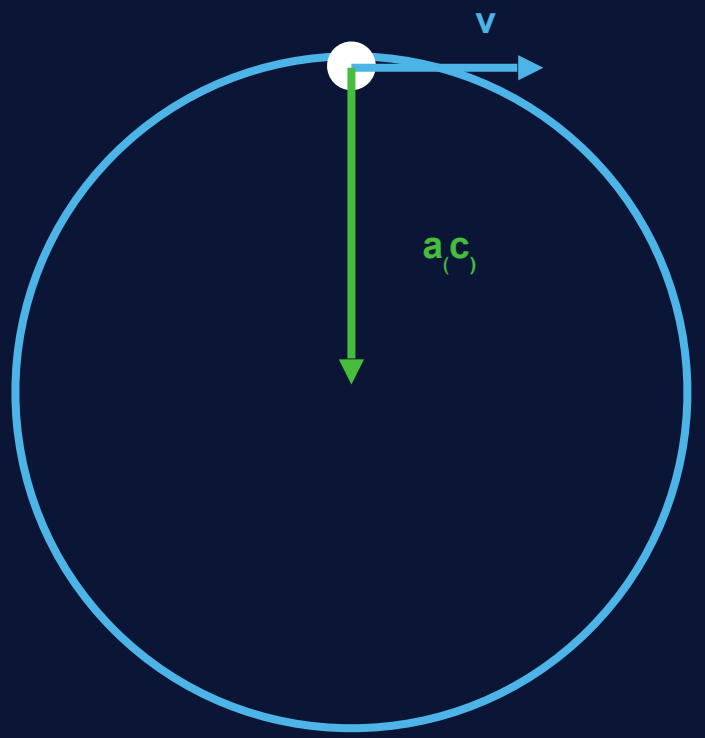
CIRCULAR MOTION

Check your understanding



STUDENT RETRIEVAL | MISCONCEPTIONS | HSC-STYLE REASONING

How to use

Vote first. Explain your choice to a partner.

QUESTION 1 OF 10

At the point shown, which direction is the object’s instantaneous velocity?

Foundation

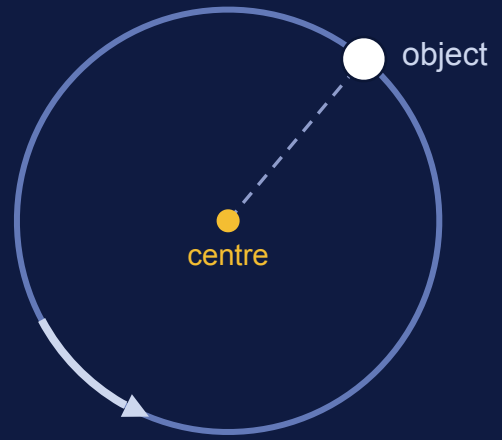
A Towards the centre

B Tangential to the circle

C Away from the centre

D In the direction of the net force

Top view: an object moving anticlockwise on a circular path



Which direction is the velocity at this point?

EASY

ANSWER 1 OF 10

At the point shown, which direction is the object’s instantaneous velocity?

Correct answer: B

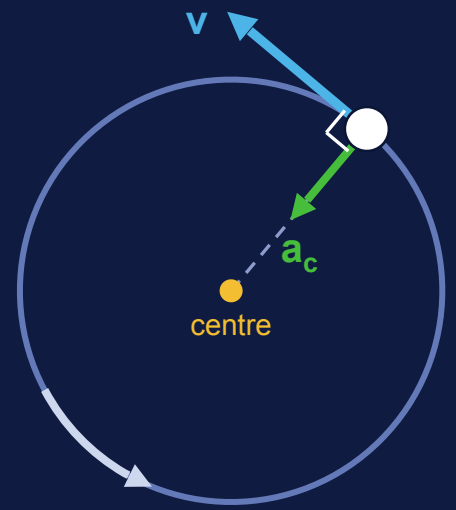
A Towards the centre

B Tangential to the circle

C Away from the centre

D In the direction of the net force

Top view: an object moving anticlockwise on a circular path



v is tangent to the path, at right angles to the radius.
The inward arrow is acceleration, not velocity.

MISCONCEPTION CHECK

Misconception: circular motion means the object is moving towards the centre.

Velocity is tangent to the path at each instant. The inward vector is acceleration, not velocity.

QUESTION 2 OF 10

An object moves in a circle at constant speed. Which statement is correct?

Foundation

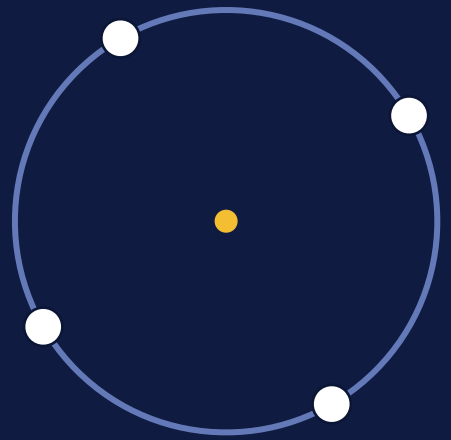
A Its velocity and acceleration are both zero

B Its velocity is constant, so acceleration is zero

C Its velocity changes direction, so it accelerates inward

D Its acceleration is tangential to the path

Top view: constant speed (equal time intervals shown)



Think about the velocity and the acceleration.

EASY

ANSWER 2 OF 10

An object moves in a circle at constant speed. Which statement is correct?

Correct answer: C

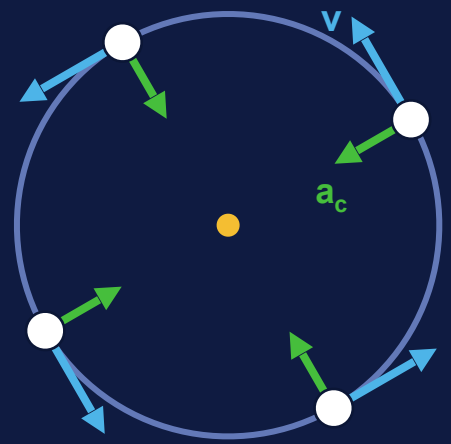
A. Its velocity and acceleration are both zero

B. Its velocity is constant, so acceleration is zero

C. Its velocity changes direction, so it accelerates inward

D. Its acceleration is tangential to the path

Top view: constant speed (equal time intervals shown)



Speed is constant, but the direction of v changes, **so there is an acceleration towards the centre.**

MISCONCEPTION CHECK

Misconception: no change in speed means no acceleration.

Constant speed does not mean constant velocity. Changing direction creates centripetal acceleration towards the centre.

QUESTION 3 OF 10

What does “centripetal force” mean?

Foundation

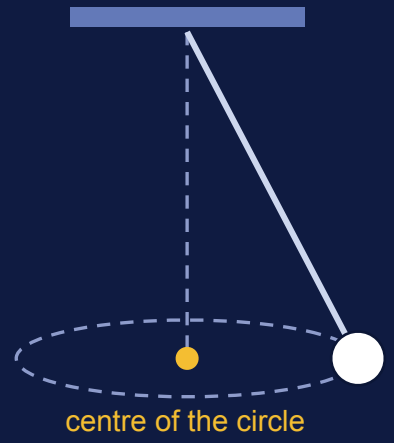
A. A special force added to the other forces

B. The net component of force directed towards the centre

C. A force that always acts outward

D. The reaction force to the object’s weight

Side view: a ball whirled in a horizontal circle on a string



What is the centripetal force here?

EASY

ANSWER 3 OF 10

What does “centripetal force” mean?

Correct answer: B

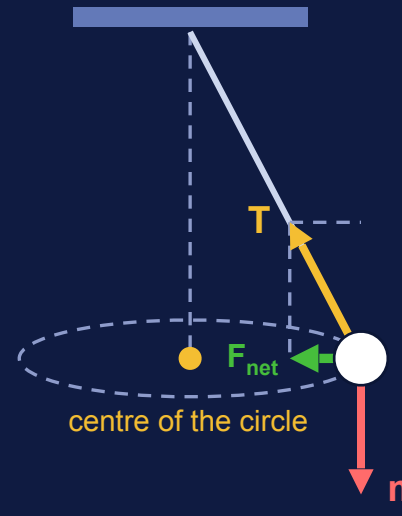
A. A special force added to the other forces

B. The net component of force directed towards the centre

C. A force that always acts outward

D. The reaction force to the object’s weight

Side view: a ball whirled in a horizontal circle on a string



Net force towards the centre (T and mg added)
is the centripetal force, not an extra force.

MISCONCEPTION CHECK

Misconception: centripetal force is a separate new force.

Centripetal force is a role played by the net inward force. It may be tension, friction, gravity, a normal force, or a combination.

QUESTION 4 OF 10

A car rounds a flat, unbanked bend without slipping. What provides the centripetal force?

Apply the model

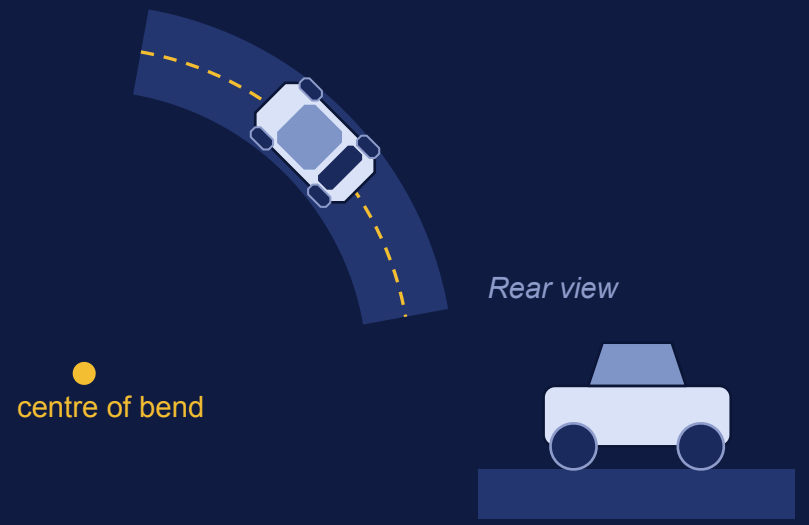
A The engine’s driving force

B The car’s weight

C Static friction from the road on the tyres

D A centrifugal force acting on the car

Flat, unbanked bend (top view)



What provides the inward force?

APPLY

ANSWER 4 OF 10

A car rounds a flat, unbanked bend without slipping. What provides the centripetal force?

Correct answer: C

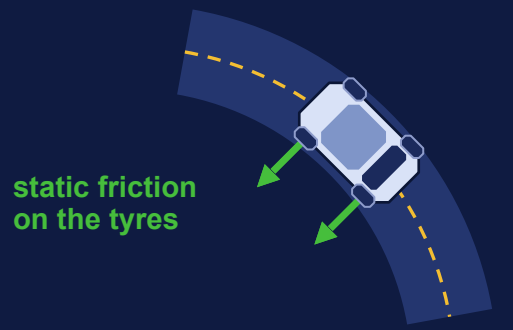
A. The engine's driving force

B. The car's weight

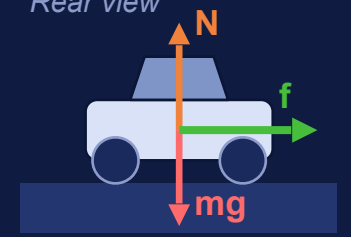
C. Static friction from the road on the tyres

D. A centrifugal force acting on the car

Flat, unbanked bend (top view)



Rear view



N and mg cancel, so the friction f is the net force.

MISCONCEPTION CHECK

Misconception: the engine or an outward force keeps the car turning.

Static friction acts horizontally towards the centre of the bend. Weight and normal force balance vertically.

QUESTION 5 OF 10

A ball moves clockwise on a string. The string breaks at the position shown. What happens next?

Apply the model

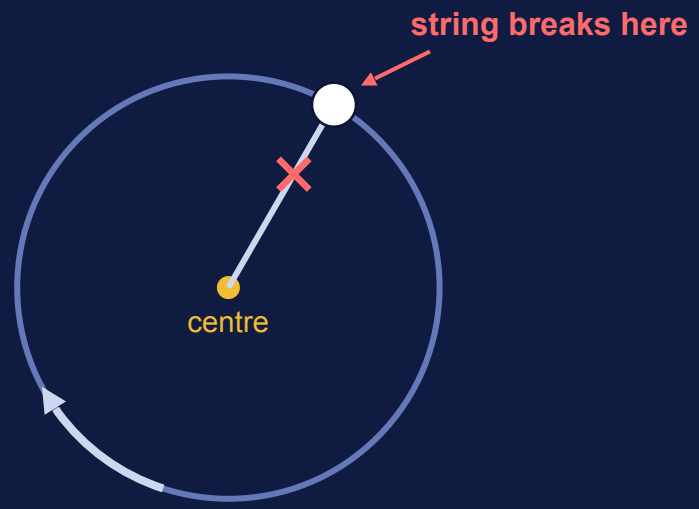
A It moves radially outward

B It continues in a smaller circle

C It moves along the tangent at the release point

D It spirals outward

Top view: a ball whirled clockwise on a string



What happens to the ball next?

APPLY

ANSWER 5 OF 10

A ball moves clockwise on a string. The string breaks at the position shown. What happens next?

Correct answer: C

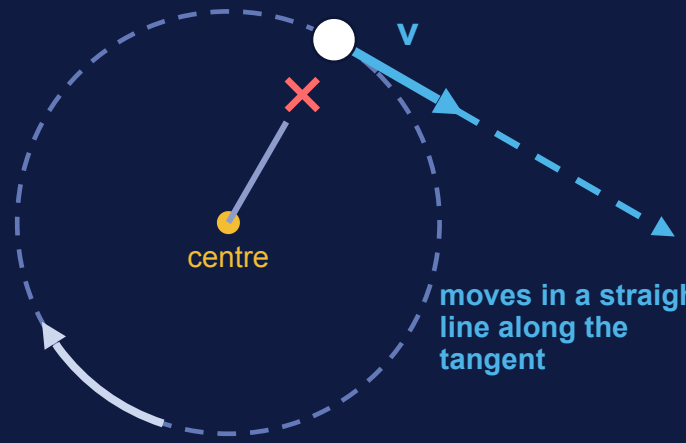
A It moves radially outward

B It continues in a smaller circle

C It moves along the tangent at the release point

D It spirals outward

Top view: a ball whirled clockwise on a string



With no inward force, nothing changes the velocity.

Newton's first law: constant velocity, a straight line.

MISCONCEPTION CHECK

Misconception: an outward force makes released objects fly radially away.

Once the inward force disappears, the ball continues with its instantaneous tangential velocity.

QUESTION 6 OF 10

For the same mass and radius, the speed doubles. How does the required centripetal force change?

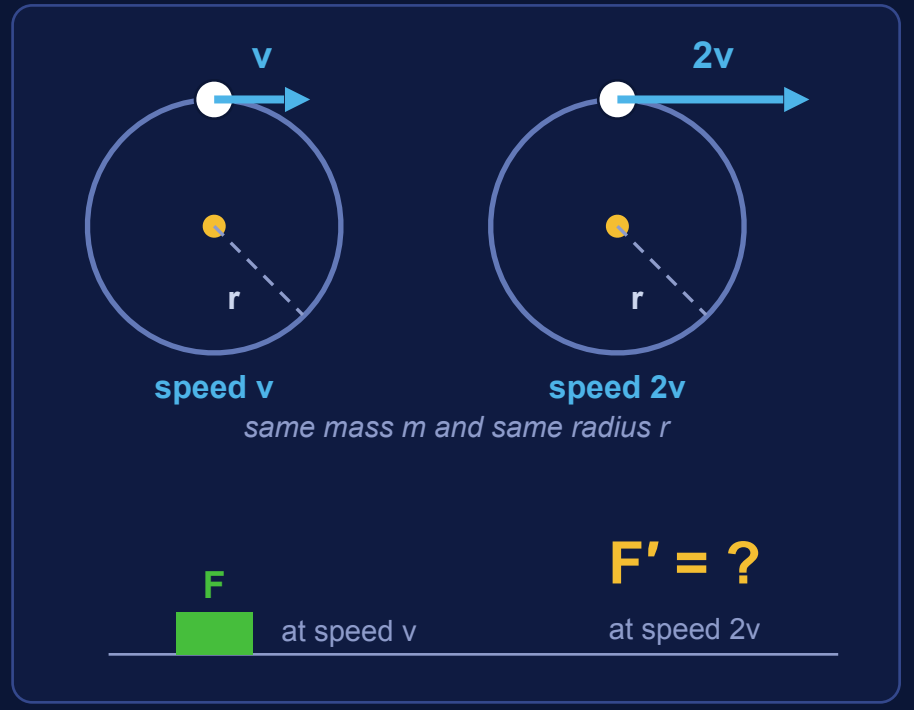
Apply the model

A It doubles

B It quadruples

C It halves

D It remains unchanged



APPLY

ANSWER 6 OF 10

For the same mass and radius, the speed doubles. How does the required centripetal force change?

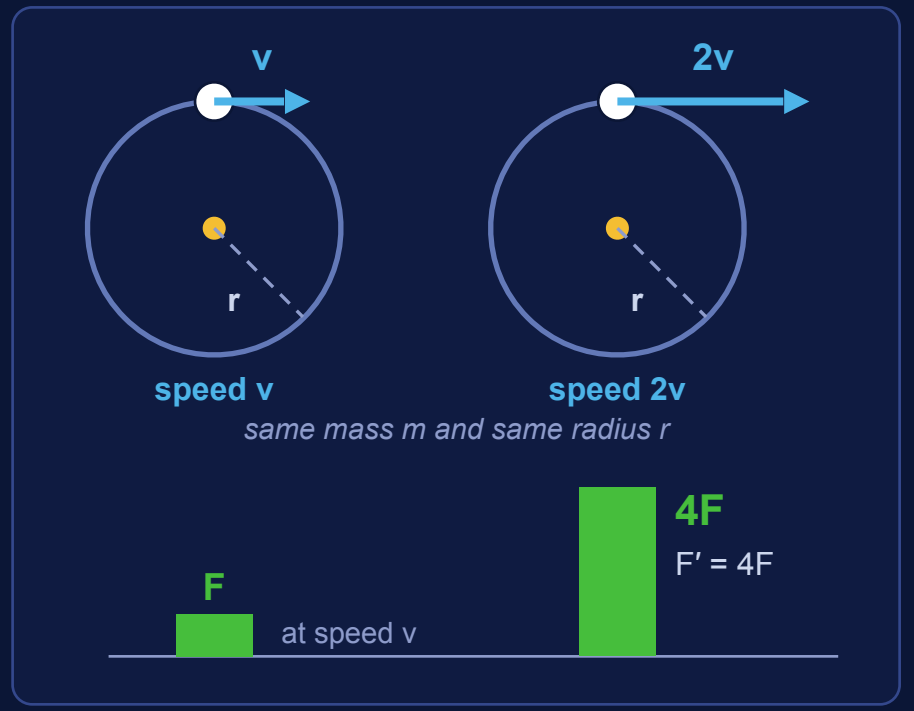
Correct answer: B

A It doubles

B It quadruples

C It halves

D It remains unchanged



MISCONCEPTION CHECK

Common error: treating force as directly proportional to speed rather than speed squared.

$F_c = mv^2/r$. Doubling v makes v^2 four times larger, so the required inward force quadruples.

QUESTION 7 OF 10

At the same speed, the radius of the circular path doubles. What happens to centripetal acceleration?

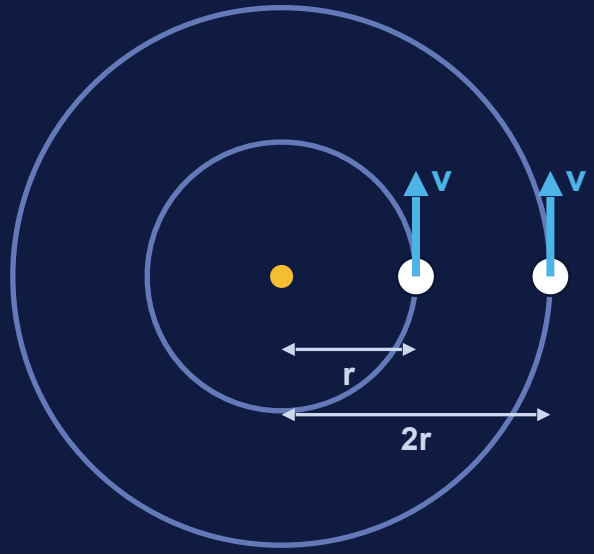
Apply the model

A It doubles

B It quadruples

C It halves

D It remains unchanged



Same speed v on both paths. Compare a_c.

APPLY

ANSWER 7 OF 10

At the same speed, the radius of the circular path doubles. What happens to centripetal acceleration?

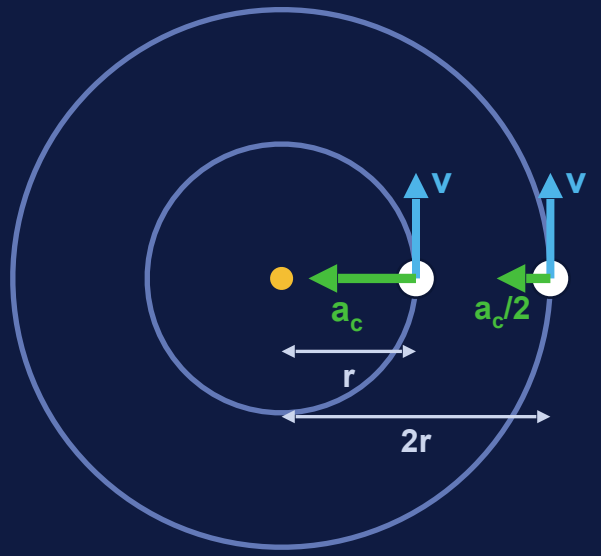
Correct answer: C

A It doubles

B It quadruples

C **It halves**

D It remains unchanged



$a_c = v^2/r$: doubling r halves the acceleration

MISCONCEPTION CHECK

Reasoning check: a tighter turn requires a larger inward acceleration.

$a_c = v^2/r$. With v unchanged, doubling r halves the centripetal acceleration.

QUESTION 8 OF 10

A rider moves at constant speed over the top of a circular Ferris wheel path. Which statement must be true?

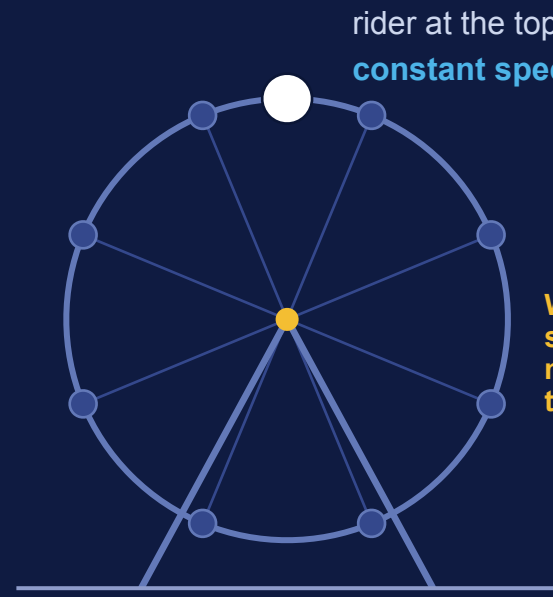
Challenge the model

A The net force is zero because speed is constant

B The net force points downward, towards the centre

C The normal force must equal the rider’s weight

D A centrifugal force on the rider points upward



CHALLENGE

ANSWER 8 OF 10

A rider moves at constant speed over the top of a circular Ferris wheel path. Which statement must be true?

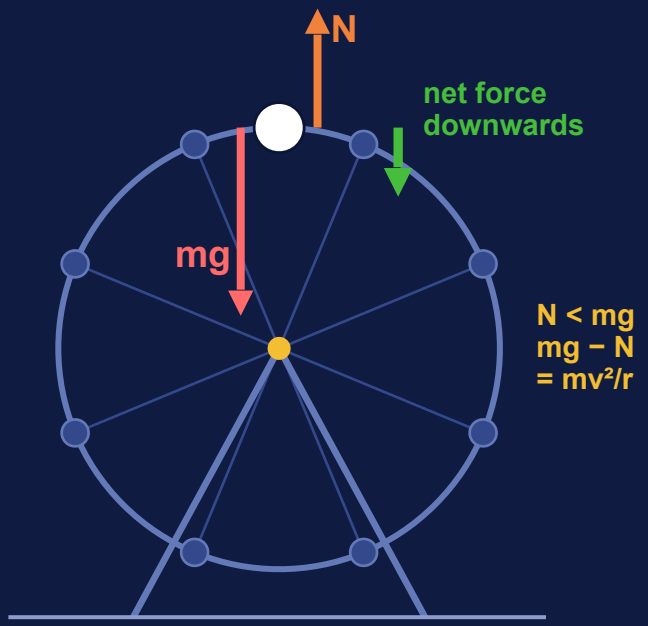
Correct answer: B

A. The net force is zero because speed is constant

B. The net force points downward, towards the centre

C. The normal force must equal the rider's weight

D. A centrifugal force on the rider points upward



MISCONCEPTION CHECK

Misconception: constant speed means balanced forces.

At the top, the centre is below the rider, so the net force must be downward. Constant speed still involves changing velocity.

QUESTION 9 OF 10

At the top of a vertical loop, what is true at the minimum speed needed to maintain contact?

Challenge the model

A The normal force is at its maximum

B The normal force is zero and gravity supplies the required inward force

C Weight is zero

D Centripetal force acts upward



CHALLENGE

ANSWER 9 OF 10

At the top of a vertical loop, what is true at the minimum speed needed to maintain contact?

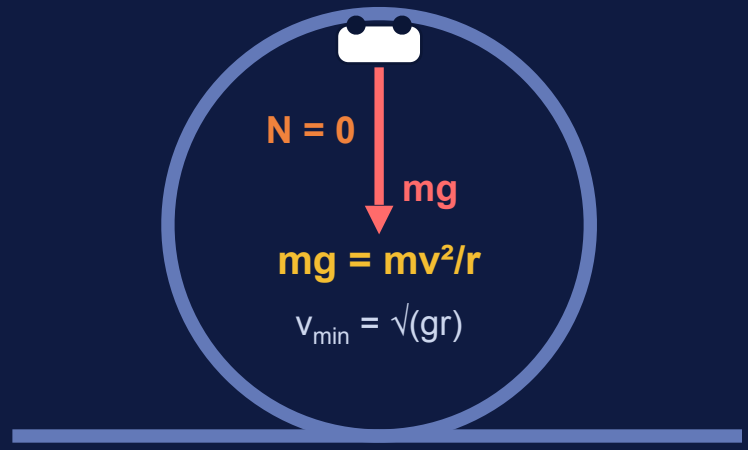
Correct answer: B

A. The normal force is at its maximum

B. The normal force is zero and gravity supplies the required inward force

C. Weight is zero

D. Centripetal force acts upward



MISCONCEPTION CHECK

Misconception: “centripetal force” must be an additional force besides gravity.

At the threshold of contact, N = 0. Gravity alone provides mv^2/r towards the centre, giving $v = \sqrt{(gr)}$.

QUESTION 10 OF 10

A road pushes inward on a turning car. Which statement correctly describes the Newton's third-law partner?

Challenge the model

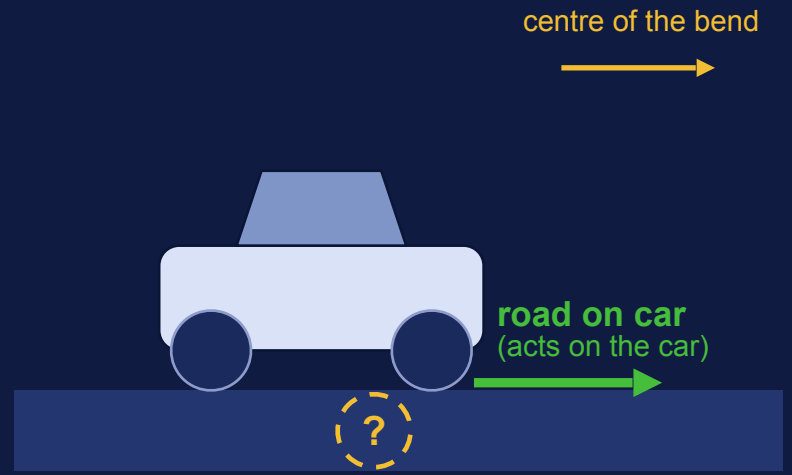
A. An outward force from the road also acts on the car

B. The car pushes outward on the road with equal magnitude

C. The car's weight is the reaction force

D. There is no reaction because the car is accelerating

Rear view: a car turning right on a flat road



What is the Newton's third-law partner of the force of the road on the car?

CHALLENGE

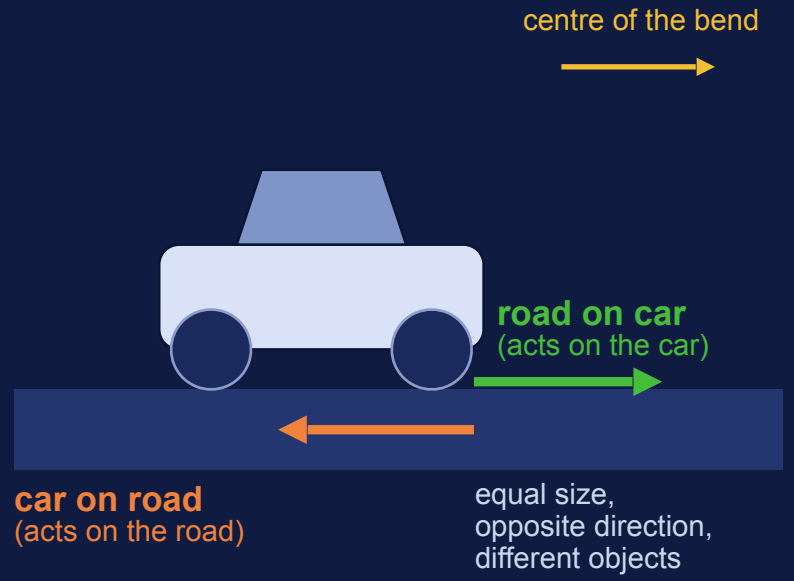
ANSWER 10 OF 10

A road pushes inward on a turning car. Which statement correctly describes the Newton’s third-law partner?

Correct answer: B

- A: An outward force from the road also acts on the car
- **B: The car pushes outward on the road with equal magnitude**
- C: The car’s weight is the reaction force
- D: There is no reaction because the car is accelerating

Rear view: a car turning right on a flat road



MISCONCEPTION CHECK

Misconception: equal and opposite forces cancel even when they act on different objects.

The interaction pair acts on different objects: road on car inward, car on road outward. The outward member does not act on the car.