S4 Science Practice Paper: Density and Buoyancy, Pressure and Hydraulic Systems, Ohm's Law and Series/Parallel Circuits, Speed and Acceleration, Heat Capacity and Latent Heat, Refraction and Acid-Base Neutralisation (100 marks)

Level: S4 | Subject: Science | 60 minutes | 100 marks | 24 questions | question paper

Section A: Density, Buoyancy and Pressure (17 marks)

Each question is worth 4-5 marks; state the formula and the unit.

#	Question	Marks
1	A metal block has a mass of 270 g and a volume of 100 cm3. (a) Find its density in g/cm3 and in kg/m3. (b) Water has a density of 1.00 g/cm3; will the block float or sink in water? Explain.	5
2	A wooden cuboid measures 20 cm by 10 cm by 5 cm and has a mass of 900 g. (a) Find its density. (b) The cuboid is placed in water; find the percentage of its total volume that floats above the surface.	4
3	A student weighs 300 N and stands on both feet with a total contact area of 0.05 m2. (a) Find the pressure he exerts on the ground. (b) If he stands on one foot so that the contact area is halved, what is the new pressure?	4
4	An object of volume 200 cm3 is completely immersed in water (density 1000 kg/m3, g = 10 N/kg). (a) Find the upthrust on the object. (b) The object weighs 5.0 N in air; find its apparent weight in water.	4

Section B: Pressure Transmission and Hydraulic Systems (16 marks)

Each question is worth 4 marks; take g = 10 N/kg.

#	Question	Marks
5	A hydraulic system has a small piston of area 5 cm2 and a large piston of area 200 cm2. A force of 50 N is applied to the small piston. (a) Find the pressure in the liquid. (b) Find the force the large piston can lift. (c) Find the mechanical advantage of the system.	4
6	A water tank holds water 3.0 m deep and the surface is at atmospheric pressure of 101 kPa (water density 1000 kg/m3, g = 10 N/kg). (a) Find the water pressure at the bottom of the tank. (b) Find the total pressure at the bottom.	4
7	In a hydraulic jack the ratio of the small piston area to the large piston area is 1 : 25. What force must be applied to the small piston to lift a car weighing 5000 N?	4
8	A gas in a sealed cylinder occupies 200 cm3 at 100 kPa. The gas is compressed to 80 cm3 at constant temperature. Find the new pressure.	4

Section C: Circuits, Ohm's Law and Energy Cost (18 marks)

Each question is worth 4-5 marks; show your working.

#	Question	Marks
9	A 6 V battery is connected in series with a 4 ohm and an 8 ohm resistor. (a) Find the current. (b) Find the voltage across each resistor. (c) Find the power delivered by the battery.	5

10	A 12 V supply is connected across a 6 ohm and a 4 ohm resistor in parallel. (a) Find the current in each branch. (b) Find the total current. (c) Find the equivalent resistance.	5
11	A 2000 W heater runs continuously for 3 hours. Electricity costs 1.2 dollars per kWh. (a) Find the energy used in kWh. (b) Find the cost.	4
12	The current through a resistor is 0.3 A when the voltage across it is 2.4 V. (a) Find the resistance. (b) If the voltage rises to 4.8 V, find the current at constant temperature.	4

Section D: Speed, Acceleration and Motion Graphs (17 marks)

Each question is worth 4-5 marks; give units in every answer.

#	Question	Marks
13	A runner covers 120 m in 20 s. (a) Find her average speed in m/s. (b) Express it in km/h.	4
14	A car accelerates uniformly from rest at 2 m/s2 for 5 s, then travels at constant speed for a further 4 s. (a) Find the speed after 5 s. (b) Find the distance covered while accelerating. (c) Find the total distance.	5
15	A car travelling at 20 m/s brakes and decelerates uniformly to rest in 8 s. (a) Find the acceleration. (b) Find the braking distance.	4
16	A car travels 60 km at 30 km/h and then another 60 km at 60 km/h. Find the average speed for the whole journey.	4

Section E: Heat Capacity, Latent Heat and Energy (16 marks)

Each question is worth 4 marks; take the specific heat capacity of water as 4200 J/(kg C).

#	Question	Marks
17	2 kg of water is heated from 20 C to 45 C. The specific heat capacity of water is 4200 J/(kg C). Find the energy required.	4
18	0.5 kg of ice at 0 C is melted completely into water at 0 C; the specific latent heat of fusion is 334000 J/kg. (a) Find the energy needed. (b) How long does a 500 W heater take?	4
19	1 kg of water at 80 C is mixed with 1 kg of water at 20 C with no heat loss. Find the final temperature.	4
20	A 1500 W kettle heats 1.5 kg of water from 20 C to 60 C (specific heat capacity 4200 J/(kg C)). (a) Find the energy needed. (b) Find the heating time, ignoring heat loss.	4

Section F: Refraction, Critical Angle and Neutralisation (16 marks)

Each question is worth 4 marks; the molar mass of NaCl is 58.5 g/mol.

#	Question	Marks
21	A ray of light passes from air into a transparent medium at an angle of incidence of 45 degrees and is refracted at 30 degrees. (a) Find the refractive index. (b) Find the speed of light in the medium (speed in vacuum 3.0 x 10^8 m/s).	4
22	A glass has a refractive index of 1.5 and light travels from the glass into air. (a) Find the critical angle. (b) What happens at an angle of incidence of 45 degrees?	4
23	25.0 cm3 of 0.10 M hydrochloric acid is titrated with 0.10 M sodium hydroxide. (a) Find the volume of sodium hydroxide needed. (b) Find the number of moles of sodium chloride formed. (c) Find its mass (molar mass 58.5 g/mol).	4

24	10 cm3 of 0.10 M hydrochloric acid is diluted with water to 1000 cm3. (a) Find the hydrogen ion concentration. (b) Find the pH.	4