\boxed{r \approx 4166.83\,m}$

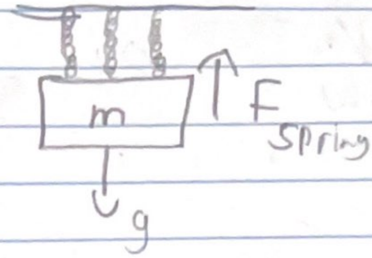
c. $T = 2\pi r/v$. halfway would change it to

$T = \pi r/V$ $\quad \frac{\pi\, r/2}{V}$

$T = \frac{\pi \cdot \frac{4166.83}{2}}{166.67\,m/s} \rightarrow \boxed{T \approx 39.27\,s}$

#6 in the back

4. a. FBD



b. derive expression for desplacement of spring

$X = F/_{-k}$ $\qquad$ $x' = 3\left(\frac{F}{-k}\right)$

c. $\lim\limits_{k \to \infty} = 0$. this is because as the denominator gets ~~way~~ way bigger, the position gets closer to zero

$X = \frac{F}{1000000...}$

5. find terminal velocity. $m = 60kg$, $A = 0.25m^2$
$P = 1.2\,kg/m^3$ $\qquad$ $C_d = 0.5$

a. $V_t = \sqrt{\frac{2mg}{PAC_d}} \to \sqrt{\frac{2(60\,kg)(9.81\,m/s^2)}{1.2\,kg/m^3 \cdot 0.25m^2 \cdot 0.5}}$

$\boxed{V_t = 88.59\,m/s}$

b. $V_t = \sqrt{\frac{2(60)(9.81)}{1.2 \cdot 100 \cdot 0.5}}$ $\qquad$ $\boxed{V_t \approx 4.43\,m/s}$

a.

6. $45 \cdot 10^9 \, N/m^2$ $\quad \Delta L \; \frac{WL}{2AE}$

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

$d = 20 \, cm \rightarrow 0.2 \, m$ $\quad \cancel{A = \pi r^2}$

$h = 10 \, m \rightarrow L$ $\quad A = \pi \frac{d}{2}^2$

$\Delta L = \frac{10{,}000 \cdot 10}{2 \; 0.0314 \cdot 45 \cdot 10^9}$ $\quad A = \cancel{0.01} \; 0.0314$

$\boxed{\Delta L \approx 3.5\cancel{2} \cdot 10^{-5} \, m}$

6. $\frac{45 \cdot 10^9}{2}$

$\rightarrow \frac{10{,}000 \cdot 10}{2 \cdot 0.0314 \cdot 2.25 \cdot 10^9}$

$\boxed{\Delta L \approx 7.077 \cdot 10^{-4}}$