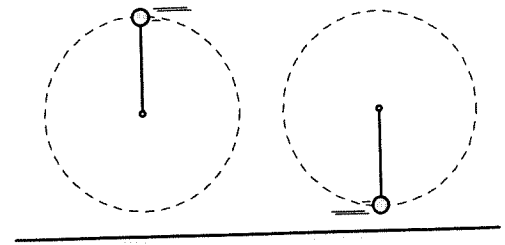


1 B3-SCT100: BALL WHIRLED IN VERTICAL CIRCLE—NET FORCE ON BALL

A ball with a weight of 2 N is attached to the end of a cord of length 2 m. The ball is whirled in a vertical circle counterclockwise. The tension in the cord at the top of the circle is 7 N, and at the bottom it is 15 N. (The speed of the ball is not the same at these points.)



(a) Three students discuss the net force on the ball at the top.

Angelica: "The net force on the ball at the top position is 7 N since the net force is the same as the tension."

Bo: "The net force on the ball at the top position is 9 N. Both the tension and the weight are acting downward so you have to add them."

Charles: "No, you are both wrong. You need to figure out the centripetal force (mv^2/r) and include it in the net force."

With which, if any, of these students do you agree?

Angelica _____ Bo _____ Charles _____ None of them _____

(b) Now the students discuss the net force on the ball at the bottom.

Angelica: "The net force on the ball at the bottom position is 15 N since the net force is the same as the tension."

Bo: "The net force on the ball at the bottom position is 17 N, since you need to add the weight of 2 N to the tension of 15 N."

Charles: "The net force on the ball at the bottom position is 13 N. I agree that you need to take into account both the weight and the tension, but they are in different directions so they will subtract."

With which, if any, of these students do you agree?

Angelica _____ Bo _____ Charles _____ None of them _____

Explain your reasoning.

2

B3-CT101: SKATEBOARDER ON CIRCULAR BUMP—WEIGHT AND NORMAL FORCE

A skateboarder is skating over a circular bump. At the instant shown, she is at the top of the bump and is moving with a speed of 5 m/s.

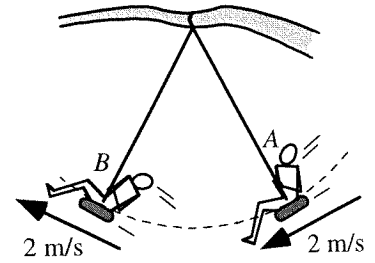
Is the normal force exerted on the skateboarder by the bump (i) greater than, (ii) less than, or (iii) equal to the weight of the skateboarder? _____



Explain your reasoning.

#3 B3-SCT102: CHILD ON A SWING—TENSION

A child is swinging back and forth on a tire swing that is attached to a tree branch by a single rope. Shown are two positions during a swing from right to left. Three students are discussing the tension in the rope at the bottom of the swing.



Alia: "At the bottom of the swing, she will be moving exactly horizontally. Since she is not moving vertically at that instant, the vertical forces cancel. The tension in the rope at that instant equals the weight."

Brian: "Just looking at the velocity vectors, the change in velocity points upward between A and B. So that is the direction of the acceleration, and also of the net force. To get a net force pointing upward, the tension would have to be greater than the weight."

Clara: "But there aren't just two forces acting on her at the bottom of the swing. Since she's moving in a circle, there's also the centripetal force, which acts toward the center of the circle. Since both the tension and the centripetal force point upward, and the weight points downward, to get zero net force the tension actually has to be less than the weight. The tension plus the centripetal force equals the weight."

With which, if any, of these students do you agree?

Alia _____ Brian _____ Clara _____ None of them _____

Explain your reasoning.

#4 B6-RT06: SPHERES ROLLING—RADIUS

The figures below show hollow spheres (not drawn to scale) that are rolling at a constant rate without slipping. The spheres all have the same mass, but their radii as well as their linear and angular speeds vary.

A $\omega = 10 \text{ rad/s}$ $v = 30 \text{ cm/s}$	B $\omega = 10 \text{ rad/s}$ $v = 50 \text{ cm/s}$	C $\omega = 10 \text{ rad/s}$ $v = 40 \text{ cm/s}$
D $\omega = 12.5 \text{ rad/s}$ $v = 50 \text{ cm/s}$	E $\omega = 20 \text{ rad/s}$ $v = 60 \text{ cm/s}$	F $\omega = 15 \text{ rad/s}$ $v = 60 \text{ cm/s}$

Rank the radius of the spheres.

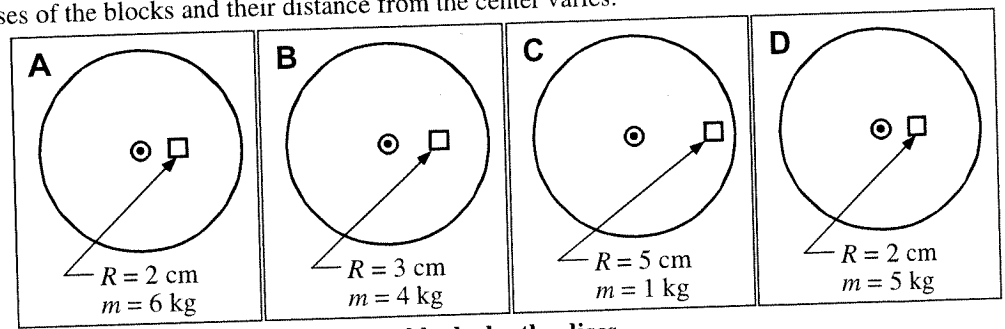
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	OR	<input type="text"/>	<input type="text"/>	<input type="text"/>
1	2	3	4	5	6		All the same	All zero	Cannot determine
Greatest					Least				

Explain your reasoning.

Tipper #1 - Unit 3

#5 B6-RT32: BLOCKS ON ROTATING DISC—HORIZONTAL FRICTIONAL FORCE

A block is placed on a rotating disc and moves in a circular path. The discs have the same rotation rate in each case, but the masses of the blocks and their distance from the center varies.



Rank the magnitude of the frictional force on blocks by the discs.

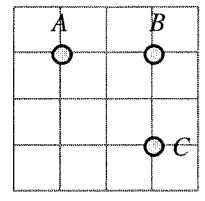
OR All the same All zero Cannot determine
 1 Greatest 2 3 4 Least

Explain your reasoning.

#6 B3-QRT94: THREE OBJECTS EXERTING GRAVITATIONAL FORCES—NET FORCE

Three objects each with a mass of M exert gravitational forces on each other. Which of the arrows below shows the direction of the net force on mass B ?

- (i) (ii) (iii) (iv) (v) None of these



Explain your reasoning.

#7 B3-QRT96: TWO OBJECTS—GRAVITATIONAL FORCE ON EACH

Object A has twice the mass of Object B.

Identify the pair of force vectors (the arrows) that correctly compare the gravitational force exerted on A by B with the gravitational force exerted on B by A.

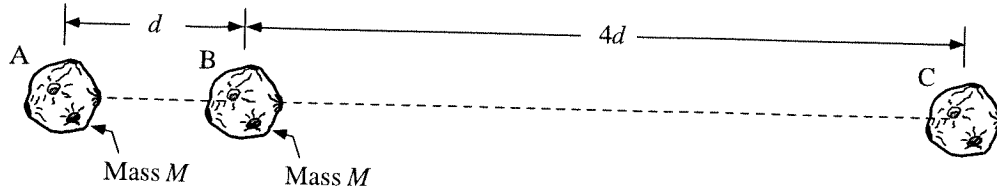


	Gravitational force on A by B	Gravitational force on B by A
(a)		
(b)		
(c)		
(d)		
(e)		
(f)		

Explain your reasoning.

#8 B3-WWT95: THREE ASTEROIDS IN A LINE—MASS OF ASTEROID

At the instant shown, three asteroids are in a line, and the distance between B and C is 4 times as large as the distance between A and B. Asteroids A and B have the same mass. There is no net force on asteroid B due to the other two asteroids.



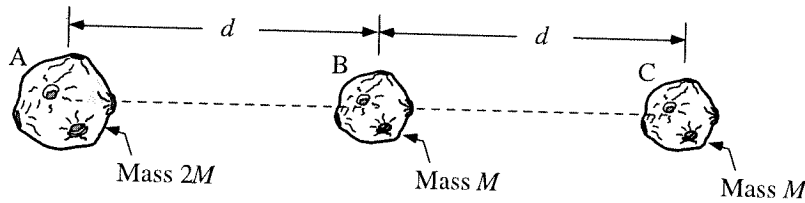
A student makes the following comment about the mass of asteroid C:

“Since C is four times as far from B as A is, it is only going to have one-quarter the effect on B. To get the forces on B to balance, you’d need the mass of C to be four times as large.”

What, if anything, is wrong with the student’s statement? If nothing is wrong, state that explicitly, and explain why it is correct. If the statement is incorrect, state what is wrong and how you would correct it.

#9 B3-RT97: THREE ASTEROIDS IN A LINE—NET FORCE

At the instant shown, three asteroids are in a line, and the distance between A and B is the same as the distance between B and C. Asteroids B and C have the same mass, while asteroid A has twice the mass.



Rank the magnitude of the net force on each asteroid due to the other two asteroids.

			OR			
1	2	3		All	All	Cannot
Greatest		Least		the same	zero	determine

Explain your reasoning.

#10 B3-WWT92: TWO ASTEROIDS—GRAVITATIONAL FORCE ON EACH

Two asteroids with masses of m and $3m$ exert gravitational forces on each other. A student contends that the forces will be in different directions and of different magnitudes as shown below.



What’s wrong, if anything, with this student’s contention? If something is wrong, identify it and explain how to correct it. If this student’s contention is correct, explain why.

#1 **B3-CT99: ASTRONAUT NEAR A MOON—GRAVITATIONAL FORCE**

In both cases shown at right, an astronaut is a distance x from a moon. The two cases are identical except that in Case A there is a large planet directly between the astronaut and the moon.

Is the gravitational force on the astronaut by the moon (i) *greater in Case A*, (ii) *greater in Case B*, or (iii) *the same in both cases*? _____

Explain your reasoning.

