PHYS 2425 - Practice Final Problems

Possibly Useful Information: $g = 9.80 m/s^2$, 1 furlong = 220 yards , 1 fortnight = 2 weeks ,
$c = 3.0\times10^8 m/s$ (speed of light), $G = 6.67\times10^{-11} N\cdot m^2/kg^2$, $1atm = 1.013\times10^5 Pa$, $0°C = 273K$, $1\ m^3 = 1000$ liter
For water: $c = 4186\ J/(kg\cdot C°)$, $c_{ice} = 2090\ J/(kg\cdot C°)$, $L_f = 3.33\times10^5\ J/kg$, $L_v = 2.26\times10^6\ J/kg$

Problem 1 If a race horse is running at a speed of 5 yards/sec, what is this in furlongs/fortnight?
(a) 27,491 (b) 13,674 (c) 6,221 (d) 2,749

Problem 2 Mt. Everest is more than 8000 m high. How fast would an object be moving if it could fall to sea level after being dropped from the top of Mt. Everest? (Ignore air resistance.)
(a) 396m/s (b) 120m/s (c) 1200m/s (d) 12,000m/s

Problem 3 Vector $\vec{A}$ is 3 units in length and points along the positive x-axis; vector $\vec{B}$ is 4 units in length and points along a direction 150° measured counterclockwise from positive x-axis. What is the direction of the resultant with respect to the positive x-axis? (a) 77° (b) 13° (c) 86° (d) 103°

Problem 4 A stone is thrown at an angle of 30° above the horizontal from the top edge of a cliff with an initial speed of 12 m/s. A stop watch measures the time from the top of the cliff to bottom to be 5.6 s. What is the height of the cliff? (Neglect air resistance.) (a) 58 m (b) 154 m (c) 120 m (d) 197 m

Problem 5 Wiley Coyote has missed the elusive road runner once again.. This time, he leaves the edge of the cliff at a 50 m/s horizontal velocity. If the canyon is 100 m deep, how far from the edge of the cliff does the coyote land? (a) 112 m (b) 225 m (c) 337 (d) 400 m

Problem 6 Two blocks of masses 6 and 9 kg on a frictionless horizontal surface and are attached by a string and pulled by second horizontal string with a tension of 30 N that is attached to the 9 kg mass. What is the tension in the string between the two blocks? (a)18 N (b) 28 N (c) 12 N (d) 15 N

Problem 7 A 500 N tight rope walker stands at the center of a rope. Each half of the rope makes a 10° angle with the horizontal. What is the rope's tension? (a) 1440 N (b) 1000 N (c) 500 N (d) 2900 N

Problem 8 A simple pendulum, 1.0 m in length, is released from rest when the support string is at an angle of 35° from the vertical. What is the speed of the suspended mass at the bottom of the swing?
(a) 0.67 m/s (b) 0.94 m/s (c) 1.33 m/s (d) 1.88 m/s

Problem 9 A girl and her bicycle have a total mass of 40 kg. At the top of a hill, that is 10 m high and 100 m long, her speed is 5 m/s. If the force of friction as she rides down the hill is 20 N, what is her speed at the bottom? (a) 5 m/s (b) 10 m/s (c) 11 m/s (d) She stops before she reaches the bottom.

Problem 10 A 0.30 kg steel ball is dropped onto a steel plate where its speeds just before impact and after are 4.5 m/s and 4.2 m/s, respectively. It the ball is in contact with the plate for 0.03 second, what is the average force applied by the plate on the ball? (a) 87 N (b) 133 N (c) 3.0 N (d) 3.5 N

Problem 11 Two satellites, X and Y, are in circular orbits about the Earth. X is eight times as far from the Earth's center as is Y. What is the ratio of the period of revolution of X to that of Y?
(a) ½ (b) 2 (c) 4 (d) 22.6

Problem 12 Two objects, one less massive than the other, collide and bounce back after the collision. If the two originally had velocities that were equal in magnitude and opposite in direction, then after the collision which one will be moving faster? (a) the lass massive one (b) the more massive one
(c) The speeds will be the same afterward. (d) One cannot answer for certain given this information.

Problem 13 A roller coaster, loaded with passengers, has a mass of 2000 kg; the radius of curvature of the track at the bottom point of a dip is 24 m. If the vehicle has a speed of 18 m/s at this point, what is the force on the vehicle by the track? (a) 2.33×10^4 N (b) 4.66×10^4 N (c) 3.00×10^4 N (d) 1.00×10^4 N

Problem 14 Somewhere between the Earth and the moon is a point where the gravitational attraction of the Earth is canceled by the gravitational pull of the moon. The mass of the moon is 1/81 that of the Earth. How far from the center of the earth is this point. (a) 8/9 the way to the moon
(b) 9/10 the way to the moon (c) ¾ the way to the moon (d) 80/81 the way to the moon

Problem 15 A uniform solid sphere with mass M and radius R rolls along a level surface with a linear velocity v. What is the ratio of rotational to translational kinetic energy. (For a solid sphere $I=0.4MR^2$.)
(a) ¼ (b) ½ (c) 1 (d) 2/5

Problem 16 A woman who weighs 500 N is standing on a board that weighs 100 N. The board is supported at each end, and the support force at the right is 3 times bigger than the supporting force at the left end. If the board is 8 m long, how far from the right end is the woman standing?
(a) 4.0 m (b) 2.0 m (c) 2.7 m (d) 1.6 m

Problem 17 With molar quantity and temperature held constant, by what factor does the pressure of an ideal gas change when the volume is five times bigger? (a) 0.2 (b) 1.0 (c) 5.0 (d) 25

Problem 18 How much heat energy is required to vaporize a 1 gm ice cube at 0°C? The heats of fusion and vaporization of water are 80 cal/gm and 540 cal/gm, respectively.
(a) 620 cal (b) 720 cal (c) 820 cal (d) 1000 cal

Problem 19 A heat engine operating between a pair of hot and cold reservoirs with temperatures 500 K and 200 K, respectively, will have what maximum efficiency? (a) 60% (b) 50% (c) 40% (d) 30%

Problem 20 The surface temperatures of the sun and Earth are approximately 5700 K and 290 K respectively. What is the <u>total entropy change</u> when 1000 J of energy is transferred from the sun to the Earth? (a) 2.89 J/K
(b) 3.27 J/K (c) 3.62 J/K (d) 3.97 J/K

Problem 21 Which of the following quantities is at its maximum, when an object is in simple harmonic motion is at its maximum displacement?
(a) velocity (b) acceleration (c) kinetic energy (d) frequency

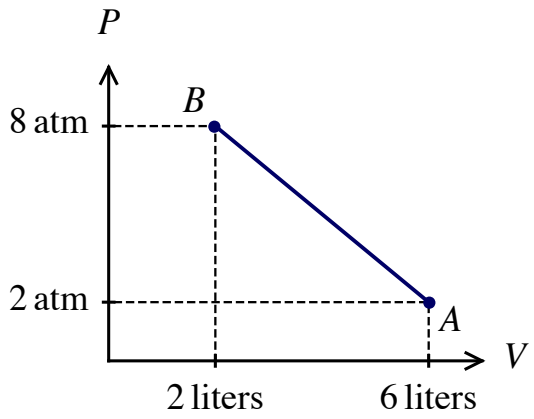
Problem 22 What is the wavelength of a radio wave with a frequency of 107.7 MHz?
(a) 3.21 m (b) 45.0 m (c) 0.10 m (d) 2.78 m

Problem 23 By what factor must the tension in a guitar string be increased to give half the wave velocity on the string? (a) 4 (b) 2 (c) ½ (d) ¼

Problem 24 How much heat does it take to completely melt 4kg of ice, initially at -20°C

Problem 25 A tank of fixed volume contains 5 kg of an ideal gas at 20°C and at 13 atm. If gas is released leaving 2 kg behind at 5°C then what is the final pressure in the tank in atm?

Problem 26 1200 J of heat flows out of gas as it is compressed from point A to point B in the PV-diagram as shown. What is the change in the internal energy of the gas?



Problem 27 A heat engine takes 3000 kcal of heat from a hot reservoir at 290°C and vents 1800 kcal to a cold reservoir at 30°C.
(a) What is the efficiency of this heat engine?

(b) What is the total change in the entropy during this process?

(b) What is the maximum efficiency that any heat engine between these two reservoirs could have?