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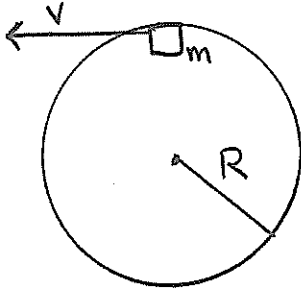
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Section _____

Final Exam Chaps. 1-17 in Cutnell and Johnson

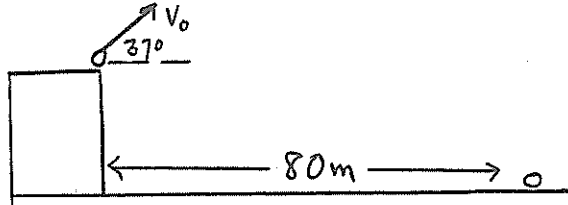
Show all your work. Partial credit will be given if earned. Write your answers in the blanks provided.

(8 pts) 1. A small block of mass m moves in a vertical circle on the inside of a circular track of radius $R = 2.0$ m. As the block moves through its highest point, its speed is $v = 8.0$ m/s and the downward normal force exerted by the track on the block is 1.60 N. What is the mass m of the block?



Ans. 0.072 kg

(10 pts) 2. A small rock is thrown at an angle of 37° above the horizontal from the roof of a tall building. The initial speed v_0 of the rock is 20 m/s. The rock strikes the ground at a horizontal distance of 80 m from the base of the building.



a) What is the maximum height above the roof that is reached by the rock during its motion?

Ans. 7.3 m

b) What are the speed and acceleration of the rock when it is at its maximum height?

Ans. $v =$ 16 m/s

$a =$ 9.8 m/s^2 (downward)

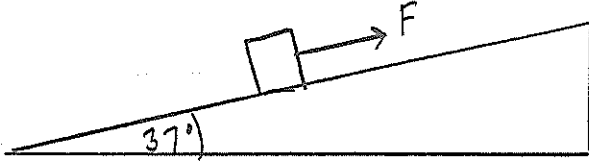
c) What is the height of the building?

Ans. 62.5 m

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

Ans. 40.3 m/s

(10 pts) 3. A 10 kg block is pulled up a 37° incline by a force F that is parallel to the incline. The coefficient of kinetic friction is 0.40. The block has an acceleration of 2.0 m/s^2 , directed up the incline.



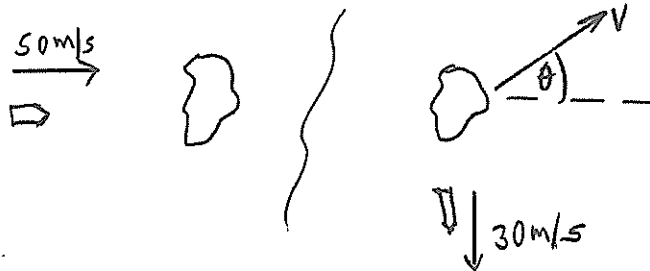
a) What is the normal force exerted by the incline on the block?

Ans. 78.3 N

b) What is the magnitude of the force F ?

Ans. 110 N

(8 pts) 4. A bullet with mass 0.040 kg initially traveling horizontally at 50 m/s collides with a rock of mass 2.0 kg that is initially at rest on a horizontal frictionless surface. The bullet strikes the rock and rebounds at right angles with speed 30 m/s. What are the magnitude v and direction θ of the velocity of the rock after it is struck by the bullet?



Ans. v 1.17 m/s

θ 31°

(8 pts) 5. A small block of mass 0.20 kg is attached to a horizontal spring and moves in simple harmonic motion on a frictionless horizontal surface. The spring has spring constant $k = 80$ N/m. When the block is 0.15 m from its equilibrium position its speed is 4.0 m/s.

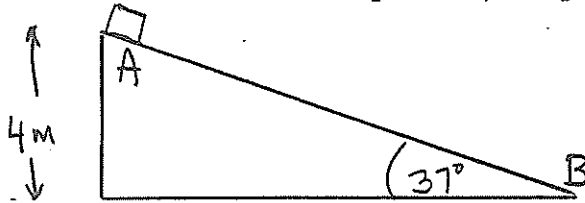
a) What is the amplitude A of the simple harmonic motion of the block?

Ans. 0.25 m

b) How much time does it take for the block to travel from $x = +A$ to $x = -A$?

Ans. 0.157 s

(10 pts) 6. A small block with mass 0.20 kg is released from rest at the top of a 37° incline (point A). When the block reaches point B , its speed is 5.0 m/s . Point A is 4.0 m above point B .



a) During its motion from A to B , how much work is done by the friction force?

Ans. -5.34 J

b) What is the coefficient of kinetic friction μ_k ?

Ans. 0.512

(6 pts) 7. A uniform sphere with mass $m = 5.0 \text{ kg}$ and radius $R = 0.20 \text{ m}$ is rolling without slipping on a horizontal surface. The moment of inertia of the sphere for an axis through its center is $\frac{2}{5}mR^2$. As it rolls, the sphere has a constant angular velocity of 0.50 rad/s .

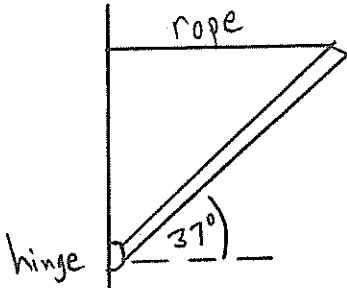
a) What is the linear speed of the center of mass of the sphere?

Ans. 0.10 m/s

b) What is the total kinetic energy of the sphere?

Ans. 0.035 J

(9 pts) 8. A uniform board that is 8.0 m long and weighs 500 N is attached to the wall by a frictionless hinge. The board is held at an angle of 37° above the horizontal by a horizontal rope. What is the tension in the rope?



Ans. 333 N

(8 pts) 9. A wheel the shape of a flat disk with radius $R = 0.20$ m is mounted on an axle through its center and rotates about that axle. The moment of inertia of the wheel for this axis is $I = \frac{1}{2}mR^2$. The mass of the wheel is 4.0 kg. A force F applied tangential to the rim of the wheel produces an angular acceleration of $\alpha = 5.0$ rad/s².

a) What is the magnitude of the force F ?

Ans. 2.0 N

b) At the instant that the wheel is turning at 3.0 rad/s, what is the magnitude of the total (resultant) acceleration of a point on the rim of the wheel?

Ans. 2.06 m/s²

(10 pts) 10. The temperature of 2.0 moles of a monatomic ideal gas is increased from 100 K to 400 K.

a) If the process is carried out at constant volume, what are Q , W , and ΔU ?

Ans. Q 7483 J

W 0

ΔU 7483 J

b) If the process is carried out at constant pressure, what are Q , W , and ΔU ?

Ans. Q 12,471 J

W 4988 J

ΔU 7483 J

c) If the process is carried out adiabatically ($Q = 0$), what are W and ΔU ?

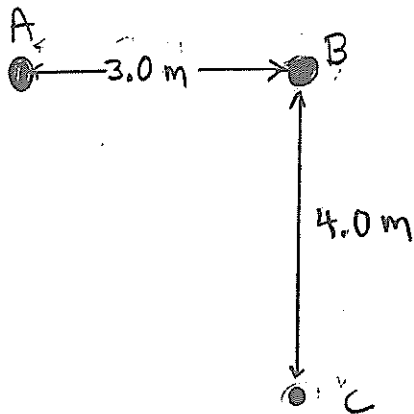
Ans. W -7483 J

ΔU 7483 J

(5 pts) 11. A cork floating on the surface of a pond rises and falls through one complete cycle in 2.0 s due to waves on the surface of the pond. The crests of the waves are 0.50 m apart. What is the speed of the waves?

Ans. 0.25 m/s

(8 pts) 12. Two loudspeakers at points A and B are emitting sound waves in phase and at the same frequency. The speed of sound is 343 m/s. What is the smallest frequency that will produce destructive interference at point C in the figure?



Ans. 172 Hz