APP1 Name: McDevitt - Key Pd: ____

NT5I-WWT102: Two Planetary Objects—Gravitational Force on Each

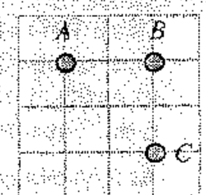
Two planetary objects with masses of m and $3m$ exert gravitational forces on each other. A student contends that the forces will be in different directions and of different magnitudes as shown.

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.

— See next page —

NT5I-QRT103: 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 show the direction of the net force on mass B?**



(a) $\swarrow$ (b) $\nearrow$ (c) $\leftarrow$ (d) $\uparrow$ (e) none of these

Explain.

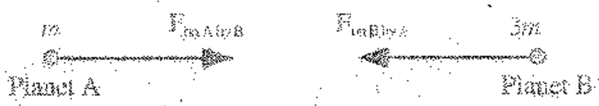
— See next page —

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.

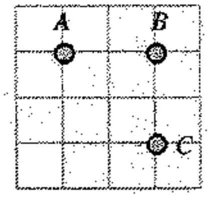
What's wrong, if anything, with this student's contention? If something is wrong, identify it and explain how to correct it. If this student's contention is correct, explain why.

Answer: The forces are attractive so the directions should be reversed and the forces should be equal as required by Newton's Third Law.



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?**



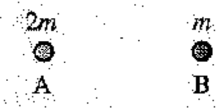
(i) ↙ (ii) ↗ (iii) ← (iv) ↑ (v) None of these

Explain your reasoning.

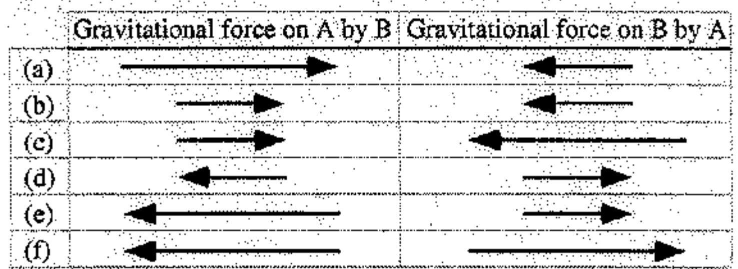
Answer (a) vector addition of the force on B by A (which is directed horizontally to the left) and the force on B by C (which is directed toward the bottom of the page or down) results in a force 45° down to the left.

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.



Explain your reasoning.

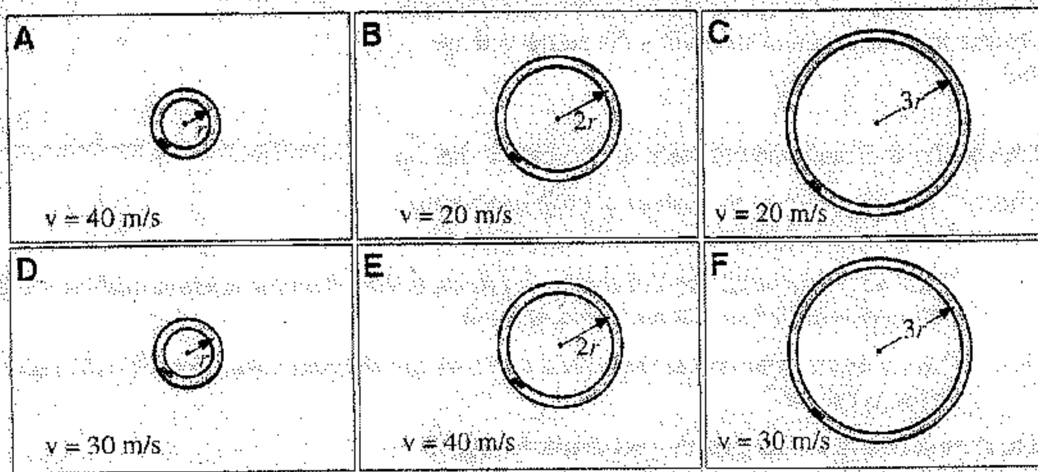
Answer: (b).

The forces must be attractive, because the gravitational force is always an attractive force. Newton's Third Law requires that the magnitude of the forces be the same.

NT5J-RT106: Cars Going in Circles—Net Force

UCM

In each case below, a stock car travels around a circular track at a constant speed. The radii of the tracks and the speeds of the cars are given for each case.



Rank the magnitude of the net force acting on the cars on these tracks.

Greatest 1 A 2 D 3 E 4 F 5 B 6 C Least

OR, The magnitude of the net force on the stock cars is the same but not zero for all these tracks. ___

OR, The magnitude of the net force on the stock cars is zero for all these tracks. ___

OR, We cannot determine the ranking for the magnitude of the net force on the stock cars. ___

Please explain your reasoning.

$\Sigma F = m \cdot a = m \cdot \frac{v^2}{r}$ mass is same $\therefore \Sigma F \propto \frac{v^2}{r}$

A: $\frac{(40)^2}{r} = \frac{1600}{r}$

B: $\frac{(20)^2}{2r} = \frac{400}{2r} = \frac{200}{r}$

C: $\frac{(20)^2}{3r} = \frac{400}{3r} = \frac{133}{r}$

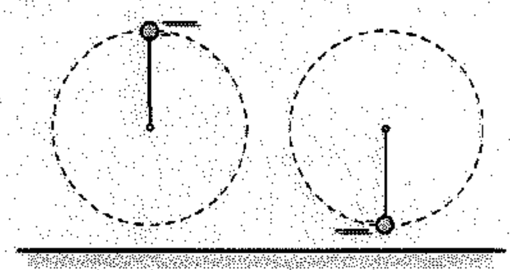
D: $\frac{(30)^2}{r} = \frac{900}{r}$

E: $\frac{(40)^2}{2r} = \frac{1600}{2r} = \frac{800}{r}$

F: $\frac{(30)^2}{3r} = \frac{900}{3r} = \frac{300}{r}$

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 _____

Explain your reasoning.

At top:

$F_g = 2N$

$F_T = 7N$

$\Sigma F = m \cdot a$

$\Sigma F = F_T + F_g$

$= 7N + 2N$

$\Sigma F = 9N$

Answer: Bo is correct, as can be seen by drawing a free-body diagram for the ball. The tension acts downward at the top (the cord cannot push on the ball!) and the weight is also downward, toward the center of the earth. So the net force at the top is the vector sum of these to forces acting in the same direction and has a magnitude of 9 N.

(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.

Answer: Charles is correct, as can be seen by drawing a free-body diagram for the ball. The tension is upward and the weight is still downward, and the vector sum of these two forces must point toward the center of the circle. The magnitude of the net force is the vector sum of these two oppositely directed forces and has a magnitude equal to 15 N minus 2 N or 13 N.

At bottom:

$F_T = 15N$

$F_g = 2N$

$\Sigma F = m\vec{a}$

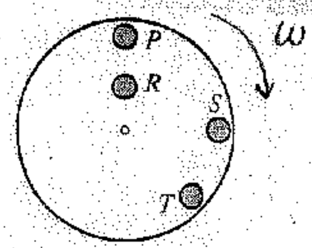
$F_T + (-F_g) = \Sigma F$

$15N - 2N = \Sigma F$

$13N = \Sigma F$

NT5J-RT108: ROTATING CYLINDERS—NET FORCE MAGNITUDE

Four identical small cylinders rest on a circular horizontal turntable at the positions shown in the top view diagram at right. The turntable is rotating clockwise at a constant angular velocity. = constant turning rate.



Turntable rotating clockwise – top view

Rank the magnitude of the net force on the cylinder at the positions on the turntable indicated in the diagram.

Greatest 1 P 2 = S 3 = T 4 R Least

OR, The magnitude of the net force on the cylinder at these positions is the same but not zero. ___

OR, The magnitude of the net force on the cylinder at all of these positions is zero. ___

OR, The ranking for the magnitude of net force on the cylinder at these positions cannot be determined. ___

Explain your reasoning.

T, Period, is the same for all because the angular velocity, ω, is the same.

Assuming positions P, S, T all are placed the same distance from the center of the circle, (∴ r is same for P, S, T) then the speed ($V = \frac{2\pi r}{T}$) and the acceleration ($a_c = \frac{V^2}{r}$) and therefore the net force ($\Sigma F = m \cdot a_c$) are the Same!

R has the least ΣF b/c it has the smallest radius (but same T)...

$V = \frac{2\pi r}{T}$ is least

$a_c = \frac{V^2}{r}$ is least

$\Sigma F = m \cdot a_c$ is least