PHYSICS 1001, INSTRUCTOR PERLMAN

PROBLEM SET 1 — SOLUTIONS

1. (CONVERSIONS): PRICE ACCEPTED BY MERCHANT = 400 TEPIZES/M^2
(a) CLOTH IN NY IS \$120/YD^2

(a) HOW MUCH MONEY DID THE CLOTHING MAKER LOSE ON 500 M^2?

COST OF MATERIAL = $\left(400 \frac{\text{TEPIZES}}{M^2}\right)(500\,M^2)(\$0.625/\text{TEPIZ})$

\$0.625/TEPIZ = \$125,000

0.9144 m = 1 yd ⟹ 1 m = 1.0936 yd

COST IN NY = $(\$120/YD^2)(\text{AREA IN } YD^2) = \$71758$

AREA IN $YD^2 = (500\,M^2)\left(1.0936\,\frac{yd}{m}\right)^2 = 598.0\,yd^2$

⟹ THE CLOTHING MAKER LOST **\$53,242**

(b) 1 SLUG = 14.59 kg 1 lb = 1 $\frac{slug \cdot ft}{s^2}$

1 ft = 0.3048 m

$15.0\,N = 15.0 \frac{kg\,M}{s^2} = (15.0)\left(14.59\frac{kg}{slug}\right)^{-1}\left(0.3048\frac{m}{ft}\right)^{-1}\frac{slug\,ft}{s^2}$

$= 0.313\,\frac{slug\,ft}{s^2} =$ **3.37 lb.**

2. DISTANCE TO MOON = 3.8×10^8 m ; THICKNESS OF DOLLAR BILL = .05 mm
(1.28)

$\Rightarrow N_{BILLS} = \left(\frac{3.8 \times 10^8\,m}{0.5\,\frac{mm}{bill}}\right)\left(10^3\,\frac{mm}{m}\right) = 7.6 \times 10^{11}$ BILLS

$\approx 10^{12}$ BILLS TO 1 SIG FIG

3. (BIKING VECTORS) $d_N = 0.9$ mi N, $d_W = 0.3$ mi W, $d_S = 0.2$ mi S

(a) $d_{MIN} = (0.700\,mi^2 + 0.300\,mi^2)^{1/2} = \underline{0.762 \text{ miles}}$

(b) $(d_N)_x, (d_N)_y = 0, 0.9$ mi. (c) $(d_W)_x, (d_W)_y = -0.3$ mi; 0 mi

(d) $(d_S)_x, (d_S)_y = 0$ mi; -0.2 mi (e) $(d_b)_x, (d_b)_y = -0.3$ mi, 0.7 mi

(f) $\phi = \cos^{-1}\left(\frac{0.3}{0.762}\right) = 66.8°$

4. (1.61)

(a) PLANET'S MASS $= M_p = 5.5\,(5.97\times10^{24}\text{ kg}) = 3.28\times10^{25}\text{ kg}$

$\rho = 1.76\,\frac{g}{cm^3} = 1760\,\frac{kg}{m^3}$ PLANET'S VOLUME $= V_p = \frac{M_P}{\rho} = \frac{3.28\times10^{25}\text{ kg}}{1760\,\frac{kg}{m^3}} = 1.86\times10^{22}\,m^3$

$$\Rightarrow r = \frac{3V}{4\pi} = \left(\frac{3\,[1.86\times10^{22}\,m^3]}{4\pi}\right)^{1/3} = 1.64\times10^{7}\,m = 1.64\times10^{4}$$

NOTE — MP WANTS YOU TO ROUND AT EACH STEP — GET 1.65×10

(b) IN EARTH RADII, $r = 2.57\,r_E$. (SIMILAR COMMENT)

5. (1.62) (a) $f = 1.420\times10^{9}\,\frac{\text{cycles}}{s} \Rightarrow t = \frac{1}{1.420\times10^{9}}\,s = 7.04\times10^{-10}\,s$

(b) $N_{9h} = (9\,hr)\,(3600\,\frac{s}{hr})\,(1.42\times10^{9}\,\frac{cy}{s}) =$
$= 4.6008\times10^{13}$ cycles.

(c) $N_{te} = (4.6\times10^{9}\,yr)\,(3.15\times10^{7}\,\frac{s}{yr})\,(1.42\times10^{9}\,\frac{cy}{s})$
$= 2.05758\times10^{26}$ cycles.

(d) off by 1 s in 10^5 yr $\Rightarrow$ off by $(1s)\,\frac{4.6\times10^{9}\,yr}{10^{5}\,yr} = 4.6\times10^{4}$

6. GRAPH OF SPORTS CAR'S VELOCITY

(a) $v_{max} = 56\ m/s$ IS WHAT I GET.

(b) ACCEL IS POSITIVE FROM $t = 0 \rightarrow 4s$

(c) $a_{max} = \left(\frac{\Delta v}{\Delta t}\right)_{max} = 30\ \frac{m}{s^2}$ (during $t = 0 \rightarrow 1s$)

(d) $a_{min} = 0$ (at 4s, when v is at max)

(e) BETWEEN $t = 0s \rightarrow 2s$:

$$d = (30\ m)(0.5) + 40\ m = 55\ m$$

7. RED LIGHT, GREEN LIGHT $\qquad a = \frac{\Delta v}{\Delta t}$

(a) CAR COMES TO A FULL STOP IN TIME $t_1 = \frac{v_0}{a_0}$

(b) CAR RESUMES SPEED IN TIME $t_2 = \frac{v_0}{a_0}$.

(c) TRAIN IS ALSO TRAVELING AT SPEED v_0

SO IN $t = t_1 + t_2 = \frac{2v_0}{a_0}$ IT TRAVELS:

$$v = \frac{\Delta x}{\Delta t} \Rightarrow \Delta x = v\Delta t = \left(\frac{2v_0}{a_0}\right)v_0 = \frac{2v_0^2}{a_0}$$

CAR TRAVELLED $\frac{1}{2}$ THIS DISTANCE

SO IT'S $x = \frac{v_0^2}{a_0}$ BEHIND.