LAST NAME: **STUDENT #:**

FIRST LETTER OF LAST NAME: **FIRST NAME:**

Phys. 101 Section 103 Mid-term exam.
Thurs. Oct. 25, 2007. Hebb Theatre 11:00 am – 12:20 pm
Instructor : J. E. Eldridge

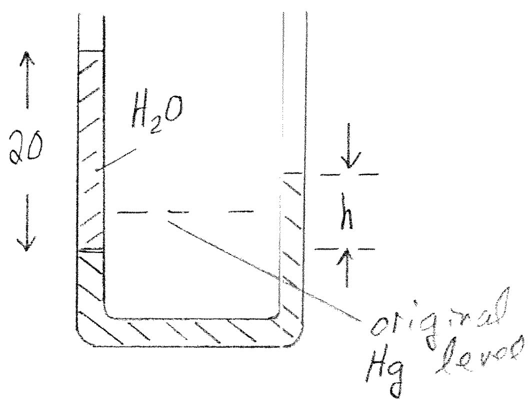
ANSWER ALL 5 QUESTIONS. PART MARKS ARE SHOWN IN THE MARGIN.

Question	#1	#2	#3	#4	#5	TOTAL
Mark						

Part marks

Question 1. A U-shaped tube, open to the air at both ends, contains mercury. Water is poured into the left arm until the water column is 20.0 cm deep. How far upward from its original position does the

15 mercury in the right arm rise? Draw a good diagram and use ρ (Hg) = 13.6 gm/cm^3.



$(\rho g h)_{water} = (\rho g h)_{Hg}$

$1 * 20 = 13.6\,h$

$h = 1.471$ cm

$\therefore$ Mercury movement $= \frac{1.471}{2} = 0.735$ cm

5 If now 20.0 cm of oil (ρ = 0.9 gm/cm3) is added to the right arm, with the water still in place in the left arm, what will be the difference in the mercury level heights in the two arms?

$(\rho g h)_{water} = (\rho g h)_{oil} + (\rho g h)_{Hg}$

$1 * 20 = 0.9 * 20 + 13.6\,h$

$h = \frac{2}{13.6} = 0.1471$ cm.

20

Question 2. A 5.0 kg rock, whose density is 5000 kg/m^3 is suspended by a string such that it is partially submerged in water, and has an apparent weight of 41.16 N.

3 What is the volume of the rock?

$V = \frac{m}{\rho} = \frac{5.0\text{ kg m}^3}{5000\text{ kg}} = 0.001\text{ m}^3$

Question 2 (cont.).

7 What is the buoyancy force acting on the rock? (Use g = 9.80 m/s^2)

$F_B = mg - 41.16\ N = 5.0*9.8 - 41.16 = 49 - 41.16$
$= 7.84\ N$

15 What percentage of the volume of the rock is under water?

$F_B = \rho_{WATER} V_{SUB}\, g$

$7.84 = 1000 * V_{SUB} * 9.8$

$V_{SUB} = 0.0008$

$\therefore$ % of rock under water $= \dfrac{0.0008}{0.001} * 100 = 80\%$

$\overline{25}$

Question 3. Estimate the air pressure inside a category 5 hurricane where the wind speed is 300 km/h.

Bernoulli's Eq.: $P + \frac{1}{2}\rho v^2 = P_0$

$P = 101,300 - \frac{1}{2}\rho v^2$

$= 101,300 - \left(\frac{1}{2} * 1.29 * \left(\frac{300 * 1000}{60 * 60}\right)^2\right)$

$= 101,300 - (0.645 * 83.33^2\ m/s)$

$= 101,300 - 4479 = 96,821\ Pa.$

$\overline{15}$

Question 4. A 100 gram mass on a 1.0-m-long string is pulled 8.0° to one side and released. How long does it take for the pendulum to reach 4.0° on the opposite side?

$\theta^\circ = \theta^\circ_{MAX} \cos \omega t$

$-4 = 8 \cos \omega t$

$-0.5 = \cos \omega t$

$\therefore \omega t = 2.0944^c \quad (120^\circ)$

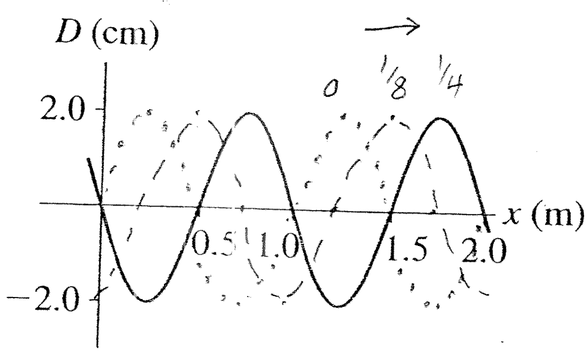
Question 4 (cont.)

$$\omega = \sqrt{\frac{g}{l}} = \sqrt{\frac{9.8}{1}} = 3.13 \text{ r/s}$$

$$\therefore t = \frac{2.0944}{3.13} = 0.6691 \text{ sec.}$$

15

Question 5. The figure below is a snapshot graph at t = ¼ sec. of a traveling wave with displacement D (x, t) = (2.0 cm) sin (2 π x – 4 π t), where x is in m and t is in sec.



Snapshot graph at $t = \frac{1}{4}$ s

$\omega = 4\pi \quad \therefore F = \frac{\omega}{2\pi} = 2 Hz$

and T = 0.5 sec.

Wave travelling to right.

At t = 0, wave is half cycle previously.

12 Draw a ***dotted*** line to show the snapshot graph at t = 0 sec and a ***dashed*** line to show the snapshot graph at t = ⅛ sec.

At t = 1/8 sec, wave half-way between t = 0 and t = 1/4 sec

4 What is the speed of this wave?

$$V = \lambda F = \frac{\lambda}{T} = \frac{\omega}{k} = \frac{4\pi}{2\pi} = 2 \text{ m/sec.} \qquad (\lambda = 1 \text{ m})$$

4 At t = ¼ sec., at which values of x is the velocity of the particles in the medium a maximum in the positive direction?

When the slope of D versus x is negative and maximum i.e at 0.0 m, 1.0 m and 2.0 m.

20 OR $V = -2 * \omega \cos(2\pi x - \frac{4\pi}{4})$ Need Cos = −1 ∴ phase = $-\pi, \pi,$ or 3π

$2\pi x - \pi = -\pi$ gives $x = 0$ $\quad 2\pi x - \pi = \pi$ gives $x = 1$ etc.