

Angular velocity, centripetal force and circular paths

Physics grades 11-12 (A Level · IB · Class 11-12) · Test

Name: _____ Date: _____ Class: _____ Mark: ____ / 20

This test lasts 45 minutes and is worth 20 marks. Calculators are allowed. Take $g = 9.81 \text{ N/kg}$, draw force diagrams where helpful, and give final answers with units and sensible significant figures.

Level: Physics grades 11-12 (A Level · IB · Class 11-12) · **Curriculum:** A Level 3.6

Time: 45 minutes · 8 questions · Total: 20 marks · Calculator allowed

Question 1 Centripetal acceleration (2 marks)

State the direction of the acceleration of an object moving at constant speed in a circle and explain why it accelerates although its speed is constant.

Question 2 Rotating disc (3 marks)

A disc of radius 6.0 cm turns at 480 rpm.

- Calculate its angular velocity. (1 mark)
- Calculate the speed of a point on the rim. (1 mark)
- Calculate the centripetal acceleration of that point. (1 mark)

Question 3 Work done (2 marks)

Explain why the centripetal force on a satellite in a circular orbit does no work and the speed stays constant.

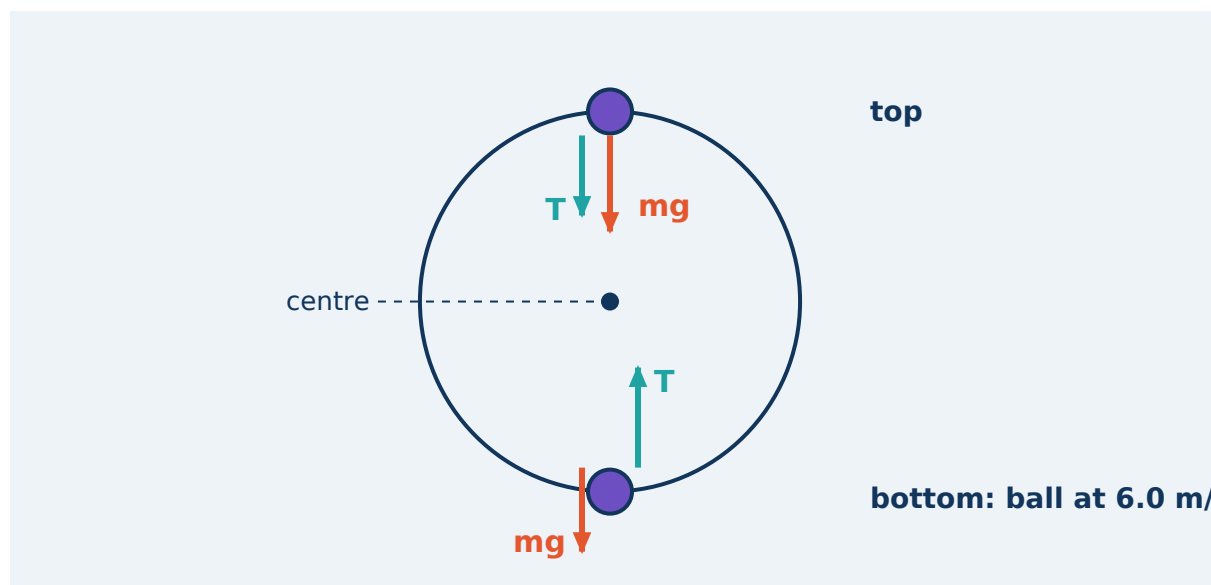
Question 4 Car on a flat bend (3 marks)

A car of mass 900 kg turns a flat bend of radius 50 m. The coefficient of friction is 0.60.

- Calculate the greatest speed at which it can turn without skidding. (2 marks)
- State whether a car of mass 1800 kg has a greater, equal or smaller limit. (1 mark)

Question 5 Ball in a vertical circle (3 marks)

A ball of mass 0.40 kg moves in a vertical circle of radius 0.90 m on a string.



A ball on a string in a vertical circle (radius 0.90 m).

- Calculate the tension at the bottom when the speed is 6.0 m/s. (2 marks)
- Calculate the minimum speed at the top. (1 mark)

Question 6 Banked road (3 marks)

A road bend of radius 150 m is banked at 8.0° to the horizontal.

- State which force provides the centripetal force at the design speed. (1 mark)
- Calculate the design speed at which no sideways friction is needed. (2 marks)

Question 7 Mud from a tyre (2 marks)

Mud flies off a spinning tyre in a straight line. A student says a centrifugal force throws it outward. Explain what really happens.

Question 8 Scaling (2 marks)

A car rounds a bend at speed v . Without calculating, state by what factor the friction needed changes if:

- the speed is doubled on the same bend; (1 mark)
- the radius is halved at the same speed. (1 mark)