

LAST NAME:

STUDENT #:

FIRST LETTER OF LAST NAME:

FIRST NAME:

Phys. 101 Section 202 Mid-term exam.
Wednesday Feb. 22 2006. Hebb Theatre, 11:00 am – 11:50 am
Instructor : J. E. Eldridge

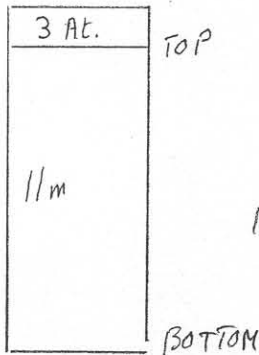
ANSWER BOTH QUESTIONS. PART MARKS ARE SHOWN IN THE MARGIN.

Question	#1	#2	TOTAL
Mark			

Part marks

Question 1. A large sealed tank containing sea-water ($\rho = 1025 \text{ kg/m}^3$) to a height of 11.0 m, also contains air above the sea-water at a gauge pressure of 3.0 atmospheres. There is a small hole at the bottom of the container, open to atmospheric pressure. Calculate the velocity with which the sea-water leaks from the hole. (Atmospheric pressure = 101.30 kPa) (neglect viscosity)

30



Bernoulli's Eq. $P + \rho gh + \frac{1}{2} \rho v^2 = \text{constant}$

Use either gauge pressure or total pressure on both side

TOP: $(3 * 101,300) + (1025 * 9.81 * 11) + 0$ using gauge pressure

BOTTOM: $0 + 0 + (\frac{1}{2} * 1025 * v^2)$

$$512.5 v^2 = 303,900 + 110,607 = 414,507$$

$$v^2 = 808.8$$

$$v = 28.44 \text{ m/s}$$

If the hole at the bottom of the container has a radius of 0.20 cm, how long will it take for 1.0 kg of sea-water to leak out? (Keep at least 3 significant figures).

20

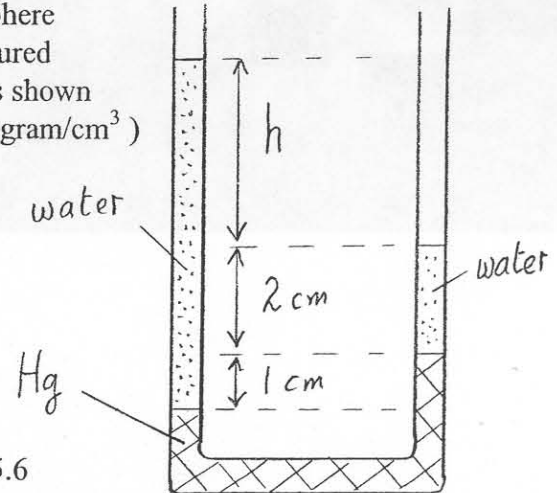
$$Q_V = \text{Volume flow} = Av = \pi * (0.2 * 10^{-2})^2 * 28.44 = 3.574 * 10^{-4} \text{ m}^3/\text{s}$$

$$Q_M = \text{Mass flow} = Av\rho = 3.574 * 10^{-4} * 1025 = 0.3663 \text{ kg/s}$$

$$\therefore \text{Time for 1 kg} = \frac{1}{\text{Mass flow}} = \frac{1}{0.3663} = 2.73 \text{ sec}$$

Question 2 MULTIPLE CHOICE (Circle the one correct answer. Each of the five questions is worth 10 marks)

1. A U-tube of uniform cross-sectional area and open to the atmosphere is partially filled with mercury (S.G. = 13.6). Water is then poured into both arms. If the equilibrium configuration of the tube is as shown in the figure, find the value of h in cm. (density of water is 1.0 gram/cm^3)



- a) 13.6 b) 12.6 c) 18.6 d) 10.6 e) 15.6

2. A 420 kg wooden raft floats on a lake. When a 75.0 kg man stands on the raft, it sinks 3.50 cm deeper into the water. What is the horizontal surface area, A , in m^2 , of the raft? ($\rho_{\text{water}} = 1000 \text{ kg/m}^3$).

- a) 2.14 b) 21.0 c) 0.219 d) 2143 e) 0.47

3. A simple harmonic oscillator has an amplitude of 5.0 cm, a spring constant of 5.0 N/m, and a maximum speed of 10.0 m/s. What is the speed, in m/s, when it reaches half of the amplitude?

- a) 8.7 b) 5.0 c) 7.6 d) 2.5 e) 7.1

4. A transverse wave is represented by the function $d = d_0 \sin (1.9x - 25t)$, where d , x and t are in cm, m and seconds respectively. Determine the speed of the wave in m/s.

- a) 3.3 b) 0.25 c) 2.3 d) 13.2 e) 4.0

5. Equilibrium is reached in the shortest time when an oscillatory system is

- a) overdamped b) underdamped c) critically damped