S2 Science Practice Paper: Cells and Life, Substances and Mixtures, Force and Motion, Heat and Temperature, Electricity and Circuits, Earth and Resources

S2 | Science | Time: 60 minutes | Total: 100 marks | 24 questions

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Part A - Cells and Life (16 marks)

Show working in questions 1 and 2; answer questions 3 and 4 in full sentences.

1. A microscope has a 10x eyepiece and a 40x objective lens. Find the total magnification, and the image diameter of a cell whose real diameter is 0.05 mm. [5]

Answer: Answer: total magnification = 10 x 40 = 400; image diameter = 0.05 x 400 = 20 mm (2 cm). Marks: 2 for magnification, 3 for the image diameter.

2. One cell divides 4 times in a row. Find the number of cells produced, and state what this kind of division means for the growth of an organism. [4]

Answer: Answer: the number doubles each time, so after 4 divisions there are 2^4 = 16 cells. It allows an organism to grow, repair damaged tissue and replace worn-out cells. Marks: 2 for the number, 2 for the meaning.

3. Compare photosynthesis and respiration: in which part of the cell does each take place, which gas does each take in, and which gas does each release? [4]

Answer: Answer: photosynthesis happens in the chloroplast, taking in carbon dioxide and releasing oxygen; respiration happens mainly in the mitochondrion, taking in oxygen and releasing carbon dioxide. The gas exchanges are opposite, and by day photosynthesis is usually faster. Marks: 2 for the sites, 2 for the gases.

4. State the main function of each cell structure: (a) cell membrane, (b) nucleus, (c) cell wall, (d) vacuole. [3]

Answer: Answer: (a) controls what enters and leaves the cell; (b) stores genetic material and controls cell activities; (c) supports and protects a plant cell and is made of cellulose; (d) stores water, nutrients and wastes and keeps the cell firm. 1 mark each, 3 marks in total.

Part B - Substances and Mixtures (17 marks)

Show working in questions 1 to 3; in question 4 state the mass relationship before and after the reaction.

5. 20 g of salt is completely dissolved in 80 g of water. Find the mass percentage of the solution. [5]

Answer: Answer: total mass = 20 + 80 = 100 g; mass percentage = 20 / 100 x 100% = 20%. Marks: 2 for the total mass, 3 for the percentage.

6. Choose a suitable method to separate each mixture and state the principle: (a) sand and water, (b) salt from salt water, (c) nitrogen and oxygen in air, (d) iron powder and copper powder. [4]

Answer: Answer: (a) filtration, sand is insoluble and stays on the filter paper; (b) distillation, water vaporises and is condensed while the salt remains; (c) fractional distillation, using the different boiling points of liquid air; (d) a magnet attracts the iron powder. 1 mark each.

7. A stone has a mass of 78 g and a volume of 30 cm³. Find its density in g/cm³ and state whether it floats or sinks in water (density 1.0 g/cm³). [4]

Answer: Answer: density = mass / volume = 78 / 30 = 2.6 g/cm³; it is greater than 1.0 g/cm³, so the stone sinks. Marks: 3 for the density, 1 for the conclusion.

8. 12 g of carbon reacts completely with 32 g of oxygen to form only carbon dioxide. Find the mass of the product and name the law this supports. [4]

Answer: Answer: mass of carbon dioxide = 12 + 32 = 44 g; the total mass of the reactants equals that of the products, which supports the law of conservation of mass. Marks: 2 for the mass, 2 for the law.

Part C - Force and Motion (17 marks)

Show working with units in questions 1 to 3; answer question 4 in words.

9. Ming runs 120 m in 15 s. Find his average speed in m/s and convert it to km/h. [5]

Answer: Answer: speed = distance / time = 120 / 15 = 8 m/s; in km/h, 8 x 3.6 = 28.8 km/h. Marks: 3 for m/s, 2 for km/h.

10. A car travels 30 km at 60 km/h and then another 30 km at 40 km/h. Find the average speed for the whole trip and explain why it is not (60 + 40) / 2. [5]

Answer: Answer: first leg takes 30 / 60 = 0.5 h and the second 30 / 40 = 0.75 h; average speed = total distance / total time = 60 / 1.25 = 48 km/h. The two legs have equal distance but unequal time, and the slower leg takes longer, so the arithmetic mean is too high. Marks: 2 for the times, 2 for the average speed, 1 for the explanation.

11. A student has a mass of 45 kg. Taking g = 10 N/kg on Earth, find his weight; find it again on the Moon where g = 1.6 N/kg, and state whether his mass changes. [4]

Answer: Answer: weight on Earth = 45 x 10 = 450 N; on the Moon = 45 x 1.6 = 72 N. The mass does not change and is still 45 kg; only the weight changes with g. Marks: 1 for Earth, 2 for the Moon, 1 for the statement about mass.

12. The same wooden block is pushed across a rough desk and a smooth desk. In which case is friction larger? State two factors that affect the size of friction. [3]

Answer: Answer: friction is larger on the rough desk. Factors: the roughness of the surfaces and the normal force (weight) pressing them together; rougher surfaces and greater force give larger friction. Marks: 1 for the choice, 2 for the factors.

Part D - Heat and Temperature (17 marks)

Show working in questions 1 and 2; answer questions 3 and 4 in words.

13. 0.5 kg of water is heated from 20°C to 40°C. The specific heat capacity of water is 4200 J/(kg·°C). Find the heat absorbed in J and in kJ. [5]

Answer: Answer: temperature rise = 40 - 20 = 20°C; Q = mcΔT = 0.5 x 4200 x 20 = 42000 J = 42 kJ. Marks: 1 for the rise, 3 for the substitution, 1 for the units.

14. 200 g of water at 80°C is mixed with 300 g of water at 20°C. Assuming no heat loss, find the final temperature. [5]

Answer: Answer: using heat balance, the final temperature is (200 x 80 + 300 x 20) / 500 = 44°C. Marks: 3 for the equation, 2 for the answer.

15. Why does a metal handrail feel colder than a wooden one in winter? Explain using heat conduction. [3]

Answer: Answer: both are at the same temperature, but metal conducts heat away from the hand quickly so the skin cools faster and feels colder, while wood is an insulator and conducts slowly, so it feels warmer. Marks: 2 for conduction, 1 for the feeling.

16. Name the main mode of heat transfer in each case: (a) heat from the Sun reaching the Earth, (b) a metal spoon warming in hot soup, (c) an air conditioner cooling a whole room, (d) a fan heater blowing warm air. [4]

Answer: Answer: (a) radiation (it travels through a vacuum); (b) conduction (particles vibrate in a solid); (c) convection (cool air sinks and warm air rises in a loop); (d) convection (forced convection). 1 mark each.

Part E - Electricity and Circuits (17 marks)

Show working in questions 1 to 3; answer question 4 in words.

17. Resistors of 4 Ω and 6 Ω are connected in series to a 6 V supply. Find the total resistance, the current in A and the total power in W. [5]

Answer: Answer: total resistance = 4 + 6 = 10 Ω; I = V / R = 6 / 10 = 0.6 A; P = VI = 6 x 0.6 = 3.6 W. Marks: 1 for R, 2 for I, 2 for P.

18. Two 6 Ω resistors are connected in parallel to a 12 V supply. Find the equivalent resistance and the total current. [5]

Answer: Answer: 1/R = 1/6 + 1/6, so R = 3 Ω, which is smaller than either resistor; I = 12 / 3 = 4 A. Marks: 3 for R, 2 for I.

19. A 1500 W heater is used 2 hours a day for 30 days. Find the energy used in kWh and the total cost at $1.2 per kWh. [4]

Answer: Answer: power = 1500 W = 1.5 kW; energy = 1.5 x 2 x 30 = 90 kWh; cost = 90 x 1.2 = $108. Marks: 2 for kWh, 2 for the cost.

20. What is the function of a fuse in a circuit? Why are household appliances earthed? State one safety rule for using electricity. [3]

Answer: Answer: a fuse melts and breaks the circuit when the current is too large, preventing overheating and fire; the earth wire carries leakage current to the ground so the metal case does not give a shock; any sensible rule such as not using several high-power appliances on one socket. 1 mark each.

Part F - Earth and Resources (16 marks)

Answer questions 1, 2 and 4 in words; show working in question 3.

21. State three main processes in the water cycle and explain why it matters to living things. [4]

Answer: Answer: evaporation (water vaporises), condensation (vapour forms clouds) and precipitation (rain or snow falls); runoff and infiltration may also be given. It keeps supplying fresh water and sustains rivers, groundwater and ecosystems. 1 mark per process, 1 for the importance.

22. Give three non-renewable energy sources and two renewable ones, and state one limitation of renewable energy. [5]

Answer: Answer: non-renewable - coal, oil and natural gas (nuclear may be accepted); renewable - solar and wind (hydro or geothermal also accepted); limitation - output depends on weather and is variable, or the high set-up cost and land use. Marks: 4 for naming the sources, 1 for a sensible limitation.

23. A school uses 320 kWh a month, of which solar panels supply 40 kWh. Find the solar percentage, and the extra kWh needed each month to raise it to 25%. [4]

Answer: Answer: percentage = 40 / 320 x 100% = 12.5%; 25% of 320 kWh is 80 kWh, so 40 kWh more is needed. Marks: 2 for the percentage, 2 for the extra energy.

24. Classify each waste as recyclable or non-recyclable and give one way of handling it: (a) aluminium can, (b) used tissue, (c) glass bottle, (d) food waste. [3]

Answer: Answer: (a) recyclable - rinse, flatten and melt down; (b) not recyclable - for hygiene reasons, dispose of it; (c) recyclable - sort by colour, rinse and re-melt; (d) compost or digest anaerobically to make biogas. 1 mark each.
