

Forces, friction and motion on slopes

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

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

This test covers Newton's second law with friction, inclined planes, connected bodies and lifts. Use a calculator, draw a free-body diagram wherever it helps and give units with every answer. Take $g = 9.81 \text{ N/kg}$. The test is worth 20 marks.

Level: Physics grades 11-12 (A Level · IB · Class 11-12) · **Curriculum:** IB A.2

Time: 40 minutes · 8 questions · Total: 20 marks · Calculator allowed

Question 1 Newton's second law (1 mark)

State Newton's second law in symbols and define each symbol. (1 mark)

Question 2 Friction and direction (2 marks)

A box is pushed along the floor. State the direction of the friction on the box and explain why the static friction on a box that does not move is smaller than the maximum possible friction. (2 marks)

Question 3 Pushed crate (3 marks)

A 30 kg crate is pushed along a level floor with a force of 150 N. The coefficient of kinetic friction is 0.25.

- Calculate the friction force. (1 mark)
- Calculate the acceleration of the crate. (2 marks)

Question 4 Block on a slope (4 marks)

A 6.0 kg block slides down the rough slope shown. The coefficient of kinetic friction is 0.30.

- Calculate the component of the weight along the slope. (1 mark)
- Calculate the normal reaction. (1 mark)
- Calculate the friction force. (1 mark)
- Calculate the acceleration. (1 mark)



A block on a 35° slope.

Question 5 Joined trolleys (3 marks)

A 4.0 kg trolley and a 1.0 kg trolley are joined by a light string on a smooth surface. A horizontal force of 15 N pulls the 4.0 kg trolley.

- Calculate the acceleration of the trolleys. (1 mark)
- Calculate the tension in the string. (1 mark)
- Explain why both trolleys have the same acceleration. (1 mark)

Question 6 Lift passenger (3 marks)

A passenger of mass 60 kg stands on a scale in a lift that accelerates downwards at 2.0 m/s^2 .

- Calculate the scale reading. (2 marks)
- State the scale reading when the lift moves at constant velocity. (1 mark)

Question 7 Static and kinetic (2 marks)

A car skids further when the wheels lock than when the driver applies the brakes gradually without locking. Explain this using static and kinetic friction. (2 marks)

Question 8 Normal reaction on a slope (2 marks)

Explain why the normal reaction on a block on a slope is less than its weight. (2 marks)