S3 Physics Practice Paper: Electric Current and Circuits, Resistance and Ohm's Law, Electrical Power and Safety, Magnetism and Electromagnets, Energy Conversion and Sources

S3 | Physics | Time: 60 minutes | Total: 100 marks | 24 questions

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1. Electric current and circuits

Answer all questions. Show your working.

1. In 120 s, 60 C of charge passes through a cross-section of a wire. Find the current. [4]

Answer: I = Q / t = 60 / 120 = 0.5 A

2. Two lamps are connected in series to a battery. The current in the first lamp is 0.4 A. State the current in the second lamp and explain. [4]

Answer: 0.4 A. A series circuit has only one path, so charge does not accumulate anywhere and the current is the same everywhere.

3. In a parallel circuit the main current is 1.2 A and the current in one branch is 0.5 A. Find the current in the other branch. [4]

Answer: 1.2 - 0.5 = 0.7 A; the branch currents add up to the main current.

4. Three 1.5 V cells are connected in series. Find the total electromotive force and state how the e.m.f. values add up in series. [4]

Answer: Total e.m.f. = 1.5 x 3 = 4.5 V; in series the e.m.f. values are added.

2. Resistance and Ohm's law

Write down the formula and the values substituted.

5. A 12 ohm resistor carries a current of 0.5 A. Find the potential difference across it. [4]

Answer: V = I R = 0.5 x 12 = 6.0 V

6. Resistors of 6 ohm and 9 ohm are connected in series to a 3 V supply. Find the total resistance and the current. [4]

Answer: Total resistance = 6 + 9 = 15 ohm; I = V / R = 3 / 15 = 0.2 A

7. Resistors of 6 ohm and 3 ohm are connected in parallel. Find the total resistance. [5]

Answer: 1 / R = 1 / 6 + 1 / 3 = 1 / 2; R = 2.0 ohm

8. A wire has a resistance of 12 ohm. Its length is doubled while its cross-sectional area and material stay the same. Find the new resistance and state how resistance depends on length. [5]

Answer: New resistance = 12 x 2 = 24 ohm. With the same area and material, resistance is proportional to length, so doubling the length doubles the resistance.

3. Electrical power and energy

Use the values given in each question.

9. An appliance is connected to a 12 V supply and carries a current of 2 A. Find its power. [5]

Answer: P = V I = 12 x 2 = 24 W

10. A 60 W lamp is used for 5 hours. Find the energy used in kWh, and the cost if electricity costs 1.2 dollars per kWh. [5]

Answer: E = 60 x 5 / 1000 = 0.3 kWh; cost = 0.3 x 1.2 = 0.36 dollars

11. A 24 W lamp is switched on for 30 s. Find the energy used in J. [4]

Answer: E = P t = 24 x 30 = 720 J

12. A 2000 W kettle is connected to a 220 V supply. Find the operating current and state whether a 5 A or a 13 A fuse should be used. [4]

Answer: I = P / V = 2000 / 220 = 9.09 A, which is above 5 A and below 13 A, so a 13 A fuse is used.

4. Magnetism and electromagnets

Answer in complete sentences.

13. A current-carrying straight wire produces a magnetic field around it. What happens to the field direction if the current is reversed? [4]

Answer: The field direction is also reversed, while its strength stays the same.

14. The number of turns of an electromagnet coil is increased from 100 to 200 while the current stays the same. How does the field strength change? [4]

Answer: The field becomes stronger, about twice as strong, because the field strength increases with the number of turns.

15. Give two differences between an electromagnet and a permanent magnet. [4]

Answer: First, an electromagnet can be switched on and off while a permanent magnet cannot; second, the strength of an electromagnet can be adjusted by the current while that of a permanent magnet is fixed.

16. What is the function of the iron core inside the coil of an electromagnetic crane? [4]

Answer: The iron core is magnetised and greatly strengthens the field, so the electromagnet can lift heavier iron loads.

5. Energy conversion and energy sources

Express efficiency as a percentage.

17. A kettle takes in 100 J of electrical energy, of which 35 J becomes internal energy of the water. Find the efficiency. [4]

Answer: Efficiency = 35 / 100 x 100% = 35%

18. Which two energy conversions occur in a working lamp, and in what form is the unwanted energy lost? [4]

Answer: Electrical energy changes into light and thermal energy; the unwanted energy is lost as heat to the surroundings.

19. A solar panel receives 200 W of light and has an efficiency of 20%. Find the electrical output power. [4]

Answer: Output power = 200 x 0.20 = 40 W

20. Classify solar energy, coal, wind energy and natural gas as renewable or non-renewable. [4]

Answer: Renewable: solar energy and wind energy. Non-renewable: coal and natural gas.

6. Integrated problems

Write the formula, the substitution and the unit for each answer.

21. Resistors of 6 ohm and 12 ohm are connected in parallel to a 12 V supply. Find the power of each resistor. [4]

Answer: P1 = V^2 / R1 = 12^2 / 6 = 24 W; P2 = V^2 / R2 = 12^2 / 12 = 12 W

22. For the circuit above, find the current in each branch and the main current. [4]

Answer: I1 = 12 / 6 = 2 A; I2 = 12 / 12 = 1 A; main current = 2 + 1 = 3 A

23. A 1500 W heater runs for 240 s. Find the energy used in J. [4]

Answer: E = P t = 1500 x 240 = 360000 J

24. An appliance of 1.5 kW is used for 4 hours each day. If electricity costs 1.2 dollars per kWh, find the daily cost. [4]

Answer: E = 1.5 x 4 = 6 kWh; cost = 6 x 1.2 = 7.2 dollars
