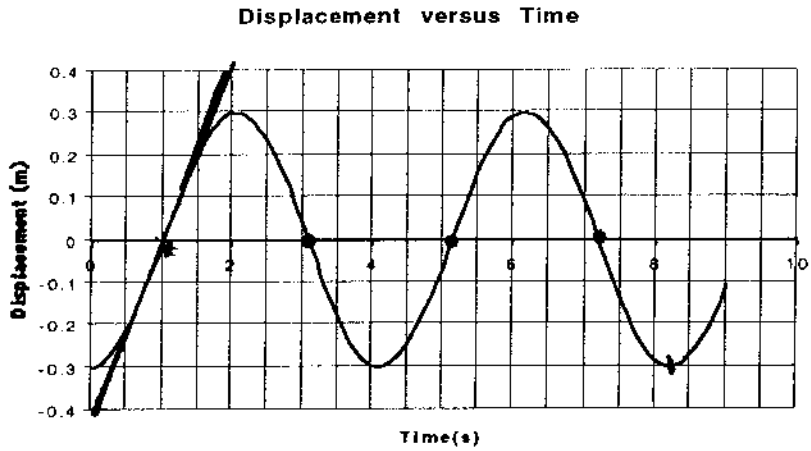
Name: _____

Student # :_____

Physics 101 Test 2 SS02

(8)

Question 1



An object moves with a displacement x as shown in the above diagram.

a) What is the amplitude of oscillation?

Amplitude = 0.30 m

b) What is the period of an oscillation?

Period = 4.1 s

c) What is the angular frequency of the oscillation?

$\omega = \frac{2\pi}{T} = 1.53 \text{ rad/s}$

d) What is the velocity at t= 1.0 s?

Either $v_m = \omega A = 0.460 \text{ m/s}$ or slope $= \frac{0.8}{1.8} = 0.44 \text{ m/s}$

e) When is the acceleration zero?

when x = 0 at 1.0, 3.1, 5.2, 7.2

f) What is the phase constant ϕ?

$x = A(\cos \omega t + \phi)$ $x = -A$ at $t = 0$

$-A = A\cos\phi$ $\cos\phi = -1$ $\phi = \pi$

g) Write an expression for the **velocity** of the motion as a function of time.

$v = -\omega A \sin(\omega t + \phi) = -0.46 \sin(1.53t + \pi)$

h) When is the Kinetic energy zero?

when $x = \pm A$; $t = 0, 2.1, 4.1, 6.2, 8.3$ s

(2)

Question 2

The cross-sectional area of a stream of water becomes smaller as the water falls from a tap.
Explain how this happens and also predict what you would see if water is shot upwards as from a fountain.

As water falls |v| ↑ & since Av = const then A ↓

If water goes up |v| ↓ " " " " then A ↑

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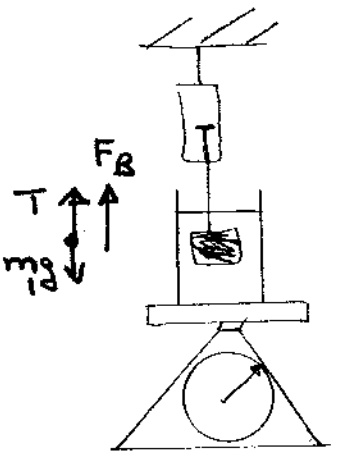
Question 3

A beaker of mass 1.0 kg contains 2.0 kg of water and is sitting on a balance. A 2.0 kg block of aluminium (density 2.70×10^3 kg/m^3) is suspended from a spring scale and is submerged in the water as shown



a) What is the volume of the aluminium block?

1 $V = \frac{m}{\rho} = \frac{2.0\,kg}{2.7\times10^3\,kg/m^3} = 7.41\times10^{-4}\,m^3$

b) What is the buoyant force acting on the aluminium block?

1 $F_B = \rho_f g V_0 = \left(1000\frac{kg}{m^3}\right)\left(9.8\frac{m}{s^2}\right)\left(7.41\times10^{-4}\,m^3\right) = 7.26\,N$

c) What is the reading on the spring scale?

1 $T = m_1 g - F_B = 12.3\,N$

d) What is the reading on the balance?

Beaker

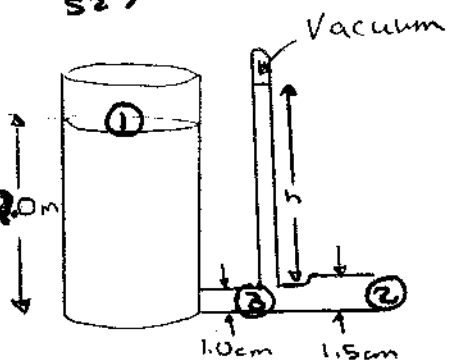
(N 3rd law action reaction)

2 $(m_b + m_w)g + F_B = (3.0\,kg)\left(9.8\frac{m}{s^2}\right) + 7.26\,N$

$= 36.7\,N$

Question 4

A 1.0 m diameter tank is filled with water to a depth of 2.0 m and is open to the atmosphere at the top. The water drains first through a 1.0 cm diameter pipe and then through a 1.5 cm diameter pipe which is open to the atmosphere as shown



At point ① $v_1 = 0$ $P_1 = P_0$ $y_1 - y_2 = 2.0\,m$

At point ② $v_2 = ?$ $P_2 = P_0$

$\frac{1}{2}\rho v_2^2 + \rho g y_2 = \rho g y_1$

$v_2^2 = 2g(y_1 - y_2)$; $v_2 = 6.26\,m/s$

a) What is the flow speed in the 1.5 cm diameter pipe?

2 6.26 m/s

b) What is the flow speed in the 1.0 cm diameter pipe?

$A_3 v_3 = A_2 v_2$ $v_3 = \frac{A_2}{A_3} v_2 = \frac{(1.5)^2}{(1.0)^2} 6.26\,m/s = 14.1\,m/s^2$

c) What is the height, h, of the water in the sealed vertical tube?

2 $P_3 + \frac{1}{2}\rho v_3 = P_2 + \frac{1}{2}\rho v_2^2$ since $y_2 = y_3$

$P_3 = 1.01\times10^5\,Pa + 500\frac{kg}{m^3}\left(6.26^2 - 14.1^2\right) = 2.14\times10^5\,Pa$

$h = \frac{2.14\times10^5\,Pa}{9.8\,m/s^2 \times (1000\,kg/m^3)} = 2.18\,m$