# PHYS 2325 - Dr. Honan - Test 4 - B     Name _____

**Possibly Useful Information:** $g = 9.80 \text{m/s}^2$

For water: $c = 4186 \ \frac{\text{J}}{\text{kg·K}}$, $c_{\text{ice}} = 2100 \ \frac{\text{J}}{\text{kg·K}}$, $L_f = 3.34 \times 10^5 \ \frac{\text{J}}{\text{kg}}$, $L_v = 2.26 \times 10^6 \ \frac{\text{J}}{\text{kg}}$

**Problem 1** Short answer  (2 points each)

A mass hangs from a spring. It is stretched a certain distance from equilibrium and released from rest it starts oscillating about its equilibrium position. If it were stretched by twice the amount before being released, then by what factor would the following quantities increase?

_____ (i) the maximum speed:     (a) $\frac{1}{4}$  (b) $\frac{1}{2}$  (c) $\frac{1}{\sqrt{2}}$  (d) 1  (e) $\sqrt{2}$  (f) 2  (g) 4

_____ (ii) the frequency:     (a) $\frac{1}{4}$  (b) $\frac{1}{2}$  (c) $\frac{1}{\sqrt{2}}$  (d) 1  (e) $\sqrt{2}$  (f) 2  (g) 4

_____ (iii) the total energy:     (a) $\frac{1}{4}$  (b) $\frac{1}{2}$  (c) $\frac{1}{\sqrt{2}}$  (d) 1  (e) $\sqrt{2}$  (f) 2  (g) 4

**Problem 2** How much ice is in the final state after 2 kg of ice at -30°C is added to a large quantity of water at 0°C?   The final state is ice-water.  (10 points)

**Problem 3** A uniform rod of length $L$ swings without friction about one end.  What is its period of small oscillations?

**Problem 4**  (7 points each)

(a) A particle moves in simple harmonic motion with a period of 0.3 s and an amplitude of 6 cm.  What are the speed and acceleration of the particle when it is 4 cm from the equilibrium position?

(b) The period of small oscillations of a physical pendulum is 2 s on Earth and 3 s on Planet X.  What is the acceleration of gravity on Planet X?

(c) A 5 kg mass swings at the end of a 3 m long string.  What is the *frequency* of small oscillations?

**Problem 5** A string has a linear density of $1.6 \times 10^{-3}$ kg/m. Suppose traveling down this string is a wave of the form: $y(x,t) = (0.015 \text{ m}) \sin[ (4 \text{ m}^{-1}) x - (140 \text{ s}^{-1}) t ]$. (7 points each)

(a) Consider a point on the string as this wave passes. What is the maximum speed of this point and what is the frequency of its oscillation?

(b) What is the tension in the string and the power carried by the wave?

**Problem 6** Out in space two identical spherical masses of radius $R$ and mass $M$ are released form rest a distance $d$ (measured between their centers) apart. What is their speed when the spheres collide? Both masses will move with the same speed.

**Problem 7** An unknown mass hangs at the end of a spring, with a force constant of 160 N/m. It makes 120 full oscillations of amplitude 1.4 cm in 15 s. What is the value of the unknown mass? (10 points)