# S2 Integrated Science Practice Paper 1 with Answers

**Science · S2 · Data-response**

S2 integrated science practice paper on heat transfer, circuits, sound and light, density, neutralisation and ecosystem energy flow, with full answers and mark scheme.

## 1. Heat transfer and specific heat capacity (16 marks)

*0.50 kg of water is heated from 20 °C to 50 °C. The specific heat capacity of water is 4200 J/(kg·K). The kettle is rated 1500 W; 70% of the energy heats the water and the rest is lost.*

| # | Question |
|---|---|
| **1** | Calculate the energy gained by the water, in kJ. |
| **2** | Calculate the time in seconds needed to heat the water to 50 °C. |
| **3** | The kettle loses 20 J each second. Find the energy lost in 5 minutes and its percentage of the energy gained by the water. |
| **4** | Explain why a metal spoon gets hot faster than a wooden spoon in hot water. |

## 2. Resistance, electrical power and running cost (16 marks)

*A 6 Ω and a 3 Ω resistor are connected to a 12 V supply. In another circuit a 100 W lamp is used 5 hours a day for 30 days; electricity costs $1.2 per kWh.*

| # | Question |
|---|---|
| **5** | Find the equivalent resistance of the two resistors in parallel. |
| **6** | In parallel, find the total current from the supply and the current through the 3 Ω resistor. |
| **7** | The two resistors are now in series; find the total resistance and the power delivered by the supply. |
| **8** | Calculate the energy used by the lamp over 30 days in kWh and the cost. |

## 3. Sound and reflection of light (17 marks)

*The echo of a sound is heard 1.5 s after it is made; the speed of sound in air is 340 m/s. A tuning fork of 170 Hz is sounded, and light falls on a plane mirror at 35° to the normal.*

| # | Question |
|---|---|
| **9** | Calculate the distance between the source and the reflecting surface. |
| **10** | Find the wavelength of the sound made by the tuning fork. |
| **11** | Find the angle of reflection and the angle between the incident and reflected rays. |
| **12** | Explain why astronauts on the surface of the Moon cannot talk to each other directly. |

## 4. Particle model, density and solutions (16 marks)

*A metal block has a mass of 240 g and a volume of 30 cm³. There is 200 g of salt solution containing 12% sodium chloride by mass; half of the water is then evaporated.*

| # | Question |
|---|---|
| **13** | Calculate the density of the metal. |
| **14** | Find the mass of sodium chloride and of water in the solution. |
| **15** | After half the water has evaporated, find the new percentage by mass of sodium chloride. |
| **16** | Use the particle model to explain why the temperature stays at 0 °C while ice melts. |

## 5. Neutralisation and dilution (18 marks)

*25.0 cm³ of 0.10 M sodium hydroxide is titrated with hydrochloric acid to the end point. A solution of pH 3 is diluted 100 times with water.*

| # | Question |
|---|---|
| **17** | Calculate the amount in moles of sodium hydroxide used. |
| **18** | Find the volume of 0.10 M hydrochloric acid needed to neutralise it. |
| **19** | If 0.050 M hydrochloric acid is used instead, find the volume needed. |
| **20** | Find the pH of the diluted solution and explain your answer. |

## 6. Ecosystems and energy flow (17 marks)

*In a grassland ecosystem the producers fix 20000 kJ of energy and 10% of the energy passes to each next trophic level. Water plants release 12 cm³ of oxygen per square metre per hour; the total leaf area is 0.5 m² with 8 hours of sunlight.*

| # | Question |
|---|---|
| **21** | Calculate the energy available to the primary, secondary and tertiary consumers in kJ. |
| **22** | Why does a food chain usually have no more than four or five trophic levels? |
| **23** | Calculate the total volume of oxygen produced during the sunny period. |
| **24** | Predict the effect on the producers and on the secondary consumers if primary consumers greatly decrease. |