S5 Physics Practice Paper: Newton's Laws and Friction, Momentum and Collisions, Circular Motion and Gravitation, Work and Energy Conservation, Wave Speed and Wave Properties, Refraction, Total Internal Reflection and Lenses (100 marks)

Level: S5 | Subject: Physics | 75 minutes | 100 marks | 24 questions | question paper

Section A: Newton's Laws and Friction (17 marks)

Each question is worth 4-5 marks; show the formula used and the substitution.

#	Question	Marks
1	A car of mass 1,200 kg starts from rest on a level road under a net force of 4,800 N. Find (a) the acceleration, (b) the speed after 5.0 s, (c) the distance travelled in the first 5.0 s.	4
2	A 5.0 kg block rests on a horizontal table; the coefficient of kinetic friction is 0.30. A horizontal push of 30 N is applied (g = 9.81 m/s2). Find (a) the friction, (b) the acceleration of the block.	4
3	In the set-up shown, a 12 kg block on a horizontal table (kinetic friction 0.20) is joined by a light string over a smooth pulley to an 8.0 kg hanging mass. Find (a) the acceleration of the system, (b) the tension (g = 9.81 m/s2).	5
4	A 70 kg person stands on a scale inside a lift. Find the reading when (a) the lift accelerates upwards at 2.0 m/s2, (b) the lift moves upwards at constant speed (g = 9.81 m/s2).	4

Section B: Momentum and Collisions (17 marks)

Each question is worth 4-5 marks; take rightwards as positive; use kg m/s for momentum.

#	Question	Marks
5	A 0.45 kg ball hits a wall normally at 8.0 m/s and rebounds at 6.0 m/s. The contact time is 0.050 s. Find (a) the change in momentum, (b) the average force on the ball.	4
6	A 3.0 kg trolley moving at 4.0 m/s collides with a stationary 2.0 kg trolley and they stick together. Find (a) the common speed, (b) the kinetic energy lost.	5
7	A 2.0 kg ball moving at 6.0 m/s makes a head-on elastic collision with a stationary 4.0 kg ball. Find their velocities after the collision.	4
8	A 4.0 kg rifle fires a 0.020 kg bullet horizontally at 400 m/s. Find (a) the momentum of the bullet, (b) the recoil speed of the rifle.	4

Section C: Circular Motion and Gravitation (17 marks)

Each question is worth 4-5 marks; give answers to a sensible number of significant figures.

#	Question	Marks
9	A car takes a flat bend of radius 50 m at 20 m/s. Find (a) the centripetal acceleration, (b) the minimum coefficient of friction needed (g = 9.81 m/s2).	4
10	A satellite orbits the Earth in a circle of radius 7.0 x 10^6 m from the Earth centre (mass 5.97 x 10^24 kg, G = 6.674 x 10^-11). Find (a) the orbital speed, (b) the period in minutes.	5
11	A 0.50 kg ball on a 0.80 m string moves in a horizontal circle at 120 revolutions per minute. Find (a) the angular speed, (b) the linear speed, (c) the centripetal acceleration.	4

12	The gravitational field strength on a planet surface is 9.81 m/s2. A second planet has the same mass but twice the radius. Find (a) its surface field strength, (b) the weight of a 60 kg person there.	4

Section D: Work, Energy and Power (17 marks)

Each question is worth 4-5 marks; state the energy conservation you use.

#	Question	Marks
13	A force of 120 N is applied to a crate at 30 degrees above the horizontal and the crate moves 8.0 m along the floor. Find the work done by the force.	4
14	A 400 kg roller-coaster car descends from rest at a height of 25 m to a height of 5.0 m, friction being negligible. Find (a) its speed at the lower point, (b) its kinetic energy there (g = 9.81 m/s2).	5
15	A pump raises 1,200 kg of water through 15 m every minute. If the efficiency is 0.75, find (a) the useful output power, (b) the input power (g = 9.81 m/s2).	4
16	A spring of stiffness 800 N/m is compressed by 0.15 m and released to push a 0.50 kg ball, friction being negligible. Find (a) the energy stored, (b) the speed of the ball leaving the spring.	4

Section E: Wave Properties (16 marks)

Each question is worth 4 marks; write down the formula used.

#	Question	Marks
17	A wave has frequency 250 Hz and wavelength 1.36 m. Find its speed.	4
18	A string of length 0.80 m is fixed at both ends, under a tension of 120 N, with linear density 0.030 kg/m. Find (a) the wave speed on the string, (b) the fundamental frequency.	4
19	In a ripple-tank experiment, 12 wave crests pass a fixed point in 3.0 s and adjacent crests are 0.06 m apart. Find (a) the frequency, (b) the period, (c) the wave speed.	4
20	(a) Thunder is heard 3.5 s after lightning is seen; find the distance to the strike (speed of sound 340 m/s). (b) Ultrasound of frequency 2.0 MHz has a wavelength of 0.77 mm in tissue; find its speed.	4

Section F: Refraction, Total Internal Reflection and Lenses (16 marks)

Each question is worth 4 marks; give angles in degrees to one decimal place.

#	Question	Marks
21	A ray of light travels from air into glass of refractive index 1.50 at an angle of incidence of 40 degrees. Find the angle of refraction.	4
22	Find the critical angle for light travelling from glass of refractive index 1.50 into air, and state what happens when the angle of incidence exceeds it.	4
23	A convex lens of focal length 12 cm has an object 18 cm in front of it. Find (a) the image distance, (b) the magnification, (c) the nature of the image.	4
24	A concave lens of focal length 15 cm has an object 30 cm in front of it. Find (a) the image distance, (b) the magnification, (c) the nature of the image.	4