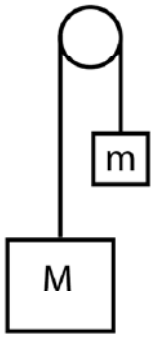
Practice Problems PHY131Summer-3

Q1:

A large and small mass (M>m) hang from a light string over a light pulley. The masses are not moving because another force is acting on the system. Which is true?



1) The extra force is zero (i.e. no extra force is needed).
2) The only possibility is a force pushing up on M with a magnitude of Mg.
3) The only possibility is a force pushing down on M with a magnitude of Mg.
4) The only possibility is a force pushing up on m with a magnitude of mg.
5) The only possibility is a force pushing down on m with a magnitude of mg.
6) More than one of the above are true. 7) None of the above are true.

Q2:

You are standing in an elevator, which is not moving. You feel the elevator floor pushing up on your feet with a force of Mg. Now, the elevator accelerates upward.

1) The floor still pushes up on you with a force of Mg and you still push down on the floor with the same force.
2) You still push down with a force of Mg but to accelerate you upward, the floor pushes up with a force larger than Mg.
3) The floor still pushes upward with a force of Mg but because you are accelerating upward, you push down with a force smaller than Mg.
4) Both the force you exert and the force the floor exerts are smaller than Mg.
5) Both the force you exert and the force the floor exerts are larger than Mg.
6) None of the above is true

Q3:

A small car is moving along a straight level highway at a speed of 3v. The car hits from behind a large truck moving in the same direction at speed v. After the collision, the car is stuck onto the truck. During the collision, which vehicle experiences the greater average force? Explain your answer.

a) The car b) The truck c) The forces are equal
d) Impossible to determine without information about the masses

Q4:

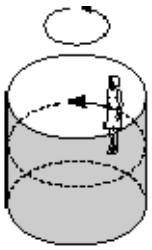
Two balls of masses 2 kg and 3 kg slide along a frictionless horizontal surface with speeds of 4 m/s and 2 m/s, respectively. After an inelastic collision, the balls stick together and move at a speed of 2 m/s. What direction did the two balls move before the collision?

a) In the same direction b) In opposite directions
c) At an angle not equal to 0° or 180° d) The situation described is impossible
e) Not enough information given to select an answer

Q5:
Two objects (labeled A & B) collide. Newton's 3rd law tells us that the force A exerts on B must be equal and opposite to the force B exerts on A. Which of the following is true:

1) The change in momentum of A due to the force between the objects must be equal and opposite of the change in momentum of B.
2) The work done on A by the force between the objects must be equal and opposite of the work done on B.
3) The change in kinetic energy of A due to the force between the objects must be equal and opposite of the change in kinetic energy of B.
4) (1) and (2) are true. 5) (2) and (3) are true. 6) (1) and (3) are true.
7) None of the above are true. 8) All of the above are true.

Q6:
The ""barrel of fun"" must spin at a certain minimum angular speed in order for a rider of mass m_1 to stick to the wall. Does this minimum angular speed change for a rider of mass $m_2 > m_1$?

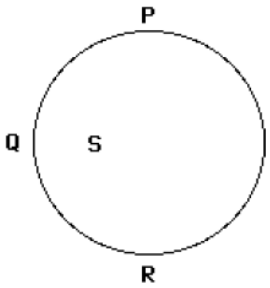


1.yes 2.no 3. Not enough information to determine.

Q7:
A satellite of mass *m* orbits a planet of mass *M* in a circular orbit of radius *R*. The time required for one revolution is

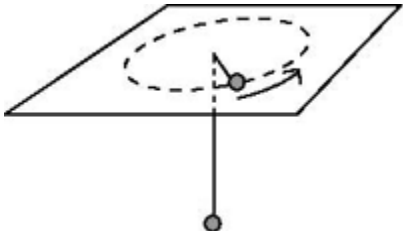
(A) independent of *M* (B) proportional to *m* (C) linear in *R*
(D) proportional to *R*^3/2 (E) proportional to *R*^2

Q8:
An object moves counter-clockwise along the circular path shown below. As it moves along the path its acceleration vector continuously points toward point *S*. The object



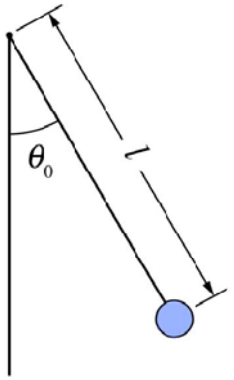
1.speeds up at *P*, *Q*, and *R*. 2.slows down at *P*, *Q*, and *R*.
3.speeds up at *P*and slows down at *R*. 4.slows down at *P*and speeds up at *R*.
5.speeds up at *Q*. 6. slows down at *Q*. 7. No object can execute such a motion.

Q9:
A puck of inertia M is moving in a circle at uniform speed on a frictionless table as shown above. It is held by a string which holds a suspended bob, also of inertia M, at rest below the table. Half of the length of the string is above the tabletop and half below. What is the centripetal acceleration of the moving puck?



1.less than g 2.g 3.greater than g
4.zero 5.insufficient information

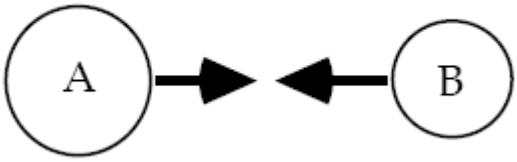
Q10:
A simple pendulum consists of a rod of negligible mass pivoted at one end. The rod has length l . A bob of mass m is placed at the end of the rod. Assume that the bob is a point-like object. The bob is initially displaced to an angle $\theta_0 = \pi / 12$ and then released from rest. The bob takes a time T_0 to return to its initial position. If the bob is displaced by an angle $2\theta_0$, will the time interval it takes to return to its initial position be



i) less than T_0,
ii) equal to T_0,
iii) greater than T_0 but not equal to $2T_0$,
iv) equal to $2T_0$?

Problem 1

Two steel spheres are shot at each other and then collide head on as shown. Sphere A has a mass of 10 kg and a velocity just before the collision of 3 m/s to the right. Sphere B has mass of 4 kg and velocity just before the collision of 4 m/s to the left. Immediately after the collision the velocity of sphere B is observed to be 6 m/s to the right.



a) What is the magnitude and direction of the velocity of sphere A immediately after the collision? Clearly indicate your coordinate system and what direction is positive.

b) Is this collision elastic or inelastic? Explain your answer.

c) Assume that the collision lasts 10!3 seconds. Calculate the magnitude and direction of the average force that sphere A exerts on sphere B during the collision. Clearly indicate your coordinate system and what direction is positive.

Problem 2

A car of mass *M* is traveling in a canyon on a circular curved bank of radius *R*. The curve is banked at angle € with the horizontal. The road surface is very icy and is effectively frictionless. Because of a natural oddity in the canyon, a horizontal wind blows radially outward from the center of the circle with a force of magnitude 1/4 Mg.

(a) Draw a fully labeled free-body diagram for the car.

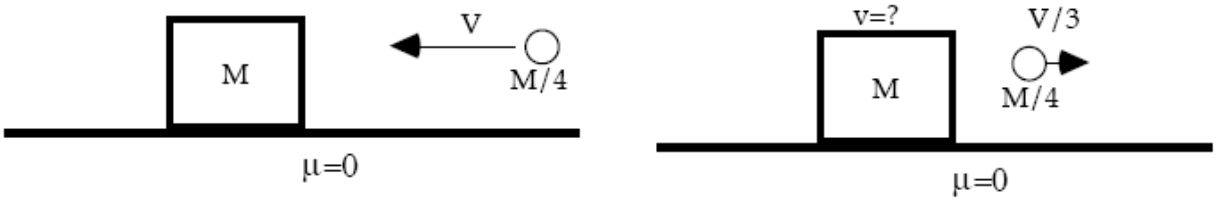
(b) Derive an expression, in terms of relevant system parameters, for the speed that the car must be going if it is to successfully follow the curve without sliding.

Problem 3

An object of mass *M* is moving on a conveyor belt. The object and the belt move together at a constant velocity _v. The coefficient of static friction is *μs*, the coefficient of kinetic friction is *μk*, and the acceleration of gravity is *g*. What is the magnitude of the force of friction on the object?

Problem 4

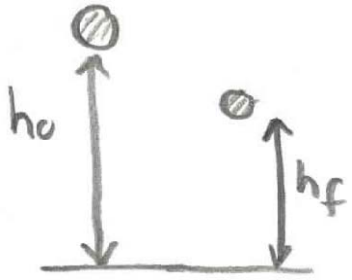
A metal block of mass M is free to slide on a frictionless, horizontal surface. A metal ball of mass M/4 is fired at the block with velocity V, and bounces straight backward off the block with one third its original speed. The block is initially at rest.



a) What is the speed of the block after the impact?
b) Is this collision elastic?
c) If the impact lasts Δt sec, what average force (magnitude and direction) acts on the block?
d) How does the average force (magnitude and direction) that acts on the ball compare to what you found in part (c) for the force on the block. Explain your answer.

Problem 5

A superball of $m1$, starting at rest, is dropped from a height $h0$ above the ground and bounces back up to a height of hf . The collision with the ground occurs over a time interval Δtc .



a) What is the momentum of the ball immediately before the collision?
b) What is the momentum of the ball immediately after the collision?
c) What is the average force of the ground on the ball?
d) What impulse is imparted to the ball?