S3 Science Practice Paper: Acids, Alkalis and Neutralisation, Forces and Pressure, Heat and Energy Transfer, Electricity and Magnetism, Reproduction and Genetics, Earth and Space

S3 | Science | Time: 75 minutes | Total: 100 marks | 24 questions

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Part A: Acids, Alkalis and Neutralisation (16 marks)

Show the working and the unit.

1. A solution has a hydrogen ion concentration of 1 x 10-3 mol/dm3. Find its pH. [4]

Answer: Answer: pH = 3 (pH = -log[H+], acidic).

2. 25.0 cm3 of 0.10 mol/dm3 sodium hydroxide is neutralised by 0.20 mol/dm3 hydrochloric acid. Find the volume of acid needed and the amount of water formed. [4]

Answer: Answer: V = 12.5 cm3; water formed = 0.0025 mol (1:1 ratio).

3. 50 g of water rises by 6.0 degC in a reaction. Find the heat released in J. [4]

Answer: Answer: 1260 J (Q = mcdT = 50 x 4.2 x 6.0).

4. 10.0 cm3 of 1.0 mol/dm3 hydrochloric acid is diluted with water to 250 cm3. Find the new concentration. [4]

Answer: Answer: 0.04 mol/dm3 (moles unchanged: 1.0 x 10.0 / 250).

Part B: Forces and Pressure (16 marks)

Write the formula and the unit.

5. A force of 600 N acts perpendicularly on an area of 0.02 m2. Find the pressure in Pa. [4]

Answer: Answer: 30000 Pa (P = F / A).

6. What is the liquid pressure at a depth of 2.5 m in water? (density of water 1000 kg/m3) [4]

Answer: Answer: 25000 Pa (p = gh = 1000 x 10 x 2.5).

7. A metal block has mass 540 g and volume 200 cm3. Find its density in g/cm3. [4]

Answer: Answer: 2.7 g/cm3 (density = mass / volume).

8. An object of volume 0.002 m3 is fully immersed in water. Find the upthrust in N. [4]

Answer: Answer: 20 N (upthrust = weight of water displaced = gV).

Part C: Heat and Energy Transfer (16 marks)

Show the formula; give answers to 3 significant figures.

9. 2 kg of water is heated from 20 degC to 80 degC. Find the energy needed in kJ. [4]

Answer: Answer: 504 kJ (Q = mcdT = 2 x 4200 x 60).

10. A 2000 W kettle raises 1.5 kg of water by 60 degC. Assuming no heat loss, find the time needed in s. [4]

Answer: Answer: 189 s (E = mcdT = 378000 J, t = E / P).

11. State the heat transfer methods for a metal rod and for rising hot water, with one everyday example each. [4]

Answer: Answer: metal rod = conduction (e.g. pan handle heating up); rising hot water = convection (e.g. air circulation in an air-conditioned room).

12. A heater takes in 5000 J and the water absorbs 3500 J. Find the efficiency in %. [4]

Answer: Answer: 70% (efficiency = useful output / total input x 100%).

Part D: Electricity and Magnetism (18 marks)

Write the formula; give units for current and voltage.

13. A 12 V supply is connected across a 4 ohm resistor. Find the current in A. [4]

Answer: Answer: 3 A (I = V / R).

14. A 6 ohm and a 3 ohm resistor are in series across 9 V. Find the total resistance, the current and the voltage across the 6 ohm resistor. [5]

Answer: Answer: R = 9 ohm; I = 1 A; V6 = 6 V.

15. An appliance draws 0.5 A at 220 V. Find its power in W and the energy used in 2 hours in kWh. [4]

Answer: Answer: P = 110 W; energy = 0.22 kWh.

16. Two 6 ohm resistors are connected in parallel across 12 V. Find the equivalent resistance and the total current in A. [5]

Answer: Answer: R = 3 ohm; I = 4 A (2 A in each branch).

Part E: Reproduction and Genetics (17 marks)

Use a Punnett square or ratios in genetics questions.

17. Two parents of genotype Aa mate. Find the percentage of offspring showing the dominant trait. [4]

Answer: Answer: 75% (AA : Aa : aa = 1 : 2 : 1, dominant = 3/4).

18. Human sex is determined by sex chromosomes. State the sex chromosome combination in male and female gametes and find the probability of a baby boy. [4]

Answer: Answer: male XY (sperm 50% X, 50% Y), female XX (all eggs X); probability of a boy = 50%.

19. One cell undergoes 4 successive mitotic divisions. How many cells are produced? [4]

Answer: Answer: 16 cells (the number doubles each time: 24).

20. Parents of genotype Bb and bb mate. Find the probability in % that two children are both Bb. [5]

Answer: Answer: 25% (each child 1/2 Bb; two children = 1/4).

Part F: Earth and Space (17 marks)

Give answers to 3 significant figures with units.

21. The lunar cycle is about 29.5 days. How many days are there in 4 complete cycles? [4]

Answer: Answer: 118 days (29.5 x 4).

22. A star is 4.2 light years away. Given 1 light year ~ 9.46 x 1012 km, find the distance in km in scientific notation. [4]

Answer: Answer: 3.97 x 1013 km (4.2 x 9.46 x 1012).

23. The Earth rotates once in 24 hours. Find the angle turned per hour in degrees. [4]

Answer: Answer: 15 degrees (360 / 24).

24. An astronaut of mass 60 kg stands on the Moon where g = 1.6 N/kg. Find the weight in N and state how the mass changes on the Moon. [5]

Answer: Answer: 96 N (W = mg); the mass is unchanged at 60 kg.
