PHY 102: TUTORIAL QUESTIONS

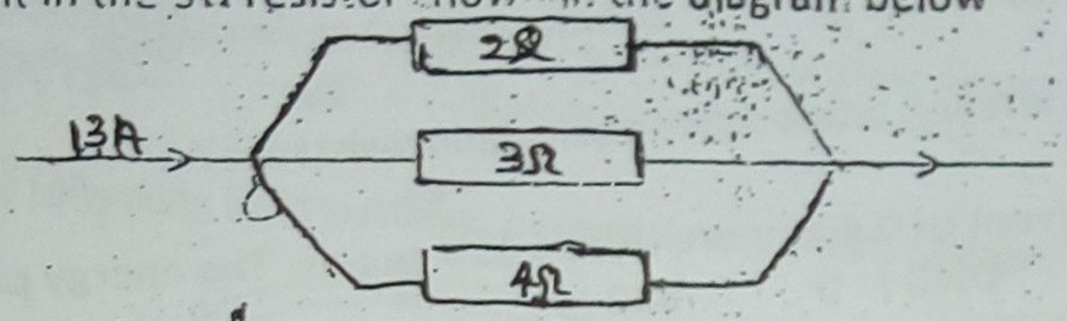
1) Which of the following expressions about the image formed by a plane mirror is/are LIKELY UNTRUE?
I. virtual II. magnified III erect IV farther from the mirror than the object
A I only B I and III only C I and II only D I and IV only

2) A transparent rectangular block 5.0cm thick is placed on a black dot. The dot when viewed from above is seen 3.0cm from the top of the block. Calculate the refractive index of the material of the block.
A 5/3 B 3/5 C 2/5 D 3/2

3) Which of the following mirrors has its radius of curvature twice its focal length?
A Plane mirror only B Convex and concave mirror C Concave mirror only D Convex mirror only

4) The image formed by a diverging lens is always
A real, inverted, diminished and on the same side as the lens.
B real, inverted, magnified and on the opposite side of the lens.
C virtual, upright diminished and on the same side as the lens.
D real, upright, magnified and on the same side as the lens.

5) Calculate the current in the 3Ω resistor shown in the diagram below



A 3.5A B 12.0A C 4.1A D 4.0A

6) Water and Glass are examples of
A Translucent bodies B Transparent and Translucent bodies C Opaque D Transparent bodies.

7) The light rays that travel from a source and meet at a point is known as
A Convergent rays of light B Beam of light C Divergence beam D Parallel rays of light

8) An image which can be formed on a screen is said to be
A virtual B erect C real D inverted.

9) If the Earth and Moon are in positions where the extreme rays at the Moon's edge intersect before reaching the Earth the type of solar eclipse that is going to form is called
A partial eclipse B lunar eclipse C total eclipse D annular eclipse

10) The refractive index of benzene is 1.5. What is the critical angle of benzene?
A 48° B 90° C 42° D 0.667°

11) A prism is used to refract a ray of light passing through it. If A is the refracting angle of the prism, n the refractive index of the material of the prism and D the minimum angle of deviation, which of the following equations denotes the correct relationship between A, n and D

A $n = \sin\frac{1}{2}(A + D)$ B $n = \cos\frac{1}{2}(A + D)$ C $n = (\sin\frac{1}{2}(A + D))/\sin\frac{1}{2}A$

D $n = (\cos\frac{1}{2}(A + D))/\cos\frac{1}{2}A$

12) The direction of a light ray changes as it passes from one medium to another. The phenomenon is called
A diffraction B reflection C dispersion D refraction

13) A ray of light is incident at an angle of 30° on a glass prism of refractive index 1.5. Calculate the angle through which the ray is minimally deviated in the prism. (Hint: The medium surrounding the prism is air).
A 10.5° B 19.5° C 38.9° D 21.1°

14) For the production of a pure spectrum, two converging lenses, a prism, and a light source are used. What is the function of the lens near the light source?
A To separate the light colours B To produce parallel rays which are incident on the prism C To diverge the light rays incident on the prism D To converge light rays on.

15) An object is placed 20.0cm from a converging lens. If the real image formed is 80.0cm from the object, the focal length of the lens is:
A 15.0cm B 30.0cm C 22.5cm D 16.0cm

16) For correcting long sight defects in the human eye we require a
A converging lens B diverging lens C periscope D microscope

17) A negatively charged rod is brought near the cap of a gold leaf electroscope. The cap is earthed momentarily while the rod is near to it. The rod is then removed. Which of the following is correct?
A The cap will be positively charged and the negatively charged leaves will diverge B The cap will be negatively charged and positively charged leaves will diverge C The cap and the leaves will be positively charged D The cap and the leaves will be negatively charged.

f a lens? A. Projector B. Periscope C. Eye D. Telescope

B (19). The ability of the eye to focus objects at different distances is called
B Accommodation C Normal vision D Long sight.

20). What part of the camera corresponds to the iris of the eye? A Shutter B Lens
C Diaphragm D Focusing ring.

21). When a ray of sunlight passes obliquely through a rectangular glass block, A it emerges without displacement parallel to the incident ray. B It get dispersed into seven visible colours without any deviation at all. C It deviates without dispersion. D It gets laterally displaced, and the emergent ray is parallel to the incident ray.

22). When a glass rod is rubbed with silk and an ebonite rod is rubbed with fur, the rod acquires
A positive and positive charges B negative and positive charges C positive and negative charges D negative and negative charges

23). When charging an insulated conductor by induction, the following steps are usually taken.
I Bring a charged body near to the conductor II Remove the charged body III Touch the conductor with a finger IV Remove the finger
C I, IV, III, II A I, II, III, IV B I, III, IV, II D I, III, II, IV

24). Which of the following instruments can be used to compare the relative magnitudes of charge on two given bodies?
A The electrophorus B Ebonite rod C Gold-leaf electroscope D Capacitor

25). Three resistors are connected in parallel. What is the equivalent resistance? A 9.0Ω B 3.0 Ω
C 1.0 Ω D 6.0 Ω

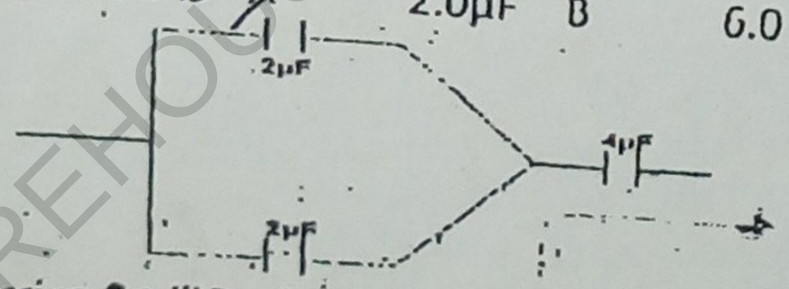
26). The headlamp of a car takes a current of 0.4 ampere from a 12V supply. The energy produced in 5 minutes is
A 24 J B 240 J C 1440 J D 330 J

27). What is the electric potential energy between two protons of charge q and at a distance of r apart? (Permittivity of free space = ε_0) A $4\pi\varepsilon_0 q^2 r$ B $qr/4\pi\varepsilon_0$ C $q/4\pi\varepsilon_0 r$ D $q^2/4\pi\varepsilon_0 r$

28). Which of the following processes will increase the size of the image in a pinhole camera?
A Enlarging the size of the pinhole B Decreasing the size of the pinhole C Moving the object away from the camera D Moving the object nearer to the camera

29). In the arrangement illustrated below, Y and B are yellow and Blue transparent light filters respectively. The colour of a white opaque object when viewed through the filters is A blue B yellow C black D red

30). The net capacitance in the circuit below is A 2.0μF B 6.0 μF C 4.0 μF D 8.0 μF



31). A work of 30J is done in transferring 8milliCoulombs of charge from a point B to a point A in an electric field. The potential difference between B and A is
A 3.4×10^3 V B 1.7×10^3V C 1.6×10^{-3}V D 6.0×10^{-3}V

32). A charge of 1.0×10^{-6}C experiences a force of 40 N at a certain point in space. What is the electrical field intensity?
A 8.0×10^{-6} NC^{-1} B 4.0×10^{-6} NC^{-1} C 4.0×10^{7} NC^{-1} D 2.0×10^{-7} NC^{-1}

33). The S.I. unit of electric charge is the
A Coulomb B ampere C coulomb D volt

34). A capacitor of capacitance 160μF is charged to a potential difference of 200V, and then connected across a discharge tube, which conducts electrons until the potential difference across it falls to 100V. The energy dissipated in the tube is
A 6.4 J B 4.8 J C 3.2 J D 3.4 J

35). An electrical lamp is marked 240V, 60W. What is its resistance when it is operated at the correct voltage?
A 1/960 B ¼ C 4 D 960

36). The image in a pin-hole camera is always A diminished B enlarged C upright inverted

37). The velocities of light in air and glass are 3.0×10^8 ms^{-1} and 1.8×10^8 ms^{-1} respectively. Find the refractive index of air to glass

A 1.2 B 1.0 C 0.8 0.6

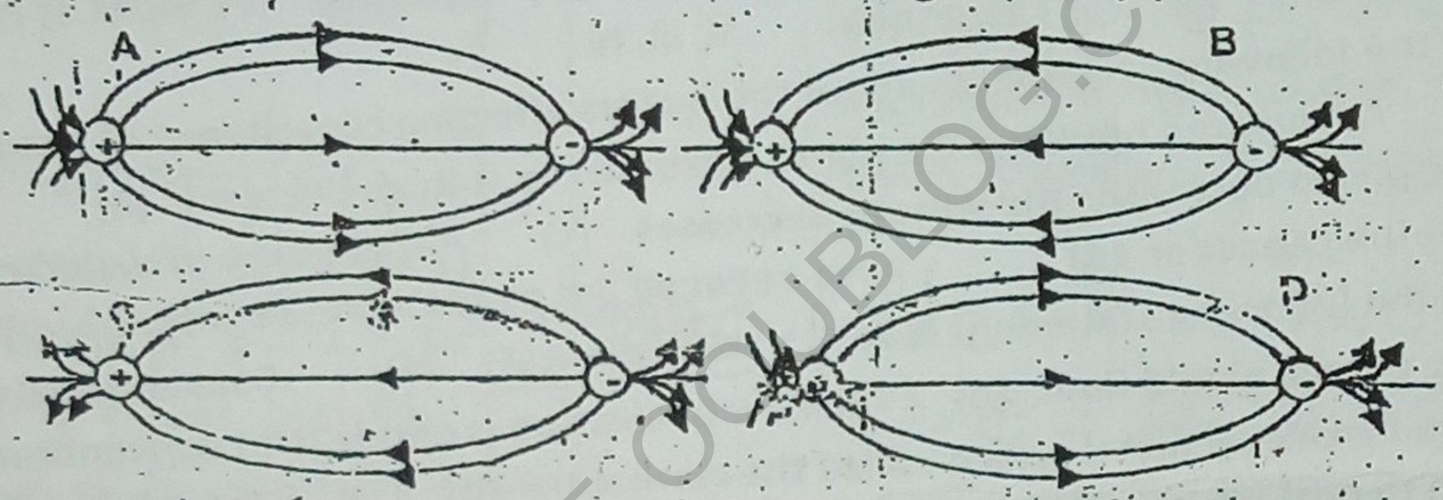
38). A concave mirror of radius of curvature 20cm has a pin placed at 15cm from its pole. What will be the magnification of the image formed? A 4.00 2.00 C 1.33 D 1.50

39). A parallel beam of light is to obtained from the headlamp of a car. At which of the following positions should the source of light be placed from the pole of its spherical mirror? At the centre of curvature C Beyond the centre of curvature at the focal point D Between the focal point and the pole

40). A simple microscope forms an image twice the size of the object, if the focal length of the lens of the microscope is 20m, how far is the object from the lens? A 10m B 30m C 20m D 60m

41). Which of the following pairs of light rays shows the widest separation in the spectrum of white light? A Yellow and red Red and indigo C Violet and blue D Blue and green

42). Which of the following field patterns between two unlike charges is likely NOT UNTRUE?



43). A cell of e.m.f. 1.5V and internal resistance of 2.5Ω is connected in series with an ammeter of resistance 0.5Ω and a resistor of resistance 7.0Ω. Calculate the current in the circuit: A 0.19A B 0.20A C 0.60A D 3.00A

44). Which one of the following is used for controlling the amount of light entering the eye? Cornea B Pupil C Optic nerve D Iris

45). Which one of the statements is not correct for a light ray passing through a rectangular glass block which is surrounded by air? A suffers a displacement at the point of emergence B emerges parallel to the incidence ray C is partly reflected at the point of incidence D is deviated at the point of emergence

46). In the normal use of a simple microscope, a person sees an A inverted, virtual and magnified image B erect, virtual and magnified image C erect, real and magnified image D inverted, real and magnified image.

47). A ray of light is incident on a plane mirror at an angle of 35°. What is the angle made by the reflected ray with the surface of the mirror? A 125° B 70° C 65°. 55°

48). An image which cannot be formed on a screen is said to be A inverted B virtual C real D blurred

49). When white light passes through a triangular glass prism, there is dispersion because of A diffraction of light B polarisation of light the difference in speeds of the components of light. D the interference of light waves in glass

50). A glass rod rubbed with silk becomes positively charged because: A some positive charges are transferred from the silk to the glass B some electrons are transferred from silk to the glass C the silk becomes deficient in electrons some electrons have been transferred from glass to silk.

51). The flow of electric charges in a capacitor when discharge is (a) from one plate to the other (b) from two plates (c) from positive to negative plates (d) from positive charge to the battery.

52). During the process of charging a capacitor, as the charges stored in the capacitor increases, the potential difference between the plates (a) neutralized (b) increase (c) decreases (d) remain constant.

53). In other to charge the capacitor in the figure below, the electron from the battery connected to the capacitor flows from (a) positive terminal of the battery on to the plate A of the capacitor, (b) positive terminal of the battery on to the plate B of the capacitor (c) negative terminal on to the plate B of the capacitor (d) negative terminal on to the plate B of the capacitor.

54). The flux inside a charge empty spherical surface of radius 'r' is (a) Q/ε_o (b) $E.4\pi r^2$ (c) 0 (d) ε_o/Q

55). The Gauss's law is given mathematically as (a) $\oint \bar{E}.d\bar{A} = \frac{Q}{\varepsilon_o}$ (b) $\oint \bar{E}.d\bar{A} = \frac{\sigma}{A}$ (c) $\oint \bar{E}.d\bar{A} = EQ$ (d) $\oint \bar{E}.d\bar{A} = E.4\pi r^2$

56). Which of these statement about electric potential are NOT UNTRUE (I) The Earth is at zero potential when any charge that enter the earth is neutralized (II) If work is done against the field, the potential is positive (III) The electric potential is a region where electric charge is experienced (IV) If work is done by field the potential is negative. So point of positive potential is said to be at higher potential than those of negative potential. (a) I & II only (b) I, II, III (c) I, II, IV (d) II, III, IV

57). Which of the following statements about the factors affecting capacitance of a capacitor is UNLIKELY NOT UNFALSE (a) As the area between the plates increase the voltage decrease (b) when the distance separating the plates decreases the voltage decreases (c) The nature of dielectric will increase the capacitance of the capacitor (d) Area between the plates increase with the voltage

58). Which of the following statement is TRULY NOT UNFALSE (a) Conventional current is in the direction in which positive charge would flow. (b) The flow of electron is opposite to conventional current (c) Current per unit cross-sectional area is called the current density. (d) The flow across a circuit of electron is from negative to positive battery terminal

59). When Ohm's law is obeyed, which of the statement is/are UNFALSE (I) Resistivity is constant (II) Temperature is constant (III) Current is inversely proportional to the potential difference (a) I only (b) II & III only (c) I & II only (d) III only

$V = IR$ $V \propto I$ $V = RI$

$\oint \bar{E}.d\bar{A} = Q/\varepsilon_o$

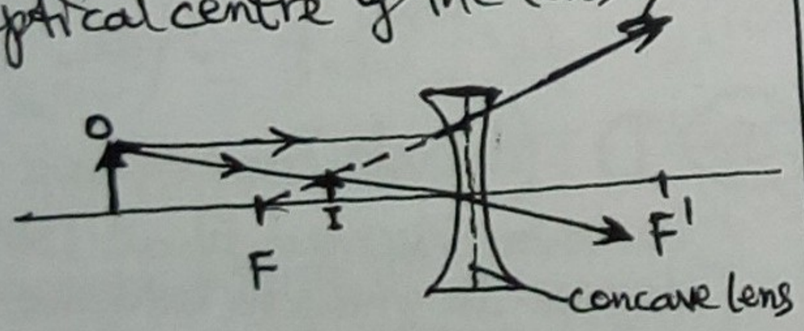
ANSWERS TO PHY 102 TUTORIAL QUESTIONS

1. **B** (Image formed by a plane mirror is virtual, erect (upright), laterally inverted, same distance from the mirror as the object, same size as the object and of linear magnification one. UNFALSE ⇒ TRUE.)

2. **A** ($t = 5\,cm$, $t' = 3\,cm$, $n = t/t'$ or $n = \frac{\text{real depth}}{\text{apparent depth}} = \frac{5cm}{3cm} = 5/3$)

3. **B** (All spherical mirrors (i.e. concave and convex mirrors) have the relationship: $r = 2f$, or $f = r/2$, where f is focal length and r is radius of curvature.)

4. **C** (Image formed by a concave or diverging lens irrespective of object's position is virtual, erect (upright), diminished (reduced) on the same side as the object (i.e. virtual side) and located between focal point and the optical centre of the lens.)



5. **D** [For the resistors in parallel and with the same potential difference, V, across, $\frac{1}{R} = \frac{1}{2} + \frac{1}{3} + \frac{1}{4} = \frac{13}{12}$, or $R = \frac{12}{13}\Omega \Rightarrow V = IR = 13 \times \frac{12}{13} = 12V$. But $V = I_3 R_3$ (for resistances in parallel), $\therefore I_3 = V/R_3 = \frac{12V}{3\Omega} = 4.0A$]

6. **D** (They allow light to travel fully through them unlike translucent bodies like frosted glass, sunglasses, wax paper, tinted windows, etc.)

7. **A** (i) S• parallel rays or beam; (ii) S• divergent rays or beam; (iii) S• convergent rays or beam; where S = source)

8. **C** (Virtual image cannot be formed on a screen ⇒ ∨ (object distance) measured for any virtual image is negative.)

9. **D** (In an annular eclipse of the sun, a ring of light is formed round the shadow of the moon unlike in total and partial eclipses of the sun.)

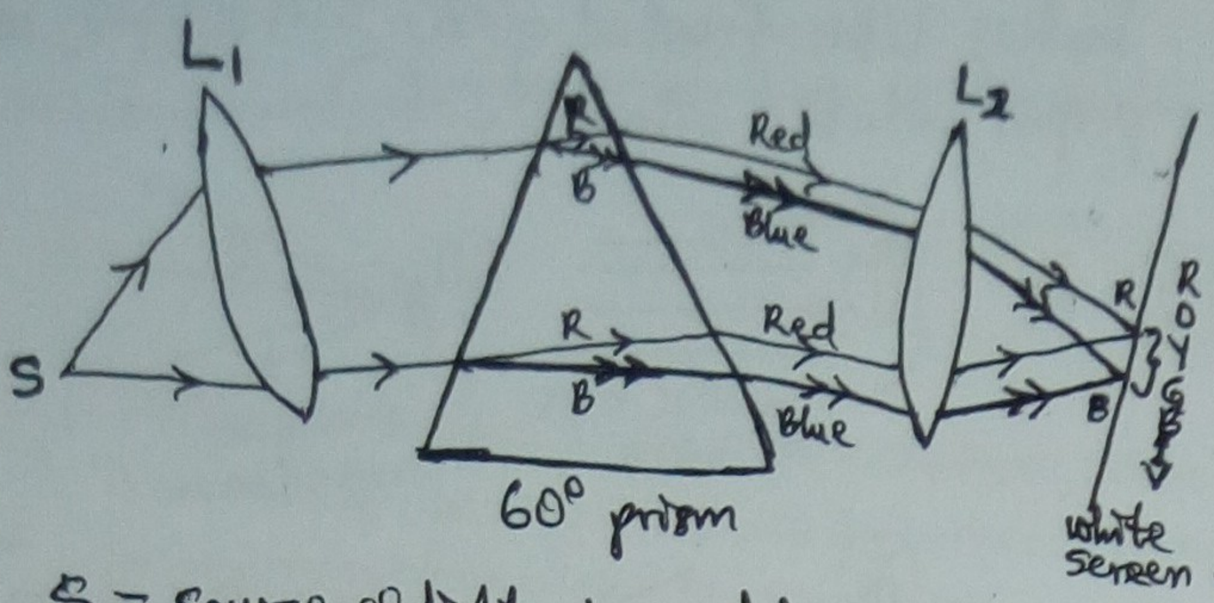
10. **C** ($\sin c = 1/n \Rightarrow \sin c = 1/1.5 = 0.6667$ $\therefore c = \sin^{-1}(0.6667) \approx 42^\circ$)

11. **C** [For refraction through a glass prism with minimum angle of deviation, D, and refracting angle, A, $\Rightarrow A = 2r$, $D = 2(i - r)$ and $n = \frac{\sin \frac{1}{2}(A + D)}{\sin \frac{1}{2} A}$ $= \cos \frac{1}{2} D + \cot \frac{1}{2} A \sin \frac{1}{2} D$]

12. **D** (Refraction or bending of light rays involves a change in speed, wavelength and direction of the light rays but frequency is unaffected as the rays pass from one optical medium to another.)

13. **D** ($i = 30^\circ$, $n = 1.5$, $D = ?$ But $n = \frac{\sin i}{\sin r}$ according to Snell's law, then $\sin r = \frac{\sin i}{n} = \frac{\sin 30^\circ}{1.5} = 0.3333$; $\therefore r = \sin^{-1}(0.3333) = 19.45^\circ$. But $D = 2(i - r)$, $\Rightarrow D = 2(30^\circ - 19.45^\circ) = 21.1^\circ$)

14. **B** (The production of a pure spectrum of white light is shown diagrammatically below ▶)



S = Source of light, L_1 and L_2 are convex lenses.)

(15.) **A** [$\frac{1}{f} = \frac{1}{20} + \frac{1}{60}$ (Since $u+v=80$, or $v = 80-u = (80-20)\text{cm} = 60\text{cm}$);
$\therefore f = \frac{60}{4}\text{cm} = 15\text{cm}$]

(16.) **A** [Converging or convex lens used to correct long sightedness or hypermetropia brings the image (formed behind the retina) to be focussed on the retina. Concave or diverging lens is used to correct short sight defect (or myopia).]

(17.) **C** (This involves charging an electroscope by induction.)

(18.) **B** (Simple periscopes utilize plane mirrors, while high-quality periscopes utilize 90°, 45°, 45° angular prisms as reflectors.)

(19.) **B** (Accommodation enables the eye to focus on both near and distant objects clearly as their images are formed on the retina.)

(20.) **C** (Read up similarities and differences between the human eye and the lens camera.)

(21.) **D** (Compare refraction through rectangular block and prism for an obliquely incident beam of light or sunlight.)

(22.) **C** [The rods (glass and ebonite rods) acquire positive and negative charges respectively.]

(23.) **B** (The acronym for electrostatic induction is "BTR".
⇒ B = Bring a charged body near to the conductor,
T = Touch the conductor with a finger for earthing,
R = Remove the finger (after earthing), and
R' = Remove the charged body so as to distribute opposite charge on the conductor.)

(24.) **C** (Gold-leaf electroscope is the simplest type of electroscope used for detecting the nature of electric charges on conductors.)

(25.) **C** [$\frac{1}{R} = \frac{1}{3} + \frac{1}{3} + \frac{1}{3}$ (resistors in parallel combination)
$\Rightarrow \frac{1}{R} = \frac{3}{3} = 1$, or $R = 1.0\Omega$]

(26.) **C** (I = 0.4A, V = 12V, t = 5minutes = (5×60)secs = 300secs.
Energy produced = IVt
= (0.4)(12)(300)J = 1440J.)

(27.) **D** [Electric potential energy
$U(r) = F_E r = \frac{kq_1q_2}{r} = \frac{q^2}{4\pi\varepsilon_0 r}$,
where $q_1 = q_2 = q$ (proton charge)
and $k = 1/4\pi\varepsilon_0$.]

(28.) **D** (Pinhole camera was the earliest camera invented about 1550 without lenses. It gives an evidence on the principle of rectilinear propagation of light. It forms an inverted image on the paper screen directly opposite its pin hole (small hole). The closer the object to the camera, the larger the image, and a brighter and blurred image is formed when the pinhole is larger in size, and vice versa.)

29. C (Light filters absorb wavelengths of light to which it is opaque and transmit the others. Read up colour mixing (both additive and subtractive) and light filters.)

30. A [The two 2μF capacitors are in parallel ⇒ $C_{eff} = C_1 + C_2$ $= (2+2)\mu F = 4\mu F$ which is in series with the 4μF capacitor. $\therefore \frac{1}{C} = \frac{1}{4} + \frac{1}{4}$ (capacitors in series) $\Rightarrow 1/C = 1/2$, or C (net capacitance) = 2μF.]

31. No correct option. [$W = qV, \Rightarrow V = \frac{W}{q} = \frac{(30J)}{8\times10^{-3}C}$ $\therefore V = 1.5\times10^{3}V$]

32. B [$E = F/q = \frac{40N}{1.0\times10^{-5}C} = 4.0\times10^{6}N/C$]

33. A [$Q = It \Rightarrow 1$ coulomb $\equiv 1As$]

34. D [$W = \frac{1}{2}CV^2 \Rightarrow W_i = \frac{1}{2}(160\times10^{-6})\times(200^2) = 3.2J$; $W_f = \frac{1}{2}(160\times10^{-6})\times(100^2) = 0.8J$. Then the energy dissipated $= \Delta W = W_i - W_f$ $= 3.2J - 0.8J = 2.4J$]

35. D [$P = IV = I^2R = V^2/R \Rightarrow R = \frac{V^2}{P}$. $\therefore R = \frac{240^2}{60} = 960\Omega$]

36. D [See information on the solution or answer to Q28.]

37. D [Refractive index of air relative to glass $= {}_gn_a = \frac{n_a}{n_g} = \frac{c_g}{c_a}$ $= \frac{1.8\times10^{8}\,ms^{-1}}{3.0\times10^{8}\,ms^{-1}} = 0.6$]

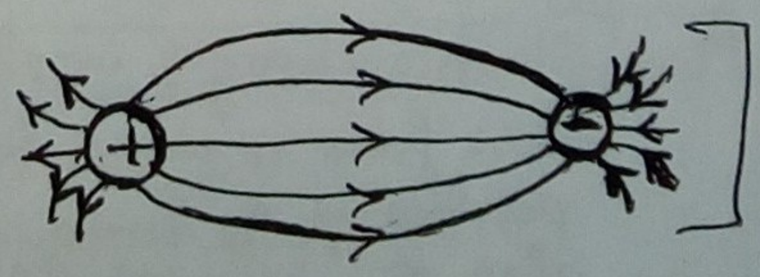
38. B [$\frac{1}{f} = \frac{2}{r} = \frac{1}{u} + \frac{1}{v} \Rightarrow \frac{2}{20} = \frac{1}{15} + \frac{1}{v}$ $\therefore v = 30cm$. But $m = \frac{v}{u} = \frac{30cm}{15cm}$ $\therefore m = 2.0$ OR $\frac{1}{m} = \frac{2u}{r} - 1$ $\Rightarrow \frac{1}{m} = \frac{2(15)}{20} - 1 = 1.5 - 1 = 0.5$ $\therefore m = 1/0.5 = 2.0$]

39. A [Any object placed at the principal focus or focal point of a concave mirror forms an image at infinity with a parallel beam of light.]

40. A [A simple microscope or magnifying glass forms an erect, virtual and enlarged image when the object is placed between the focal point and the optical centre of its convex or converging lens. $\Rightarrow m = \frac{-v}{u}$ (virtual image) $\therefore 2 = \frac{-v}{u}$, or $v = -2u$ But $1/f = 1/u + 1/v$, $\Rightarrow 1/20 = 1/u - 1/2u$ $\therefore 1/20 = \frac{2-1}{2u} \Rightarrow 1/20 = 1/2u$ OR $u = \frac{20m}{2} = 10m$.]

41. B [Remember "ROYGBIV"]

42. A ["NOT UNTRUE" $\Rightarrow$ TRUE. The field patterns are given below



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(43.) A [Total resistance, $R_t = r + R_1 + R_2$ (series combination),
$\Rightarrow R_t = (2.5 + 0.5 + 7.0)\Omega = 10\Omega$
$\therefore$ current, $I = \frac{E}{R_t} = \frac{1.5V}{10\Omega}$
$= 0.15A$.]

(44.) D [See information on the answer to Q20.]

(45.) A [It suffers a displacement at the point of refraction through the glass block.]

(46.) B [See information on the answer to Q40.]

(47.) D [According to the laws of reflection, $i = r = 35°$.
the angle made by the reflected ray with the mirror surface = glancing angle
$= 90° - 35° = 55°$.]

(48.) B [See information on the answer to Q8.]

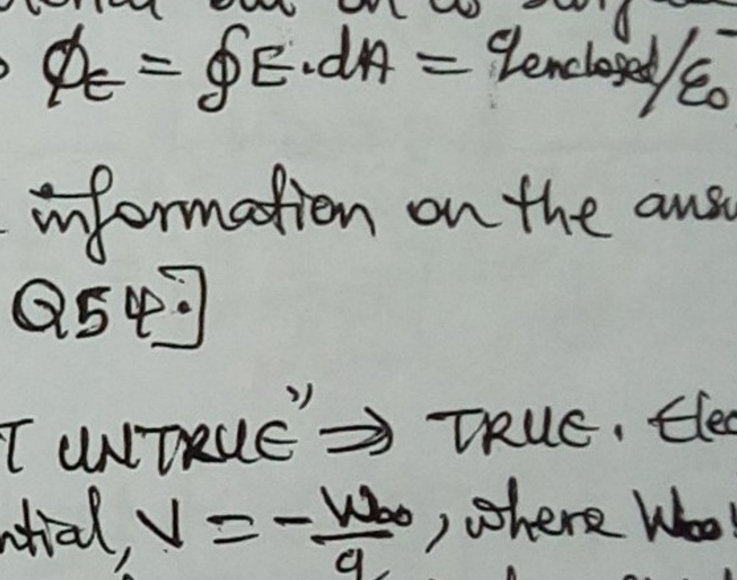
(49.) C [See information on the answer to Q14.]

(50.) D [The glass rod is deficient in electrons while the silk is in excess of electrons accepted from the rod after rubbing or charging by friction.]

(51.) A [Electric charges or electrons flow from negative to positive plate during discharging of a capacitor.]

(52.) B [More charge is stored on the capacitor when the p.d. is increased during charging of a capacitor because more electrons are driven to the negative plate when the battery p.d. is increased.]

(53.) B [The illustrated diagram is shown below for capacitor charging



Note the charged plates A and B of the capacitor.]

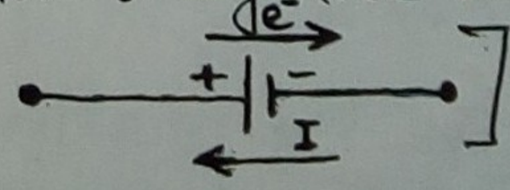
(54.) C [No charge is distributed inside a charged empty spherical material but on its surface.
$\Rightarrow \Phi_E = \oint E \cdot dA = q_{enclosed}/\varepsilon_0$.]

(55.) A [See information on the answer to Q54.]

(56.) C ["NOT UNTRUE" $\Rightarrow$ TRUE. Electric potential, $V = -\frac{W_{\infty}}{q}$, where W_{∞} is the work done by the electric field on a positive charge moving from infinity to a reference point.]

(57.) D ["NOT UNFALSE" $\Rightarrow$ FALSE. For a parallel-plate capacitor, the capacitance, $C = \varepsilon\frac{A}{d} = \frac{Q}{V}$.]

(58.) D [Conventional current, $I = \frac{dq}{dt} = \frac{Q}{t}$; current density $J = I/A$ and the flow across a circuit of electron is from positive to negative battery terminal.



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(59.) ["UNFALSE" $\Rightarrow$ TRUE. Electrical resistivity, $\rho = \frac{RA}{L} = \frac{E}{J} = \frac{1}{K}$ and Ohm's law states that $V = IR$, other factors remain