S4 Physics Practice Paper

S4 | Physics | Time: 75 minutes | Total: 100 marks | 24 questions

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Part 1: Kinematics and Newton's Laws (18 marks)

Show the formula, the substitution and the unit in every answer. Take g = 10 m/s2.

1. A car starts from rest and accelerates uniformly at 2.5 m/s2 for 8 s. Find (a) its speed after 8 s, and (b) the distance it travels in 8 s.

2. A car travelling at 20 m/s decelerates uniformly at 5 m/s2 until it stops. Find the braking time and the braking distance, and explain why the real braking distance is usually longer than the calculated value.

3. A car of mass 1,200 kg accelerates at 1.5 m/s2. If the resistive force is 400 N, find (a) the net force on the car, and (b) the driving force produced by the engine.

4. Two forces of 6 N and 8 N act at the same point and are perpendicular to each other. Find (a) the magnitude of the resultant, and (b) the angle between the resultant and the 8 N force.

Part 2: Momentum, Moments and Pressure (17 marks)

Take the initial direction of motion as positive; for collisions state both momentum conservation and the change in energy.

5. A ball of mass 0.5 kg hits a wall at 8 m/s and rebounds at 6 m/s along the same line. If the contact time is 0.05 s, find (a) the change in momentum of the ball, and (b) the average force exerted by the wall on the ball.

6. A 2 kg object moving at 3 m/s collides with a stationary 1 kg object and they stick together. Find (a) their common velocity, and (b) the kinetic energy before and after the collision, and explain where the energy goes.

7. A 30 kg child sits 1.6 m from the pivot on one side of a see-saw. How far from the pivot on the other side must a 40 kg adult sit to balance it?

8. A person weighing 600 N stands on both feet with a total contact area of 0.03 m2. Find (a) the pressure on the ground, and (b) the water pressure on him at a depth of 2.5 m (water density 1,000 kg/m3, g = 10 m/s2).

Part 3: Work, Energy and Power (17 marks)

In energy conservation questions state which form of energy changes into which. Ignore air resistance.

9. A student of mass 50 kg runs up a staircase of height 12 m in 20 s. Find (a) the work done against gravity, and (b) the average power output.

10. A ball of mass 0.2 kg moves at 15 m/s. Find its kinetic energy, and state how many times larger the kinetic energy becomes if its speed doubles.

11. A motor with an input power of 1,500 W lifts a 40 kg load at a steady speed of 1.2 m/s. Find (a) the useful power output, and (b) the efficiency of the motor.

12. A 0.5 kg object falls freely from a height of 1.8 m. Find its speed when it reaches the ground and state which conservation law you used.

Part 4: Waves and Optics (16 marks)

For refraction and lens questions take the speed of light in air as c = 3.0 x 10^8 m/s and the speed of sound as 340 m/s.

13. A source emits sound of frequency 680 Hz; the speed of sound in air is 340 m/s. Find (a) the wavelength, and (b) the new wavelength if the frequency doubles while the speed stays the same.

14. Light passes from air into a medium at an angle of incidence of 45° and is refracted at 30°. Find (a) the refractive index of the medium, and (b) the speed of light in the medium.

15. A convex lens has a focal length of 10 cm and an object is placed 15 cm in front of it. Find (a) the image distance, and (b) the magnification, and state whether the image is real or virtual.

16. A person shouts towards a cliff and hears the echo 0.6 s later. If the speed of sound is 340 m/s, find the distance to the cliff.

Part 5: Heat and Gases (16 marks)

Take the specific heat capacity of water as 4,200 J/(kg °C) and the latent heat of fusion of ice as 334,000 J/kg; assume no heat loss.

17. 2 kg of water is heated from 25 °C to 75 °C. Find the heat required and explain why more energy is needed in practice.

18. 0.3 kg of water at 90 °C is added to 0.6 kg of water at 20 °C. Assuming no heat loss, find the final temperature.

19. A fixed mass of gas at 100 kPa, 2 L and 300 K is compressed to 250 kPa and 1 L. Find the final temperature in K and state which gas law you used.

20. A 500 W heater melts 0.5 kg of ice at 0 °C. Find (a) the energy needed to melt the ice, and (b) the time taken to melt it completely.

Part 6: Electricity and Circuits (16 marks)

Assume the internal resistance of the supply and the resistance of connecting wires are negligible, and take the power factor as 1.

21. A resistor is connected to a 12 V supply and carries a current of 0.4 A. Find its resistance and the energy it dissipates in 1 minute.

22. Resistors of 6 ohm and 9 ohm are connected in series across a 12 V supply. Find (a) the current in the circuit, and (b) the voltage across the 9 ohm resistor.

23. Resistors of 6 ohm and 12 ohm are connected in parallel across a 12 V supply. Find (a) the equivalent resistance, and (b) the total current from the supply.

24. An electric kettle rated 1,500 W at 240 V is used on a 240 V supply for 5 minutes. Find (a) the current, (b) the resistance of the heating element, and (c) the energy used in kWh.
