CUET (UG) Exam Paper 2023

National Testing Agency

Held on 26th May 2023

PHYSICS
Solved

[This includes Questions pertaining to Domain Specific Subject only]

Max. Marks: 200 **Time allowed: 45 Minutes**

General Instructions:

1. *The test is of 45 Minutes duration.*
2. *The test contains 50 questions out of which 40 questions need to be attempted.*
3. *Marking Scheme of the test:*
   a. *Correct answer or the most appropriate answer: Five marks (+5).*
   b. *Any incorrectly marked option will be given minus one mark (−1).*
   c. *Unanswered/Marked for Review will be given zero mark (0).*

1. A beam of electron is used in Young's double slits experiment. The slit width is d. When velocity of electron is increased, then:

(1) No interference is observed
(2) Fringe width increases
(3) Fringe width decreases
(4) Fringe width remains same

Ans. Option (3) is correct.

Explanation: For electron, $\lambda = \frac{h}{mv}$, $\beta = \frac{\lambda D}{d}$

So, the higher the velocity, the lesser the fringe width.

2. Match List - I with List - II.

List - I		List - II	
(A)	Simple Microscope	(I)	A concave mirror is used as an objective
(B)	Compound Microscope	(II)	Two convex lenses both of small focal length
(C)	Refracting Telescope	(III)	Two convex lenses, one of small focal length other of large focal length
(D)	Reflecting Telescope	(IV)	Single convex lens of small focal length

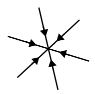
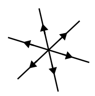
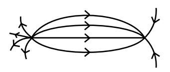
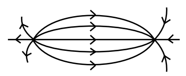
Choose the correct answer from the options given below:

(1) (A)-(IV), (B)-(II), (C)-(I), (D)-(III)
(2) (A)-(IV), (B)-(II), (C)-(III), (D)-(I)
(3) (A)-(II), (B)-(IV), (C)-(III), (D)-(I)
(4) (A)-(IV), (B)-(III), (C)-(II), (D)-(I)

Ans. Option (4) is correct.

Explanation: A simple microscope is a magnifying glass that has a bi convex lens with a short focal length.
A compound microscope uses multiple lenses to magnify an image for an observer. It is made of two convex lenses. The first, the ocular lens, is close to the eye and the other lens is objective lens.
Reflecting telescopes use mirrors while refracting telescopes use lenses.

3. Match List - I with List - II

List - I (Field lines)		List - II (Charge configuration)	
(A)		(I)	$q<0$
(B)		(II)	Electric dipole
(C)		(III)	$q>0$
(D)		(IV)	Unequal charges

Choose the correct answer from the options given below:

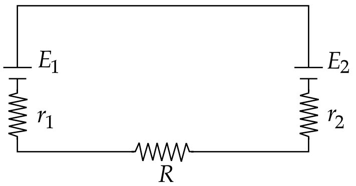
(1) (A)-(I), (B)-(III), (C)-(II), (D)-(IV)
(2) (A)-(IV), (B)-(III), (C)-(I), (D)-(II)
(3) (A)-(III), (B)-(I), (C)-(IV), (D)-(II)
(4) (A)-(I), (B)-(III), (C)-(IV), (D)-(II)

Ans. Option (3) is correct.

Explanation: Electric field lines always point away from a positive charge and towards a negative point. In fact, electric fields originate at a positive charge and terminate at a negative charge.

For unequal charges the field lines will not be proportionate at the two sides of the charge, that is the number of field lines will differ.

4. The emfs and resistances in the given circuit have the following values



$E_1 = 4.2$ V, $E_2 = 1.9$ *V*

$r_1 = 2.0$ W, r_{2},$=1.6\ \Omega$, R = 6.0 Ω

What is the current in the circuit ?

(1) 383 mA **(2)** 635 mA
(3) 240 mA **(4)** 958 mA

Ans. Option (3) is correct.

Explanation: Applying Kirchhoff's law,
Let the current in the circuit be *i*, then
$4.2 + 2i + 6i + 1.6i - 1.9 = 0$

$$\therefore |i| = \frac{2.3}{9.6} = 0.23958 \text{ A} = 239.58 \text{ mA} \approx 240 \text{ mA}$$

5. During forward bias in a *p–n* junction:

(1) Width of the depletion layer increases and resistance increases
(2) Width of the depletion layer decreases and resistance decreases
(3) Width of the depletion layer increases and resistance decreases
(4) Width of the depletion layer decreases and resistance increases

Ans. Option (2) is correct.

Explanation: During forward bias of *p–n* junction diode, we are aware of the fact that the *p* type semiconductor is connected to the positive terminal and the *n* type semiconductor is connected to the negative terminal. This causes the holes as well as the electrons to migrate towards the junction from the *p* and *n* regions, respectively. As they come closer and closer, the width of the depletion layer decreases. The distance between the diffused electrons and holes starts to get reduced and this causes a decrease in the electric field in the depletion area. Thus we can conclude that there will be a decrease in the barrier potential and also the resistance.

6. A wire carries a current of 10 A in south to north direction. The magnetic field due to 1 cm piece of wire at a point 200 cm north-east from the piece:

(1) 0.9×10^{-9} downwards
(2) 0.9% $\times 10^{-9}$ T upwards
(3) 1.8×10^{-9} T south to north
(4) 1.8×10^{-9} T downwards

Ans. Option (4) is correct.

Explanation: As the distance of point of observation being much larger than the length of the wire we may write

$$dB = \frac{\mu_0}{4\pi} \times \frac{idl\sin\theta}{r^2}$$

or, $$dB = (10)^{-7} \times \frac{10 \times 10^{-2} \times \sin 45°}{(200 \times 10^{-2})^2}$$

$\therefore dB = 1.8 \times 10^{-9}$ *T*.

By right hand thumb rule, the direction is vertically downward.

7.

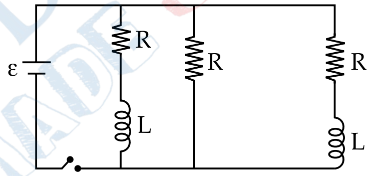


Figure shows a circuit contains three identical resistors with resistance R = 9.0 Ω each, two identical inductors with inductance, $L = 2.0$ mH each, and an ideal battery with emf ε = 18 *V*. In the given circuit if the switch is closed. In steady state the current will be:

(1) 2 A **(2)** 27 A
(3) 6 A **(4)** 0.67 A

Ans. Option (3) is correct.

Explanation: In the steady state the inductor resistance will be zero (closed circuit), so, all the resistances will be parallel.
Equivalent resistance will be *R*/3 =9/3 = 3 ohm
V=*IR* or I =*V*/*R*=18/3=6 *A*

8. Identify the wrong nuclear equation:

(1) $^{11}_{6}\text{C} \to ^{11}_{5}\text{B} + \text{e}^{+} + \gamma$

(2) $^{210}_{83}\text{B} \to ^{211}_{84}\text{P}_0 + \text{e}^{-} + \overline{\gamma}$

(3) $^{242}_{94}\text{Pu} \to ^{238}_{92}\text{U} + ^{4}_{2}\text{He}$

(4) $^{120}_{54}\text{Xe} + \text{e}^{-} \to ^{120}_{53}\text{I} + \gamma$

Ans. Option (2) is correct.

Explanation: Electron release will not change the mass number it will remain unchanged so option (2) is wrong.

9. A potentiometer is supplied with a constant voltage of 5 V. A cell of emf 1.4 V is balanced by the voltage drop across 280 cm of the potentiometer wire. The total length of the potentiometer wire will be:

(1) 5 m **(2)** 4 m
(3) 10 m **(4)** 8 m

Ans. Option (3) is correct.

Explanation: Let the total length be l

so $E/E' = l/l'$

or $l = El'/E'$

or $l = 5\times\frac{2.8}{1.4} = 10$ m

10. Arrange these in ascending order of wavelength while propagating through different medium.

(A) Light propagating in air
(B) Light propagating in water
(C) Light propagating in diamond
(D) Light propagating in glass

Choose the correct answer from the options given below:

(1) (A) <(B)<(D)<(C) **(2)** (A)=B)=(C)=(D)
(3) (C)=(D)<(B)<(A) **(4)** (C) <(D)<(B)<(A)

Ans. Option (4) is correct.

Explanation: Light can propagate in material media such as vacuum, water, air, diamond, glass, and all kinds of transparent or translucent materials. In each medium, light travels at a different speed. Light travels fastest in air, then water, then glass and slowest in diamond.

11. Where is donor energy level located ?

(1) In n type semiconductor just above valence band
(2) In n type semiconductor just below conduction band
(3) In p type semiconductor just below conduction band
(4) In p type semiconductor just above valence band

Ans. Option (2) is correct.

Explanation: In an n-type semiconductor, the donor energy level lies just below the conduction band near the fermi level of the semiconductor.

12. A spherical metallic conductor of radius 6.0 cm is held in air. The maximum charge it can hold if dielectric strength of air is 20 kV/cm will be:

$$\left(\text{Take } \frac{1}{4\pi\varepsilon_0} = 9\times10^9 \text{ N m}^2 \text{ C}^{-2}\right)$$

(1) 0.8 µC **(2)** 8.0 µC
(3) 80 µC **(4)** 8 µC

Ans. Option (3) is correct.

Explanation: Considering that the charge is Q. The dielectric strength of air is given. The maximum charge which can be given without ionizing the air around it is given by,

$$E = \frac{kQ}{r^2}$$

$$\text{Or, } 20\times10^3 = \frac{9\times10^9\times Q}{6^2}$$

$$\text{Or, } Q = \frac{20\times10^3\times36}{9\times10^9}$$

$$\therefore Q = 80\times10^{-6}\text{ C} = 80\ \mu\text{C}$$

13. The deBroglie wavelength of electron when it accelerates through potential V is given by $\lambda = \frac{h}{\sqrt{x}\sqrt{V}}$ then x is equal to:

(1) $2p$ **(2)** $2me$
(3) $1.2me$ **(4)** $2mk$

where, m = mass of electron
k = kinetic energy of electron
p = momentum
e = charge

Ans. Option (2) is correct.

Explanation: $K = \frac{1}{2}mv^2 = \frac{p^2}{2m} \backslash\ p = \sqrt{2mK} = \sqrt{2meV}$

The de Broglie wavelength λ of the electron is

$$\lambda = \frac{h}{p} = \frac{h}{\sqrt{2mK}} = \frac{h}{\sqrt{2meV}}$$

$$\lambda = \frac{h}{\sqrt{2me}}\cdot\frac{1}{\sqrt{V}}$$

$$\Rightarrow \lambda \alpha \frac{1}{\sqrt{V}}$$

$$\lambda = \frac{h}{\sqrt{x}}\cdot\frac{1}{\sqrt{V}}$$

So $x = 2me$

14. Two capacitors of capacitances 8 µF and 20 µF are connected in series with a battery. The voltage across the 8 µF capacitor is 5 V. The total battery voltage is:

(1) 5 V **(2)** 10 V
(3) 7 V **(4)** 125 V

Ans. Option (3) is correct.

Explanation: $C_{total} = \frac{8\times20}{8+20} = 5.71\ \mu\text{F}$

Q = CV = 8 × 5 = 40 µC.

$$V_{total} = \frac{Q}{C} = \frac{40}{5.71} = 7\text{ V}$$

15. What would be the effective mass of a photon, if the frequency of radiation is 6×10^{14} Hz?

(1) 4.4×10^{-36} kg **(2)** 6×10^{-36} kg
(3) 44×10^{-36} kg **(4)** 18×10^{-36} kg

Ans. Option (1) is correct.

> ***Explanation:*** $E = h\upsilon = mc^2$
>
> $$\therefore m = \frac{h\upsilon}{c^2} = \frac{6.6\times10^{-34}\times6\times10^{14}}{(3\times10^8)^2}$$
>
> $$= 4.4\times10^{-36}\ \text{kg}$$

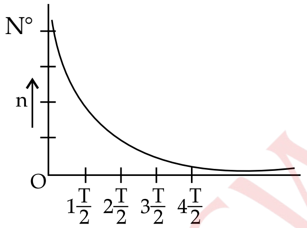
16. For a transistor, which of the following statement is true?

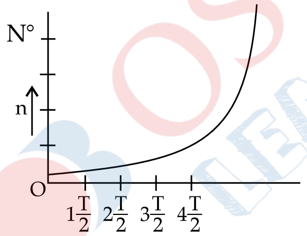
(1) Emitter is the smallest region of a transistor.
(2) The emitter junction is forward biased and the collector junction is reverse biased.
(3) The emitter junction is reverse biased and the collector junction is forward biased.
(4) The collector region has the heaviest doping.

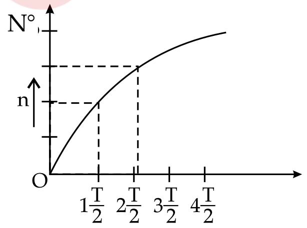
Ans. Option (2) is correct.

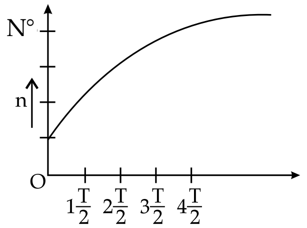
> ***Explanation:*** A transistor consists of two *p–n* diodes connected back to back. It has three terminals namely emitter, base and collector. Most important factor in the function of a transistor is the middle section which is present as a very thin layer. For an appropriate working of a transistor, the emitter-base junction is forward biased and the collector-base junction is reverse biased.

17. The graph showing number of decayed nuclei versus time *t* is:

(1)


(2)


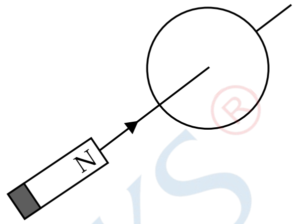
(3)


(4)


Ans. Option (3) is correct.

> ***Explanation:*** Number of atom decayed, $N' = N_0(1-e^{-\lambda t})$
>
> N' will increases with time (t) exponentially.

18. In the given figure the north-pole of a bar magnet is being pushed towards the circular loop with constant speed.



(1) The induced current developed is clockwise as seen from the side of the magnet
(2) No induced current is developed
(3) loop has north polarity towards the north pole of approaching magnet
(4) loop has south polarity towards the north pole of approaching magnet

Ans. Option (3) is correct.

> ***Explanation:*** As north pole is moved towards the coil, magnetic field increases in the direction of motion. So, by Fleming's right hand rule current will be in anti-clockwise direction and will show north polarity, when viewed in the direction of the motion of the magnet.

19. The S.I. unit of electron mobility is:

(1) m/Vs **(2)** m^2/Vs
(3) Vs/m^2 **(4)** Vsm^2

Ans. Option (2) is correct.

> ***Explanation:*** The S.I. unit of velocity is m/s, and the S.I. unit of electric field is V/m. Therefore the S.I. unit of mobility is $\frac{\text{m/s}}{\text{V/m}} = \frac{\text{m}^2}{\text{Vs}}$.

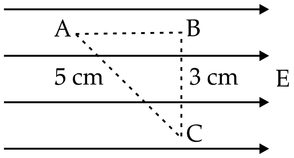
20. Electrical capacity of earth is approximately:

(1) 57.6 μF **(2)** 1 F
(3) 711 μF **(4)** 9×10^9 μF

Ans. Option (3) is correct.

> ***Explanation:***
>
> $$C = 4\pi\varepsilon_0 r$$
>
> Here, $4\pi\varepsilon_0 = \frac{1}{9\times10^9}$;
>
> $r = 6400\ \text{km} = 6.4\times10^6\ \text{m}$
>
> $$C = \frac{6.4\times10^6}{9\times10^9}$$
>
> $$= 0.711\ 10^{-3}\ \text{F}$$
>
> $$= 711\ \mu\text{F}$$

21. Three points A, B and C lie in an uniform electric field E of 2×10^3 N/C as shown in figure. The potential difference between points A and C is:



(1) 100 V **(2)** 60 V
(3) 80 V **(4)** Zero

Ans. Option (3) is correct.

Explanation: The line joining B to C is perpendicular to electric field, so potential at B = potential at C
Distance AC =5 cm
Potential difference between A and C=Ex(AB):
$2\times10^3\times(4\times10^{-2})$=80 volt.

22. The resistivity of a wire depends on:

(A) its length
(B) its area of cross-section
(C) its temperature
(D) nature of material
(E) voltage applied across it

Choose the correct answer from the options given below:

(1) (A) and (B) only **(2)** (B) and (C) only
(3) (C) and (D) only **(4)** (D) and (E) only

Ans. Option (3) is correct.

Explanation: Resistivity of the wire is an intrinsic property of the material with which the wire is made and thus depends on the material of the wire and its temperature and, not on the dimensions of the wire.

23. In a Young's double slits experiment, the source is white light, one of the slits is covered by a red filter and another by a blue filter. In this case:

(1) there shall be alternate interference patterns of red and blue
(2) there shall be an interference pattern with both red and blue fringes
(3) there shall be no interference fringes
(4) there shall be the pattern multicolour and blurred

Ans. Option (3) is correct.

Explanation: The light from two slits of Young's double-slit experiment is of different colours , and having different wavelengths and frequencies. Hence, there shall be no interference fringes.

24. The half angular width of the central bright maximum in Fraunhoffer diffraction pattern, for a slit of width 1.2×10^{-3} mm illuminated by monochromatic light of wavelength 600 nm is:

(1) $\frac{\pi}{12}$ **(2)** $\frac{\pi}{6}$
(3) $\frac{\pi}{4}$ **(4)** $\frac{\pi}{2}$

Ans. Option (2) is correct.

Explanation:
$$d = 1.2 \times 10^{-6}\text{ m}$$
$$\lambda = 600 \times 10^{-9}\text{ m}$$

$$\text{Angular width} = \frac{\lambda}{d} = \frac{600\times10^{-9}}{1.2\times10^{-6}\times1.2\times10^{-6}}$$
$$= \frac{600\times10^{-9+7}}{12}$$
$$= 50 \times 10^{-2}$$
$$a\sin\theta = \lambda$$
$$\sin\theta = \frac{\lambda}{a}$$
$$\therefore \quad \sin\theta = 50 \times 10^{-2}$$
$$\theta = \sin^{-1}\left(\frac{1}{2}\right)$$
$$\theta = 30°$$
$$\theta = \frac{\pi}{6}$$

25. The line of sight distance between two antennas of heights 144 m and 324 m above earth surface is:

(Given $\sqrt{20}$ = 4.4)

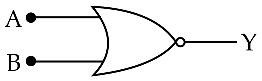
(1) 124.2 km **(2)** 105.6 km
(3) 36.4 km **(4)** 52.8 km

Ans. Option (2) is correct.

Explanation: Maximum line of sight distance

$$d_m = d_r + d_R = \sqrt{2Rh_T} + \sqrt{2Rh_R}$$

26.



(A) This is a NAND gate
(B) if A=0, B=0 then Y=1
(C) if A=0, B=1 then Y=0
(D) if A=1, B=0 then Y=1
(E) if A=1, B=1 then Y=1

Choose the correct answer from the options given below:

(1) (A), (D) and (E) only
(2) (D) and (E) only
(3) (B) and (C) only
(4) (A) and (B) only

Ans. Option (3) is correct.

Explanation: This is a NOR gate. A NOR gate is the reciprocal of the OR gate. In a NOR gate if both the inputs are false then the output is true and if either of the inputs is true then the output is false.

27. The correct relation(s) among total energy, kinetic energy and potential energy as per Bohr's theory of hydrogen atom is/are:

(A) T.E. = −K.E.

(B) K.E. = P.E.

(C) K.E. = $-\frac{\text{P.E.}}{2}$

(D) T.E. = $\frac{\text{P.E.}}{2}$

(E) T.E. = P.E.

Choose the correct answer from the options given below:

(1) (A), (C) and (D) only

(2) (A) and (D) only

(3) (C), (D) and (E) only

(4) (B) and (C) only

Ans. Option (1) is correct.

Explanation: The kinetic energy equals the negative of the total energy of an electron and the potential energy equals the twice the value of the total energy of an electron. The sum of the potential energy and the kinetic energy equals the total energy.

28. The work function for a metal surface is 8.28 eV. The threshold wavelength for this metal surface is:

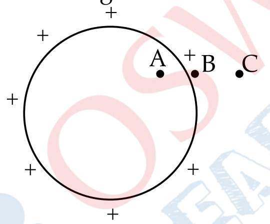
(1) 3×10^{-7} m **(2)** 2×10^{-6} m

(3) 1.5×10^{-7} m **(4)** 2.8×10^{-6} m

Ans. Option (3) is correct.

Explanation: Threshold wavelength = $\lambda = hc/\phi$

29. For a given charged conducting hollow sphere arrange the electric field at the given points A, B and C in decreasing order:



(1) $E_B > E_C > E_A$ **(2)** $E_A = E_B > E_C$

(3) $E_C > E_B > E_A$ **(4)** $E_A > E_B > E_C$

Ans. Option (1) is correct.

Explanation: As there are no charges inside the hollow conducting sphere, as all charges reside on its surface. So, electric field inside the hollow conducting sphere is zero. Electric field decreases exponentially outside the conductor.

30. The amplitude of the magnetic field of an electromagnetic wave in vacuum is $B_0 = 300$ nT. What is the amplitude of the electric field part of the wave? (Given: speed of light in vacuum, $c = 3\times10^8\ \text{ms}^{-1}$)

(1) 90 N/C **(2)** 900 N/C

(3) 9×10^3 N/C **(4)** 0.9 N/C

Ans. Option (1) is correct.

Explanation: $E = cB$

$E = 300\times10^{-9}\times3\times10^8 = 90$ N/C

31. The speed of light in a medium depends on:

(1) nature of the source

(2) motion of the source

(3) wavelength

(4) intensity of the light

Ans. Option (3) is correct.

Explanation: The speed of light depends on the refractive index of the medium. If a medium is denser than the refractive index of that medium will be more and thus the speed of light that medium will be less. So, we can say that the speed of light only depends on the density of the medium in which it is travelling.

32. The ratio of speed of light in vacuum to the speed of light in a medium is:

(1) $\sqrt{\mu_r \varepsilon_r}$ **(2)** $\frac{1}{\sqrt{\mu_r \varepsilon_r}}$

(3) $\mu_r \varepsilon_r$ **(4)** $\frac{1}{\mu_r \varepsilon_r}$

where μ_r = relative permeability of the medium

ε_r = relative permittivity of the medium

Ans. Option (1) is correct.

Explanation: Speed of light in a medium $v = \frac{1}{\sqrt{\mu\varepsilon}}$

Speed of light in vacuum, $c = \frac{1}{\sqrt{\mu_0\varepsilon_0}}$

Refractive index, $n = \frac{\sqrt{\mu\varepsilon}}{\sqrt{\mu_0\varepsilon_0}} = \sqrt{\mu_r\varepsilon_r}$

33. The radius of the inner most electron orbit of a hydrogen atom is 0.53 Å. What is the radius of orbit of 2nd excited state ?

(1) 1.06 Å **(2)** 1.59 Å

(3) 2.12 Å **(4)** 4.77 Å

Ans. Option (4) is correct.

Explanation: for $n=3$, second excited state

$r_3 = n^2 r_1$

$r_3 = 9\times0.53$

$= 4.77\times10^{-10}$ m

34. The loss of strength of a signal while propagating through a medium is known as:

(1) Amplification **(2)** Modulation

(3) Demodulation **(4)** Attenuation

Ans. Option (4) is correct.

Explanation: Attenuation is a general term that refers to any reduction in the strength of a signal. Attenuation occurs with any type of signal, whether digital or analog. Sometimes called loss, attenuation is a natural consequence of signal transmission over long distances.

35. Choose the correct statements:

(A) The angle of incidence corresponding to an angle of refraction 90° is called critical angle (i_c).

(B) Refractive index of denser medium $\mu = \frac{1}{\sin i_c}$

(C) For $i > i_c$, Snell's law of refraction cannot be satisfied.

(D) The refractive index of air increases with decrease in density.

(E) Rainbow is the combined effect of dispersion, refraction and reflection of sunlight by droplets.

Choose the correct answer from the options given below:

(1) (A) and (B) only
(2) (A), (B), (C) and (E) only
(3) (C), (D) and (E) only
(4) (A), (D) and (E) only

Ans. Option (2) is correct.

Explanation: As the density of the medium increases, number of particles per unit volume increases. Thus, more light gets obstructed and the refractive index of the medium increases. Therefore as density increases, refractive index also increases. Rest all are correct.

36. A current of 10^{-7} A produces 50 division deflection in a galvanometer. The figure of merit would be:

(1) 50×10^{-7} A/div **(2)** 50×10^{7} A/div
(3) 2×10^{-9} A/div **(4)** 2×10^{-8} A/div

Ans. Option (3) is correct.

Explanation: Figure of merit is defined as the current which produces a deflection of one scale division in the galvanometer. One division corresponds to

$$\frac{10^{-7}}{50}$$

$= 2 \times 10^{-9}$ A/div

37. Choose the incorrect statement from the following:

(1) A transformer can produce *ac* power
(2) A transformer cannot work on *dc*
(3) In a transformer when *ac* voltage is stepped up x times, the alternating current reduces to $\frac{1}{x}$ times
(4) A transformer cannot change the frequency of alternating current

Ans. Option (1) is correct.

Explanation: In the primary coil of a transformer when alternating voltage is applied, a changing magnetic field is produced which can induce a changing voltage in the secondary coil according to Faraday's law of electromagnetic induction.

So, power cannot be produced by transformer. Only power can be induced.

38. Match List - I with List - II.

List - I (Physical Quantity)		List - II (S.I. Unit)	
(A)	Linear charge density	(I)	newton (metre)^2/ columb
(B)	Electric dipole moment	(II)	coulomb/metre
(C)	Polarisation vector	(III)	coulomb/(metre)^2
(D)	Electric flux	(IV)	coulomb - metre

Choose the correct answer from the options given below:

(1) (A)-(II), (B)-(I), (C)-(III), (D)-(IV)
(2) (A)-(IV), (B)-(III), (C)-(II), (D)-(I)
(3) (A)-(II), (B)-(IV), (C)-(I), (D)-(III)
(4) (A)-(II), (B)-(IV), (C)-(III), (D)-(I)

Ans. Option (4) is correct.

Explanation: Linear charge density (λ) is the quantity of charge per unit length, measured in coulombs per meter (C m^{-1}), at any point on a line charge distribution.
The S.I. unit for electric dipole moment is the coulomb-meter (C · m).
Polarisation vector, P is equal to the bound charge per unit area or equal to the surface density of bound charges (because surface charge density is charge per unit area), S.I. unit Cm^{-2}.
The S.I. unit of electric flux is volt meters (V-m), this is also equal to newton-meters squared per coulomb (N m^2 C^{-1}).

39. The desirable properties of materials for making permanent magnets are:

(1) low retentivity and high coercivity
(2) low retentivity and low coercivity
(3) high retentivity and high coercivity
(4) high retentivity and low coercivity

Ans. Option (3) is correct.

Explanation: Materials suitable for permanent magnets should have high retentivity, high coercivity and high permeability.

40. A resistor, an inductor and a capacitor are connected in series with a variable frequency source of alternating emf. At resonance, the amplitude of current depends on:

(A) Resistance **(B)** Inductance
(C) Capacitance **(D)** Frequency of source

Choose the correct answer from the options given below:

(1) (A) only **(2)** (A) and (D) only
(3) (A), (B) and (C) only **(4)** (D) only

Ans. Option (1) is correct.

Explanation: At an RLC circuit's resonant frequency, $\omega_0 = \sqrt{\frac{1}{LC}}$, the current amplitude is at its maximum value.

41. The wavelength of matter wave is independent of

(1) Momentum (2) Charge
(3) Velocity (4) Mass

Ans. Option (2) is correct.

Explanation: The wavelength of the matter wave is dependent on the mass (m), velocity (v) and momentum (p) but not on charge (q). In other words, wavelength of the matter wave is independent of charge.

42. A metal rod of length 10 cm and a rectangular cross-section 1 cm $\times \frac{1}{2}$ cm is connected to a battery across opposite faces. The resistance will be:

(1) maximum when the battery is connected across 1 cm $\times \frac{1}{2}$ cm faces.
(2) maximum when the battery is connected across 10 cm $\times$ 1 cm faces.
(3) maximum when the battery is connected across 10 cm $\times \frac{1}{2}$ cm faces.
(4) same irrespective of the three faces.

Ans. Option (1) is correct.

Explanation: For maximum resistance A should be minimum and l should be longer.

43. An equiconvex lens $\left(\mu = \frac{3}{2}\right)$ of focal length 20 cm in air is immersed in water of refractive index $\left(\mu = \frac{4}{3}\right)$. What is the percentage change in focal length of the lens ?

(1) 400% (2) 150%
(3) 300% (4) 200%

Ans. Option (3) is correct.

Explanation: In air,

$1/f_{air} = ({}_{air}\mu_{lens} - 1)(1/R_1 - 1/R_2)$

Or, $1/20 = \left(\frac{3}{2} - 1\right)(1/R_1 - 1/R_2)$

$\therefore (1/R_1 - 1/R_2) = 1/10$

In water,

$$1/f_{\ water} = \left(\frac{\mu_{lens}}{\mu_{water}} - 1\right)(1/R_1 - 1/R2)$$

$$\text{Or, } 1/f_{\ water} = \left(\frac{\frac{3}{2}}{\frac{4}{3}} - 1\right) \times 1/10$$

$\therefore f_{\ water} = 80$ cm

Percentage change in focal length

$$= \frac{80 - 20}{20} \times 100 = 300\%$$

44. Match List - I with List - IL

	List - 1		List - II
(A)	Microwaves	(I)	used in cellphone communication
(B)	Radiowaves	(II)	used in remote sensing
(C)	UV rays	(III)	used in aircraft navigation
(D)	Infrared rays	(IV)	causes tanning of skin

Choose the correct answer from the options given below:

(1) (A)-(III), (B)-(I), (C)-(IV), (D)-(II)
(2) (A)-(II), (B)-(I), (C)-(IV), (D)-(III)
(3) (A)-(III), (B)-(II), (C)-(I), (D)-(IV)
(4) (A)-(I), (B)-(III), (C)-(II), (D)-(IV)

Ans. Option (1) is correct.

Explanation: The uses of the microwave are similar to that of radio waves. They are used in communications, radio astronomy, remote sensing, radar, and of course, owing to their heating application, they are used in cooking as well.
Various frequencies of radio waves are used for television and FM and AM radio broadcasts, military communications, mobile phones, ham radio, wireless computer networks, and numerous other communications applications.
Ultraviolet (UV) radiation is a form of non-ionising radiation that is emitted by the sun and artificial sources, such as tanning beds. While it has some benefits for people, including the creation of Vitamin D, it also can cause health risks. Our natural source of UV radiation is the sun.
Near-infrared rays are used in electronic applications like TV remote sensors and photography. Their applications can be similar to visible light applications since their wavelength ranges are close. Far infrared rays are more thermal. Anything generating heat gives out far-infrared radiation.

45. Three charges $+4q$, Q and q are placed along x-axis at points, x=0, $l/2$ and l, respectively. The value of Q to make the net force on q to be zero:

(1) $4q$ (2) $\frac{-q}{2}$
(3) $-2q$ (4) $-q$

Ans. Option (4) is correct.

Explanation: The force exerted on the charge q, Q is given as follows.

$$F(q, Q) = k\left[\frac{qQ}{l^{2/4}}\right] = \frac{4kqQ}{l^2}$$

The force exerted on the charge q, $4q$ is given as follows.

$$F\ (q, 4q) = k\left[\frac{4q^2}{l^2}\right] = \frac{4kq^2}{l^2}$$

The net force = F (q, Q) + F (q,4q) = 0

$$\frac{4kqQ}{l^2}+\frac{4kq^2}{l^2}=0$$

So, $qQ + q^2 = 0$.

$q[Q + q] = 0$

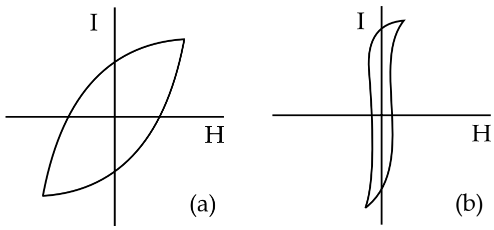
As, q cannot be $= 0$

$Q + q = 0$

Therefore, $Q = -q$

Hence, Q should be $-q$ in order to make the net force on q to be zero.

46.



I → Intensity of magnetization

H → Magnetic intensity

(A) (a) is steel, (b) is soft iron

(B) retentivity of (b) > (a)

(C) (a) is used to make temporary magnets

(D) (b) can be easily demagnetised

Which of the given statements are correct ?

(1) (A), (C) and (D) **(2)** (A), (B) and (D)

(3) (B), (C) and (D) **(4)** (A) and (B) Only

Ans. **Option (2) is correct.**

Explanation: Hysteresis curve of steel is shown in figure (a) and the hysteresis curve of soft iron is shown in figure (b).
From the above figures, it is clear that the steel has more coercivity and less retentivity as compared to the soft iron.
Retentivity of steel is more than the retentivity of soft iron. Soft iron is easily magnetised and demagnetised as compared to steel. The coercivity of soft iron is less than that of the coercivity of the steel. Energy loss in soft iron is less than energy loss in steel because of the small area of soft iron (B – H) curve.

47. The magnetic energy stored in a current carrying solenoid is (if B=magnetic field, l=length of solenoid, A =area of cross section of solenoid):

(1) $\frac{B^2}{2\mu_0}$ **(2)** $\frac{\mu_0 B^2}{2}$

(3) $\frac{\mu_0 B^2 Al}{2}$ **(4)** $\frac{B^2 Al}{2\mu_0}$

Ans. **Option (4) is correct.**

Explanation: Let the permittivity, permeability of free medium, electric field, velocity of light are ε_0, μ_0, E, c respectively.
The permittivity is given as,

$$\varepsilon_0=\frac{1}{c^2\mu_0}$$

The electric field is given as,

$E = Bc$

The energy stored on a capacitor for per volume is given as,

$$\frac{U}{Al}=\frac{1}{2}\varepsilon_0 E^2$$

$$U=\frac{1}{2}\times\frac{1}{c^2\mu_0}\times(Bc)^2\times Al$$

$$U=\frac{1}{2}\frac{B^2}{\mu_0}\times Al$$

Thus, the magnetic energy stored in a solenoid is $\frac{1}{2}\frac{B^2}{\mu_0}Al$.

48. The mutual inductance of a pair of solenoid depends

(A) on their separation

(B) on their relative orientation

(C) on the current flowing

(D) on the number of turns in the solenoids

Choose the correct answer from the options given below:

(1) (D) only **(2)** (A) and (B) only

(3) (B), (C) and (D) only **(4)** (A), (B) and (D) only

Ans. **Option (4) is correct.**

Explanation: The mutual inductance depends on the distance between the coils, the orientation of the coils and also on the number of turns in the coil.

49. An electron is projected with uniform velocity along the axis of a current carrying long solenoid. Which of the following is true ?

(1) The electron will be accelerated along the axis

(2) The electron path will be circular about the axis

(3) The electron will have helical path

(4) The electron will continue to move with uniform velocity along the axis of the solenoid

Ans. **Option (4) is correct.**

Explanation: The magnetic field lines when current is passed through, become parallel to the axis of the solenoid. It is given in the question that an electron is projected along the axis of the solenoid. The force due to the magnetic field on the charge will be zero. Hence, the charge q will move, will neither be accelerated nor will deviate from its path.

50. A circular loop of area 1 cm^2, carrying a current of 10 A, is placed in a magnetic field of 0.1 T perpendicular to the plane of the loop. The torque on the loop due to the magnetic field is:

(1) Zero **(2)** 10^{-4} Nm

(3) 10^{-2} Nm **(4)** 1 Nm

Ans. **Option (1) is correct.**

Explanation: $T=NBiA\sin\theta$
As $\theta = 0$
T =0

❑❑❑

CUET Question Paper—2022

NATIONAL TESTING AGENCY

5th August 2022—Slot-2

Physics

[This Includes Questions Pertaining to Domain Specific Subject only]

SOLVED

Time Allowed: 45 Mins. **Maximum Marks: 200**

General Instructions:

1. *The test is of 45 Minutes duration.*
2. *The test contains 50 Questions out of which 40 questions need to be attempted.*
3. *Marking Scheme of the test:*
   a. *Correct answer or the most appropriate answer: Five marks (+5)*
   b. *Any incorrect option marked will be given minus one mark (–1).*
   c. *Unanswered/Marked for Review will be given no mark (0).*

Choose the correct answer :

1. During the formation of depletion layer around the imaginary *pn*-junction, electrons diffuse from n-region to p-region because.

(A) Electron concentration in n-segment is higher than electron concentration in p-segment.
(B) Holes of p-segment attract the electrons.
(C) Electrons are lighter and have higher drift velocity.
(D) Hole concentration in n-segment is higher than the electron concentration in p-segment.

Sol. Option (A) is correct

Explanation: In p-type semiconductor, hole concentration is more than n-side and in n-type semiconductor, electron concentration is more than p-side. Diffusion process takes place from higher to lower concentration. So, electron diffuses from n-side to p-side.

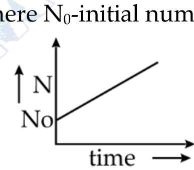
2. The most exotic diamagnetic materials are super conductors. They exhibit perfect diamagnetism and perfect conductivity. The values of magnetic susceptibility (χ) and relative permeability of such materials have values

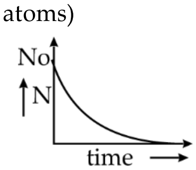
(A) $\chi = 1$, $\mu_r = 0$
(B) $\chi = -1$, $\mu_r = 0$
(C) $\chi = 0$, $\mu_r = 1$
(D) $\chi = -1$, $\mu_r = 1$

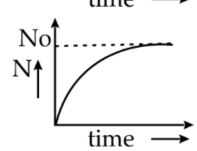
Sol. Option (B) is correct

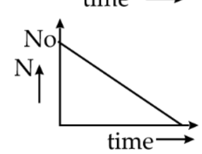
Explanation: Susceptibility (χ) and relative permeability (μ_r) are related as
$\mu_r = \chi + 1$
For super conductor $\mu_r = 0$
i.e. $0 = \chi + 1$
$\therefore \chi = -1$

3. The variation of the number of undecayed nuclei with time is best represented by
(Where N_0-initial number of atoms)

(A)


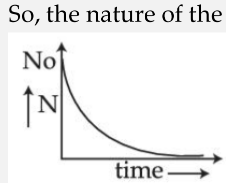
(B)


(C)


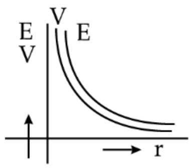
(D)


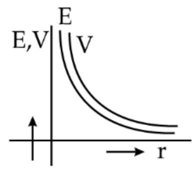
Sol. Option (B) is correct

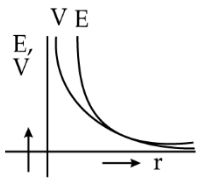
Explanation: The variation of the number of undecayed nuclei with time is represented as
$N = N_0 e^{-\lambda t}$
Where N is the number of undecayed nuclei at any time t
and N_0 is the number of nuclei at $t = 0$
The relation is exponential.
So, the nature of the graph will be.

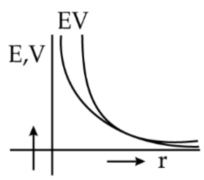


4. Which one of the following correctly represents the variation of electric field and electric potential with a distance r from a point charge?

(A) 

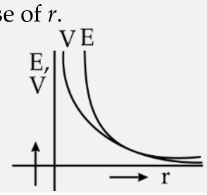
(B) 

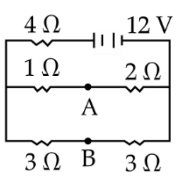
(C) 

(D) 

Sol. Option (C) is correct

Explanation: So, E will come down faster than V with an increase of *r*.



5. 

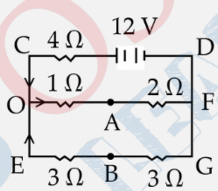
The above circuit potential difference between point A and B $(V_A - V_B)$ =

(A) $\frac{4}{3}V$ **(B)** $\frac{2}{3}V$

(C) $\frac{1}{3}V$ **(D)** $\frac{5}{3}V$

Sol. Option (B) is correct

Explanation:



1 Ω and 2 Ω are in series.

So, equivalent resistance is 3 Ω.

Two 3 Ω resistors are in series.

So, equivalent resistance is 6 Ω.

These two resistances 3 Ω and 6 Ω are in parallel.

$$R_{eq} = 4 + \frac{3\times 6}{9} = 6\Omega$$

$$I = \frac{V}{R_{eq}}$$

$$= \frac{12}{6} = 2\text{A}$$

Applying Kirchhoff's Voltage law in the loop CDFO,

$$12 - 4 \times 2 - I_1 \times 3 = 0$$

$$I_1 = \frac{4}{3}A$$

Applying Kirchhoff's Voltage law in the loop OFGE,

$$12 - 4 \times 2 - 6I_2 = 0$$

$$I_2 = \frac{2}{3}A$$

Voltage across 1Ω

$$= V_O - V_A$$

$$= 1\times\left(\frac{4}{3}\right)$$

$$= \frac{4}{3}\text{ V}$$

Voltage across 3 Ω

$$= V_O - V_B$$

$$= 3\times\left(\frac{2}{3}\right)$$

$$= 2V$$

So, $V_A - V_B = 2 - \frac{4}{3} = \frac{2}{3}V$

6. A circular lamina of radius 'R' is having surface charge density σ cm^{-2}. Electric field at axial distance '$2R$' is

(A) $\frac{\sigma}{4\pi\varepsilon_0 R^2}$ **(B)** $\frac{\sigma}{\varepsilon_0}$

(C) $\frac{\sigma}{2\varepsilon_0}$ **(D)** $\frac{\sigma}{4\varepsilon_0}$

Sol. None of the answer is correct.

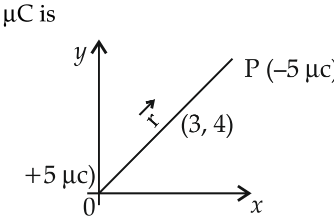
Explanation:

$E = \frac{\sigma}{2\varepsilon_0}(1-\cos\theta)$, where $\cos\theta = \frac{2R}{\sqrt{4R^2+R^2}}$

Putting the value of cosθ

$$E = \frac{\sigma}{2\varepsilon_0}\left(1-\frac{2}{\sqrt{5}}\right)$$

7. Two-point charges +5 μC and –5 μC are placed at O (0 mm, 0 mm) and P (3 mm, 4 mm) respectively force on +5 μC is



(A) $1.8\left(3\hat{i}-4\hat{j}\right)\times 10^{+3}N$

(B) $-1.8\left(3\hat{i}+4\hat{j}\right)\times 10^{+3}N$

(C) $1.8\left(3\hat{i}+4\hat{j}\right)\times 10^{3}N$

(D) $1.8\left(-3\hat{i}+4\hat{j}\right)\times 10^{3}N$

Sol. Option (C) is correct

Explanation: Force between two-point charges Q_1 and Q_2

$$\vec{F} = \frac{kQ_1Q_2\left(\vec{r_2}-\vec{r_1}\right)}{|r_2-r_1|^3}$$

$$\vec{F} = \frac{9\times10^9\times5\times10^{-6}\times5\times10^{-6}\left(4\hat{j}+3\hat{i}\right)\times10^{-3}}{\left(\sqrt{4^2+3^2}\right)\times10^{-9}}$$

$$\vec{F} = 1.8\left(3\hat{i}+4\hat{j}\right)\times10^3 N$$

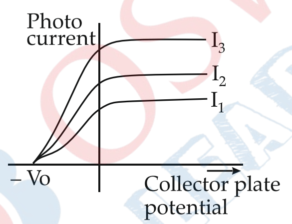
8. Which of the following statements is true for a *p*-type semiconductor?

(A) Holes are minority carriers and pentavalent atoms are the dopant
(B) Electrons are minority carriers and pentavalent atoms are dopant
(C) Holes are majority carriers and trivalent atoms are the dopant
(D) Electrons are majority carriers and trivalent atoms are the dopant

Sol. Option (C) is correct

Explanation: Holes and electrons are the majority and minority carriers in p-type semiconductor respectively. Electrons and holes are majority and minority carriers in n-type semiconductor respectively.
When pentavalent element is doped, n-type semiconductor is formed. When trivalent element is doped p-type semiconductor is formed.

9. A graph for variation of photo current with anode potential is given for different intensities of incident radiation:

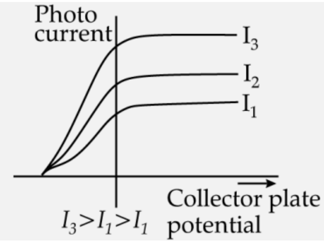


Choose the correct order of anode intensities.

(A) $I_1 > I_2 > I_3$ **(B)** $I_1 = I_2 = I_3$
(C) $I_1 < I_2 < I_3$ **(D)** $I_1 < I_2 > I_3$

Sol. Option (C) is correct

Explanation: For a fixed collector plate potential, as intensity of incident light increases, emission of photoelectrons increases and the photo current increases.
As collector plate potential increases, photo current also increases and ultimately reaches a constant value. This current does not increase further unless the intensity is increased.



10. NPN transistor is set up as an amplifier in common emitter mode, output signal voltage obtained across the load resistance of 4 kΩ is 1 volt. Calculate input signal voltage. Assume current amplification factor = 250 and base resistance = 1 kΩ:

(A) 4 mV **(B)** 2.5 mV
(C) 1 mV **(D)** Insufficient data

Sol. Option (C) is correct

Explanation:

$$I_c = \frac{V_c}{R_c} = \frac{1}{4\times10^3} = 0.25 \text{ mA}$$

$$\beta = I_C/I_B$$

$$or,\ I_B = \frac{I_c}{\beta} = \frac{0.25\times10^{-3}}{250} = 10^{-6} A$$

Input signal voltage $= V_i = I_BR_B$
$= 10^{-6} \times 10^3 = 1$ mV

11. For what distance of ray optics as a good approximation, when the aperture is 5 mm wide and the wavelength is 600 nm is nearly:

(A) 18 m **(B)** 15 m
(C) 4.43 m **(D)** 8.34 m

Sol. Correct answer not available.

Explanation: Fresnel distance $= Z = \dfrac{a^2}{\lambda}$

Where a is the aperture width

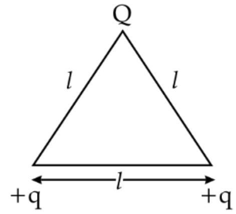
λ is wavelength of light

Putting the values of *a* and Z.

$$Z = \frac{(5\times10^{-3})^2}{600\times10^{-9}}$$

$$= \frac{25}{6}\times10 \approx 41.67m$$

12. Three charges Q, $+q$ and $+q$ are placed at the vertices of an equilateral triangle of side I, as shown in the figure. If the net electrostatic energy of the system is zero, the Q is equal to:

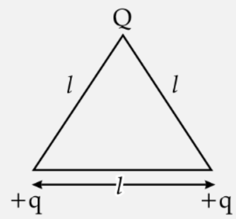


(A) $+\frac{q}{2}$ **(B)** Zero

(C) $-\frac{q}{2}$ **(D)** $-q$

Sol. Option (C) is correct

Explanation:



Net electrostatic energy $= U = \frac{kqQ}{l} + \frac{kqQ}{l} + \frac{kq^2}{l}$

Given, $U = 0$

Or, $\frac{kq^2}{l} + \frac{2kqQ}{l} = 0$

So, $Q = \frac{-q}{2}$

13. If the ratio of maximum to minimum resultant intensity in interference pattern of two waves is 25 : 4, then, ratio of amplitudes of two waves is :

(A) 5 : 2 **(B)** 2 : 5

(C) 7 : 3 **(D)** 49 : 9

Sol. Option (C) is correct

Explanation:

$$\frac{I_{max}}{I_{min}} = \frac{\left(\sqrt{I_1}+\sqrt{I_2}\right)^2}{\left(\sqrt{I_1}-\sqrt{I_2}\right)^2}$$

Or, $\frac{25}{4} = \left(\frac{\sqrt{I_1}+\sqrt{I_2}}{\sqrt{I_1}-\sqrt{I_2}}\right)^2$

Or, $\frac{5}{2} = \left(\frac{\sqrt{I_1}+\sqrt{I_2}}{\sqrt{I_1}-\sqrt{I_2}}\right)$

Or, $3\sqrt{I_1} = 7\sqrt{I_2}$

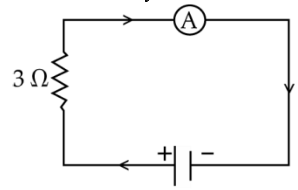
Or, $\frac{I_1}{I_2} = \frac{49}{9}$

Since, $I = A^2$

$\therefore$ $A \propto \sqrt{I}$

$\therefore$ $\frac{A_1}{A_2} = \sqrt{\frac{I_1}{I_2}} = \sqrt{\frac{49}{9}} = \frac{7}{3}$

14. In the circuit given below the current is to be measured. If the ammeter shown is a galvanometer with a resistance R_G = 60 Ω but converted to an ammeter by a shunt resistance r_s = 0.02 Ω, then the flow of current is nearly:

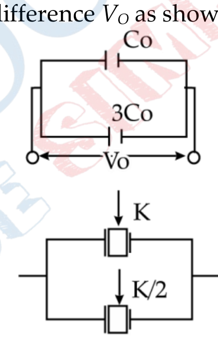


(i) 0.5 A **(ii)** 3.02 A
(iii) 0.99 A **(iv)** 1.5 A
(A) 1 **(B)** 2
(C) 3 **(D)** 4

Sol. None of the Answer is correct

Explanation: Emf of battery is not given Data is insufficient.

15. Consider a capacitor circuit charged by a battery to a potential difference V_O as shown in the figure.



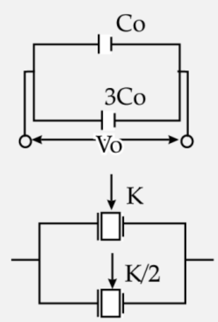
When a dielectric slab is inserted into both the capacitors, new potential difference will be

(A) V_0 **(B)** $\frac{V_0}{K}$

(C) $\frac{8V_0}{5K}$ **(D)** $\frac{8V_0}{K}$

Sol. Option (C) is correct

Explanation:



On inserting dielectric, charge on the combination of capacitor does not change.

Equivalent capacitance = $C_0 + 3C_0 = 4C_0$

New potential difference be V_1

Charge $= 4C_0V_0 = \left(KC_0 + \frac{3C_0K}{2}\right)V_1$

So, $V_1 = \frac{8V_0}{5K}$

16. An intrinsic semiconductor has 5×10^{28} atoms/m^3. It is doped by 0.01 ppm concentration of arsenic. If $n_i = 1.5 \times 10^{16}$ m^3, then number of holes in the n-type semiconductor will be

(A) 5×10^{28}/m^3 **(B)** 5×10^{11}/m^3

(C) 3.0×10^{11}/m^3 **(D)** 4.5×10^{11}/m^3

Sol. Option (D) is correct

Explanation: 0.01 atom of Arsenic is doped out of 10^6 atom of intrinsic semiconductor.

In 5×10^{28} atom of intrinsic semiconductor number of Arsenic atoms doped $= \dfrac{\dfrac{5\times10^{28}}{10^6}}{0.01} = 5 \times 10^{20}$

1 Arsenic atom donates 1 excess electron.

So number of excess electrons $= 5 \times 10^{20} = n_e$

From law of mass action, $n_e n_h = n_1^2$

$$n_h = \frac{n_i^2}{n_e} = \frac{(1.5\times10^{16})^2}{5\times10^{20}}$$

$= 0.45 \times 10^{12}$

$= 4.5 \times 10^{11}$/m^3

So, number of holes $= 4.5 \times 10^{11}$/m^3

17. In the block diagram of a simple modulator, a square law device generates DC and sinusoidal of frequencies ω_m, $2\omega_m$, ω_c, $2\omega_c$, $\omega_c - \omega_m$ and $\omega_c + \omega_m$. The device which rejects dc and unwanted frequencies and retains frequencies, ω_c, $\omega_c - \omega_m$ and $\omega_c + \omega_m$ is called

(A) Envelope detector **(B)** Band pass filter

(C) Rectifier **(D)** Amplifier

Sol. Option (B) is correct

Explanation: Band pass filter rejects dc and unwanted frequencies and retains frequencies, ω_c, $\omega_c - \omega_m$ and $\omega_c + \omega_m$.

18. An expression for the frequency of revolution of the electron in the Bohr's orbit is:

(A) $\dfrac{me^4}{4\varepsilon_0^2 h^3} \times \dfrac{1}{n^3}$ **(B)** $\dfrac{me^4}{8\varepsilon_0^2 h^2} \times \dfrac{1}{n^3}$

(C) $\dfrac{me^4}{4\varepsilon_0^2 ch^3} \times \dfrac{1}{n^3}$ **(D)** $\dfrac{me^4}{8\varepsilon_0^2 ch^2} \times \dfrac{1}{n^3}$

Sol. Option (A) is correct

Explanation: According to Bohr's postulate,

$$mvr = \frac{nh}{2\pi} \quad \text{...(i)}$$

$$\frac{e^2 z}{4\pi\varepsilon_0 r^2} = \frac{mv^2}{r}$$

$$\therefore \quad mv^2 r = \frac{e^2 z}{4\pi\varepsilon_0} \quad \text{...(ii)}$$

On putting the value of mvr from equation (i)

$$v \times \frac{nh}{2\pi} = \frac{e^2 z}{4\pi\varepsilon_0}$$

Or, $$v = \left(\frac{e^2 z}{2nh}\right)$$

Putting the value of v in equation (i)

$$\frac{m \times e^2 z}{2nh} r = \frac{nh}{2\pi}$$

Or, $$r = \frac{n^2 h^2}{\pi m e^2 z}$$

Now, Frequency of revolution $= f = \dfrac{v}{2\pi r}$

$$= \frac{\dfrac{e^2 z}{2nh}}{\dfrac{2\pi n^2 h^2}{\pi m e^2 z}}$$

$$= \frac{me^4 z^2}{4\varepsilon_0^2 h^3} \times \frac{1}{n^3}$$

For $Z = 1$

$$f = \left(\frac{me^4}{4\pi\varepsilon_0^2 h^3}\right) \times \left(\frac{1}{n^3}\right)$$

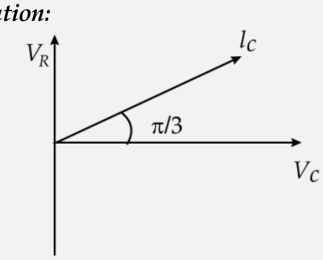
19. Current in an alternating circuit is ahead of voltage by a phase difference of $\dfrac{\pi}{3}$. The alternating circuit is

(A) C circuit **(B)** LC circuit

(C) LR circuit **(D)** L circuit

Sol. Correct option is not available.

Explanation:



In RC circuit Current leads voltage.

20. A particle moves in a closed orbit around the origin, due to a force which is directed towards the origin. The de-Broglie wavelength of particle varies cyclically between two values (λ_1), (λ_2) with ($\lambda_1 > \lambda_2$) then, the correct statements from the following are:

(a) The particle could be moving in a circular orbit with origin as centre

(b) The particle could be moving in an elliptical orbit with origin as its focus.

(c) When the de-Broglie wavelength is λ_1,the particle is nearer to origin then when its value is λ_2.

(d) When the de Broglie wavelength is λ_2, the particle is nearer to the origin than when its value is λ_1.

(A) (a) and (d) only **(B)** (b) and (d) only

(C) (b) and (c) only **(D)** (c) and (a) only

Sol. Option (B) is correct

Explanation: de-Broglie wavelength of a moving particle $\lambda = \dfrac{h}{mv}$

Since, $\lambda_1 > \lambda_2$ so $v_1 < v_2$ velocity of the particle becomes greater at nearer point on an elliptical orbit.

21. A circular coil made up of copper, is placed on a table top. Magnetic field is normally outwards. Now, the magnetic field is gradually decreased. The direction of induced current as seen from the top side is

(A) Clock wise

(B) Anti clock wise

(C) Current will not be induced

(D) Information is insufficient

Sol. Option (B) is correct

Explanation: Magnetic field decreases outwards gradually. According to Lenz's law, current will flow anticlockwise so that decrease is opposed.

22. In case of Bohr's model of atoms, which of the following statement is incorrect?

(A) Bohr's model is applicable only for one electron atom.

(B) Bohr's model correctly predicts the frequencies of light emitted by one electron atoms/ions.

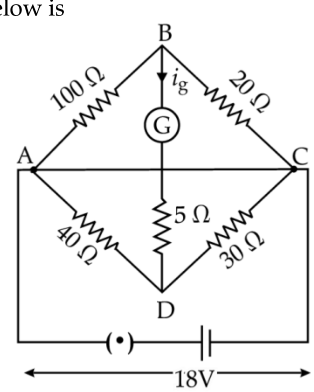
(C) Bohr's model correctly predicts the intensity variations in the light of different frequencies emitted by one-electron atoms, ions.

(D) Bohr's model does not consider the electron-electron interaction in an atom.

Sol. Option (C) is correct

Explanation: Bohr's model correctly predicts the frequencies of light emitted by one electron atoms, ions.

23. Current through the galvanometer in the circuit given below is



(A) 6.13 mA **(B)** 33.9 mA

(C) 6.69 mA **(D)** 51.7 mA

Sol. Correct answer is not available.

Explanation: Diagram is not correct.

24. During the process of Beta decay, the ratio of neutron to proton:

(A) increases

(B) decreases

(C) remain unchanged

(D) first increases and then decreases

Sol. Option (B) is correct

Explanation: During beta decay, the atomic number increases i.e. number of protons increases. Hence neutron to proton ratio decreases.

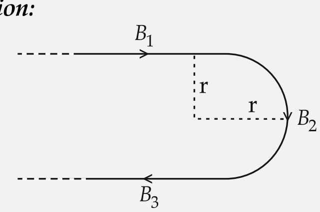
25. The resultant magnetic field at point *O*, due to current I in the conductor shown in the figure is

(A) $\vec{B} = \dfrac{\mu_0 l}{4r}\left[\dfrac{1}{\pi}+1\right]$ **(B)** $\vec{B} = \dfrac{\mu_0 l}{4r}\left[\dfrac{2}{\pi}+1\right]$

(C) $\vec{B} = \dfrac{\mu_0 l}{4r}\left[\dfrac{2}{\pi}-1\right]$ **(D)** $\vec{B} = \dfrac{\mu_0 l}{4r}\left[\dfrac{1}{\pi}-1\right]$

Sol. Option (B) is correct

Explanation:



$$B_1 = \frac{\mu_0 l}{4\pi r}$$

$$B_2 = \frac{\mu_0 l}{4r}$$

$$B_3 = \frac{\mu_0 l}{4r}$$

Resultant magnetic field $= B = B_1 + B_2 + B_3$

$$= \left(\frac{\mu_0 l}{4\pi r} + \frac{\mu_0 l}{4r} + \frac{\mu_0 l}{4\pi r}\right)$$

$$= \frac{\mu_0 l}{4\gamma}\left(\frac{2}{\pi}+1\right)$$

26. Correct symbol of NPN transistor is:

(A)