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CLASS X · SCIENCE (086) · PHYSICS · CBSE BOARD EXAMINATION 2027

CHAPTER 11

Electricity

Answer Booklet · CBSE marking-scheme answers with marks for every point

Every question of the chapter booklet | Marks shown point by point | MCQ keys with reasons

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HOW TO USE THE ANSWERS

1. Answer the question in your notebook **first**. Open this booklet only to check.
2. Each answer is written the way the CBSE marking scheme sets it out: **value points**, with the **mark for each point** in orange beside it.
3. Give yourself marks point by point. Use the same **key words** in your own answers.
4. Equations must be balanced; diagrams must be labelled; numericals need formula, substitution and unit.
5. Copy every wrong answer to the My Mistakes page of your booklet.

READ THIS FIRST

Marking Guide

Model answers to every question in the chapter booklet, set out the way a CBSE examiner marks them.

HOW MARKS ARE GIVEN IN SCIENCE ANSWERS

1. **MCQ and assertion–reason (1 mark):** only the correct option scores. The reason given here is for your understanding.
2. **2 and 3 marks:** one mark (or ½) for each correct **value point**. The examiner looks for the key word – a long answer without it scores less than a short answer with it.
3. **Equations:** a correct balanced equation earns its full mark; an unbalanced one, or one with wrong formulae, usually earns ½ or nothing.
4. **Numericals:** formula, substitution and the final answer **with unit** are marked separately.
5. **Diagrams:** marks for a correct drawing and for the labels asked for. An unlabelled diagram earns little.
6. **Case study (4 marks):** 1 + 1 + 2. **Long answer (5 marks):** the split is shown beside each point.

A

PART A · ANSWERS

NCERT Practice – Answers

Marking-scheme answers for every question in Part A of the chapter booklet.

Current and potential difference

A1. What is an electric circuit? What is meant by a current of 1 ampere? [2]

A continuous, closed path along which electric current flows. 1

1 A is the current when 1 coulomb of charge flows through a cross-section in 1 second. 1

A2. Calculate the number of electrons that make up a charge of one coulomb. (Charge on an electron = 1.6×10^{-19} C) [2]

$n = Q / e = 1\ C / (1.6 \times 10^{-19}\ C)$ 1

$= 6.25 \times 10^{18}$ electrons 1

A3. A current of 0.4 A flows through a bulb for 5 minutes. How much charge passes through it? [2]

$Q = I\,t = 0.4\ A \times (5 \times 60)\ s$ 1

$= 120\ C$ 1

A4. Name a device that maintains a potential difference across a conductor. What is meant by saying that the PD between two points is 1 volt? [2]

A cell or a battery. 1

1 joule of work is done in moving 1 coulomb of charge from one point to the other. 1

A5. How much energy is given to each coulomb of charge passing through a 9 V battery? [1]

$W = VQ = 9\ V \times 1\ C = 9\ J.$ 1

A6. How are an ammeter and a voltmeter connected in a circuit? [2]

Ammeter: in series, so that the whole current passes through it. 1

Voltmeter: in parallel across the two points whose PD is to be measured. 1

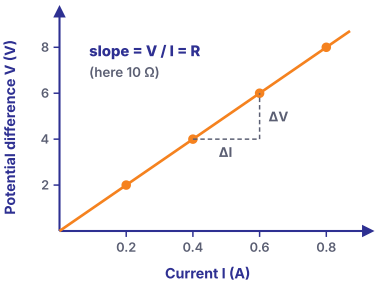
Ohm's law and resistance

A7. State Ohm's law. Draw the V–I graph for a conductor that obeys it. [3]

The current through a conductor is directly proportional to the PD across its ends, if its temperature stays the same. 1

V ∝ I, so V = IR, where R is the resistance. 1

Graph: a straight line through the origin; slope V/I = R. 1



A8. On what factors does the resistance of a conductor depend? [2]

Length (R ∝ l) and area of cross-section (R ∝ 1/A). 1

The nature of the material (its resistivity) and its temperature. 1

A9. Will current flow more easily through a thick wire or a thin wire of the same material and length, joined to the same source? Why? [2]

Through the thick wire. 1

R ∝ 1/A: the thick wire has a larger area of cross-section, hence less resistance, so more current flows. 1

A10. The resistance of a component stays constant while the PD across it is halved. What happens to the current? [1]

I = V/R, so the current also becomes half. 1

A11. Why are the coils of electric toasters and irons made of an alloy rather than a pure metal? [2]

An alloy has a higher resistivity, so more heat is produced. 1

It does not oxidise (burn) readily at high temperatures. 1

A12. The resistivities of four materials, in Ω m, are: P – 1.6×10^{-8}, Q – 10×10^{-8}, R – 94×10^{-8} and S – 10^{13}. **(i)** Which is the best conductor? **(ii)** Which is an insulator? **(iii)** Which is a better conductor, Q or R? [2]

(i) P (lowest resistivity). ½

(ii) S. ½

(iii) Q, since its resistivity is lower than that of R. 1

A13. A wire 2 m long and 0.4 mm in diameter has a resistance of 16 Ω. Find the resistivity of its material. What will be the resistance of a wire of the same material and length but twice the diameter? (π = 3.14) [3]

$r = 0.2$ mm $= 2 \times 10^{-4}$ m; $A = \pi r^2 = 3.14 \times 4 \times 10^{-8} = 1.256 \times 10^{-7}$ m² — 1

$\rho = RA / l = 16 \times 1.256 \times 10^{-7} / 2 \approx 1.0 \times 10^{-6}$ Ω m — 1

Twice the diameter gives four times the area, so R = 16/4 = 4 Ω. — 1

A14. A wire of resistance R is cut into four equal parts, which are then joined in parallel. If the resistance of the combination is R′, find R/R′. [2]

Each part has resistance R/4. — ½

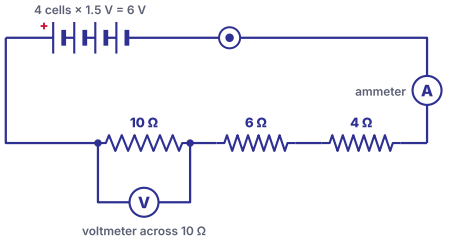
Four equal resistors in parallel: R′ = (R/4)/4 = R/16. — 1

R/R′ = 16. — ½

Combination of resistors

A15. Draw a circuit with a battery of four 1.5 V cells, resistors of 4 Ω, 6 Ω and 10 Ω and a plug key, all in series, with an ammeter in the circuit and a voltmeter across the 10 Ω resistor. What will the two meters read? [3]

Circuit diagram: — 1



V = 4 × 1.5 = 6 V; $R_s = 4 + 6 + 10 = 20$ Ω; ammeter: I = 6/20 = 0.3 A. — 1

Voltmeter: V = IR = 0.3 × 10 = 3 V. — 1

A16. Judge the equivalent resistance when these are joined in parallel: (a) 2 Ω and 10^5 Ω (b) 2 Ω, 10^3 Ω and 10^6 Ω. [2]

(a) Slightly less than 2 Ω. — 1

(b) Also slightly less than 2 Ω – in parallel, R_p is less than the smallest resistance. — 1

A17. A lamp of 100 Ω, a toaster of 50 Ω and a water filter of 100 Ω are joined in parallel to a 220 V supply. What is the resistance of an iron that, on the same supply, takes as much current as all three together? What is this current? [3]

$1/R_p = 1/100 + 1/50 + 1/100 = 4/100$ — 1

$R_p = 25$ Ω, so the iron has a resistance of 25 Ω. — 1

I = V/R = 220/25 = 8.8 A. — 1

A18. Give two advantages of joining electrical devices in parallel with the supply instead of in series. [2]

Each device gets the full supply voltage and the current it needs. 1

If one device fails or is switched off, the others keep working. 1

A19. Three resistors of 4 Ω, 6 Ω and 12 Ω are available. How will you join them to get a total resistance of (a) 8 Ω (b) 2 Ω? [2]

(a) 6 Ω and 12 Ω in parallel (= 4 Ω), in series with 4 Ω: 4 + 4 = 8 Ω. 1

(b) All three in parallel: 1/R = 1/4 + 1/6 + 1/12 = 6/12, R = 2 Ω. 1

A20. What is (a) the highest and (b) the lowest total resistance that can be obtained from four coils of 3 Ω, 6 Ω, 9 Ω and 18 Ω? [2]

(a) All in series: 3 + 6 + 9 + 18 = 36 Ω. 1

(b) All in parallel: 1/R = 1/3 + 1/6 + 1/9 + 1/18 = 12/18, R = 1.5 Ω. 1

Heating effect, power and energy

A21. Why does the cord of an electric heater not glow while its heating element does? [2]

The same current flows through both; heat H = I^2Rt depends on R. 1

The cord (copper) has a very low resistance, so little heat; the element (nichrome) has a high resistance, so it gets red-hot. 1

A22. Find the heat produced when 72 000 C of charge is moved in one hour through a potential difference of 25 V. [2]

H = VQ = 25 V × 72 000 C 1

= 1.8×10^6 J 1

A23. An electric iron of resistance 40 Ω draws a current of 5 A. Find the heat produced in 20 s. [2]

H = $I^2Rt = 5^2 \times 40 \times 20$ 1

= 20 000 J = 2×10^4 J 1

A24. What determines the rate at which energy is delivered by a current? A water pump draws 4 A from a 220 V line. Find its power and the energy it uses in 3 hours. [3]

Electric power (P = VI). 1

P = 220 × 4 = 880 W 1

E = Pt = 0.88 kW × 3 h = 2.64 kWh (= 9.5×10^6 J) 1

A25. Which uses more energy: a 150 W TV set in 2 hours or a 1500 W heater in 10 minutes? [2]

TV: 150 W × 2 h = 300 Wh. Heater: 1500 W × (1/6) h = 250 Wh. 1

The TV uses more energy. 1

A26. Two lamps, rated 100 W and 40 W at 220 V, are joined in parallel to a 220 V supply. Find the current drawn from the supply. [2]

In parallel each lamp gets 220 V, so total power = 100 + 40 = 140 W. 1

I = P/V = 140/220 ≈ 0.64 A 1

A27. An electric heater of resistance 10 Ω draws 12 A from the mains. At what rate is heat produced? [1]

P = I^2R = 12^2 × 10 = 1440 W (1440 J every second). 1

A28. Why is tungsten used for bulb filaments? Why are bulbs filled with nitrogen or argon? [2]

Tungsten has a very high melting point (3380 °C), so it glows white-hot without melting. 1

These inactive gases do not react with the hot filament, so it lasts longer. 1

A29. What is an electric fuse? How is it connected, and why is its wire made of a material with a low melting point? [2]

A safety device: a short wire in series with the appliance or circuit. 1

When the current becomes too large, the wire heats up, melts quickly and breaks the circuit, protecting the appliances. 1

PART B · ANSWERS

B Exemplar Practice – Answers

Marking-scheme answers for every question in Part B of the chapter booklet.

Multiple choice

Q	Answer	Working / reason
B1	**(b)** Voltmeter	It measures the PD across the resistor.
B2	**(c)** material	Resistivity is a property of the material.
B3	**(b)** Ω m	ρ = RA/l gives Ω × m^2 / m = Ω m.
B4	**(a)** Current	There is only one path for the charge.
B5	**(d)** 4 : 1	R ∝ l/A = 2 ÷ ½ = 4.
B6	**(a)** 0.27 A	I = P/V = 60/220.
B7	**(c)** 3.6 × 10^6 J	1000 W × 3600 s.
B8	**(b)** a straight line through the origin	V ∝ I.
B9	**(c)** nichrome	High resistivity; does not oxidise easily.
B10	**(b)** 2 Ω	R/n = 6/3.

Short answer

B11. Resistors of 4 Ω and 12 Ω are joined in parallel across a 6 V battery. Find the equivalent resistance, the total current and the current in each resistor. [3]

$R_p = (4 \times 12)/(4 + 12) = 3\ \Omega$ 1

$I = 6/3 = 2$ A 1

$I_1 = 6/4 = 1.5$ A; $I_2 = 6/12 = 0.5$ A (sum 2 A). 1

B12. An electric bulb is rated 100 W, 220 V. Find its resistance and the current it draws. [2]

$R = V^2/P = 220^2 / 100 = 484\ \Omega$ 1

$I = P/V = 100/220 \approx 0.45$ A 1

B13. Two identical resistors are joined first in series and then in parallel to the same supply. Find the ratio of the heat produced in the two cases in the same time. [2]

Series: 2R; parallel: R/2. With the same V, $H = V^2t / R$. 1

$H_{series} : H_{parallel} = (1/2R) : (2/R) = 1 : 4$ 1

B14. Why is a series arrangement not used in domestic circuits? [2]

If one appliance fails or is switched off, the circuit breaks and all appliances stop. 1

The voltage is shared, and all appliances get the same current, though they need different currents. 1

B15. On a graph of V (y-axis) against I (x-axis), the line for resistor A is steeper than that for resistor B. Which has the higher resistance? Where would the line for A and B joined in series lie? [2]

A, since the slope V/I equals R. 1

R_s is more than both, so its line is steeper than A's (above it). 1

B16. A house uses a 1.5 kW geyser for 2 h a day and four 20 W LED bulbs for 5 h a day. Find the units used in 30 days and the cost at ₹6 per unit. [3]

Geyser: 1.5 kW × 2 h = 3 kWh per day; bulbs: 4 × 0.02 kW × 5 h = 0.4 kWh per day. 1

In 30 days: 3.4 × 30 = 102 kWh (units). 1

Cost = 102 × ₹6 = ₹612. 1

C

PART C · ANSWERS

Board Pattern Practice – Answers

Marking-scheme answers for every question in Part C of the chapter booklet.

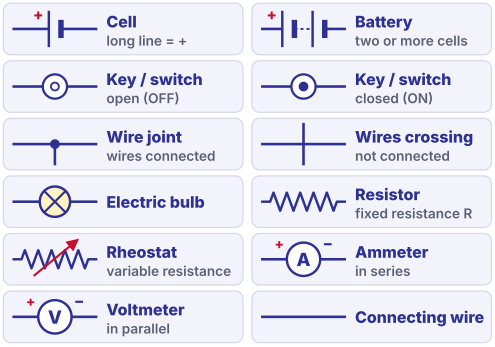
Current, potential difference, symbols

Q	Answer	Working / reason
C1	**(a)** 1 J / C	V = W/Q.
C2	**(a)** 2 A	I = 180 C / 90 s.
C3	**(a)**	Both true; R explains A.

C4. (a) Define 1 volt. (b) Draw the symbols for a battery, a closed plug key, a rheostat and a voltmeter. [3]

(a) The PD between two points is 1 V if 1 J of work is done to move 1 C of charge between them. 1

(b) Symbols (½ mark each) as below: 2



Ohm's law, resistance and resistivity

Q	Answer	Working / reason
C5	**(a)** 5 Ω	Each half is 10 Ω; two in parallel give 5 Ω.
C6	**(a)** half	l × 2, A × 4, so R × ½.
C7	**(a)**	Both true; R explains A.

C8. A wire 50 cm long with a radius of 0.2 mm has a resistance of 4 Ω. Find the resistivity of its material. ($\pi = 3.14$) [2]

$A = \pi r^2 = 3.14 \times (2 \times 10^{-4}\ m)^2 = 1.256 \times 10^{-7}\ m^2$; $l = 0.5$ m 1

$\rho = RA/l = 4 \times 1.256 \times 10^{-7} / 0.5 \approx 1.0 \times 10^{-6}\ \Omega$ m 1

C9. (a) How is resistivity different from resistance? (b) How does the resistance of a wire change if (i) its length is tripled (ii) its area of cross-section is doubled? (c) Why is copper used for house wiring? [3]

(a) Resistance depends on the size of the wire; resistivity depends only on the material (and temperature). 1

(b) (i) becomes 3 times; (ii) becomes half. 1

(c) Copper has a very low resistivity, so little energy is wasted as heat. 1

C10. In an experiment, a student got these readings for a wire: V = 1, 2, 3, 4 V and I = 0.25, 0.50, 0.75, 1.00 A. (a) What will the V–I graph look like? (b) Find the resistance. (c) Under what condition does this relation hold? **[3]**

(a) A straight line through the origin. 1

(b) R = V/I = 1/0.25 = 4 Ω (the same for every reading). 1

(c) The temperature (physical conditions) of the wire must stay the same. 1

Series and parallel combinations

Q	Answer	Working / reason
C11	**(a)** 2 Ω	(3 × 6)/(3 + 6) = 2 Ω.
C12	**(b)** 20	240 V / 12 V = 20.
C13	**(a)**	Both true; R explains A.

C14. Resistors of 6 Ω and 3 Ω are joined in series to a 9 V battery. Find (a) the total resistance (b) the current (c) the PD across each resistor. **[3]**

(a) $R_s = 6 + 3 = 9\ \Omega$ 1

(b) I = 9/9 = 1 A 1

(c) $V_1 = 1 \times 6 = 6$ V; $V_2 = 1 \times 3 = 3$ V (sum 9 V). 1

C15. Two bulbs X and Y are joined in parallel to a 6 V battery. X draws 1 A and Y draws 0.5 A. Find (a) the current from the battery (b) the resistance of each bulb (c) the equivalent resistance. **[3]**

(a) I = 1 + 0.5 = 1.5 A 1

(b) $R_X = 6/1 = 6\ \Omega$; $R_Y = 6/0.5 = 12\ \Omega$ 1

(c) $R_p = 6/1.5 = 4\ \Omega$ (check: 6 × 12 / 18 = 4 Ω). 1

C16. Resistors of 10 Ω and 15 Ω are joined to a 12 V supply (a) in series (b) in parallel. Find the current drawn in each case. **[2]**

(a) R = 25 Ω; I = 12/25 = 0.48 A 1

(b) R = 150/25 = 6 Ω; I = 12/6 = 2 A 1

Heating effect of current

Q	Answer	Working / reason
C17	**(b)** four times	$H \propto I^2$.
C18	**(d)** Electric fan	A fan uses an electric motor.

C19. State Joule's law of heating and write its formula. How does the heat change if the resistance is doubled, the current staying the same? **[2]**

Heat produced is proportional to I^2, R and t: $H = I^2Rt$. 1

The heat doubles ($H \propto R$ at constant I). 1

C20. A 2 kW oven is used on a 220 V line protected by a 5 A fuse. What will happen, and why? Suggest a suitable fuse. [3]

I = P/V = 2000/220 ≈ 9.1 A. 1

This is more than 5 A, so the fuse wire heats up, melts and the circuit breaks. 1

A 10 A fuse should be used. 1

Electric power and energy

Q	Answer	Working / reason
C21	**(a)** 880 Ω	R = V²/P = 48 400/55.
C22	**(c)** 5 A	I = P/V.

C23. A heater rated 220 V, 5 A is used on a 110 V supply. Find its power now, taking its resistance to be constant. [2]

R = V/I = 220/5 = 44 Ω 1

P = V²/R = 110²/44 = 275 W (a quarter of its rated 1100 W). 1

C24. Two identical bulbs, each rated 60 W, 220 V, are joined to a 220 V supply (a) in parallel (b) in series. Find the total power in each case. [3]

R of each bulb = 220²/60 ≈ 807 Ω. 1

(a) Parallel: each gets 220 V and works at 60 W, total 120 W. 1

(b) Series: total R ≈ 1613 Ω; P = 220²/1613 ≈ 30 W. 1

C25. In a house a 1 kW microwave oven runs 30 minutes a day and five 15 W LED bulbs run 6 hours a day. Find the units used in 30 days and the cost at ₹8 per unit. [3]

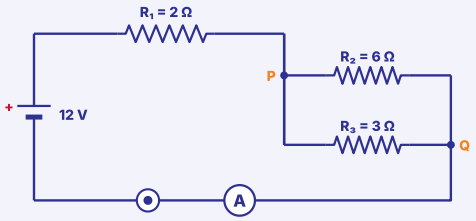
Oven: 1 kW × 0.5 h = 0.5 kWh; bulbs: 5 × 0.015 kW × 6 h = 0.45 kWh; total 0.95 kWh per day. 1

30 days: 0.95 × 30 = 28.5 units. 1

Cost = 28.5 × ₹8 = ₹228. 1

Long answer

C26. In the circuit shown, find (a) the equivalent resistance (b) the current from the battery (c) the PD across R_1 and across PQ (d) the current in R_2 and in R_3 (e) the power used in R_1. [5]



(a) $R_2 \parallel R_3 = (6 \times 3)/(6 + 3) = 2\ \Omega$; total $R = 2 + 2 = 4\ \Omega$ — 1

(b) $I = 12/4 = 3$ A — 1

(c) $V_1 = 3 \times 2 = 6$ V; $V_{PQ} = 3 \times 2 = 6$ V — 1

(d) $I_2 = 6/6 = 1$ A; $I_3 = 6/3 = 2$ A (sum 3 A) — 1

(e) $P = I^2R_1 = 3^2 \times 2 = 18$ W — 1

C27. (a) Define resistivity and give its SI unit. (b) Why are alloys used in heating devices? (c) Define 1 ampere. (d) A wire 1.5 m long with an area of cross-section of 0.5 mm² has a resistance of 3 Ω. Find its resistivity. [5]

(a) $\rho = RA/l$: the resistance of a conductor of unit length and unit area of cross-section; unit Ω m. — 1½

(b) High resistivity, and they do not oxidise readily at high temperature. — 1

(c) 1 A flows when 1 C of charge passes a cross-section in 1 s. — 1

(d) $\rho = RA/l = 3 \times 0.5 \times 10^{-6} / 1.5 = 1.0 \times 10^{-6}\ \Omega$ m — 1½

C28. (a) Derive $H = I^2Rt$ for the heat produced in a resistor. (b) Find the heat produced in a 4 Ω resistor carrying 2 A for 5 minutes. (c) Why is a fuse joined in series? (d) Express 1 kWh in joules. [5]

(a) Work done on charge Q through PD V: $W = VQ = VIt$ (as $Q = It$). — 1

Using $V = IR$, $H = W = I^2Rt$. — 1

(b) $H = 2^2 \times 4 \times 300 = 4800$ J — 1

(c) So that the whole current flows through it, and it can break the circuit when the current becomes too large. — 1

(d) 1 kWh = 1000 W × 3600 s = 3.6×10^6 J — 1

PART D · ANSWERS

D Case-Based Questions – Answers

Marking-scheme answers for every question in Part D of the chapter booklet.

D1. Case Study · Testing Two Wires [4]

(i) Which law do these readings follow? **[1]**

Ohm's law: V/I is constant for each wire, so I ∝ V. 1

(ii) Find the resistance of wire X. **[1]**

$R_X = V/I = 1.0/0.50 = 2\ \Omega$ 1

(iii) Find the equivalent resistance when X and Y are joined (a) in series (b) in parallel. **[2]**

$R_Y = 1.0/0.25 = 4\ \Omega$. (a) Series: $2 + 4 = 6\ \Omega$ 1

(b) Parallel: $(2 \times 4)/(2 + 4) \approx 1.33\ \Omega$ 1

OR

(iii) X and Y are joined in parallel across a 4 V battery. Find the current through each wire and from the battery. **[2]**

$I_X = 4/2 = 2$ A; $I_Y = 4/4 = 1$ A 1

From the battery: $2 + 1 = 3$ A 1

D2. Case Study · The Kitchen Circuit [4]

(i) Find the current drawn by the kettle alone. **[1]**

$I = P/V = 2000/220 \approx 9.1$ A 1

(ii) Why did the fuse melt when both were switched on? **[1]**

Total power 2800 W draws $2800/220 \approx 12.7$ A, more than the 10 A rating, so the fuse wire melted. 1

(iii) Find the energy used by the kettle in 30 days and the cost at ₹7 per unit. **[2]**

$E = 2$ kW × 0.25 h × 30 = 15 kWh (units) 1

Cost = 15 × ₹7 = ₹105 1

OR

(iii) Find the resistance of the kettle's heating element. Why is it made of nichrome? **[2]**

$R = V^2/P = 220^2/2000 = 24.2\ \Omega$ 1

Nichrome has a high resistivity and does not oxidise easily at high temperature. 1

D3. Case Study · Festival Lights [4]

(i) Why did the whole string go dark when one bulb fused? **[1]**

In series there is only one path; a fused bulb breaks the circuit, so no current flows. 1

(ii) What is the PD across each bulb? **[1]**

220 V / 20 = 11 V 1

(iii) Find the current in the string and the power of each bulb. **[2]**

Total R = 20 × 22 = 440 Ω; I = 220/440 = 0.5 A — 1

$P = I^2R = 0.5^2 \times 22 = 5.5$ W — 1

OR

(iii) Give two reasons why the lights and fans of a house are joined in parallel. **[2]**

Each appliance gets the full 220 V and the current it needs. — 1

Each can be switched on or off on its own; if one fails, the others keep working. — 1