S5 Physics Practice Paper: Kinematics, Forces, Energy, Momentum, Waves and Electricity

S5 Physics | Time allowed: 90 minutes | Total: 100 marks | 24 questions

A. Kinematics (18 marks)

In the following questions air resistance is negligible and g = 10 m s^{-2}.

1. A car accelerates uniformly from rest to 20 m s^{-1} in 8 s. Find its acceleration. (3 marks)

2. For the same car, find the distance travelled in these 8 s. (4 marks)

3. A stone is dropped from rest at a height of 45 m. Find the time it takes to reach the ground. (5 marks)

4. For the same stone, find its speed on landing and explain why the answer does not depend on its mass. (6 marks)

B. Forces and Motion (17 marks)

Take g = 10 m s^{-2}.

5. A 4 kg block rests on a rough horizontal table. The coefficient of friction is 0.25. Find the friction acting on the block. (4 marks)

6. A horizontal force of 18 N now pulls the block. Find its acceleration. (4 marks)

7. The same block is placed on a smooth incline of 30°. Find its acceleration down the slope. (4 marks)

8. For the block on the incline, find the normal force from the slope and state its reaction pair. (5 marks)

C. Work, Energy and Power (16 marks)

Take g = 10 m s^{-2}.

9. A force of 60 N at 30° above the horizontal pulls a sledge 5 m along level ground. Find the work done by the force. (4 marks)

10. 20 kg of water is lifted through 1.5 m in 5 s. Find the power delivered. (4 marks)

11. A 1200 kg car travels at 72 km/h. Find its kinetic energy. (4 marks)

12. The car brakes to a stop and all its kinetic energy becomes heat. If the average resistance is 6000 N, find the braking distance. (4 marks)

D. Momentum and Collisions (16 marks)

Take the direction away from the wall as positive.

13. A 0.4 kg ball hits a wall at 6 m s^{-1} and rebounds at 4 m s^{-1}. Find its change in momentum. (4 marks)

14. A 2 kg toy car at 3 m s^{-1} hits a stationary 1 kg toy car and they stick together. Find the common velocity. (4 marks)

15. For the collision above, find the kinetic energy lost. (4 marks)

16. Explain why momentum is conserved in this collision but kinetic energy is not. (4 marks)

E. Waves and Light (17 marks)

Take the speed of sound in air as 340 m s^{-1} and the speed of light in vacuum as 3.0×10^8 m s^{-1}.

17. A sound wave of frequency 170 Hz travels at 340 m s^{-1} in air. Find its wavelength. (5 marks)

18. Light in air strikes glass (refractive index 1.5) at an angle of incidence of 45°. Find the angle of refraction. (4 marks)

19. For the light entering the glass, how do its speed and wavelength change, and does its frequency change? (4 marks)

20. State the two conditions for total internal reflection. (4 marks)

F. Circuits and Electricity Cost (16 marks)

The circuits below use a 12 V battery of negligible internal resistance.

21. A 6 Ω resistor and a 3 Ω resistor are connected in parallel. Find the equivalent resistance. (4 marks)

22. A 4 Ω resistor is now in series with that parallel combination, across the 12 V battery. Find the total current. (4 marks)

23. Find the power delivered by the battery and the power dissipated in the 4 Ω resistor. (4 marks)

24. A 2000 W water heater is used 3 hours a day for 30 days. If electricity costs $1.2 per kWh, find the total cost. (4 marks)