Solution

Class 10 - Science

2020-2021 - Paper-2

Section A

1. Since convex mirror always forms a virtual and erect image irrespective of the position of the object in front of the mirror. So the given spherical mirror is convex mirror.
2. Cornea and Aqueous humour refract most of the light entering the eye.
3. The total energy consumed by the refrigerator in 30 days would be
   400 w $\times$ 8.0 hour/day $\times$ 30 days = 96000 W h
   = 96 kWh
   Thus the cost of energy to operate the refrigerator for 30 days is
   96 kW h $\times$ ₹ 3.00 per kWh = ₹ 288.00

   OR

   Refraction can change path of light with change of medium.
4. A concave lens is used to form an image formed is diminished and between focus and optical centre on the same side as that of the object.

   OR

   Magnification of a lens is to the ratio of the height of the image formed by lens to the actual height of object. If h is the height of the object and h' the height of the image formed by lens, then magnification $m = \frac{h'}{h}$

   If u and v are the distances of object and image
   $m = \frac{h'}{h} = \frac{v}{u}$
5. Ciliary muscles help in changing the focal length of the eye lens.
6. The amount of charge Q, that flows between two points at potential difference V (= 12 V) is 2 C. Thus, the amount of work W, done in moving the charge [from Eq. ($V = \frac{W}{Q}$)] is
   W = VQ
   = 12 V $\times$ 2 C
   = 24 J
   Hence, 24 J of work is done in moving a charge of 2 C across two points having a potential difference 12 V.

   OR

   Light is a form of energy which gives us the sensation of sight or vision.
7. When the equivalent resistance of connecting wire is low then, wire should be connected in parallel combination. So equivalent resistance can be obtained by the given formula :
   $\therefore \frac{1}{R_{\text{eff}}} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{6} + \frac{1}{3} = \frac{1+2}{6} = \frac{3}{6} = \frac{1}{2}$
   $\Rightarrow \quad R_{\text{eff}} = 2\Omega$
8. Power of a lens is one dioptre if focal length of a lens is 1m

   OR

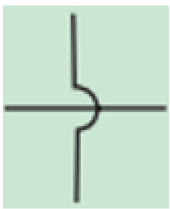
   When image formed at retina, light sensitive cells get activated and generate electrical signal. These signals are sent to brain via optic nerve.
9. P = VI
   = 220V $\times$ 0.50 A
   = 110 J/s
   = 110 W
   The power of the bulb is 110W.
10. 1kWh = 1,000 Ω × 1h = 1,000 J/S × 3600S
    1kWh = 3,600,000 J = 3.6 ×10^6 J
11. **(a)** Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.
    Explanation: Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

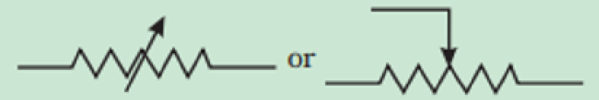
    OR

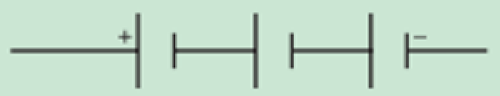
(a) Both A and R are true and R is the correct explanation of the assertion.
Explanation: Both A and R are true and R is the correct explanation of the assertion.

12. **(a)** Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.
Explanation: Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.
13. i. (c) spectacles for the correction of short sight
ii. (c) virtual, inverted and diminished
iii. (a) concave lens
iv. (b) focal length
v. (a) converges, diverges
14. i. (d) all of these
ii. (b) $H = I^2RT$
iii. (a) 3380°C
iv. (c) both (a) and (b)
v. (a) series
15. i. (c) - Watt
ii. (b) - ₹ 24
iii. (d) - all of these
iv. (a) - 1000 watts
v. (b) - 110 W
16. i. (d) At the focus F
ii. (b) At C
iii. (c) Both (a) and (b)
iv. (a) at the focus F
v. (c) Highly enlarged
17. We are given, I = 0.5 A; t = 10 min = 600 s.
we have,
$Q = I \times t$
$= 0.5 \text{ A} \times 600 \text{ s}$
= 300 C
Hence, the amount of electric charge that flows through the circuit is 300 C
18. The device used as a lens in case, when the image formed is virtual and erect and when an object is placed between the focus and device image formed is enlarged and on the same side as that of the object is a convex lens.
19. Concave mirrors are used as reflectors in headlights of cars. When a bulb is located at the focus of the concave mirror, the light rays after reflection from the mirror travel over a large distance as a parallel beam of high intensity.
20. Electrical resistivity of a material of a conductor is the resistance offered by unit length and unit area of cross section of a wire of the material.
Its S.I. unit is ohm-metre.

Section B

21. Refractive index of glass = $\frac{speed\ of\ light\ in\ vacuum}{speed\ of\ light\ in\ glass}$
$1.50 = \frac{3 \times 10^8}{V_g}$
$V_g = 2 \times 10^8 ms^{-1}$
22. The symbols of the following components that are used in the circuit diagram are as follows:
i. 

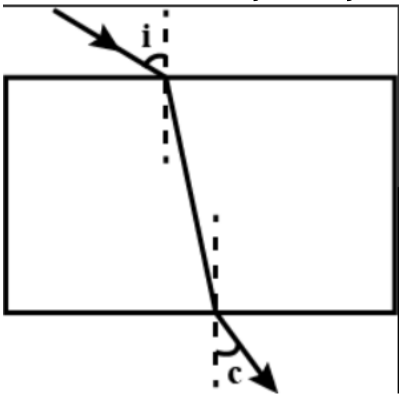
ii. 

iii. 

23. The refractive index for the light going from medium ‘ 1’ to medium ‘2’ is e to the reciprocal of the refractive index for light going from medium ‘2’ medium ‘1’. $1^{u}2 = \frac{1}{2^{u}1}$
24. Resistance R of a conductor depends upon length and area A of conductor. It has been experimentally confirmed that:
$R \propto I$, the length of the wire
$R \propto \frac{1}{A}$, where A is the area cross-section of the wire
Combining above, we have: $R \propto \frac{1}{A}$ or R = $\rho\frac{1}{A}$
Where ρ is a constant called specific resistance or electric resistivity of the material of the conductor.
If I = 1, A = 1, ρ = R.
i.e. specific resistance (or electric resistivity) of a conductor is the resistance of a wire of unit length and a unit area cross-section. It may be defined as:
Specific resistance of a conductor is the resistance of unit cube of the conductor.
Unit of ρ:
$\rho = \frac{RA}{l} = \frac{ohm\ m^2}{m} = ohm\ m$

OR

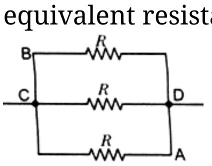
Advantages of parallel wiring in the domestic circuit are:
   1. Voltage supply remains the same for all appliances connected in parallel.
   2. If one appliance is not in order, it is not going to affect the working of other appliances.
   3. If one appliance is turned on then other appliances can remain off saving lot of power.
25. When a rectangular glass slab is immersed in any medium, the ray incident on the slab suffers two refractions and emerges parallel to itself but displaced//shifted laterally as shown in the figure. This is because deviation suffered by the ray in the first refraction at one face of slab is equal and opposite to deviation suffered by the ray in 2nd refraction at the other face of the slab.



26. According to Ohm's law, physical conditions remaining constant, V μ I where V is the potential difference across the ends of conductor and I, the current flowing through it.
When potential difference is halved, the current will be halved since resistance remain constant.
∴ For same resistance, current is half of the former.

Section C

27. The point C is connected to B and the point D is connected to A. Therefore, three identical resistors, each having resistance R, are connected in parallel and the equivalent circuit diagram is shown in the figure. If the equivalent resistance is R then

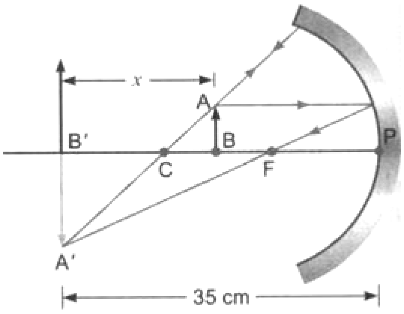


$\frac{1}{R'} = \frac{1}{R} + \frac{1}{R} + \frac{1}{R}$

$= \frac{3}{R}$

$\Rightarrow$ R' = $\frac{R}{3}$

28. (i) Focal length = 1/power = 1/5D = 1/5m = 20cm
It is convex lens of focal length 20cm.
So, the Magnified image will be formed in all cases, 20cm is focus, 18 cm is on focal length, 22 cm and 30 cm is between focus and focus and center of curvature. In all cases, magnified image is formed.
(ii) In case of 22 cm and 30 cm image formed is real and hence can be obtained on screen.
29. According to Ohm's law, the current (I) flowing through a conductor is directly proportional to the potential difference (V) across its ends, provided its physical conditions remain the same.
Ohm's law does not hold good under all conditions as it is not a fundamental law of nature like Newton's laws.
It is obeyed by metallic conductors only when physical conditions like temperature etc. are kept unchanged.
It is not obeyed by a lamp filament, Junction diode, thermistor, etc.
30. i. R_{AC}= R
ii. The potential of B and D when the voltage source is applied across A and C remains the same.
iii. The potential of B and D when the voltage source is applied across A and B is different.
31. Here, f =-10 cm; v = - 35 cm (since the image is formed on the wall and distance between the wall and mirror is 35 cm). Image is beyond 2f so object has to be in between F and C.
Let the distance of the object from the wall be x.



Let the distance of the object from the wall be x.
Therefore, u = -(35 - x)

$\frac{1}{u}+\frac{1}{v}=\frac{1}{f}$

$\frac{1}{-(35-x)}+\frac{1}{35}=\frac{1}{-10}$

or $\frac{1}{35-x}=\frac{1}{10}-\frac{1}{35}$

or $\frac{1}{35-x}=\frac{7-2}{70}$

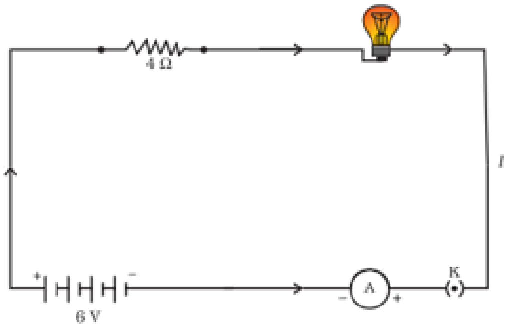
$\frac{1}{35-x}=\frac{5}{70}$

35-x = 14
x = 49 cm
Therefore, the distance of the object from the wall = 49 cm

OR

The resistivity of a given material is defined as the resistance of a conductor made of that material of unit length and unit cross-sectional area. It can be further defined as the resistance offered by a cube of that material of side 1 m, when current flows perpendicular to the opposite faces. Its S.I unit is ohm-metre (Ωm)
Using, R = $\rho\frac{l}{A}$,it can be noted that $R \propto l$ and $R \propto 1/A$
So, as the length of the wire is doubled,(area of cross section becomes half,if its streched to double its size). Hence, the resistance of the wire gets doubled.
From Ohm's Law, V = IR
If V remains unchanged,with resistance getting doubled,current becomes half of its original value.

32. Figure: An electric lamp connected in series with a resistor of 4 Ω to a 6 V battery.



a. The resistance of electric lamp, R1 = 20 Ω,
   The resistance of the conductor connected in series, R2 = 4 Ω.
   Then the total resistance in the circuit R =R1 + R2 Rs = 20 Ω + 4 Ω = 24 Ω.
   The total potential difference across the two terminals of the battery V = 6 V.
b. Now by Ohm's law, the current through the circuit is given by I = V/Rs = 6 V/24 Ω = 0.25 A.

33. i. In the above figure,
   $\angle N'OO' = \angle MO'O = \angle r$ = angle of refraction
   lateral displacement = Distance O'B
   ii. Given, refractive index from air to glass is $\frac{3}{2}$.
   i.e. ${}_a\mu_g = \frac{\mu_g}{\mu_a} = \frac{3}{2}$.
   and we know that,
   $\Rightarrow {}_a\mu_g \times_g \mu_a = 1$
   $\Rightarrow {}_g\mu_a = \frac{1}{{}_a\mu_g}$
   $\Rightarrow {}_g\mu_a = \frac{1}{\left(\frac{3}{2}\right)} \Rightarrow_g \mu_a = \frac{2}{3}$
   i.e. refractive index of air for light going from glass to air is ${}_g\mu_a = \frac{2}{3}$

Section D

34. i. There will be no effect on the glow of the other two bulbs and will remain the same when B_1 gets fused because the three bulbs are connected in parallel and the glowing of the bulb depends on power and the potential difference and resistance remains same of other two bulbs.
   ii. When there are parallel connections:
   Net resistance will be $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$
   Since resistance is the same so, $R' = \frac{1}{R_3}$
   Applying ohm's law V= IR
   R = 4.5Ω
   Since B_2 gets fused, so now only two bulbs B_1 and B_3 are in parallel
   Therefore net resistance in parallel $\frac{1}{R'} = \frac{2}{R}$
   R' = $\frac{4.2}{2}\Omega$
   I = $\frac{V}{R'} = 2 \times \frac{4.5}{4.5}$
   I = 2A
   So, current will be distributed in both the bulbs as 1 A each.
   iii. The power dissipated when all three bulbs glow together is
   P = V $\times$ I
   P= 4.5 $\times$ 3 = 13.5 W

OR

Height of the object h = + 2.0 cm; Focal length f = + 10 cm; object-distance u = -15 cm; Image-distance v = ?
Height of the image h' = ?
Since $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$
or, $\frac{1}{v} = \frac{1}{u} + \frac{1}{f}$

$\frac{1}{v} = \frac{1}{(-15)} + \frac{1}{10} = -\frac{1}{15} + \frac{1}{10}$

$\frac{1}{v} = \frac{-2+3}{30} = \frac{1}{30}$

or, v = + 30 cm

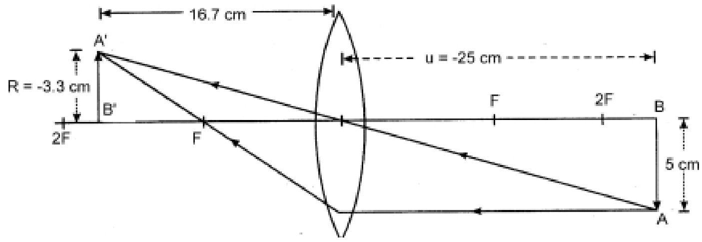
The positive sign of v shows that the image is formed at a distance of 30 cm on the other side of the optical centre. The image is real and inverted.

Magnification m = $\frac{h'}{h} = \frac{v}{u}$ or, h' = $h\frac{v}{u}$

Height of the image, h' = $(2.0)(\frac{+30}{-15})$ = -4.0 cm

or m = $\frac{+30\text{cm}}{-15\text{cm}}$ = -2

The negative signs of m and h' show that the image is inverted and real. It is formed below the principal axis. Thus, a real, inverted image, 4 cm tall, is formed at a distance of 30 cm on the other side of the lens. The image is two times enlarged.

35. 

h = 5 cm; h' = ?, u = - 25 cm [Object distance is always negative]

v = ?; f = + 10 cm [convex lens]

Using $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$ or $\frac{1}{v} = \frac{1}{f} + \frac{1}{u}$

$\frac{1}{v} = \frac{1}{-25} + \frac{1}{10} = \frac{-2+5}{50} = \frac{3}{50}$

v = 16.7 cm

m = $\frac{h'}{h} = \frac{v}{u}$ $or\ h' = h\frac{v}{u}$

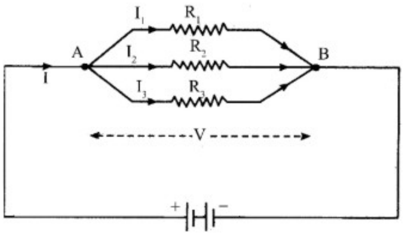
$h' = 5\frac{\frac{50}{3}}{-25} = \frac{-250}{75} = -3.3\ cm$

h' = - 3.3 cm

Negative sign shows image is inverted, real, diminished (3.3 cm) and at 16.7 cm on the right side of lens.

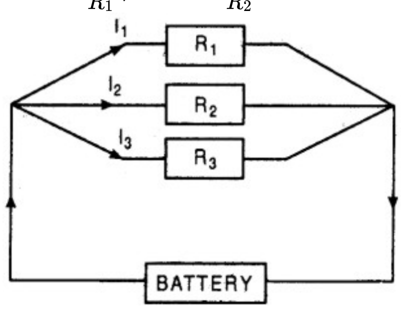
36. A circuit in which two or more resistors are connected across common points so as to provide separate paths is called parallel circuit.

In this case, the same potential difference will be maintained between the two ends of every resistor and the current will divide itself in various branches.



Let the resistors R_1, R_2 and R_3 be joined in parallel to the points A and B. Let the current I reaching A divide itself into three parts I_1, I_2 and I_3 along R_1, R_2 and R_3 respectively. Let V be the potential difference between the points A and B. The current flowing in the individual resistors are then given by :

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



Let R_p be the resistance of the combination, then I = $\frac{V}{R_p}$ But I = $I_1 + I_2 + I_3$

or $\frac{V}{R_p} = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3} or \frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$
The result holds true for any number of resistors.

OR

If u is the distance of object and v, the distance of image from optical centre of the lens, then focal length *f* is related to *u* and *v* by $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$ which is called lens formula. The formula is equally applicable to convex, concave or any other type of lens. (e.g. concavo-convex, plano-convex, convexo-concave, plano-concave etc.)

Sign Conventions:

(1) The object is always placed to the left of the lens.
(2) All distances parallel to principal axis are measured from optical centre of the lens.
(3) All distance measured to the right of optical centre (along x-axis) are taken as positive while those measured to the left of optical centre (along x-axis) are taken as negative.
(4) Distance measured perpendicular to and above the principal axis (along y axis) are taken as positive.
(5) Distance measure perpendicular to and below the principal axis (y'-axis) are taken as negative.

Assumptions (1) Object is taken on principal axis. (2) The lens is thin.