Physics 101
Test 2

1. The amplitude and phase constant of an oscillator are determined by:

a) the frequency

b) the angular frequency

2 c) the initial displacement alone

d) the initial velocity alone

e) both the initial velocity and the initial displacement.

2. An object hangs from a spring balance. The balance indicates 30 N in air, 20 N when the object is immersed in water and 24 N when it is immersed in an unknown liquid. The density of the unknown liquid equals the density of water multiplied by:

I) $\rho_{H_2O} g V_{obj} = 10$ $V_{obj} = \frac{10}{\rho_{H_2O} g}$

2 a) 10/4 b) 6/10 c) 24/20 d) 4/10 e) 10/30

II) $\rho_u g V_{ob} = 6$ $\rho_u = \frac{6\ g}{g\ 10} \rho_{H_2O}$

3. A guitar string vibrates at a frequency of 440 Hz. A point on its centre moves in Simple Harmonic Motion with an amplitude of 3.0 mm and a phase constant of zero.

a) Write an equation for the position of the centre of the string as a function of time.

1 $X = (3.0 \times 10^{-3} m) \cos 880\pi t$

b) What are the maximum values of the magnitudes of the velocity and acceleration of this point.

$\omega A = 2\pi\ 440 \times 3.0 \times 10^{-3} = 8.3\ m/s$

2

$\omega^2 A = 2.3 \times 10^{4}\ m/s^2$

4. A 0.400 kg object is undergoing SHM on the end of a horizontal spring with force constant 400 N/m. When the object is 0.012 m from its equilibrium position, it is observed to have speed 0.300 m/s. What is:

a) the total energy of the object at any point in its motion?

4 $U_t = \frac{1}{2} 400 \times 0.012^2 + \frac{1}{2} 0.400 \times 0.3^2$

$= 0.0288 + 0.018 = 0.0468\ J$

b) the amplitude of the motion?

1 $\frac{1}{2} k A^2 = 0.0468\ J$ $A = 0.0153\ m$

c) the maximum speed attained by the object during its motion?

1 $\frac{1}{2} m v_{max}^2 = 0.0468\ J$ $v_{max} = 0.484\ m/s$

5. A single ice cube of mass 8.40 g floats in a glass that is completely full of 350 cm^3 of water. (ρ_{ice}= 0.917x10^3 kg/m^3)

a) What volume of water does the ice cube displace?

1 $F_B = mg = \rho_f g V_f$ $\quad V_f = \frac{m}{\rho_f} = 8.4 \times 10^{-6}\ m^3$

b) When the ice cube has melted , has any water overflowed? If so how much? If not explain why this is so.

1 Volume water in ice cub $\frac{8.4\times10^{-3}\ kg}{1000\ kg/m^3}$ → as in a no water overflows

c) Suppose the water in the glass had been very salty water of density 1050 kg/m3. What volume of the salt water would a 8.40 g ice cube displace?

1 $V_f = \frac{8.4 \times 10^{-3}\ kg}{1050\ kg/m^3}$ → fluid displaced $8.0 \times 10^{-6}\ m^3$

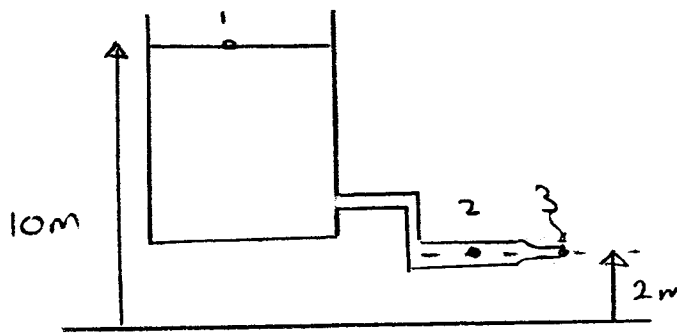
d) For the cube in salty water, when the ice cube has melted , has any water overflowed? If so how much?

1 volume water in ice cube $8.4 \times 10^{-6}\ m^3$

$\therefore$ $0.4 \times 10^{-6}\ m^3$ overflows

6. Water flows out steadily out of an open tank. The elevation of point 1 is 10.0 m and the elevation of points 2 and 3 is 2.00 m. The cross-sectional area at point 2 is 0.0300 m^2; and at point 3 it is 0.0150 m^2. The area of the tank is very large in comparison with the cross sectional area of the pipe. If Bernoulli's equation applies determine:

a)The speed of the water at point 3



$V_1 = 0$ $\quad h = 8\ m$

2 $V_3 = \sqrt{2gh} = 12.5\ m/s$

b) the speed of the water at point 2

$A_2 v_2 = A_3 v_3$

$v_2 = \frac{A_3}{A_2} v_3 = \frac{0.015}{0.030} \times 12.52 = 6.26\ m/s$

c) the gauge pressure at point 2

P_3 = atm.

$P_2 + \frac{1}{2}\rho v_2^2 = P_3 + \frac{1}{2}\rho v_3^2$ ⇐ same height

$P_2 - P_3 = \frac{1}{2} 1000 (12.52^2 - 6.26^2)$

$= 5.88 \times 10^4\ Pa$

Gauge pressure is $5.88 \times 10^4\ Pa$.