S3 Integrated Science Practice Paper with Answers

Integrated Science · S3 · Data and explanation

Simulated-data S3 science paper on density, circuits and Ohm law, heating water and efficiency, reflection and lenses, food chains, pressure and power, with full answers.

Part 1: Density and floating

Data A (simulated): a metal block has a mass of 270 g and a volume of 100 cm3; the density of water is 1.0 g/cm3. Study the data and answer all parts.

#	Question
1	Calculate the density of the metal in g/cm3.
2	What is the mass of 500 cm3 of the same metal?
3	Will the metal float or sink in water? Estimate the volume of 1000 g of the metal to one decimal place.
4	Steel is about eight times as dense as water, yet steel ships float. Explain this in terms of average density.

Part 2: Series circuits and Ohm law

Data B (simulated): a 12 ohm resistor is connected to a 6.0 V supply and a current flows for 5 minutes. Study the data and answer all parts.

#	Question
5	Calculate the current through the resistor.
6	Calculate the power of the resistor.
7	Calculate the energy used by the resistor in 5 minutes in joules.
8	If two identical 12 ohm resistors are joined in series across the same supply, what are the total resistance, the current and the power of each resistor?

Part 3: Heating water and efficiency

Data C (simulated): 0.50 kg of water is heated from 22 degrees to 78 degrees; the specific heat capacity of water is 4200 J/(kg K); the heater has a power of 500 W and the energy supplied is 150,000 J. Study the data and answer all parts.

#	Question
9	Calculate the energy gained by the water in kJ.
10	Assuming no heat loss, how many seconds are needed? About how many minutes to one decimal place?
11	Calculate the energy efficiency of the heating process.
12	Covering the beaker during heating raises the efficiency. Give two reasons.

Part 4: Reflection, refraction and convex lenses

Data D (simulated): a ray hits a plane mirror at an angle of incidence of 35 degrees; another ray enters glass of refractive index 1.50 from air at 40 degrees; an object is placed 15 cm in front of a convex lens of focal length 10 cm. Study the data and answer all parts.

#	Question
13	State the angle of reflection and calculate the angle between the reflected ray and the mirror surface.
14	When light passes from air into glass, does the refracted ray bend towards or away from the normal? Calculate the angle of refraction to one decimal place.
15	Calculate the image distance and the magnification, and state whether the image is real or virtual.
16	A pencil placed slantwise in a glass of water looks bent at the surface when seen from the side. Explain this with refraction.

Part 5: Food chains and energy flow

Data E (simulated): in a grassland ecosystem the producers fix 50,000 kJ of energy, and 10 per cent of the energy passes from one trophic level to the next. Study the data and answer all parts.

#	Question
17	Calculate the energy obtained by the primary consumers.
18	Calculate the energy obtained at the fourth trophic level, that is by the tertiary consumers.
19	Calculate the efficiency of energy transfer from the primary to the secondary consumers, and explain why food chains seldom have more than five trophic levels.
20	List three ways in which energy is lost between trophic levels.

Part 6: Pressure, work and power

Data F (simulated): a box of weight 240 N rests on a floor with a contact area of 0.04 m2; a force of 120 N pulls it 5.0 m along the floor in 4.0 s, and 540 J of that work is useful. Study the data and answer all parts.

#	Question
21	Calculate the pressure the box exerts on the floor in kPa.
22	Calculate the work done by the pulling force.
23	Calculate the power of the pulling force.
24	Calculate the mechanical efficiency of the process and suggest one way to reduce the energy loss.