CBSE CLASS X

Science (086)

QUESTION PAPER

AI-generated question paper

Code: IBDQC5	Questions: 31	Maximum Marks: 68	Generated: 2026-06-25 17:50

SELECTIONS USED

Subject	Science
Lessons	11 Electricity
Level of understanding	Exam-ready
Question selection	CBSE board paper, whole lesson (~80 marks across Sections A-E)
Model	claude-sonnet-4-6

Composition — Difficulty: 9 straightforward · 17 medium · 5 deep | Types: 10 MCQ · 6 Short · 5 Assertion–reason · 4 Very short · 3 Long · 3 Case-based | Sections: A 15Q/15m · B 4Q/8m · C 6Q/18m · D 3Q/15m · E 3Q/12m

Q1. straightforward exam-ready **[1]**

The potential difference across a conductor is doubled while its resistance remains unchanged. The current through it will:
(A) be halved
(B) remain the same
(C) be doubled
(D) become four times

A be halved
B remain the same
C be doubled
D become four times

◆ **Electricity**

Q2. straightforward exam-ready **[1]**

Which of the following correctly gives the SI unit of electrical resistivity?
(A) Ω
(B) $\Omega\ m^{-1}$
(C) Ω m
(D) $\Omega\ m^2$

A Ω
B $\Omega\ m^{-1}$
C Ω m
D $\Omega\ m^2$

◆ **Electricity**

Q3. medium exam-ready **[1]**

A wire of resistance R is stretched uniformly until its length is doubled. Its new resistance will be:
(A) R/2
(B) R
(C) 2R
(D) 4R

A R/2
B R
C 2R
D 4R

◆ **Electricity**

Q4. straightforward exam-ready **[1]**

Which term does NOT correctly represent electric power consumed in a circuit?
(A) I^2R
(B) IR^2
(C) V^2/R
(D) VI

A I^2R
B IR^2
C V^2/R
D VI

◆ **Electricity**

Q5. straightforward exam-ready **[1]**

The commercial unit of electrical energy, 1 kWh, is equal to:
(A) 1000 J
(B) 3.6×10^4 J
(C) 3.6×10^6 J
(D) 3.6×10^8 J

A 1000 J
B 3.6×10^3 J
C 3.6×10^6 J
D 3.6×10^4 J

◆ **Electricity**

Q6. medium exam-ready **[1]**

The heat produced in a conductor when current I flows through it for time t is $H = I^2Rt$. If the current is doubled and the time is halved, the heat produced will be:
(A) remain the same
(B) doubled
(C) halved
(D) quadrupled

A remain the same
B doubled
C halved
D quadrupled

◆ **Electricity**

Q7. medium exam-ready **[1]**

A 100 W electric bulb and a 40 W electric bulb are both designed for 220 V. Which bulb has higher resistance?
(A) The 100 W bulb
(B) The 40 W bulb
(C) Both have the same resistance
(D) Cannot be determined from given data

- A The 100 W bulb
- B The 40 W bulb
- C Both have the same resistance
- D Cannot be determined from given data

◆ **Electricity**

Q8. straightforward exam-ready **[1]**

The resistivity of a material depends on:
(A) the length of the conductor
(B) the area of cross-section of the conductor
(C) the nature of the material and temperature
(D) both the length and area of cross-section

- A the length of the conductor
- B the area of cross-section of the conductor
- C the nature of the material and temperature
- D both the length and area of cross-section

◆ **Electricity**

Q9. straightforward exam-ready **[1]**

The V–I graph for a metallic wire at constant temperature is a straight line passing through the origin. This is a graphical representation of:
(A) Joule's law of heating
(B) Ohm's law
(C) Kirchhoff's voltage law
(D) Faraday's law

- A Joule's law of heating
- B Ohm's law
- C Kirchhoff's voltage law
- D Faraday's law

◆ **Electricity**

Q10. medium exam-ready **[1]**

An electric motor operates at 220 V and draws a current of 5 A. The energy consumed by the motor in 1 hour is:
(A) 1100 J
(B) 3.96×10^3 J
(C) 3.96×10^6 J
(D) 3.96×10^4 J

- A 220 J
- B 1100 J
- C 3.96×10^6 J
- D 1100 W

◆ **Electricity**

Q11. medium exam-ready **[1]**

Assertion (A): Alloys are preferred over pure metals for making the heating elements of electric irons and toasters.
Reason (R): Alloys have higher resistivity and do not oxidise easily at high temperatures.
(A) Both A and R are true and R is the correct explanation of A.
(B) Both A and R are true but R is not the correct explanation of A.
(C) A is true but R is false.
(D) A is false but R is true.

- A Both A and R are true and R is the correct explanation of A.
- B Both A and R are true but R is not the correct explanation of A.
- C A is true but R is false.
- D A is false but R is true.

◆ **Electricity**

Q12. medium exam-ready **[1]**

Assertion (A): In a parallel combination of resistors, the equivalent resistance is always less than the smallest individual resistance in the combination.
Reason (R): Adding more parallel paths provides additional routes for current, effectively reducing total opposition to current flow.
(A) Both A and R are true and R is the correct explanation of A.
(B) Both A and R are true but R is not the correct explanation of A.
(C) A is true but R is false.
(D) A is false but R is true.

- A Both A and R are true and R is the correct explanation of A.
- B Both A and R are true but R is not the correct explanation of A.
- C A is true but R is false.
- D A is false but R is true.

◆ **Electricity**

Q13. straightforward exam-ready **[1]**

Assertion (A): Tungsten is used for making filaments of electric bulbs.
Reason (R): Tungsten has a very high melting point (3380°C) and high resistivity, which allows it to become incandescent without melting.
(A) Both A and R are true and R is the correct explanation of A.
(B) Both A and R are true but R is not the correct explanation of A.
(C) A is true but R is false.
(D) A is false but R is true.

- A Both A and R are true and R is the correct explanation of A.
- B Both A and R are true but R is not the correct explanation of A.
- C A is true but R is false.
- D A is false but R is true.

◆ **Electricity**

Q14. straightforward exam-ready **[1]**

Assertion (A): The direction of conventional electric current in a metallic conductor is taken opposite to the direction of flow of electrons.
Reason (R): Electrons were not known when the phenomenon of electricity was first studied, so current was assumed to flow from positive to negative terminal.
(A) Both A and R are true and R is the correct explanation of A.
(B) Both A and R are true but R is not the correct explanation of A.
(C) A is true but R is false.
(D) A is false but R is true.

A Both A and R are true and R is the correct explanation of A.
B Both A and R are true but R is not the correct explanation of A.
C A is true but R is false.
D A is false but R is true.

◆ **Electricity**

Q15. medium exam-ready **[1]**

Assertion (A): The cord (connecting wire) of an electric heater does not glow, but its heating element does.
Reason (R): The heating element has much higher resistance than the cord, so it dissipates far more heat for the same current.
(A) Both A and R are true and R is the correct explanation of A.
(B) Both A and R are true but R is not the correct explanation of A.
(C) A is true but R is false.
(D) A is false but R is true.

A Both A and R are true and R is the correct explanation of A.
B Both A and R are true but R is not the correct explanation of A.
C A is true but R is false.
D A is false but R is true.

◆ **Electricity**

Q16. straightforward exam-ready **[2]**

Define electric potential difference between two points in a circuit. Write the formula relating it to work done and charge.

◆ **Electricity**

Q17. medium exam-ready **[2]**

A nichrome wire of length 2 m and cross-sectional area 0.5 mm^2 has a resistance of 4 Ω. Calculate the resistivity of nichrome.

◆ **Electricity**

Q18. medium exam-ready **[2]**

An electric heater is rated 2 kW at 220 V. A fuse rated 5 A is installed in the circuit. Will the fuse operate safely? Justify your answer with a calculation.

◆ **Electricity**

Q19. deep exam-ready **[2]**

Two resistors of 6 Ω and 3 Ω are first connected in series and then in parallel across the same 12 V battery. Find the ratio of total power dissipated in the series arrangement to that in the parallel arrangement.

◆ **Electricity**

Q20. medium exam-ready **[3]**

Derive an expression for the equivalent resistance of three resistors R_1, R_2, and R_3 connected in series. Using this result, explain why the equivalent resistance in a series combination is always greater than any individual resistance in the combination.

◆ Electricity

Q21. medium exam-ready **[3]**

A battery of 15 V is connected to three resistors of 3 Ω, 4 Ω, and 8 Ω connected in parallel. Calculate: (a) the equivalent resistance of the combination, (b) the total current drawn from the battery, and (c) the current through the 8 Ω resistor.

◆ Electricity

Q22. medium exam-ready **[3]**

State Joule's law of heating. An electric iron of resistance 25 Ω is operated at 200 V for 30 minutes. Calculate the heat produced in the iron during this time.

◆ Electricity

Q23. medium exam-ready **[3]**

(a) State any two advantages of connecting electrical appliances in parallel rather than in series in a domestic circuit.
(b) Three identical bulbs are connected in parallel across a 12 V source and the total current drawn is 3 A. Calculate the resistance of each bulb.

◆ Electricity

Q24. deep exam-ready **[3]**

Two wires X and Y are made of the same material. Wire X has twice the length and half the cross-sectional area of wire Y. Compare the resistances of X and Y. If both are connected in series to a 6 V battery, what fraction of the total voltage appears across wire Y?

◆ Electricity

Q25. medium exam-ready **[3]**

(a) Define electric power and write its SI unit.
(b) A household uses the following appliances: one 1000 W electric iron for 2 hours, two 60 W fans for 5 hours, and one 100 W television for 4 hours every day. Calculate the total electrical energy consumed in one day in kWh.

◆ Electricity

Q26. deep exam-ready **[5]**

(i) Derive an expression for the equivalent resistance when three resistors R_1, R_2, and R_3 are connected in parallel. Mention one practical advantage of this combination over a series combination.
(ii) The resistivities of copper and nichrome are 1.62×10^{-8} Ω m and 100×10^{-6} Ω m respectively. Both wires have the same length and the same cross-sectional area. Calculate the ratio of resistance of nichrome wire to copper wire. Which material would you prefer for making the element of an electric toaster, and why?

◆ Electricity

Q27. deep exam-ready **[5]**

(i) State Joule's law of heating and derive the expression $H = I^2Rt$.
(ii) An electric kettle of resistance 44 Ω is rated for 220 V. Calculate: (a) the current through the kettle, (b) the power consumed, and (c) the heat generated in 5 minutes of operation.
(iii) Why is tungsten used for making filaments of electric bulbs rather than copper, even though copper is a better conductor?

◆ Electricity

Q28. deep exam-ready **[5]**

(i) What factors affect the resistance of a metallic conductor? Write the mathematical relation showing how resistance depends on each factor, and define resistivity.
(ii) A copper wire of diameter 0.4 mm and resistivity 1.62×10^{-8} Ω m is to be used as a resistor in a circuit requiring a resistance of 10 Ω. Calculate the length of wire needed.
(iii) If this copper wire is replaced by an aluminium wire of the same length and diameter (resistivity of aluminium = 2.63×10^{-8} Ω m), how does the resistance change?

◆ Electricity

Q29. medium exam-ready **[4]**

Read the following information and answer the questions that follow:

Meera sets up a circuit with a 6 V battery, an ammeter, a plug key, and three resistors of 2 Ω, 3 Ω, and 6 Ω connected in parallel.

(a) Calculate the equivalent resistance of the three resistors connected in parallel. [1 mark]
(b) Calculate the total current shown by the ammeter. [1 mark]
(c) Find the current flowing through the 2 Ω resistor alone. [1 mark]
(d) If Meera disconnects the 6 Ω resistor from the parallel combination while keeping the other two connected, will the total current increase, decrease, or remain the same? Justify your answer in one sentence. [1 mark]

◆ Electricity

Q30. medium exam-ready **[4]**

Read the following information and answer the questions that follow:

A technician tests various conductors in a laboratory at constant temperature. She records that nichrome has a resistivity of 100×10^{-6} Ω m, while silver has a resistivity of 1.60×10^{-8} Ω m. She uses a nichrome wire of length 1 m and cross-sectional area 1×10^{-6} m^2 as a heating element.

(a) The technician observes that for the conductor at constant temperature, the current is directly proportional to the potential difference applied. Which law does this represent? State the law. [1 mark]
(b) Which material — nichrome or silver — is a better conductor of electricity? Justify your answer using the given data. [1 mark]
(c) Calculate the resistance of the nichrome heating element. [1 mark]
(d) If the cross-sectional area of the nichrome wire is doubled while its length remains the same, what will be the new resistance? [1 mark]

◆ Electricity

Q31. medium exam-ready **[4]**

Read the following information and answer the questions that follow:

A household has the following electrical appliances all connected in parallel to a 220 V mains supply: a 1100 W electric iron, a 100 W television, and a 60 W table fan. The household uses a single fuse in the main line to protect the circuit.

(a) Calculate the total current drawn from the mains when all three appliances are operating simultaneously. [1 mark]
(b) The family has fuses of ratings 5 A and 10 A available. Which fuse should be used in the main line, and why? [1 mark]
(c) Explain briefly how a fuse wire protects the appliances in a circuit when excessive current flows. [1 mark]
(d) If the electric iron is operated daily for 2 hours and the cost of electricity is ₹3.00 per kWh, what is the cost of running the iron for 30 days? [1 mark]

◆ **Electricity**

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CBSE CLASS X

Science (086)

ANSWER KEY

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Q1. straightforward exam-ready **[1]**

The potential difference across a conductor is doubled while its resistance remains unchanged. The current through it will:
(A) be halved
(B) remain the same
(C) be doubled
(D) become four times

A be halved
B remain the same
C be doubled
D become four times

◆ **Electricity**

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Model Answer

(C) be doubled

By Ohm's law, $I = V/R$. If V is doubled and R remains unchanged, the current I also doubles.

Source: Chapter 11, Section 11.4 (Ohm's Law)

Explanation

Ohm's law states $I = V/R$. Current is directly proportional to potential difference when resistance is constant. So doubling V doubles I. Examiners expect you to state the law and apply it directly — one line is sufficient for 1 mark.

Q2. straightforward exam-ready **[1]**

Which of the following correctly gives the SI unit of electrical resistivity?

(A) Ω

(B) Ω m^{-1}

(C) Ω m

(D) Ω m^2

A Ω

B Ω m^{-1}

C Ω m

D Ω m^2

◆ **Electricity**

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Model Answer

(C) Ω m

The SI unit of electrical resistivity is **ohm-metre (Ω m)**, from the relation $R = \rho \frac{l}{A}$, giving $\rho = \frac{RA}{l}$ → Ω × m^2 / m = Ω m.

Source: Chapter 11, Section 11.5

Explanation

From $R = \rho \frac{l}{A}$, rearranging gives $\rho = \frac{RA}{l}$. Units: $\frac{\Omega \cdot m^2}{m} = \Omega\ m$. The textbook explicitly states "The SI unit of resistivity is Ω m." Don't confuse resistance (Ω) with resistivity (Ω m).

Q3. medium exam-ready **[1]**

A wire of resistance R is stretched uniformly until its length is doubled. Its new resistance will be:
(A) R/2
(B) R
(C) 2R
(D) 4R

A R/2
B R
C 2R
D 4R

◆ Electricity

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Model Answer

(D) 4R

When length is doubled, area of cross-section is halved (volume is constant). Using $R = \rho\frac{l}{A}$, new resistance $= \rho\frac{2l}{A/2} = 4\rho\frac{l}{A} = 4R$.

Source: Chapter 11, Section 11.5

Explanation

The key idea is **volume conservation**: stretching doubles the length but halves the cross-sectional area. Since $R \propto \frac{l}{A}$, both changes multiply the resistance — doubling l gives ×2 and halving A gives another ×2, so the net effect is ×4. Always remember to account for the change in *both* l and A when a wire is stretched.

Q4. straightforward exam-ready **[1]**

Which term does NOT correctly represent electric power consumed in a circuit?
(A) I^2R
(B) IR^2
(C) V^2/R
(D) VI

A I^2R
B IR^2
C V^2/R
D VI

◆ **Electricity**

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Model Answer

(B) IR^2

Electric power is given by $P = VI = I^2R = V^2/R$. The expression IR^2 has no physical basis and does not represent electric power.

Source: Chapter 11 – Electricity, Section 11.8 Electric Power

Explanation

The examiner expects you to know the three standard formulae for electric power: $P = VI$, $P = I^2R$, and $P = V^2/R$. The term IR^2 is dimensionally incorrect for power and is the odd one out. Simply state the correct formulae and identify the incorrect one.

Q5. straightforward exam-ready **[1]**

The commercial unit of electrical energy, 1 kWh, is equal to:
(A) 1000 J
(B) 3.6×10^4 J
(C) 3.6×10^6 J
(D) 3.6×10^8 J

A 1000 J
B 3.6×10^3 J
C 3.6×10^6 J
D 3.6×10^4 J

◆ **Electricity**

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Model Answer

(C) 3.6×10^6 J

1 kWh = 1000 W × 3600 s = 3.6×10^6 J.

Explanation

The key calculation: multiply 1000 watts by 3600 seconds (1 hour). Examiners expect you to know this conversion directly. Option C is correct as stated in the textbook passage.

Q6. medium exam-ready **[1]**

The heat produced in a conductor when current I flows through it for time t is H = I^2Rt. If the current is doubled and the time is halved, the heat produced will be:

(A) remain the same
(B) doubled
(C) halved
(D) quadrupled

A remain the same
B doubled
C halved
D quadrupled

◆ Electricity

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Model Answer

(A) remain the same

New heat: $H' = (2I)^2 \cdot R \cdot (t/2) = 4I^2R \cdot t/2 = 2I^2Rt$. Wait — correct option is **(B) doubled**.

When $I' = 2I$ and $t' = t/2$:

$$H' = (2I)^2 \cdot R \cdot \frac{t}{2} = 4I^2R \cdot \frac{t}{2} = 2I^2Rt = 2H$$

Answer: (B) doubled

Source: Chapter 11 – Electricity, Section 11.7 Heating Effect of Electric Current, Eq. (11.21)

Explanation

- Use Joule's law: $H = I^2Rt$.
- Doubling I increases H by factor 4 (since I is squared); halving t reduces it by factor 2.
- Net effect: $4 \div 2 = 2$, so heat is **doubled**.
- A common mistake is forgetting that current is squared — don't just double it linearly.

Q7. medium exam-ready **[1]**

A 100 W electric bulb and a 40 W electric bulb are both designed for 220 V. Which bulb has higher resistance?
(A) The 100 W bulb
(B) The 40 W bulb
(C) Both have the same resistance
(D) Cannot be determined from given data

- A The 100 W bulb
- B The 40 W bulb
- C Both have the same resistance
- D Cannot be determined from given data

◆ **Electricity**

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Model Answer

(B) The 40 W bulb

Using $R = V^2/P$, the 40 W bulb has resistance $= 220^2/40 = 1210\ \Omega$, while the 100 W bulb has $220^2/100 = 484\ \Omega$. Lower power rating means higher resistance.

Source: Chapter 11 (Electricity), Section 11.8 Electric Power

Explanation

Key formula: $R = V^2/P$. Since both bulbs operate at the same voltage (220 V), resistance is **inversely proportional to power**. The lower the wattage, the higher the resistance. Examiners expect you to recall or derive $R = V^2/P$ from $P = V^2/R$.

Q8. straightforward exam-ready **[1]**

The resistivity of a material depends on:
(A) the length of the conductor
(B) the area of cross-section of the conductor
(C) the nature of the material and temperature
(D) both the length and area of cross-section

A the length of the conductor
B the area of cross-section of the conductor
C the nature of the material and temperature
D both the length and area of cross-section

◆ **Electricity**

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Model Answer

(C) the nature of the material and temperature

Resistivity (ρ) is a characteristic property of the material and varies with temperature. It does not depend on the length or area of cross-section of the conductor.

Source: Chapter 11, Section 11.5

Explanation

- Resistance depends on length, area, and material — but **resistivity** (ρ) is an intrinsic property that depends only on the **nature of the material** and **temperature**.
- The textbook states: "It (ρ) is a characteristic property of the material. Both the resistance and resistivity of a material vary with temperature."
- Examiners specifically test whether students can distinguish between *resistance* (which depends on dimensions) and *resistivity* (which does not). Option C is the only correct choice.

Q9. straightforward exam-ready **[1]**

The V–I graph for a metallic wire at constant temperature is a straight line passing through the origin. This is a graphical representation of:

(A) Joule's law of heating

(B) Ohm's law

(C) Kirchhoff's voltage law

(D) Faraday's law

- A Joule's law of heating
- B Ohm's law
- C Kirchhoff's voltage law
- D Faraday's law

◆ **Electricity**

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Model Answer

(B) Ohm's law

The V–I graph being a straight line through the origin shows that V ∝ I at constant temperature, which is the graphical representation of Ohm's law.

Source: Chapter 11, Section 11.4 Ohm's Law

Explanation

Ohm's law states that potential difference (V) across a metallic conductor is directly proportional to the current (I) through it, provided temperature remains constant. A straight-line V–I graph passing through the origin is the standard graphical proof of this law, as described in Activity 11.1 and Fig. 11.3 of the textbook. Joule's law relates heat to current; Kirchhoff's and Faraday's laws are unrelated to this graph.

Q10. medium exam-ready **[1]**

An electric motor operates at 220 V and draws a current of 5 A. The energy consumed by the motor in 1 hour is:
(A) 1100 J
(B) 3.96×10^3 J
(C) 3.96×10^6 J
(D) 3.96×10^4 J

- A 220 J
- B 1100 J
- C 3.96×10^6 J
- D 1100 W

◆ **Electricity**

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Model Answer

(C) 3.96×10^6 J

Energy = V × I × t = 220 × 5 × 3600 = 3,960,000 J = **3.96×10^6 J**

Explanation

Use E = VIt; convert 1 hour to 3600 seconds. Power P = 220 × 5 = 1100 W; Energy = 1100 × 3600 = 3.96×10^6 J. Note: option (D) in the question stem matches option (C) in the given options list — the correct answer is 3.96×10^6 J.

Q11. medium exam-ready **[1]**

Assertion (A): Alloys are preferred over pure metals for making the heating elements of electric irons and toasters.
Reason (R): Alloys have higher resistivity and do not oxidise easily at high temperatures.
(A) Both A and R are true and R is the correct explanation of A.
(B) Both A and R are true but R is not the correct explanation of A.
(C) A is true but R is false.
(D) A is false but R is true.

- A Both A and R are true and R is the correct explanation of A.
- B Both A and R are true but R is not the correct explanation of A.
- C A is true but R is false.
- D A is false but R is true.

◆ Electricity

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Model Answer

(A) Both A and R are true and R is the correct explanation of A.

Alloys are used in heating elements because they have higher resistivity than pure metals and do not oxidise (burn) readily at high temperatures, making R the correct explanation of A.

Source: Chapter 11, Section 11.5 (Factors on which Resistance depends)

Explanation

The textbook explicitly states: *"The resistivity of an alloy is generally higher than that of its constituent metals. Alloys do not oxidise (burn) readily at high temperatures. For this reason, they are commonly used in electrical heating devices, like electric iron, toasters etc."* Both properties — high resistivity (generates more heat per unit current) and resistance to oxidation — directly explain why alloys are preferred, so R correctly and completely explains A. Choose option (A).

Q12. medium exam-ready **[1]**

Assertion (A): In a parallel combination of resistors, the equivalent resistance is always less than the smallest individual resistance in the combination.

Reason (R): Adding more parallel paths provides additional routes for current, effectively reducing total opposition to current flow.

(A) Both A and R are true and R is the correct explanation of A.

(B) Both A and R are true but R is not the correct explanation of A.

(C) A is true but R is false.

(D) A is false but R is true.

A Both A and R are true and R is the correct explanation of A.

B Both A and R are true but R is not the correct explanation of A.

C A is true but R is false.

D A is false but R is true.

◆ Electricity

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Model Answer

(A) Both A and R are true and R is the correct explanation of A.

In parallel combination, $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots$, so R_p is always less than the smallest individual resistance. Adding parallel paths gives more routes for current, reducing total opposition — which correctly explains why R_p is smallest.

Source: Chapter 11, Section 11.6 (Resistance of a System of Resistors)

Explanation

- **Assertion** is true: mathematically, $\frac{1}{R_p} > \frac{1}{R_{smallest}}$, so $R_p < R_{smallest}$.
- **Reason** is true and directly explains the Assertion: each extra parallel branch adds a new current path, reducing the net resistance below any single branch value.
- This makes option **(A)** correct — R is indeed the correct physical explanation of A.
- Examiner looks for you to confirm both statements are correct **and** judge whether R explains A causally, not just coincidentally.

Q13. straightforward exam-ready **[1]**

Assertion (A): Tungsten is used for making filaments of electric bulbs.
Reason (R): Tungsten has a very high melting point (3380°C) and high resistivity, which allows it to become incandescent without melting.
(A) Both A and R are true and R is the correct explanation of A.
(B) Both A and R are true but R is not the correct explanation of A.
(C) A is true but R is false.
(D) A is false but R is true.

A Both A and R are true and R is the correct explanation of A.
B Both A and R are true but R is not the correct explanation of A.
C A is true but R is false.
D A is false but R is true.

◆ **Electricity**

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Model Answer

(A) Both A and R are true and R is the correct explanation of A.

Tungsten is used for bulb filaments because of its very high melting point (3380°C), which prevents it from melting even at incandescent temperatures.

Source: Chapter 11, Section 11.7.1

Explanation

The passage explicitly states that "a strong metal with high melting point such as tungsten (melting point 3380°C) is used for making bulb filaments." Note: the Reason mentions **high resistivity** as well — tungsten does have relatively high resistivity among metals, which helps generate sufficient heat/light. Both properties are relevant and R correctly explains A, so option **(A)** is correct. Watch out for option (B) — examiners test whether students recognise that R genuinely explains A, not just that both are true.

Q14. straightforward exam-ready **[1]**

Assertion (A): The direction of conventional electric current in a metallic conductor is taken opposite to the direction of flow of electrons.
Reason (R): Electrons were not known when the phenomenon of electricity was first studied, so current was assumed to flow from positive to negative terminal.
(A) Both A and R are true and R is the correct explanation of A.
(B) Both A and R are true but R is not the correct explanation of A.
(C) A is true but R is false.
(D) A is false but R is true.

A Both A and R are true and R is the correct explanation of A.
B Both A and R are true but R is not the correct explanation of A.
C A is true but R is false.
D A is false but R is true.

◆ **Electricity**

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Model Answer

(A) Both A and R are true and R is the correct explanation of A.

Electrons were not known when electricity was first studied, so current was assumed to flow from positive to negative terminal. Hence, conventional current is taken opposite to electron flow.

Explanation

The textbook (Chapter 11, Section 11.1) explicitly states: "electrons were not known at the time when the phenomenon of electricity was first observed, so electric current was considered to be the flow of positive charges." This directly explains why conventional current is opposite to electron flow — making R the correct explanation of A. Choose option (A).

Q15. medium exam-ready **[1]**

Assertion (A): The cord (connecting wire) of an electric heater does not glow, but its heating element does.
Reason (R): The heating element has much higher resistance than the cord, so it dissipates far more heat for the same current.
(A) Both A and R are true and R is the correct explanation of A.
(B) Both A and R are true but R is not the correct explanation of A.
(C) A is true but R is false.
(D) A is false but R is true.

- A Both A and R are true and R is the correct explanation of A.
- B Both A and R are true but R is not the correct explanation of A.
- C A is true but R is false.
- D A is false but R is true.

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Model Answer

(A) Both A and R are true and R is the correct explanation of A.

The heating element (made of alloy like nichrome) has much higher resistance than the copper cord, so it dissipates more heat ($H = I^2Rt$) and glows.

Explanation

The key concept is Joule's heating: $H = I^2Rt$. Since the same current flows through both cord and element (series), heat produced depends directly on resistance. The nichrome heating element has very high resistance compared to the low-resistance copper cord, so it gets hot enough to glow. R directly and correctly explains A. Always check if R is the *correct* explanation, not just both being true.

Q16. straightforward exam-ready **[2]**

Define electric potential difference between two points in a circuit. Write the formula relating it to work done and charge.

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Model Answer

Electric potential difference between two points in a circuit is defined as the work done to move a unit positive charge from one point to the other.

Formula:

$$V = \frac{W}{Q}$$

where V = potential difference (in volts), W = work done (in joules), and Q = charge moved (in coulombs).

Its SI unit is **volt (V)**. 1 V = 1 J C^{-1}.

Source: Chapter 11 – Electricity, Section 11.2 Electric Potential and Potential Difference

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Explanation

- **Definition + formula = 2 marks.** Examiners award 1 mark each. Do not skip either part.
- The definition must include "unit charge" and "work done" — these are the key phrases.
- Writing the SI unit and its expansion (1 J C^{-1}) adds completeness and is expected in board answers.
- The formula $V = W/Q$ is Eq. (11.2) from the textbook — use exactly this form.

Q17. medium exam-ready **[2]**

A nichrome wire of length 2 m and cross-sectional area 0.5 mm^2 has a resistance of 4 Ω. Calculate the resistivity of nichrome.

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Model Answer

Given: l = 2 m, A = 0.5 mm^2 = 0.5 × 10^{-6} m^2, R = 4 Ω

Using the formula:

$$R = \rho \frac{l}{A}$$

$$\rho = \frac{R \times A}{l} = \frac{4 \times 0.5 \times 10^{-6}}{2}$$

$$\rho = 1 \times 10^{-6}\ \Omega\ \text{m}$$

The resistivity of nichrome is **1 × 10^{-6} Ω m**.

Source: Chapter 11, Section 11.5 – Factors on which the resistance of a conductor depends

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Explanation

- The key formula is $\rho = RA/l$ (rearranged from $R = \rho l/A$).
- Always convert mm^2 to m^2: 1 mm^2 = 10^{-6} m^2.
- Show the substitution step clearly — examiners award marks for the formula, correct substitution, and the final answer with unit (Ω m).
- The answer (≈ 10^{-6} Ω m) is consistent with Table 11.2 which gives nichrome resistivity as 100 × 10^{-6} Ω m — note the textbook value uses a different wire; the numerical here gives 1 × 10^{-6} Ω m based on the given data, so use the calculated answer, not the table value.

Q18. medium exam-ready **[2]**

An electric heater is rated 2 kW at 220 V. A fuse rated 5 A is installed in the circuit. Will the fuse operate safely? Justify your answer with a calculation.

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Model Answer

Current drawn by the heater:

$$I = \frac{P}{V} = \frac{2000\ \text{W}}{220\ \text{V}} \approx 9.09\ \text{A}$$

Since the current drawn (9.09 A) is greater than the fuse rating (5 A), **the fuse will blow (melt)**. It will NOT operate safely — the fuse will cut the circuit, protecting the appliance.

Source: Chapter 11, Section 11.7.1

Explanation

- Use $I = P/V$ to find the actual current. 2 kW = 2000 W.
- Compare it with the fuse rating: 9.09 A > 5 A, so the fuse melts and breaks the circuit.
- Note the phrasing: "will the fuse operate safely?" means will it work without blowing — the answer is **No**, it will blow. That is actually the fuse doing its job of protection, but it means the circuit cannot run safely on a 5 A fuse; a higher-rated fuse (e.g., 10 A) is needed. Examiners want you to state this clearly with the calculation.

Q19. deep exam-ready **[2]**

Two resistors of 6 Ω and 3 Ω are first connected in series and then in parallel across the same 12 V battery. Find the ratio of total power dissipated in the series arrangement to that in the parallel arrangement.

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Model Answer

Series combination:

$R_s = 6 + 3 = 9\ \Omega$

$P_s = \frac{V^2}{R_s} = \frac{12^2}{9} = 16\ \text{W}$

Parallel combination:

$\frac{1}{R_p} = \frac{1}{6} + \frac{1}{3} = \frac{1}{2}$, so $R_p = 2\ \Omega$

$P_p = \frac{V^2}{R_p} = \frac{144}{2} = 72\ \text{W}$

Ratio:

$$\frac{P_s}{P_p} = \frac{16}{72} = \boxed{\frac{2}{9}}$$

The ratio of power in series to parallel is **2 : 9**.

Source: Chapter 11 – Electricity, Section 11.8 Electric Power

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Explanation

- Use $P = V^2/R$ since voltage (12 V) is the same in both cases — this is the quickest approach.
- Series resistance is simply the sum; for parallel, use the reciprocal formula.
- Examiners expect you to show both R_s and R_p calculations before writing the ratio. Do not skip steps in a 2-mark question.
- The key insight: parallel resistance is smaller, so more power is dissipated in parallel — hence the ratio is less than 1.

Q20. medium exam-ready **[3]**

Derive an expression for the equivalent resistance of three resistors R1, R2, and R3 connected in series. Using this result, explain why the equivalent resistance in a series combination is always greater than any individual resistance in the combination.

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Model Answer

Derivation:

In a series combination, the same current I flows through each resistor. The potential differences across R1, R2, R3 are V1, V2, V3 respectively.

The total potential difference:

$$V = V_1 + V_2 + V_3 \tag{1}$$

Applying Ohm's law to each resistor:

$$V_1 = IR_1, \quad V_2 = IR_2, \quad V_3 = IR_3$$

If R_s is the equivalent resistance, then $V = IR_s$. Substituting in (1):

$$IR_s = IR_1 + IR_2 + IR_3$$

$$\boxed{R_s = R_1 + R_2 + R_3}$$

Why R_s is always greater than any individual resistance:

Since R1, R2, and R3 are all positive values, their sum $R_s = R_1 + R_2 + R_3$ is necessarily greater than each individual resistance. For example, $R_s > R_1$ because $R_2 + R_3 > 0$.

Source: Chapter 11, Section 11.6.1 – Resistors in Series

Explanation

- The two key facts for series are: **same current** through all resistors, and **voltages add up**. State both clearly before deriving.
- The derivation follows: apply Ohm's law to the whole circuit ($V = IR_s$) and to each resistor, then substitute into $V = V_1 + V_2 + V_3$.
- For the explanation part (worth ~1 mark), simply state that all resistances are positive, so adding them always gives a sum larger than any single term. One line is enough.

Q21. medium exam-ready **[3]**

A battery of 15 V is connected to three resistors of 3 Ω, 4 Ω, and 8 Ω connected in parallel. Calculate: (a) the equivalent resistance of the combination, (b) the total current drawn from the battery, and (c) the current through the 8 Ω resistor.

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Model Answer

Given: V = 15 V, R_1 = 3 Ω, R_2 = 4 Ω, R_3 = 8 Ω (parallel)

(a) Equivalent resistance:

$$\frac{1}{R_p} = \frac{1}{3} + \frac{1}{4} + \frac{1}{8} = \frac{8+6+3}{24} = \frac{17}{24}$$

$$R_p = \frac{24}{17} \approx 1.41\ \Omega$$

(b) Total current:

$$I = \frac{V}{R_p} = \frac{15}{\frac{24}{17}} = \frac{15 \times 17}{24} = \frac{255}{24} \approx 10.6\ \text{A}$$

(c) Current through 8 Ω resistor:

In parallel, voltage across each resistor = 15 V

$$I_3 = \frac{V}{R_3} = \frac{15}{8} = 1.875\ \text{A}$$

Source: Chapter 11, Section 11.6.2

Explanation

- In parallel, **same voltage** (15 V) appears across each resistor — use this directly for part (c).
- For equivalent resistance, use the reciprocal formula: $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$.
- Show all steps clearly — CBSE awards marks for the formula, substitution, and final answer separately.
- Keep fractions exact first, then convert to decimals.

Q22. medium exam-ready **[3]**

State Joule's law of heating. An electric iron of resistance 25 Ω is operated at 200 V for 30 minutes. Calculate the heat produced in the iron during this time.

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Model Answer

Joule's Law of Heating: The heat produced in a resistor is directly proportional to (i) the square of current (I^2), (ii) the resistance (R), and (iii) the time (t) for which current flows.

$$H = I^2 Rt$$

Calculation:

Given: R = 25 Ω, V = 200 V, t = 30 min = 30 × 60 = 1800 s

Current, $I = \frac{V}{R} = \frac{200}{25} = 8$ A

Heat produced:

$$H = I^2 Rt = (8)^2 \times 25 \times 1800$$

$$H = 64 \times 25 \times 1800 = 28,80,000 \text{ J} = 2.88 \times 10^6 \text{ J}$$

Source: Chapter 11, Section 11.7 (Heating Effect of Electric Current)

Explanation

- The law statement must mention all three factors (I^2, R, t) — each is a potential 1-mark point.
- First find current using Ohm's law (V = IR), then apply $H = I^2Rt$. Convert minutes to seconds.
- Final answer **2.88×10^6 J** must be clearly stated. Leaving units out or forgetting the conversion of time are the most common errors.

Q23. medium exam-ready **[3]**

(a) State any two advantages of connecting electrical appliances in parallel rather than in series in a domestic circuit.
(b) Three identical bulbs are connected in parallel across a 12 V source and the total current drawn is 3 A. Calculate the resistance of each bulb.

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Model Answer

(a) Two advantages of parallel connection in domestic circuits:

1. Each appliance gets the same (full) voltage of the supply, so they work at their rated capacity.
2. If one appliance fails, the others continue to work as each branch is an independent path.

(b) In parallel, voltage across each bulb = 12 V; total current = 3 A.

Since bulbs are identical, current through each bulb:

$$I_{each} = \frac{3}{3} = 1 \text{ A}$$

By Ohm's law, resistance of each bulb:

$$R = \frac{V}{I} = \frac{12}{1} = 12 \, \Omega$$

The resistance of each bulb is 12 Ω.

Source: Electricity, Section 11.6.2 (Resistors in Parallel)

Explanation

- For part (a), examiners expect two distinct points — full/equal voltage to each device and independent operation. Either of these plus one more (e.g., easy to add/remove appliances, lower equivalent resistance) scores full marks.
- For part (b), the key insight is: identical bulbs in parallel share the total current equally. Once you find current per bulb (1 A), a simple V = IR calculation gives the answer. Show all steps clearly for full credit.

Q24. deep exam-ready **[3]**

Two wires X and Y are made of the same material. Wire X has twice the length and half the cross-sectional area of wire Y. Compare the resistances of X and Y. If both are connected in series to a 6 V battery, what fraction of the total voltage appears across wire Y?

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Model Answer

Comparing Resistances of X and Y:

Using $R = \rho\dfrac{l}{A}$, let wire Y have length l and area A.

Then wire X has length $2l$ and area $A/2$.

$$R_X = \rho\frac{2l}{A/2} = \frac{4\rho l}{A}$$

$$R_Y = \rho\frac{l}{A}$$

$$\therefore \frac{R_X}{R_Y} = 4 \quad \Rightarrow \quad R_X = 4R_Y$$

Voltage across wire Y in series:

In series, the same current flows, so voltage divides in proportion to resistance.

Total resistance = $R_X + R_Y = 4R_Y + R_Y = 5R_Y$

$$V_Y = \frac{R_Y}{R_X + R_Y} \times 6 = \frac{R_Y}{5R_Y} \times 6 = \frac{1}{5} \times 6 = 1.2 \text{ V}$$

Fraction of total voltage across Y $= \dfrac{1}{5}$.

Source: Chapter 11, Section 11.5 – Factors on which the resistance of a conductor depends

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Explanation

- Examiners expect the formula $R = \rho l/A$ to be stated first, then substituted for both wires to get the 4:1 ratio.
- For the series voltage part, use the voltage divider rule: $V \propto R$ in series. Since $R_X : R_Y = 4 : 1$, wire Y carries $\frac{1}{5}$ of the total voltage = 1.2 V.
- Write the ratio clearly; a common error is inverting X and Y.

Q25. medium exam-ready **[3]**

(a) Define electric power and write its SI unit.
(b) A household uses the following appliances: one 1000 W electric iron for 2 hours, two 60 W fans for 5 hours, and one 100 W television for 4 hours every day. Calculate the total electrical energy consumed in one day in kWh.

◆ Electricity

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Model Answer

(a) Electric power is the rate at which electric energy is consumed (or dissipated) in a circuit. It is given by $P = VI$.
SI unit: Watt (W). 1 W = 1 V × 1 A.

(b)

Appliance	Power × Time	Energy
Electric iron	1000 W × 2 h	2000 Wh
Two fans	2 × 60 W × 5 h	600 Wh
Television	100 W × 4 h	400 Wh

Total energy = 2000 + 600 + 400 = **3000 Wh = 3 kWh**

Source: Chapter 11 – Electric Power, Section 11.8

Explanation

- For part (a), define power as rate of energy consumption and state the unit; both are needed for full marks.
- For part (b), calculate energy for each appliance separately (Energy = Power × Time), sum them, then convert Wh → kWh by dividing by 1000. Don't forget the fans are **two** in number — multiply the 60 W by 2. Showing a clear table or stepwise working fetches full marks.

Q26. deep exam-ready **[5]**

(i) Derive an expression for the equivalent resistance when three resistors R_1, R_2, and R_3 are connected in parallel. Mention one practical advantage of this combination over a series combination.
(ii) The resistivities of copper and nichrome are 1.62×10^{-8} Ω m and 100×10^{-6} Ω m respectively. Both wires have the same length and the same cross-sectional area. Calculate the ratio of resistance of nichrome wire to copper wire. Which material would you prefer for making the element of an electric toaster, and why?

◆ Electricity

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Model Answer

(i) Derivation – Parallel Combination

Let three resistors R_1, R_2, R_3 be connected in parallel across points X and Y. The potential difference V across each is the same.

By Ohm's law, currents through each resistor:

$$I_1 = \frac{V}{R_1}, \quad I_2 = \frac{V}{R_2}, \quad I_3 = \frac{V}{R_3}$$

Total current: $I = I_1 + I_2 + I_3$

If R_p is the equivalent resistance:

$$\frac{V}{R_p} = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3}$$

$$\boxed{\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}}$$

Practical advantage: If one appliance fails, others continue to work (each branch is independent), unlike in series where failure of one breaks the entire circuit.

(ii) Calculation

Given: $\rho_{\text{nichrome}} = 100 \times 10^{-6}\ \Omega\text{m}$, $\rho_{\text{copper}} = 1.62 \times 10^{-8}\ \Omega\text{m}$; same length and area.

Since $R = \rho \dfrac{l}{A}$, for same l and A:

$$\frac{R_{\text{nichrome}}}{R_{\text{copper}}} = \frac{\rho_{\text{nichrome}}}{\rho_{\text{copper}}} = \frac{100 \times 10^{-6}}{1.62 \times 10^{-8}} \approx 6173$$

Preferred material for toaster element: Nichrome, because its resistivity is very high (generates more heat), and it does not oxidise (burn) readily at high temperatures.

Source: Chapter 11, Sections 11.5 and 11.6

Explanation

- The derivation must show the step: same V, currents add, divide throughout by V — examiners look for this logic explicitly.
- The practical advantage point is standard and must specifically contrast with series.

- For part (ii), since l and A are identical, resistance ratio equals resistivity ratio directly — show the substitution clearly.
- The reason for choosing nichrome must include **two points**: high resistivity AND resistance to oxidation at high temperature. Both are in Table 11.2's explanatory text and are commonly tested.

Q27. deep exam-ready **[5]**

(i) State Joule's law of heating and derive the expression H = I^2Rt.
(ii) An electric kettle of resistance 44 Ω is rated for 220 V. Calculate: (a) the current through the kettle, (b) the power consumed, and (c) the heat generated in 5 minutes of operation.
(iii) Why is tungsten used for making filaments of electric bulbs rather than copper, even though copper is a better conductor?

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Model Answer

(i) Joule's Law of Heating:
The heat produced in a resistor is directly proportional to (a) the square of current (I^2), (b) the resistance (R), and (c) the time (t) for which current flows.

$$H = I^2 Rt$$

Derivation: When charge Q flows through resistance R under potential difference V in time t,
Work done = W = VQ = V × It (since Q = It)
Using V = IR: W = IR × It = I^2Rt
Since this work converts to heat: **H = I^2Rt**

(ii) Given: R = 44 Ω, V = 220 V, t = 5 min = 300 s

(a) Current: $I = \frac{V}{R} = \frac{220}{44} = \mathbf{5\ A}$

(b) Power: $P = VI = 220 \times 5 = \mathbf{1100\ W}$

(c) Heat generated: $H = I^2 Rt = (5)^2 \times 44 \times 300 = 25 \times 44 \times 300 = \mathbf{3,30,000\ J}$

(iii) Tungsten is used because it has a very high melting point (3380°C), so it can become white-hot and emit light without melting. Copper, though a better conductor, has a much lower melting point and would melt at the high operating temperatures of a bulb filament.

Source: Chapter 11, Section 11.7.1 and 11.8

Explanation

- **Joule's law derivation** must start from W = VIt and substitute V = IR — examiners look for this logical step.
- **Part (ii):** Use I = V/R first, then P = VI, then H = I^2Rt (or P×t). Show substitution clearly for full marks.
- **Part (iii):** The key words examiners expect are **high melting point** and the contrast with copper's lower melting point. The source passage explicitly states tungsten's melting point (3380°C) — mention it for full credit.
- Budget your time: derivation ~2 marks, numericals ~2 marks, reason ~1 mark.

Q28. deep exam-ready **[5]**

(i) What factors affect the resistance of a metallic conductor? Write the mathematical relation showing how resistance depends on each factor, and define resistivity.
(ii) A copper wire of diameter 0.4 mm and resistivity 1.62×10^{-8} Ω m is to be used as a resistor in a circuit requiring a resistance of 10 Ω. Calculate the length of wire needed.
(iii) If this copper wire is replaced by an aluminium wire of the same length and diameter (resistivity of aluminium = 2.63×10^{-8} Ω m), how does the resistance change?

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Model Answer

(i) Factors affecting resistance:

The resistance of a metallic conductor depends on:

1. **Length (l):** $R \propto l$
2. **Area of cross-section (A):** $R \propto \frac{1}{A}$
3. **Nature of material**

Combining: $R = \rho \frac{l}{A}$

Resistivity (ρ): It is the constant of proportionality in the relation $R = \rho \frac{l}{A}$. It is a characteristic property of the material of the conductor. SI unit: **Ω m**.

(ii) Calculation of length of copper wire:

Given: $d = 0.4 \text{ mm} = 4 \times 10^{-4} \text{ m}$, $\rho = 1.62 \times 10^{-8} \, \Omega \, \text{m}$, $R = 10 \, \Omega$

$$A = \frac{\pi d^2}{4} = \frac{3.14 \times (4 \times 10^{-4})^2}{4} = \frac{3.14 \times 16 \times 10^{-8}}{4} = 1.256 \times 10^{-7} \text{ m}^2$$

From $R = \rho \frac{l}{A}$:

$$l = \frac{R \times A}{\rho} = \frac{10 \times 1.256 \times 10^{-7}}{1.62 \times 10^{-8}} = \frac{1.256 \times 10^{-6}}{1.62 \times 10^{-8}} \approx 77.5 \text{ m}$$

Length of copper wire required ≈ 77.5 m

(iii) Resistance of aluminium wire (same length and diameter):

$$R_{Al} = \rho_{Al} \frac{l}{A} = 2.63 \times 10^{-8} \times \frac{77.5}{1.256 \times 10^{-7}} \approx 16.2 \, \Omega$$

Since $\rho_{Al} > \rho_{Cu}$, the aluminium wire has **higher resistance (~16.2 Ω)** compared to copper (10 Ω) for the same dimensions.

Source: Chapter 11 – Electricity, Section 11.5 Factors on which the resistance of a conductor depends

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Explanation

- **(i)** Examiners expect the three factors named clearly, both proportionality statements written, the combined formula $R = \rho l / A$, and a one-line definition of resistivity with its SI unit. Don't skip the unit.
- **(ii)** The most common mistake is forgetting to convert diameter to radius or to metres. Use $A = \pi d^2/4$ directly (not πr^2, unless you halve the diameter first — both are equivalent). Show substitution clearly for full marks.
- **(iii)** Simply apply the same formula with ρ_{Al} and compare. A clear statement that resistance **increases** because aluminium has higher resistivity is essential for the mark.

Q29. medium exam-ready **[4]**

Read the following information and answer the questions that follow:

Meera sets up a circuit with a 6 V battery, an ammeter, a plug key, and three resistors of 2 Ω, 3 Ω, and 6 Ω connected in parallel.

(a) Calculate the equivalent resistance of the three resistors connected in parallel. [1 mark]
(b) Calculate the total current shown by the ammeter. [1 mark]
(c) Find the current flowing through the 2 Ω resistor alone. [1 mark]
(d) If Meera disconnects the 6 Ω resistor from the parallel combination while keeping the other two connected, will the total current increase, decrease, or remain the same? Justify your answer in one sentence. [1 mark]

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Model Answer

(a) For parallel combination:

$$\frac{1}{R_p} = \frac{1}{2} + \frac{1}{3} + \frac{1}{6} = \frac{3+2+1}{6} = \frac{6}{6} = 1$$

$$\therefore R_p = 1\ \Omega$$

(b) Total current (by Ohm's law):

$$I = \frac{V}{R_p} = \frac{6\text{ V}}{1\ \Omega} = 6\text{ A}$$

(c) In parallel, the same 6 V acts across each resistor.

$$I_1 = \frac{V}{R_1} = \frac{6\text{ V}}{2\ \Omega} = 3\text{ A}$$

(d) The total current will **increase**, because removing the 6 Ω resistor reduces the number of parallel branches, but the equivalent resistance of the remaining two (2 Ω and 3 Ω) becomes $\frac{6}{5}$ = 1.2 Ω, which is **higher** than 1 Ω — wait, that means current decreases.

Correction: The total current will **decrease**, because removing one parallel branch increases the equivalent resistance of the combination, and by Ohm's law ($I = V/R$), higher resistance means lower current.

Source: Chapter 11, Section 11.6.2 — Resistors in Parallel

Explanation

- **(a)** Always use the reciprocal formula $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$ for parallel circuits. Show each step.
- **(b)** Once R_p is found, a straightforward Ohm's law application gives total current.
- **(c)** Key concept: in parallel, **voltage is the same** across each branch, so apply $I = V/R$ to the individual resistor.
- **(d)** This is a common conceptual trap. Adding more resistors in parallel *decreases* equivalent resistance and *increases* total current; removing one does the opposite — equivalent resistance rises, total current falls. State the reason clearly for full marks.

Q30. medium exam-ready **[4]**

Read the following information and answer the questions that follow:

A technician tests various conductors in a laboratory at constant temperature. She records that nichrome has a resistivity of 100×10^{-6} Ω m, while silver has a resistivity of 1.60×10^{-8} Ω m. She uses a nichrome wire of length 1 m and cross-sectional area 1×10^{-6} m^2 as a heating element.

(a) The technician observes that for the conductor at constant temperature, the current is directly proportional to the potential difference applied. Which law does this represent? State the law. [1 mark]
(b) Which material — nichrome or silver — is a better conductor of electricity? Justify your answer using the given data. [1 mark]
(c) Calculate the resistance of the nichrome heating element. [1 mark]
(d) If the cross-sectional area of the nichrome wire is doubled while its length remains the same, what will be the new resistance? [1 mark]

◆ Electricity

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Model Answer

(a) This represents **Ohm's Law**. It states that the potential difference (V) across the ends of a conductor is directly proportional to the current (I) flowing through it, provided its temperature remains constant. i.e., V ∝ I, or V = IR.

(b) Silver is a better conductor. A lower resistivity means less opposition to current flow. Silver has resistivity 1.60×10^{-8} Ω m, which is much lower than nichrome's 100×10^{-6} Ω m.

(c) Using $R = \rho \frac{l}{A}$:

$$R = \frac{100 \times 10^{-6} \times 1}{1 \times 10^{-6}} = \frac{10^{-4}}{10^{-6}} = \mathbf{100\ \Omega}$$

(d) Since $R \propto \frac{1}{A}$, doubling the area halves the resistance:

$$R_{\text{new}} = \frac{100}{2} = \mathbf{50\ \Omega}$$

Source: Chapter 11 – Electricity, Sections 11.4 (Ohm's Law) and 11.5 (Factors on which resistance depends)

Explanation

- **(a)** Always state the law in full — "provided temperature remains constant" is essential for full marks.
- **(b)** The key principle: lower resistivity = better conductor. Justify by comparing the actual values.
- **(c)** Substitute directly in $R = \rho l / A$. Show the formula, substitution, and final answer with units.
- **(d)** No re-calculation needed — just apply the inverse proportionality. Since area doubles, resistance halves. This tests conceptual understanding, not arithmetic.

Q31. medium exam-ready **[4]**

Read the following information and answer the questions that follow:

A household has the following electrical appliances all connected in parallel to a 220 V mains supply: a 1100 W electric iron, a 100 W television, and a 60 W table fan. The household uses a single fuse in the main line to protect the circuit.

(a) Calculate the total current drawn from the mains when all three appliances are operating simultaneously. [1 mark]
(b) The family has fuses of ratings 5 A and 10 A available. Which fuse should be used in the main line, and why? [1 mark]
(c) Explain briefly how a fuse wire protects the appliances in a circuit when excessive current flows. [1 mark]
(d) If the electric iron is operated daily for 2 hours and the cost of electricity is ₹3.00 per kWh, what is the cost of running the iron for 30 days? [1 mark]

◆ **Electricity**

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Model Answer

(a) Total power = 1100 + 100 + 60 = 1260 W

Total current, $I = \frac{P}{V} = \frac{1260}{220} \approx 5.73 \text{ A}$

(b) The **10 A fuse** should be used. The total current drawn is ~5.73 A, which exceeds the 5 A fuse rating, so a 5 A fuse would blow immediately. A 10 A fuse allows normal operation while still protecting against dangerously excessive current.

(c) A fuse wire is made of a metal/alloy with a low melting point, connected in series. When current exceeds the rated value, the fuse wire heats up, melts, and breaks the circuit — stopping current flow and protecting the appliances.

(d) Energy consumed = 1100 W × 2 h × 30 days = 66,000 Wh = **66 kWh**

Cost = 66 × ₹3.00 = **₹198.00**

Source: Chapter 11 – Electricity, Section 11.7.1 (Fuse) and Section 11.8 (Electric Power)

Explanation

- **(a)** Use $I = P/V$ for total power since all appliances are in parallel across the same 220 V.
- **(b)** Key rule from the textbook: fuse rating must be *above* normal current but as low as safely possible. 5 A would blow under normal use; 10 A is correct. The textbook example of a 1000 W iron drawing 4.54 A uses a 5 A fuse — here total current is higher, so 10 A is needed.
- **(c)** Mention: series connection, low melting point, melts on excess current, breaks circuit. These are the examiner's expected points.
- **(d)** Follow the textbook's Example 11.13 method exactly: Energy (kWh) = Power (kW) × time (h) × days, then multiply by rate.

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