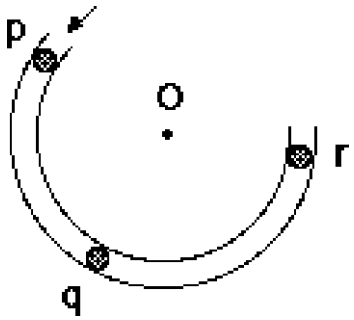
Phys 220
Quiz 4

Names: _____

Answer all of the following questions by choosing the best multiple choice answer. Then ***provide an explanation for every problem*** in the space below.

1. The figure shows a frictionless channel in the shape of a segment of a circle with center at "O". The channel has been anchored to a frictionless horizontal table top. You are looking down at the table. Forces exerted by the air are negligible. A ball is shot at high speed into the channel at "p" and exits at "r."



Consider the following distinct forces:

1. A downward force of gravity.
2. A force exerted by the channel pointing from q to O.
3. A force in the direction of motion.
4. A force pointing from O to q.

Which of the above forces is (are) acting on the ball when it is within the frictionless channel at position "q"?

A. 1 only.
B. 1 and 2.
C. 1 and 3.
D. 1, 2, and 3.
E. 1, 3, and 4.

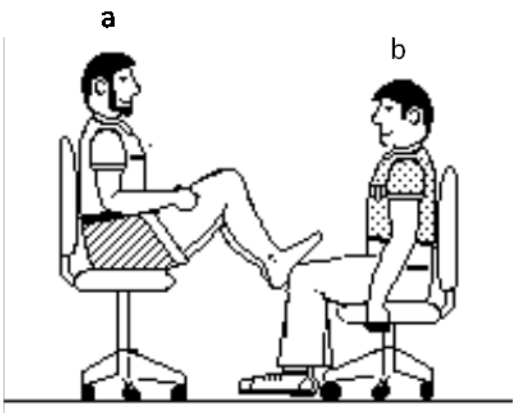
The force exerted by the channel from q to O is the force that turns the ball in a circular path.

There is not a force in the direction of motion. The ball is in motion so it's natural state is to remain in motion without something pushing it along. Another way to look at it is there is nothing there that can be pushing the ball in the direction of motion. There's no hand, kick, string or anything that can apply a force in that direction.

A force from O to q would push it away from the circular path.

There's also a normal force but the question does not say to identify all forces just asking if the ones they suggest are in existence.

2. Student "a" has a mass of 95 kg and student "b" has a mass of 77 kg. They sit in identical office chairs facing each other.



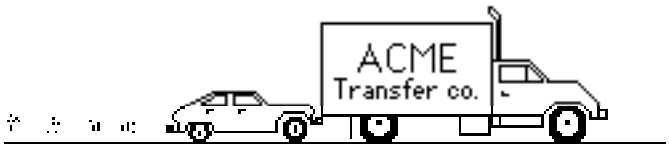
Student "a" places his bare feet on the knees of student "b", as shown. Student "a" then suddenly pushes outward with his feet, causing both chairs to move.

During the push and while the students are still touching one another:

A. neither student exerts a force on the other.
B. student "a" exerts a force on student "b", but "b" does not exert any force on "a".
C. each student exerts a force on the other, but "b" exerts the larger force.
D. each student exerts a force on the other, but "a" exerts the larger force.
E. each student exerts the same amount of force on the other.

Newton's third law tells us that for every force there is an equal and opposite force - force pair. If we are concerned with how much acceleration one of the students has, then we look at only the forces ON that student. Option E says Student A exerts a force on Student B and that Student B exerts the same force on Student A. A on B equals B on A. Only one of those is useful when analyzing the motion.

A large truck breaks down out on the road and receives a push back into town by a small compact car as shown in the figure below.



3. While the car, still pushing the truck, is speeding up to get up to cruising speed:

A. the amount of force with which the car pushes on the truck is equal to that with which the truck pushes back on the car.
B. the amount of force with which the car pushes on the truck is smaller than that with which the truck pushes back on the car.
C. the amount of force with which the car pushes on the truck is greater than that with which the truck pushes back on the car.
D. the car's engine is running so the car pushes against the truck, but the truck's engine is not running so the truck cannot push back against the car. The truck is pushed forward simply because it is in the way of the car.
E. neither the car nor the truck exert any force on the other. The truck is pushed forward simply because it is in the way of the car.

Newton's third law tells us that for every force there is an equal and opposite force - force pair. If we are concerned with how much acceleration one of the vehicles has, then we look at only the forces ON that vehicle. Option A says the amount of force with which the car pushes on the truck is equal to that with which the truck pushes back on the car. A on B equals B on A. Only one of those is useful when analyzing the motion.

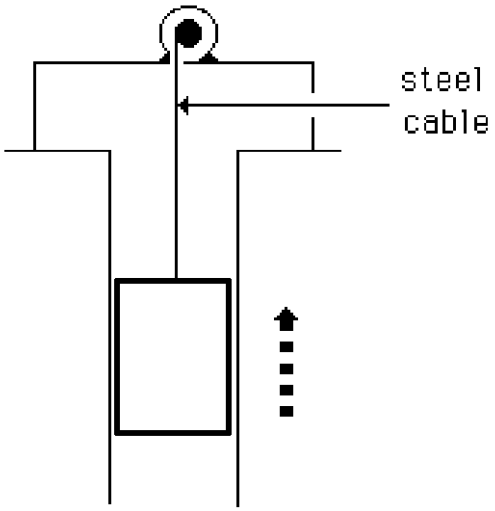
4. After the car reaches the constant cruising speed at which its driver wishes to push the truck:

A. the amount of force with which the car pushes on the truck is equal to that with which the truck pushes back on the car.
B. the amount of force with which the car pushes on the truck is smaller than that with which the truck pushes back on the car.
C. the amount of force with which the car pushes on the truck is greater than that with which the truck pushes back on the car.
D. the car's engine is running so the car pushes against the truck, but the truck's engine is not running so the truck cannot push back against the car. The truck is pushed forward simply because it is in the way of the car.
E. neither the car nor the truck exert any force on the other. The truck is pushed forward simply because it is in the way of the car.

Newton's third law tells us that for every force there is an equal and opposite force - force pair. If we are concerned with how much acceleration one of the vehicles has, then we look at only the forces ON that vehicle. Option A says the amount of force with which the car pushes on the truck is equal to that with which the truck pushes back on the car. A on B equals B on A. Only one of those is useful when analyzing the motion.

5. An elevator is being lifted up an elevator shaft at a constant speed by a steel cable as shown in the figure below. All frictional effects including air resistance are negligible. In this situation, forces on the elevator are such that:

   A. the upward force by the cable is greater than the downward force of gravity.
   B. the upward force by the cable is equal to the downward force of gravity.
   C. the upward force by the cable is smaller than the downward force of gravity.
   D. the upward force by the cable is greater than the sum of the downward force of gravity and a downward force due to the air.
   E. none of the above. (The elevator goes up because the cable is being shortened, not because an upward force is exerted on the elevator by the cable).



Elevator going up

at a constant speed

the key to this question is that the elevator is moving at a constant velocity which means it's in "dynamic equilibrium". It's in a state that it wants to be in – no net force is needed to maintain this state. The forces that are mentioned in most of the options are tension and gravity. These are not force pairs. What's most important is that these are indeed forces acting ON the elevator so will determine its motion. The question also conveniently ignores friction and air resistance so the only forces are Tension and Gravity. Since we want no net force (constant velocity) these two forces must be equal.

6. A woman exerts a constant horizontal force on a large box. As a result, the box moves across a horizontal floor at a constant speed.

   The constant horizontal force applied by the woman:

   A. has the same magnitude as the weight of the box.
   B. is greater than the weight of the box.
   C. has the same magnitude as the total force which resists the motion of the box.
   D. is greater than the total force which resists the motion of the box.
   E. is greater than either the weight of the box or the total force which resists its motion.

All the forces discussed are indeed forces acting ON the box so will determine its motion.

the key to this question is that the box is moving at a constant velocity which means it's in "dynamic equilibrium". It's in a state that it wants to be in – no net force is needed to maintain this state. The force that is mentioned in the question is force exerted by the woman. Since it is in equilibrium, constant velocity, acceleration is zero. That means there's no net force. If there's no net force, the woman's push must equal whatever resists its motion. The question does not say that friction is being ignored. Weight is down so not in the direction of motion so cannot resist her push.

7. If the woman in the previous question doubles the constant horizontal force that she exerts on the box to push it on the same horizontal floor, the box then moves:

   A. with a constant speed that is double the speed in the previous question.
   B. with a constant speed that is greater than the speed in the previous question, but not necessarily twice as great.
   C. for a while with a speed that is constant and greater than the speed in the previous question, then with a speed that increases thereafter.
   D. for a while with an increasing speed, then with a constant speed thereafter.
   E. with a continuously increasing speed.

This question makes use of the idea from above that the box has a certain amount of friction resisting its motion. Now the woman applies twice the force. Maybe this box is being pulled by a forklift – doesn't matter. The force that was just adequate to overcome friction is now doubled. That means there is a NET FORCE on the box. If there is a net force, there is an acceleration. Acceleration is change in velocity so it will continuously speed up as long as that double force can be applied.