

Rotational inertia and Newton's second law

AP Physics 1 (algebra-based) · Test

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

This test covers rotational inertia, torque and Newton's second law for rotation, including a pulley problem. Show your working, give units and state any assumptions. A calculator is allowed.

Level: AP Physics 1 (algebra-based) · **Curriculum:** AP P1 Unit 5

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

Question 1 Definition (2 marks)

- Define rotational inertia. (1 mark)
- State two factors that determine the rotational inertia of a rigid object. (1 mark)

Question 2 Three point masses (3 marks)

Masses of 0.20 kg, 0.30 kg and 0.50 kg are at 0.10 m, 0.20 m and 0.40 m from an axis.

- Calculate the total rotational inertia. (2 marks)
- State which mass contributes most and explain why. (1 mark)

Question 3 Wheel on an axle (2 marks)

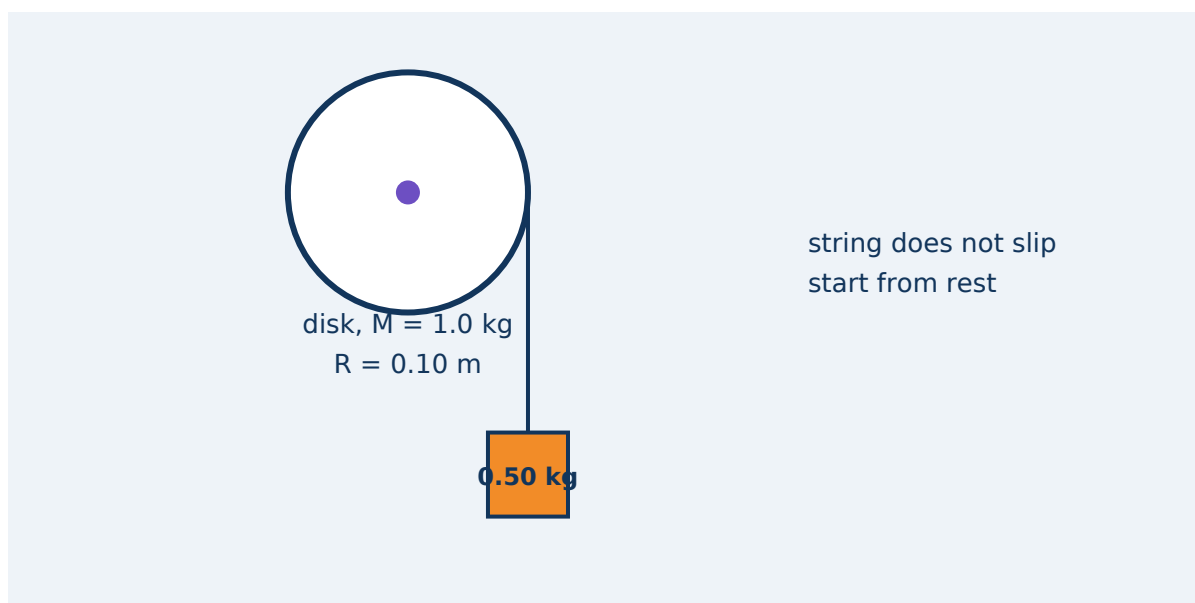
A tangential force of 12 N acts at the rim of a wheel of radius 0.30 m and rotational inertia 0.25 kg m².

- Calculate the torque. (1 mark)
- Calculate the angular acceleration. (1 mark)

Question 4 Pulley and hanging mass (3 marks)

A 0.50 kg mass hangs from a string wound on the solid disk shown (mass 1.0 kg, radius 0.10 m).

- Calculate the acceleration of the mass. (2 marks)
- Calculate the tension in the string. (1 mark)



The mass is released from rest.

Question 5 Swinging a bat (3 marks)

Explain why a bat is harder to swing when held at the very end than when it is held with the hands close to the heavy part. Refer to Newton's second law for rotation in your answer. (3 marks)

Question 6 Pushing a door (2 marks)

A 30 N force is applied to a door at a distance of 0.80 m from the hinges, at 60° to the plane of the door.

- State the formula for the torque and substitute the values. (1 mark)
- Calculate the torque. (1 mark)

Question 7 Accelerating a wheel (3 marks)

A constant net torque of 0.60 N m acts on a wheel at rest. After 5.0 s it spins at 30 rad/s.

- Calculate the angular acceleration. (1 mark)
- Calculate the rotational inertia. (1 mark)
- Calculate the angle turned in the 5.0 s. (1 mark)

Question 8 Hoop or disk (2 marks)

A hoop and a disk have the same mass and radius, and the same torque is applied to each. State which has the greater angular acceleration and calculate how many times greater it is. (2 marks)