PHYSICS POINT

Where Concepts Come Alive

NCERT Class 10
PHYSICS SOLUTIONS

Chapter-Wise Complete Solutions

Session 2026 - 27 | As per Latest Rationalised CBSE / NCERT Syllabus

Chapters Covered

Prepared by the Faculty of Physics Point • For Private Circulation to Students Only

Table of Contents

Note: This solution booklet is prepared strictly as per the rationalised NCERT Class 10 Science (Physics units) syllabus applicable for the 2026-27 academic session, wherein the Physics portion comprises four chapters – Chapters 9 to 12 of the NCERT “Science” textbook. Each chapter includes a quick-revision concept summary followed by fully worked, step-by-step solutions to the NCERT exercise questions.

Chapter 9

Light – Reflection and Refraction

Key Concepts & Formulae (Quick Revision)

- **Laws of Reflection:** (i) Angle of incidence = Angle of reflection, (ii) Incident ray, reflected ray and normal all lie in the same plane.
- **Mirror formula:** 1/v + 1/u = 1/f, where u = object distance, v = image distance, f = focal length (all measured from the pole, with sign convention: distances measured against the direction of incident light are negative).
- **Focal length and radius of curvature:** f = R/2.
- **Magnification (mirror):** m = h′/h = –v/u.
- **Sign convention (concave mirror):** f and R are negative; (convex mirror): f and R are positive.
- **Laws of Refraction (Snell's Law):** (i) Incident ray, refracted ray and normal lie in the same plane, (ii) sin i / sin r = constant = n (refractive index) for a given pair of media.
- **Lens formula:** 1/v – 1/u = 1/f.
- **Magnification (lens):** m = h′/h = v/u.
- **Power of a lens:** P = 1/f (f in metres); unit is the dioptre (D). Convex (converging) lens has positive power/focal length; concave (diverging) lens has negative power/focal length.

NCERT Exercise Questions – Complete Solutions

Q1. Which one of the following materials cannot be used to make a lens? (a) Water (b) Glass (c) Plastic (d) Clay

Solution: (d) Clay. A lens must be made of a transparent material that allows light to pass through and be refracted at its curved surfaces. Clay is opaque, so it cannot be used to make a lens.

Q2. The image formed by a concave mirror is observed to be virtual, erect and larger than the object. Where should be the position of the object?
(a) Between the principal focus and the centre of curvature (b) At the centre of curvature (c) Beyond the centre of curvature (d) Between the pole of the mirror and its principal focus

Solution: (d) Between the pole of the mirror and its principal focus (i.e., when the object lies between P and F). Only in this position does a concave mirror form a virtual, erect and magnified image (as used in a shaving mirror).

Q3. Where should an object be placed in front of a convex lens to get a real image of the size of the object?
(a) At the principal focus of the lens (b) At twice the focal length (c) At infinity (d) Between the optical centre of the lens and its principal focus

Solution: (b) At twice the focal length (at $2F_1$). When an object is placed at 2F on either side of a convex lens, a real, inverted image of the same size is formed at 2F on the other side.

Q4. A spherical mirror and a thin spherical lens have each a focal length of –15 cm. The mirror and the lens are likely to be:
(a) both concave (b) both convex (c) the mirror is concave and the lens is convex (d) the mirror is convex and the lens is concave

Solution: (a) Both concave. By the sign convention used, the focal length of a concave mirror is taken as negative, and the focal length of a concave (diverging) lens is also taken as negative. A convex mirror and convex lens both have positive focal lengths. Hence a focal length of –15 cm for both the mirror and the lens means both are concave.

Q5. One-half of a convex lens is covered with a black paper. Will this lens produce a complete image of the object? Verify your answer experimentally. Explain your observation.

Solution: Yes, the lens will still produce a **complete image** of the object, but the image will be **less bright (dimmer)** than before. This is because rays of light from every point of the object still fall on the uncovered half of the lens and are refracted to meet and form the full image; only the number of rays contributing to the image is reduced (as one half of the lens is blocked), which reduces the intensity/brightness of the image, not its completeness. This can be verified experimentally by covering half of a convex lens with black paper and observing that a complete but dimmer image of a candle flame is still formed on a screen.

Q6. An object 5 cm in length is held 25 cm away from a converging lens of focal length 10 cm. Draw the ray diagram and find the position, size and the nature of the image formed.

Solution: Here, object height h = 5 cm, object distance u = –25 cm, focal length f = +10 cm (convex/converging lens).

Using the lens formula: $1/v - 1/u = 1/f$

$1/v = 1/f + 1/u = 1/10 + (-1/25) = 1/10 - 1/25 = (5 - 2)/50 = 3/50$

∴ $v = 50/3 =$ **+16.67 cm** (image forms on the opposite side of the lens from the object, i.e. it is real).

Magnification, $m = v/u = 16.67/(-25) = -0.67$.

Image height, $h' = m \times h = -0.67 \times 5 =$ **–3.33 cm**.

Nature of image: Since v is positive and m is negative and less than 1 in magnitude, the image is **real, inverted and diminished**, formed at 16.67 cm from the lens on the side opposite to the object, and its size is 3.33 cm.

Q7. A concave lens of focal length 15 cm forms an image 10 cm from the lens. How far is the object placed from the lens? Find the nature of the image.

Solution: For a concave (diverging) lens, f = –15 cm. A concave lens always forms a virtual image on the same side as the object, so v = –10 cm.

Using the lens formula: $1/v - 1/u = 1/f$

$1/(-10) - 1/u = 1/(-15)$

$-1/u = -1/15 + 1/10 = (-2 + 3)/30 = 1/30$

$1/u = -1/30 \Rightarrow u =$ **–30 cm**.

So the object is placed **30 cm in front of the lens**. Since v is negative and on the same side as the object, the image is **virtual, erect and diminished**, located 10 cm from the lens.

Q8. An object is placed at a distance of 10 cm from a convex mirror of focal length 15 cm. Find the position and nature of the image.

Solution: For a convex mirror, f = +15 cm; object distance u = –10 cm.

Using the mirror formula: $1/v + 1/u = 1/f$

$1/v = 1/f - 1/u = 1/15 - (-1/10) = 1/15 + 1/10 = (2 + 3)/30 = 5/30 = 1/6$

∴ v = **+6 cm**.

Magnification, $m = -v/u = -6/(-10) = +0.6$.

Nature of image: Since v is positive (behind the mirror) and m is positive and less than 1, the image is **virtual, erect and diminished**, formed 6 cm behind the mirror.

Q9. An object of size 7.0 cm is placed at 27 cm in front of a concave mirror of focal length 18 cm. At what distance from the mirror should a screen be placed to obtain a sharp image? Find the size and nature of the image.

Solution: Here, object height h = 7 cm, u = –27 cm, f = –18 cm (concave mirror).
Using the mirror formula: 1/v + 1/u = 1/f
1/v = 1/f – 1/u = 1/(–18) – 1/(–27) = –1/18 + 1/27 = (–3 + 2)/54 = –1/54
∴ v = **–54 cm**. The screen should therefore be placed **54 cm in front of the mirror** (on the same side as the object) to obtain a sharp image.
Magnification, m = –v/u = –(–54)/(–27) = **–2**.
Image height, h′ = m × h = –2 × 7 = **–14 cm**.
Nature of image: Real, inverted and magnified (twice the object size), formed 54 cm in front of the mirror.

Q10. Find the focal length of a lens of power –2.0 D. What type of lens is this?

Solution: Power, P = 1/f (f in metres) ⇒ f = 1/P = 1/(–2.0) = **–0.5 m = –50 cm**.
Since the focal length is negative, the lens is a **concave (diverging) lens**.

Q11. A doctor has prescribed a corrective lens of power +1.5 D. Find the focal length of the lens. Is the prescribed lens diverging or converging?

Solution: f = 1/P = 1/1.5 = **+0.67 m (≈ +66.7 cm)**.
Since the power (and hence focal length) is positive, the prescribed lens is a **convex (converging) lens**.

Chapter 10

The Human Eye and the Colourful World

Key Concepts & Formulae (Quick Revision)

- **Human eye:** Light entering the eye is refracted mainly at the cornea; the crystalline lens fine-tunes the focus so that a real, inverted image forms on the **retina**; the **iris** controls the size of the **pupil** (amount of light entering), and **ciliary muscles** change the curvature (and hence focal length) of the eye lens – a process called **accommodation**.
- **Near point** of a normal eye ≈ 25 cm; **far point** of a normal eye = infinity.
- **Myopia (near-sightedness):** far point comes closer than infinity; corrected using a **concave lens** of suitable power.
- **Hypermetropia (far-sightedness):** near point moves farther than 25 cm; corrected using a **convex lens**.
- **Presbyopia:** loss of accommodation power with age; often corrected using **bifocal lenses**.
- **Dispersion of white light:** splitting of white light into its seven constituent colours (VIBGYOR) on passing through a prism, due to different wavelengths (colours) bending by different amounts.
- **Atmospheric refraction:** bending of light as it passes through the atmosphere of varying density/refractive index – responsible for the twinkling of stars and advance sunrise / delayed sunset.
- **Scattering of light (Tyndall effect / Rayleigh scattering):** fine particles in the atmosphere scatter shorter (blue) wavelengths of light much more strongly than longer (red) wavelengths.

NCERT Exercise Questions – Complete Solutions

Q1. The human eye can focus objects at different distances by adjusting the focal length of the eye lens. This is due to:
(a) presbyopia (b) accommodation (c) near-sightedness (d) far-sightedness

Solution: (b) accommodation.

Q2. The human eye forms the image of an object at its:
(a) cornea (b) iris (c) pupil (d) retina

Solution: (d) retina.

Q3. The least distance of distinct vision for a young adult with normal vision is about:
(a) 25 m (b) 2.5 cm (c) 25 cm (d) 2.5 m

Solution: (c) 25 cm.

Q4. The change in focal length of an eye lens is caused by the action of the:
(a) pupil (b) retina (c) ciliary muscles (d) iris

Solution: (c) ciliary muscles – these muscles change the curvature of the eye lens, and hence its focal length, allowing the eye to focus on objects at varying distances.

Q5. A person with a myopic eye cannot see objects distinctly beyond a distance of 1.2 m. What is the type of the corrective lens used to restore proper vision?

Solution: The far point of this myopic eye is 1.2 m instead of infinity. A **concave (diverging) lens** is required, of such a focal length that it forms a virtual image of an object at infinity at the person's actual far point (1.2 m). Thus the required focal length f = –1.2 m, i.e. power P = 1/f = 1/(–1.2) ≈ –**0.83 D**.

Q6. What is meant by power of accommodation of the eye?

Solution: The ability of the eye lens to adjust (increase or decrease) its focal length, with the help of the ciliary muscles, so as to focus objects at different distances clearly on the retina is called the **power of accommodation** of the eye.

Q7. A person with a myopic eye cannot see objects distinctly beyond 1.2 m. This defect can be corrected by using a lens of power:
(a) +0.5 D (b) –1.0 D (c) +1.0 D (d) –0.5 D

Solution: Using f = –1.2 m, P = 1/f ≈ –0.83 D, which is closest to **(d)** –**1.0 D** among the options typically given, since a concave lens (negative power) is what is required to correct myopia.

Q8. A student has difficulty reading the blackboard while sitting in the last row. What could be the defect the child is suffering from? How can it be corrected?

Solution: The child is likely suffering from **myopia (near-sightedness)**, in which distant objects (like the blackboard from the back row) are not seen clearly because their image forms in front of the retina. It can be corrected by using spectacles with a suitable **concave lens**, which diverges the incoming rays slightly before they enter the eye so that the image is formed exactly on the retina.

Q9. How will you use two identical prisms so as to produce a beam of white light?

Solution: Take two identical glass prisms. Allow a narrow beam of white light to fall on the first prism; it disperses the light into its seven constituent colours (VIBGYOR). Place the second prism **inverted with respect to the first** (turned upside down), directly in the path of the dispersed beam. The second prism recombines the coloured beams and produces a beam of white light again, since its refraction effects on each colour exactly reverse those of the first prism.

Q10. At noon the sun appears white as compared to its colour at sunrise or sunset. Explain why.

Solution: At noon, the Sun is nearly overhead, so sunlight has to travel a relatively **short distance through the Earth's atmosphere** to reach an observer. Very little scattering of any colour therefore occurs, and all colours of sunlight reach the eye together, making the sun appear almost white. At sunrise/sunset, however, the Sun is near the horizon and its light must travel a much **longer path through the atmosphere**. Most of the blue (shorter-wavelength) light gets scattered away by air molecules along this long path, and mainly the red/orange (longer-wavelength) light, which is scattered the least, reaches the observer directly – giving the sun a reddish appearance.

Q11. Why does the sky appear dark instead of blue to an astronaut?

Solution: The blue colour of the sky as seen from the Earth's surface is due to the **scattering of sunlight by the molecules of the atmosphere** (Rayleigh/Tyndall scattering). An astronaut in space, high above the Earth's atmosphere, is essentially in a vacuum with no (or negligible) air molecules to scatter sunlight. In the absence of scattering, no coloured light reaches the astronaut's eyes from the surrounding sky, so the sky appears **dark/black** to the astronaut, with the sun and stars visible as points of light against this dark background.

Q12. Why does the sky appear blue on a clear day?

Solution: Air molecules and other fine particles present in the atmosphere are much smaller in size than the wavelength of visible light and scatter light according to **Rayleigh's law of scattering**, by which shorter wavelengths of light are scattered much more strongly than longer wavelengths. Since blue light has a shorter wavelength than red light, it is scattered far more by the atmosphere. As we look at the sky (away from the sun), this scattered blue light reaches our eyes from all directions, giving the sky its characteristic **blue colour**.

Q13. Why do the planets not twinkle, but stars twinkle?

Solution: Stars are extremely far away and behave essentially as **point sources of light**. Light from a star undergoes refraction repeatedly as it passes through atmospheric layers of continuously changing refractive index (due to changing air density/temperature), so the amount of light reaching the eye keeps fluctuating, causing the star's apparent brightness and position to flicker – this is **twinkling**. Planets, being much closer to the Earth, can be considered as a collection of a large number of point sources of light (i.e. an **extended source**). The total light received from a planet is the sum of light from many point-sized sources; the twinkling (increase/decrease) effects of these individual points average out and largely cancel each other, so the net brightness variation is negligible and planets appear to shine steadily without twinkling.

Q14. Explain the phenomena responsible for the advance sunrise and the delayed sunset.

Solution: This is due to **atmospheric refraction**. The Earth's atmosphere is not uniform; its density (and hence refractive index) decreases with altitude, being maximum near the surface. Light from the sun, therefore, keeps bending (refracting) towards the Earth's surface as it enters the atmosphere from less dense to denser layers, following a slightly curved path instead of a straight line. Because of this, the sun becomes visible to us a little before it actually rises above the horizon (advanced/early sunrise) and remains visible for a little while after it has actually set below the horizon (delayed sunset). This advances the visibility of the sun by about **2 minutes** both at sunrise and at sunset, effectively making the day about 4 minutes longer than it would be without atmospheric refraction.

Q15. Explain why the sky appears blue instead of violet, even though violet light is scattered even more than blue light by the atmosphere.

Solution: Although violet light has a shorter wavelength than blue light and is scattered somewhat more strongly, (i) sunlight itself contains a much smaller proportion of violet light compared to blue light, and (ii) the human eye is **more sensitive to blue light** than to violet light. Because of this combination – lower intensity of violet in sunlight and lower sensitivity of our eyes to violet – we perceive the scattered light from the sky predominantly as **blue** rather than violet.

Chapter 11

Electricity

Key Concepts & Formulae (Quick Revision)

- **Electric current**, I = Q/t (unit: ampere, A); conventional current flows from + to – terminal outside the source.
- **Potential difference**, V = W/Q (unit: volt, V).
- **Ohm's Law:** V = IR, provided physical conditions (temperature, etc.) remain constant; R is the resistance (unit: ohm, Ω).
- **Resistivity:** R = ρL/A, where L = length, A = area of cross-section, ρ = resistivity of the material (depends only on the material and temperature, not on dimensions).
- **Series combination:** $R_s = R_1 + R_2 + R_3 + \ldots$ (same current through each; resultant resistance is greater than the largest individual resistance).
- **Parallel combination:** $1/R_p = 1/R_1 + 1/R_2 + 1/R_3 + \ldots$ (same voltage across each; resultant resistance is smaller than the smallest individual resistance).
- **Heating effect (Joule's law):** $H = I^2Rt$ (heat produced in joules, when I is in amperes, R in ohms, t in seconds).
- **Electric power:** $P = VI = I^2R = V^2/R$ (unit: watt, W); Energy consumed, E = Pt (commercial unit: **kWh**, 1 kWh = 3.6×10^6 J).

NCERT Exercise Questions – Complete Solutions

Q1. A piece of wire of resistance R is cut into five equal parts. These parts are then connected in parallel. If the resultant resistance of this combination is R′, then the ratio R/R′ is:
(a) 1/25 (b) 1/5 (c) 5 (d) 25

Solution: Each of the 5 equal parts has resistance R/5. For 5 equal resistors of R/5 in parallel:
1/R′ = 5 ÷ (R/5) = 25/R ⇒ R′ = R/25.
∴ R/R′ = R ÷ (R/25) = **25**. Answer: (d) 25.

Q2. Which of the following terms does not represent electrical power in a circuit?
(a) I^2R (b) IR^2 (c) VI (d) V^2/R

Solution: Electric power can be written as $P = VI = I^2R = V^2/R$. The term IR^2 does not correspond to any of these valid expressions for power. Answer: **(b) IR^2**.

Q3. An electric bulb is rated 220 V and 100 W. When it is operated on 110 V, the power consumed will be:
(a) 100 W (b) 75 W (c) 50 W (d) 25 W

Solution: Resistance of the bulb (constant), $R = V^2/P = 220^2/100 = 484\ \Omega$.
At 110 V, power consumed = $V^2/R = 110^2/484 = 12100/484 =$ **25 W**. Answer: (d) 25 W.

Q4. Two conducting wires of the same material and equal lengths and equal diameters are first connected in series and then in parallel in a circuit across the same potential difference. The ratio of heat produced in series and parallel combinations is:
(a) 1:2 (b) 2:1 (c) 1:4 (d) 4:1

Solution: Let each wire have resistance R. In series, $R_s = 2R$ and the same current $I_s = V/2R$ flows; heat produced, $H_s = I_s^2 R_s t = V^2 t/2R$.
In parallel, $R_p = R/2$; heat produced, $H_p = V^2 t/R_p = 2V^2 t/R$.
$H_s : H_p = (1/2) : 2 =$ **1 : 4**. Answer: (c) 1:4.

Q5. How is a voltmeter connected in the circuit to measure the potential difference between two points?

Solution: A voltmeter is always connected in **parallel** across the two points between which the potential difference is to be measured. An ideal voltmeter has a very high (ideally infinite) resistance so that it draws negligible current from the circuit.

Q6. A copper wire has diameter 0.5 mm and resistivity of 1.6×10^{-8} Ωm. What will be the length of this wire to make its resistance 10 Ω? How much does the resistance change if the diameter is doubled?

Solution: Radius, $r = 0.25$ mm $= 2.5 \times 10^{-4}$ m.
Area, $A = \pi r^2 = \pi \times (2.5 \times 10^{-4})^2 = 1.96 \times 10^{-7}$ m^2.
From $R = \rho L/A$: $L = RA/\rho = (10 \times 1.96 \times 10^{-7}) / (1.6 \times 10^{-8}) \approx$ **122.7 m**.
If the diameter is doubled, the area A becomes 4 times (since $A \propto d^2$), and since $R \propto 1/A$ (for the same length and material), the new resistance becomes **10/4 = 2.5** Ω, i.e. it becomes one-fourth of the original value.

Q7. The values of current I flowing in a given resistor for several values of potential difference V are given below. Plot a graph between V and I and calculate the resistance of the resistor.
I (A): 0.5, 1.0, 2.0, 3.0, 4.0 V (V): 1.6, 3.4, 6.7, 10.2, 13.2

Solution: When V is plotted against I for this data, a straight line passing through the origin is obtained, confirming Ohm's law ($V \propto I$). The resistance is the **slope of the V–I graph** (R = V/I for each pair, which stays fairly constant):
V/I values: 1.6/0.5 = 3.2, 3.4/1.0 = 3.4, 6.7/2.0 = 3.35, 10.2/3.0 = 3.4, 13.2/4.0 = 3.3.
Taking the average / slope of the best-fit straight line, the resistance of the resistor ≈ **3.34** Ω (≈ 3.3 Ω).

Q8. When a 12 V battery is connected across an unknown resistor, there is a current of 2.5 mA in the circuit. Find the value of the resistance of the resistor.

Solution: $R = V/I = 12 / (2.5 \times 10^{-3}) =$ **4800 Ω = 4.8 kΩ**.

Q9. A battery of 9 V is connected in series with resistors of 0.2 Ω, 0.3 Ω, 0.4 Ω, 0.5 Ω and 12 Ω. How much current would flow through the 12 Ω resistor?

Solution: Since all resistors are in series, total resistance R = 0.2 + 0.3 + 0.4 + 0.5 + 12 = **13.4** Ω.
Current in the circuit, I = V/R = 9/13.4 ≈ **0.67 A**. Since the same current flows through every element of a series circuit, the current through the 12 Ω resistor is also ≈ 0.67 A.

Q10. How many 176 Ω resistors (in parallel) are required to carry 5 A on a 220 V line?

Solution: Total resistance required, R = V/I = 220/5 = 44 Ω.
For n identical resistors of 176 Ω in parallel: $1/R = n/176 \Rightarrow n = 176/44 =$ **4**. So 4 resistors of 176 Ω each, connected in parallel, are required.

Q11. Show how you would connect three resistors, each of resistance 6 Ω, so that the combination has a resistance of (i) 9 Ω (ii) 4 Ω.

Solution: (i) **9 Ω:** Connect two of the 6 Ω resistors in parallel to get (6×6)/(6+6) = 3 Ω, then connect this parallel combination in series with the third 6 Ω resistor: 3 + 6 = **9** Ω.
(ii) **4 Ω:** Connect two of the 6 Ω resistors in series to get 6 + 6 = 12 Ω, then connect this in parallel with the third 6 Ω resistor: (12 × 6)/(12 + 6) = 72/18 = **4** Ω.

Q12. Several electric bulbs designed to be used on a 220 V supply are rated 10 W. How many lamps can be connected in parallel with each other across the two wires of a 220 V line if the maximum allowable current is 5 A?

Solution: Current drawn by each bulb, i = P/V = 10/220 A.
Maximum number of bulbs, n = Total allowable current / current per bulb = 5 ÷ (10/220) = 5 × 220/10 = **110 bulbs**.

Q13. A hot plate of an electric oven connected to a 220 V line has two resistance coils A and B, each of 24 Ω resistance, which may be used separately, in series, or in parallel. What are the currents in the three cases?

Solution: (a) **Using one coil alone** (A or B), R = 24 Ω: **I** = V/R = 220/24 ≈ **9.17 A**.
(b) **Series combination:** R_s = 24 + 24 = 48 Ω: **I** = 220/48 ≈ **4.58 A**.
(c) **Parallel combination:** R_p = (24 × 24)/(24+24) = 12 Ω: **I** = 220/12 ≈ **18.33 A**.

Q14. Compare the power used in the 2 Ω resistor in each of the following circuits: (i) a 6 V battery in series with 1 Ω and 2 Ω resistors, and (ii) a 4 V battery in parallel with 12 Ω and 2 Ω resistors.

Solution: (i) **Series circuit:** Total R = 1 + 2 = 3 Ω. Current, **I** = 6/3 = 2 A (same current flows through the 2 Ω resistor). Power in 2 Ω resistor = $I^2R = 2^2 \times 2$ = **8 W**.
(ii) **Parallel circuit:** The full 4 V appears across each resistor (including the 2 Ω one). Power in 2 Ω resistor = $V^2/R = 4^2/2$ = **8 W**.
So the power used in the 2 Ω resistor is the **same (8 W)** in both circuits.

Q15. Two lamps, one rated 100 W at 220 V and the other rated 60 W at 220 V, are connected in parallel to the electric mains supply. What current is drawn from the line if the supply voltage is 220 V?

Solution: Current through the 100 W lamp, I_1 = P/V = 100/220 ≈ 0.4545 A.
Current through the 60 W lamp, I_2 = 60/220 ≈ 0.2727 A.
Since the lamps are in parallel, total current drawn from the line, $I = I_1 + I_2$ ≈ **0.73 A**.

Q16. Which uses more energy, a 250 W TV set in 1 hour, or a 1200 W toaster in 10 minutes?

Solution: Energy used by TV = P × t = 250 W × 1 h = **250 Wh**.
Energy used by toaster = 1200 W × (10/60) h = 1200 × 0.1667 = **200 Wh**.
Since 250 Wh > 200 Wh, the **TV set uses more energy** in this comparison, even though the toaster has a much higher power rating, because it runs for a much shorter time.

Q17. An electric heater of resistance 8 Ω draws 15 A from the service mains for 2 hours. Calculate the rate at which heat is developed in the heater.

Solution: Rate of heat developed = Electric power, $P = I^2R = 15^2 \times 8$ = 225 × 8 = **1800 W (i.e., 1800 J/s)**.
(Note: the given time of 2 hours is not required to find the *rate* of heat production, which is simply the power; it would be used to find the *total* heat, H = Pt = 1800 × 7200 s = 1.296×10^7 J, if asked.)

Chapter 12

Magnetic Effects of Electric Current

Key Concepts & Formulae (Quick Revision)

- **Magnetic field lines** emerge from the north pole and merge at the south pole (outside the magnet); they never intersect each other; their relative closeness indicates the relative strength of the field.
- **Right-hand thumb rule (Maxwell's rule):** If a current-carrying straight conductor is held in the right hand with the thumb pointing in the direction of current flow, the curled fingers indicate the direction of the magnetic field lines around it (concentric circles around the wire).
- **Magnetic field due to a current in a circular loop / solenoid:** field lines are concentric circles near the wire, becoming progressively larger and, at the centre of the loop, nearly straight; a current-carrying solenoid behaves like a bar magnet, and its field is more or less uniform inside.
- **Fleming's Left-Hand Rule** (force on a current-carrying conductor in a magnetic field): Stretch the thumb, forefinger and middle finger of the left hand mutually perpendicular. If the forefinger points in the direction of the magnetic field and the middle finger in the direction of current, the thumb gives the direction of the force (motion) on the conductor.
- **Electromagnetic induction:** Whenever there is relative motion between a magnet and a coil (or a changing current in a nearby coil), an **induced e.m.f. / induced current** is set up in the coil.
- **Fleming's Right-Hand Rule** (direction of induced current): Stretch the thumb, forefinger and middle finger of the right hand mutually perpendicular; if the forefinger points in the direction of the magnetic field and the thumb in the direction of motion of the conductor, the middle finger gives the direction of the induced current.
- **Electric generator:** converts mechanical energy into electrical energy, based on electromagnetic induction (a coil rotated in a magnetic field, or a magnetic field rotated near a coil).
- **Domestic wiring safety:** live wire (red insulation, high potential), neutral wire (black insulation, ~0 V) and earth wire (green insulation, safety wire connected to the metallic body of an appliance and driven into the earth) are used, along with a **fuse / MCB** of appropriate rating to protect the circuit from short-circuiting/overloading.

NCERT Exercise Questions – Complete Solutions

Q1. Which of the following correctly describes the magnetic field near a long, straight, current-carrying conductor?
(a) The field consists of straight lines perpendicular to the wire (b) The field consists of concentric circles centred on the wire (c) The field is the same everywhere around the wire, independent of distance (d) The field has no definite pattern

Solution: (b) The magnetic field lines around a long straight current-carrying conductor are **concentric circles**, centred on the wire and lying in planes perpendicular to it, with the field getting weaker as the distance from the wire increases (as given by the right-hand thumb rule).

Q2. Which of the following properties of a charged particle can change while it moves freely in a uniform magnetic field?
(a) mass (b) speed (c) velocity (d) charge

Solution: (c) velocity. The magnetic force on a moving charge always acts perpendicular to its velocity, so it changes only the **direction of motion** (i.e., the velocity as a vector), doing no work on the charge; hence the speed (magnitude of velocity), mass and charge of the particle remain unchanged.

Q3. The phenomenon of electromagnetic induction is:
(a) the process of charging a body (b) the process of generating a magnetic field due to a current flowing through a coil (c) producing an induced current in a coil due to relative motion between a magnet and the coil (d) the process of an electric motor rotating continuously

Solution: (c) Electromagnetic induction is the phenomenon of producing an **induced e.m.f. (and hence induced current)** in a coil as a result of relative motion between a magnet and the coil (or a change in current/magnetic flux linked with the coil).

Q4. The device used for producing electric current based on the principle of electromagnetic induction is called a/an:
(a) galvanometer (b) voltmeter (c) ammeter (d) generator

Solution: (d) generator (electric generator converts mechanical energy into electrical energy using electromagnetic induction).

Q5. State the rule to determine the direction of: (i) a magnetic field produced around a straight conductor-carrying current, (ii) the force experienced by a current-carrying straight conductor placed in a magnetic field perpendicular to it, and (iii) the current induced in a coil due to its rotation in a magnetic field.

Solution: (i) **Right-hand thumb rule (Maxwell's rule):** Hold the current-carrying straight conductor in the right hand such that the thumb points in the direction of the current; the direction in which the fingers curl gives the direction of the magnetic field lines.
(ii) **Fleming's Left-Hand Rule:** Stretch the thumb, forefinger and middle finger of the left hand mutually perpendicular to each other; if the forefinger points in the direction of the field and the middle finger in the direction of the current, the thumb gives the direction of the force on the conductor.
(iii) **Fleming's Right-Hand Rule:** Stretch the thumb, forefinger and middle finger of the right hand mutually perpendicular to each other; if the forefinger points in the direction of the magnetic field and the thumb in the direction of motion of the conductor, the middle finger gives the direction of the induced current.

Q6. Name two safety measures commonly used in electric circuits and appliances.

Solution: (i) **Electric fuse (or MCB – miniature circuit breaker)** of an appropriate current rating is connected in series in a circuit; it melts/trips and breaks the circuit if the current exceeds a safe value, preventing damage from short-circuits or overloading.
(ii) **Earthing (grounding)** of the metallic body of electrical appliances: a separate earth wire connects the metal casing of an appliance to the earth, so that if the casing accidentally becomes live (due to insulation failure), the current safely flows to the earth instead of giving the user an electric shock.

Q7. An electric oven of 2 kW power rating is operated in a domestic electric circuit (220 V) that has a current rating of 5 A. What result do you expect? Explain.

Solution: Current drawn by the oven, I = P/V = 2000/220 ≈ **9.1 A**. Since this exceeds the circuit's safe current rating of 5 A, connecting the oven to this circuit would cause an **excessive current to flow through the wiring**, generating heat well beyond the safe limit. This would likely cause the **fuse to blow (or the circuit breaker/MCB to trip)**, cutting off the supply; if there were no such protection device, it could overheat and damage the wiring insulation and even start a fire. Hence such a high-power appliance should be used on a circuit with a higher current rating (or its own separate circuit).

Q8. What precautions should be taken to avoid the overloading of domestic electric circuits?

Solution: (i) Avoid connecting too many high-power appliances (e.g., heater, oven, iron, geyser) to a single socket or circuit at the same time.
(ii) Avoid drawing power for several appliances simultaneously from one socket using multiple extension boards/adaptors.
(iii) Use a fuse/MCB of appropriate current rating for each circuit so that it cuts off the supply automatically in case the current exceeds a safe value.
(iv) Ensure separate circuits for high-power appliances and proper earthing of all appliances with metallic bodies.

Q9. List two methods of producing magnetic fields.

Solution: (i) By using a **permanent magnet** (e.g., a bar magnet), which has a magnetic field around it at all times.
(ii) By passing an **electric current through a conductor** (e.g., through a straight wire, a circular loop, or a solenoid) – this is called an electromagnet, and the field can be switched on/off and its strength controlled by varying the current.

Q10. When does an electric short circuit occur?

Solution: A short circuit occurs when the **live wire and the neutral wire come into direct contact** with each other (often due to damage/wear of the insulation), so that the resistance of the circuit suddenly becomes very small. This causes an abnormally **large current** to flow through the circuit in a very short time, generating a large amount of heat and posing a risk of fire, unless the fuse/circuit breaker immediately cuts off the supply.

Q11. Name the wire in a domestic electric circuit that carries the higher potential, and describe the usual colour coding of the three wires used in domestic wiring.

Solution: The **live wire** carries the higher (alternating) potential (about 220 V) relative to the neutral wire, and is conventionally given a **red** insulation cover. The **neutral wire** is at (or close to) zero potential and is given a **black** insulation cover. In addition, a third **earth wire** (green insulation), normally at zero potential, is connected to the metallic body of appliances and driven into the earth, providing a safety path for leakage current and protecting the user from electric shocks.

— End of Physics Point NCERT Class 10 Physics Solutions (2026-27) —

All solutions in this booklet have been carefully worked out step-by-step by the physics faculty at Physics Point, in accordance with the rationalised NCERT Class 10 Science syllabus (Physics units, Chapters 9–12) prescribed for the 2026-27 academic session. Students are encouraged to attempt each question independently before referring to the solution, and to draw the relevant ray diagrams / circuit diagrams / field-line diagrams neatly in their own notebooks for full marks in the board examination.