Name_____ Physics 110 Quiz #7, May 28, 2021

Please show all work, thoughts and/or reasoning in order to receive partial credit. The quiz is worth 10 points total.

I affirm that I have carried out my academic endeavors with full academic honesty.

A hurricane is a tropical storm formed over the ocean by low atmospheric pressure. As the hurricane approaches land from the open ocean, we get large tides (ocean swells) that come much farther up the beach than they would normally. Consider an area of the beach where there is no hurricane. The winds are calm (v_A~0^m/_s) and the air pressure is 1.01 × 10⁵ N/m², as shown in Figure A. Suppose that in Figure B, a category 5 hurricane has made landfall (v_B = 69^m/_s (~155^{mi}/_{hr})) and the air pressure now has been reduced to 6.8 × 10⁴ N/m². How high (h) will the seawater rise into the air? The density of seawater and are ρ_{SW} = 1025^{kg}/m³ and ρ_{air} = 1.29^{kg}/m³ respectively.



$$P_{A} + \frac{1}{2}\rho_{air}v_{air,A}^{2} + \rho_{SW}gh_{A} = P_{B} + \frac{1}{2}\rho_{air}v_{air,B}^{2} + \rho_{SW}gh_{B}$$

$$h = h_{B} - h_{A} = \frac{(P_{A} - P_{B}) + (\frac{1}{2}\rho_{air}v_{air,A}^{2} - \frac{1}{2}\rho_{air}v_{air,B}^{2})}{\rho_{SW}g}$$

$$h = \frac{(1.01 \times 10^{5}\frac{N}{m^{2}} - 6.8 \times 10^{4}\frac{N}{m^{2}}) + (0 - \frac{1}{2}(1.29\frac{kg}{m^{3}})(69\frac{m}{s})^{2})}{1025\frac{kg}{m^{3}} \times 9.8\frac{m}{s^{2}}} = 3m$$

2. A helium filled balloon is tied to the ground. The balloon/basket/riders have a mass of 200kg. What is the initial magnitude of the upward acceleration of the system when the balloon/basket/riders lift off from the ground? Hint: The density of air and helium are $\rho_{air} = 1.29 \frac{kg}{m^3}$ and $\rho_{He} = 0.18 \frac{kg}{m^3}$ respectively and model the balloon as a sphere with volume $\frac{4}{3}\pi r^3$.

$$\begin{split} F_B &- F_{W,He} - F_{W,bbr} = m_{system} a\\ \rho_{air} g V_{air} &- \rho_{He} g V_{He} - m_{bbr} g = (m_{bbr} + M_{He}) a\\ a &= \frac{(\rho_{air} - \rho_{he}) g V_{He} - m_{bbr} g}{m_{bbr} + \rho_{He} V_{He}}\\ a &= \frac{\left(1.29 \frac{kg}{m^3} - 0.18 \frac{kg}{m^3}\right) \times 9.8 \frac{m}{s^2} \times \frac{4}{3} \pi (5m)^3 - 200 kg \times 9.8 \frac{m}{s^2}}{200 kg + \left(0.18 \frac{kg}{m^3} \times \frac{4}{3} \pi (5m)^3\right)}\\ a &= 12.7 \frac{m}{s^2} \end{split}$$

3. An auto accident leaves a car and driver submerged at the bottom of a lake ($\rho_{water} = 1000 \frac{kg}{m^3}$). What is the difference in pressure between the inside and outside of the car? Assume that the windows were rolled up and remained rolled up when the car went into the lake. Assume that the pressure from the water acts at the center of the car's door.

 $\begin{array}{l} P_{inside} = P_{air} \\ P_{outisde} = P_{air} + \rho_{water}gd \\ \Delta P = P_{outside} - P_{inside} = \rho_{water}gd \\ \Delta P = 1000 \frac{kg}{m^3} \times 9.8 \frac{m}{s^2} \times 8.6m = 8.4 \times 10^4 \frac{N}{m^2} \end{array}$



4. What is the magnitude and direction of the net force on the car door?

 $\Delta P = \frac{F_{net}}{A_{door}} \rightarrow F_{net} = \Delta P A_{door} = 8.4 \times 10^4 \frac{N}{m^2} \times (1.2m \times 1.0m) = 1.0 \times 10^5 N$ Since the pressure is greater on the outside than the inside the net force points into the car from the water.

10*m*



Vectors

$$v = \sqrt{v_x^2 + v_y^2}$$

$$\phi = \tan^{-1}\left(\frac{v_y}{v_x}\right)$$

Motion Definitions

Displacement: $\Delta x = x_f - x_i$ Average velocity: $v_{avg} = \frac{\Delta x}{\Delta t}$ Average acceleration: $a_{avg} = \frac{\Delta v}{\Delta t}$

Equations of Motion

displacement: $\begin{cases}
x_f = x_i + v_{ix}t + \frac{1}{2}a_xt^2 \\
y_f = y_i + v_{iy}t + \frac{1}{2}a_yt^2
\end{cases}$ velocity: $\begin{cases}
v_{fx} = v_{ix} + a_xt \\
v_{fy} = v_{iy} + a_yt
\end{cases}$ time-independent: $\begin{cases}
v_{fx}^2 = v_{ix}^2 + 2a_x\Delta x \\
v_{fy}^2 = v_{iy}^2 + 2a_y\Delta y
\end{cases}$

Rotational Motion Definitions

Angular displacement: $\Delta s = R\Delta\theta$ Angular velocity: $\omega = \frac{\Delta \theta}{\Delta t} \rightarrow v = R\omega$ Angular acceleration: $\alpha = \frac{\Delta \omega}{\Delta t} \rightarrow \begin{cases} a_t = r\alpha \\ a_c = r\omega^2 \end{cases}$

Rotational Equations of Motion

$$\theta_{f} = \theta_{i} + \omega_{i}t + \frac{1}{2}\alpha t^{2}$$
$$\omega_{f} = \omega_{i} + \alpha t$$
$$\omega_{f}^{2} = \omega_{i}^{2} + 2\alpha\Delta\theta$$

Momentum & Force

$$\vec{p} = m\vec{v} \rightarrow p_x = mv_x; \ p_y = mv_y$$

$$\Delta \vec{p} = \vec{F} \Delta t \rightarrow \vec{p}_f = \vec{p}_i + \vec{F} \Delta t$$

$$\vec{F} = \frac{d\vec{p}}{dt} = m\vec{a} \rightarrow F_x = ma_x; \ F_y = ma_y$$

$$F_{fr} = \mu F_N$$

$$F_w = mg$$

$$F_s = -kx$$

$$F_G = G \frac{M_1 M_2}{r^2}$$

$$F_c = ma_c = m \frac{v^2}{R}$$

Work & Energy

$$\begin{cases} W_T = \int \vec{F} \cdot d\vec{r} = F dr \cos \theta = \Delta K_T \\ W_R = \int \vec{\tau} \cdot d\vec{\theta} = \tau d\theta = \Delta K_R \end{cases}$$

$$W_{net} = W_T + W_R = \Delta K_T + \Delta K_R = -\Delta U$$

$$K_{T} = \frac{1}{2}mv^{2}$$

$$K_{R} = \frac{1}{2}I\omega^{2}$$

$$U_{g} = mgy$$

$$U_{s} = \frac{1}{2}kx^{2}$$

$$\Delta E = \Delta E_{R} + \Delta E_{T}$$

$$\Delta E = \Delta K_{R} + \Delta K_{T} + \Delta U_{g} + \Delta U_{s} = \begin{cases} 0\\W_{fr} \end{cases}$$

Rotational Momentum & Force

 $\vec{\tau} = \vec{r} \times \vec{F}; \ \tau = r_{\perp}F = rF_{\perp} = rF\sin\theta$ $\tau = \frac{\Delta L}{\Delta t} = I\alpha$ $L = I\omega$ $\Delta \vec{L} = \vec{\tau} \Delta t \rightarrow \vec{L}_f = \vec{L}_i + \vec{\tau} \Delta t$

Fluids

$$\rho = \frac{m}{v}$$

$$P = \frac{F}{A}$$

$$P_{y} = P_{air} + \rho gy$$

$$F_{B} = \rho gV$$

$$\rho_{1}A_{1}v_{1} = \rho_{2}A_{2}v_{2}; \text{ compressible}$$

$$A_{1}v_{1} = A_{2}v_{2}; \text{ incompressible}$$

$$P_{1} + \frac{1}{2}\rho v_{1}^{2} + \rho gy_{1} = P_{2} + \frac{1}{2}\rho v_{2}^{2} + \rho gy_{2}$$

Simple Harmonic Motion

$$\omega = 2\pi f = \frac{2\pi}{T}$$
$$T_s = 2\pi \sqrt{\frac{m}{k}}; \quad \omega = \sqrt{\frac{k}{m}}$$
$$T_p = 2\pi \sqrt{\frac{l}{g}}; \quad \omega = \sqrt{\frac{g}{l}}$$

Geometry/Algebra

Circles:

 $A = \pi r^2$

Sound

$$\begin{split} v_s &= f\lambda = (331 + 0.6T) \frac{m}{s} \\ \beta &= 10 \log \frac{I}{I_o} \\ f_n &= nf_1 = n \frac{v}{2L}; n = 1,2,3, \dots \text{ open pipes} \\ f_n &= nf_1 = n \frac{v}{4L}; n = 1,3,5, \dots \text{ closed pipes} \end{split}$$

Waves

$$v = f\lambda = \sqrt{\frac{F_T}{\mu}}$$

$$f_n = nf_1 = n\frac{v}{2L}; n = 1,2,3,...$$

$$I = 2\pi^2 f^2 \rho v A^2$$

Equations of Motion for SHM

$$x(t) = \begin{cases} x_{max} \sin\left(\frac{2\pi}{T}t\right) \\ x_{max} \cos\left(\frac{2\pi}{T}t\right) \\ x_{max} \cos\left(\frac{2\pi}{T}t\right) \end{cases}$$
$$v(t) = \begin{cases} v_{max} \cos\left(\frac{2\pi}{T}t\right) \\ -v_{max} \sin\left(\frac{2\pi}{T}t\right) \\ -v_{max} \sin\left(\frac{2\pi}{T}t\right) \end{cases}$$
$$V = \frac{4}{3}\pi r^{3} \qquad a(t) = \begin{cases} -a_{max} \sin\left(\frac{2\pi}{T}t\right) \\ -a_{max} \cos\left(\frac{2\pi}{T}t\right) \\ -a_{max} \cos\left(\frac{2\pi}{T}t\right) \end{cases}$$
$$v = \pm v_{max} \sqrt{1 - \left(\frac{x}{x_{max}}\right)^{2}}$$
$$v = \pm \omega x_{max} \sqrt{1 - \left(\frac{x}{x_{max}}\right)^{2}}$$

Spheres: $A = 4\pi r^2$ $V = \frac{4}{3}\pi r^3$ Triangles: $A = \frac{1}{2}bh$ $v = \pm v_{max}\sqrt{1 - \left(\frac{x}{x_{max}}\right)^2}$ Quadratics: $ax^2 + bx + c = 0 \rightarrow x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ $v = \pm \omega x_{max}\sqrt{1 - \left(\frac{x}{x_{max}}\right)^2}$ Periodic Table of the Elements

IA						1.00	-										VIIIA
H	2 11A				Atomic Number	- Hydr	-	Symbol				13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	He
Li	Be	Betrespe del Unit Internegat Betrespe del Unit Internegat Betrespe del Unit Internegat Betrespe del Unit Un										0	F	Ne			
Na streetse 285	Mg	■ Buches ext Findle & Carlotten miles = Baches extracted.s = Baches ext										Cl	Ar				
K	Ca	Scandium Scandium 1991	Transium atant 19-07	Variation No.	Cr Cr Drumium Intel Intel	Managariseter Managariseter Managariseter Managariseter Managariseter	Fe Box Blass Jabe	Co	20 Nickat MAN 2451	Cu	Zn Jose Line	Ga	Ge Germanium TLAN TAN	Araanic N. 122 16 1	Setantan Setantan Nam	Br	Kr
Rb	Sr	Y Thrium Mirium Mirium	Zr Zr Dimension N226 N226	Nb Notice State	Mo	Tc Sector	Ru	Rh Rhodum Marti Marti	Patudium NMAR 1488	Ag Sitter UTAT 24884		In Made	Sn In International	Sb	Te Televium 17245 24004	53 Lading Sb.N 344845	Xe
Cs	Ba	\$5-11 Latibandys	Hf	Ta Technian Technian Technian	W Negative Milite Milite	Re	Os Namuum HE21 HE21	lr 1221 14.0.0.57	Pt Pt Matimum Jack 201	Au	Hg	TI TI Nation Billion Jacobil	Pb	Bi	Po	At Atlatine CTU 148282	Rn
Fr	Ra	87-103 Activides	Rf Intertertien Gan Intelliger	Db Db Db Dates	Sg	Bh Bh Bh Balling Bhalling	Hs financian gray 144000447	Mt Maitron term (276) 24 B M (216-2	Ds Ds Dev Dev Dev	Rg International	Cn	Nh Internet	Fl	Mc		Ts Internet	
		La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb Intern	Dy Drawnaw	Ho	Er	Tm	Yb	n Lu Lutetur	
		Activities Activities Contractions	Th Th Datas HEAD BAT	n Pa Polacinam 2004 2004	92 U Dranium 258.25 34.50.047	Neptonam Corr Season	Pu Pu Putanan Oki International	Manarithan (202) SERVICES	Té Cm Outium Demittorine	97 Bk Serkation 249/2044	to Cf Californian Californian Californian Californian	Processon and a second	Final Street	Md Md Internet Internet	102 No Internet Internet		

https://www.wuwm.com/post/periodic-table-elements-turns-150#stream/0