S4 Physics Practice Paper: Uniformly Accelerated Motion and v-t Graphs, Newton's Laws and Friction, Work and Power, Conservation of Momentum and Collisions, Pressure and Upthrust, Specific Heat Capacity and Heating

S4 Physics | 100 marks | 75 minutes

Question 1 Uniformly Accelerated Motion and v-t Graphs

Answer all parts. Show the formula and the steps of calculation.

A car starts from rest and accelerates uniformly at 2.0 m/s² for 8.0 s. Find its final velocity. *(4 marks)*

Find the distance travelled during the acceleration stage. *(4 marks)*

The car then travels at a constant 16 m/s for 10 s and finally decelerates uniformly to rest in 4 s. Find the distance travelled during the deceleration stage. *(3 marks)*

Find the total distance and the average speed for the whole journey. *(5 marks)*

Question 2 Newton's Laws and Friction

Take g = 9.8 m/s².

A block of mass 5.0 kg rests on a horizontal table. Find its weight and the normal force from the table. *(4 marks)*

The coefficient of kinetic friction between the block and the table is 0.35. Find the friction acting on the sliding block. *(4 marks)*

A horizontal force of 30 N is now applied to push the block. Find its acceleration. *(5 marks)*

Starting from rest, the block is pushed for 3.0 s. Find its velocity and displacement. *(5 marks)*

Question 3 Work, Energy and Power

Take g = 9.8 m/s².

A student of mass 60 kg climbs 5.0 m up a staircase in 12 s. Find the work done against gravity. *(4 marks)*

Find the average power of the student against gravity. *(4 marks)*

A lift of mass 1,500 kg rises 20 m at constant speed in 8.0 s. Find its output power. *(4 marks)*

If the efficiency of the lift system is 70%, find its input power. *(4 marks)*

Question 4 Conservation of Momentum and Collisions

All collisions take place on a horizontal frictionless track.

A trolley of mass 2.0 kg moving at 3.0 m/s collides with a stationary trolley of mass 1.0 kg. Find the total momentum before the collision. *(4 marks)*

After the collision the two trolleys move together. Find their common velocity. *(5 marks)*

Find the total kinetic energy before and after the collision, and the kinetic energy lost. *(5 marks)*

If the stationary trolley has a mass of 4.0 kg instead, find the common velocity and the kinetic energy lost. *(4 marks)*

Question 5 Pressure and Upthrust

The density of water is 1,000 kg/m³. Take g = 9.8 m/s².

A cubical wooden block of side 0.20 m has a density of 600 kg/m³. Find its volume, mass and weight. *(5 marks)*

The block floats in equilibrium on water. Find the upthrust and the volume of water displaced. *(5 marks)*

Find the depth of the block that is submerged. *(3 marks)*

What mass must be placed on the block so that it is just completely submerged? *(3 marks)*

Question 6 Specific Heat Capacity and Heating Calculations

The specific heat capacity of water is 4,200 J kg⁻¹ K⁻¹.

An electric heater of power 1,500 W heats 2.0 kg of water for 300 s. Find the energy supplied. *(4 marks)*

Neglecting heat loss, find the rise in temperature of the water. *(4 marks)*

If 20% of the energy is actually lost to the surroundings, find the rise in temperature. *(4 marks)*

If the heater efficiency is 70%, how long does it take to raise the temperature of 2.0 kg of water by 30 °C? *(4 marks)*