S3 Integrated Science Practice Paper | density and floating, circuits, photosynthesis, pH, pressure, heat

Junior Secondary Integrated Science

S3 Integrated Science practice paper with answers: density and floating, circuits, photosynthesis, pH, pressure and heat capacity.

Question 1 Density and floating

A wooden block has a mass of 24.0 g and a volume of 30 cm3. A metal block has a mass of 270 g and a volume of 100 cm3. Take the density of water as 1.00 g/cm3.

#	Question
1	(a) Find the density of the wooden block and state whether it floats or sinks in water.
2	(b) When the wooden block floats, what volume of it is under water, and what volume stays above water?
3	(c) Find the density of the metal block and explain why it sinks in water.
4	(d) The same block is placed in salt water of density 1.05 g/cm3. How does the submerged volume change? Explain.

Question 2 Series and parallel circuits

Two resistors of 6 ohm and 12 ohm are connected to a supply of 9 V.

#	Question
5	(a) The resistors are connected in series. Find the total resistance and the current.
6	(b) Find the power of each resistor in the series circuit and the total power supplied.
7	(c) The resistors are now connected in parallel. Find the total resistance and the current in each.
8	(d) With the same supply, how many times larger is the total power in parallel than in series? Explain.

Question 3 Photosynthesis and energy in food chains

Photosynthesis is 6CO2 + 6H2O -> C6H12O6 + 6O2. In a food chain the producers fix 200000 kJ, and only ten per cent of the energy passes to each higher trophic level.

#	Question
9	(a) Check that the numbers of carbon, hydrogen and oxygen atoms balance on both sides.
10	(b) Find the relative molecular mass of glucose (C = 12, H = 1, O = 16).
11	(c) Find the energy available to the tertiary consumer and the overall transfer efficiency.
12	(d) One pondweed releases 40 bubbles per minute at 10 cm from a lamp but only 10 at 20 cm. Predict the rate at 40 cm and explain.

Question 4 Neutralisation and pH

Hydrochloric acid of concentration 0.10 M is used to neutralise 25.0 cm3 of sodium hydroxide solution: HCl + NaOH -> NaCl + H2O.

#	Question
13	(a) Find the number of moles of HCl in 25.0 cm3 of 0.10 M acid.
14	(b) If the sodium hydroxide has a concentration of 0.2 M, what volume is needed to neutralise it?
15	(c) A solution of pH 2 is diluted a hundred times with water. What is the new pH?
16	(d) Write the ionic equation for the neutralisation, name the salt formed, and state the colour change of methyl orange at the end point.

Question 5 Pressure in solids and liquids

A student of weight 600 N stands with both feet on the floor, the total contact area being 0.02 m2. Take the density of water as 1000 kg/m3 and g as 10 m/s2.

#	Question
17	(a) What pressure does the student exert on the floor when standing on both feet?
18	(b) What is the pressure when the student stands on one foot only? Explain.
19	(c) Find the pressure due to the water alone at a depth of 1.5 m in a pool.
20	(d) What is the total pressure there if atmospheric pressure is 101000 Pa? Why must a diver rise slowly?

Question 6 Specific heat capacity and heat transfer

The specific heat capacity of water is 4200 J/(kg degC). Ignore heat losses.

#	Question
21	(a) How much energy is needed to heat 0.50 kg of water from 20 degC to 100 degC?
22	(b) A kettle rated at 2000 W heats the same amount of water. What is the shortest time needed?
23	(c) 0.20 kg of water at 90 degC is mixed with 0.30 kg of water at 20 degC. Find the final temperature.
24	(d) Give one example each of conduction, convection and radiation, and explain how a vacuum flask reduces all three.