

Name (printed) _____

Name (signature as on ID) _____

Section _____

Final Exam Chpts. 1-16 in Young/Geller

Show all your work. Partial credit will be given if earned. Write your answers in the blanks provided.

(8 pts) 1. A quantity of ideal gas is slowly compressed to one-third of its original volume. In this compression, the work done on the gas has magnitude 800 J. For the gas, $C_p = 7R/2$.

a) If the process is isothermal ($\Delta T = 0$), what is the heat flow Q for the gas? Does the heat flow into the gas or out of the gas?

Ans. $Q = \underline{-800 \text{ J}}$

into the gas or out of the gas? out of the gas

b) If the process is isobaric ($\Delta p = 0$), what is the change in internal energy of the gas? Does the internal energy increase or decrease?

Ans. $\Delta U = \underline{-2000 \text{ J}}$

increase or decrease? decrease

(5 pts) 2. A pipe 3.6 m in length is open at one end and closed at the other end. The sequence of standing wave frequencies in the air column of such a pipe, starting at the lowest frequency, are the fundamental, the first overtone, the second overtone, etc. What is the wavelength for the second overtone standing wave?

Ans. 2.88 m

(8 pts) 3. A slab of ice with volume 0.060 m^3 is floating in a freshwater lake. Water has density 1000 kg/m^3 and ice has density 920 kg/m^3 .

a) What is the mass of the slab of ice?

Ans. 55.2 kg

b) What maximum mass of rocks can be placed on the slab of ice without the ice sinking below the surface of the water?

Ans. 4.8 kg

(10 pts) 4. A small stone is thrown with a horizontal velocity of 20 m/s from the roof of a building. The stone strikes the ground a horizontal distance of 60 m from the base of the building.

a) In how many seconds after it was thrown does the stone strike the ground?

Ans. 3.0 s

b) What is the height of the building?

Ans. 44.1 m

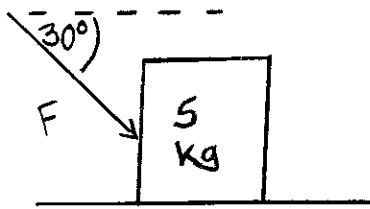
c) What is the speed of the rock just before it strikes the ground?

Ans. 35.6 m/s

(4 pts) 5. A stone is thrown straight up with an initial speed of 18 m/s. In how many seconds after it was thrown does the stone reach its maximum height?

Ans. 1.84 s

(10 pts) 6. A box of mass 5.0 kg is on a horizontal surface. The coefficient friction between the box and the surface is $\mu_k = 0.30$. A force with magnitude $F = 60$ N and direction 30° below the horizontal is applied to the box.



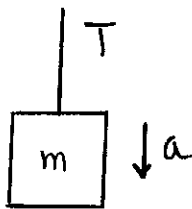
a) What is the normal force that the surface exerts on the box?

Ans. 79 N

b) What is the acceleration of the box?

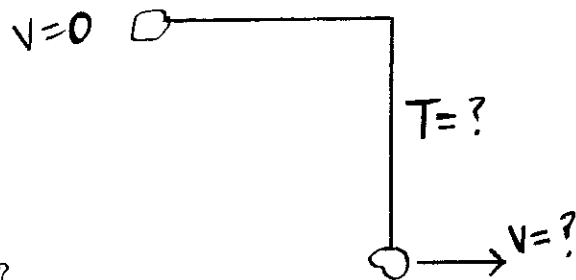
Ans. 5.66 m/s²

(5 pts) 7. A box of mass m is suspended from to a vertical rope. The tension in the rope is 40 N and the box has a downward acceleration of 5.0 m/s². What is the mass of the box?



Ans. 8.33 kg

(8 pts) 8. A small stone with mass 0.20 kg is tied to a string that is 4.0 m long. The other end of the string is held fixed. The stone is released from rest with the string horizontal. As the rock swings through its lowest position in its motion, what are



a) the speed of the rock?

Ans. 8.85 m/s

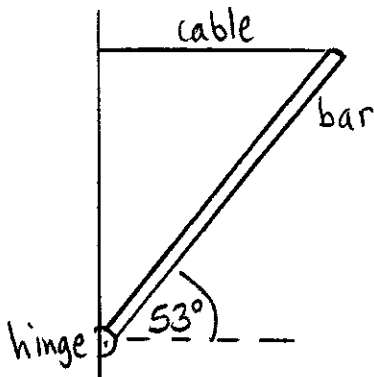
b) the tension in the string?

Ans. 5.88 N

(8 pts) 9. A block with mass 5.0 kg is attached to a horizontal spring and moves in simple harmonic motion with amplitude 0.80 m. At one point in the motion, the object is 0.40 m to the left of the equilibrium position and is moving to the right with a speed of 0.50 m/s. What is the force constant k of the spring?

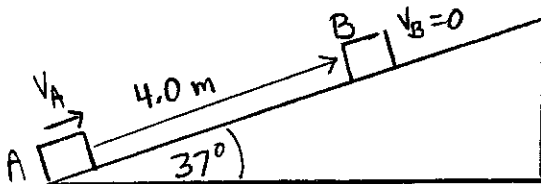
Ans. 2.60 N/m

(8 pts) 10. One end of a uniform bar that has weight 60.0 N is attached to a wall by a frictionless hinge. The bar is held at 53° above the horizontal by a horizontal cable. What is the tension in the cable?



Ans. 22.6 N

(8 pts) 11. A 5.0 kg box is projected up a ramp with an initial speed of $v_A = 8.0$ m/s. The ramp is inclined at 37° above the horizontal. The box slides up the ramp and momentarily comes to rest at point B that is 4.0 m from point A, as measured along the ramp.



a) For the motion from A to B, what is the change in the gravitational potential energy of the box? Does the gravitational potential energy increase or decrease?

Ans. $\Delta U =$ 118 J

increase or decrease? increase

b) During the motion from A to B, what is the work done by friction?

Ans. -42 J

(8 pts) 12. Your spaceship lands on an unknown planet and you explore the surface. You release a small rock from rest at a point 12.0 m above the surface of the planet and you find that the rock hits the surface 2.0 s after it was released. The radius of the planet is 5.0×10^6 m. The planet is a uniform sphere and has no atmosphere. What is the mass of the planet?

Ans. 2.25×10^{24} kg

(10 pts) 13. Bob and Donald are sitting in a sleigh that is initially at rest on frictionless ice. Bob's mass is 60 kg, Donald's mass is 80 kg, and the mass of the sleigh is 100 kg. The two men see a poisonous spider on the floor of the sleigh and they immediately jump off the sleigh. Bob jumps to the left with a velocity (relative to the ice) of 8.00 m/s at 37° above the horizontal and Donald jumps to the right with a velocity (relative to the ice) of 5.00 m/s at 60° above the horizontal. What is the sleigh's horizontal velocity (magnitude and direction) after the two men have jumped out?

Ans. 1.84 m/s, to the right