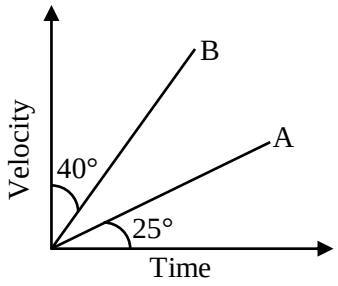
KCET-2015 (Physics)

1. The ratio of the dimensions of Planck constant and that of moment of inertia has the dimensions of
   a. time
   b. frequency
   c. angular momentum
   d. velocity

2. The velocity – time graph for two bodies A and B are shown. Then the acceleration of A and B are in the ratio



   a. tan 25° to tan 40°
   b. tan 25° to tan 50°
   c. sin 25° to sin 50°
   d. cos 25° to cos 50°

3. A particle is projected with a velocity v so that its horizontal range is twice the greatest height attained. The horizontal range is
   a. $\frac{v^2}{g}$
   b. $\frac{2v^2}{3g}$
   c. $\frac{4v^2}{5g}$
   d. $\frac{v^2}{2g}$

4. A stone of mass 0.05 kg is thrown vertically upwards. What is the direction and magnitude of net force on the stone during its upward motion?
   a. 0.49 N vertically upwards
   b. 0.49 N vertically downwards
   c. 0.98 N vertically downwards
   d. 9.8 N vertically downwards

5. The kinetic energy of a body of mass 4 kg and momentum 6 Ns will he
   a. 2.5 J
   b. 3.5 J
   c. 4.5 J
   d. 5.5 J

6. The ratio of angular speed of a second-hand to the hour-hand of a watch is
   a. 720 : 1
   b. 60 : 1
   c. 3600 : 1
   d. 72 : 1

7. If the mass of a body is M on the surface of the earth, the mass of the same body on the surface of the moon will be
   a. M/6
   b. M
   c. 6 M
   d. zero

8. Moment of Inertia of a thin uniform rod rotating about the perpendicular axis passing through its centre is 1. If the same rod is bent into a ring and its moment of inertia about its diameter is F. then the ratio $\frac{I}{I'}$ will be

   a. $\frac{3}{2}\pi^2$ b. $\frac{8}{3}\pi^2$

   c. $\frac{2}{3}\pi^2$ d. $\frac{5}{3}\pi^2$

9. The ratio of hydraulic stress to the corresponding strain is known as

   a. Compressibility b. Bulk modulus

   c. Young's modulus d. Rigidity modulus

10. The efficiency of a Carnot engine which operates between the two temperatures T_1 = 500 K and T_2 = 300 K is

    a. 50% b. 25%

    c. 75% d. 40%

11. Water is heated from 0 °C to 10 °C. then its volume

    a. decreases
    b. increases
    c. does not change
    d. first decreases and then increases

12. 1 gram of ice is mixed with 1 gram of steam. At thermal equilibrium, the temperature of the mixture is

    a. 0 °C b. 100 °C

    c. 50 °C d. 55 °C

13. The ratio of kinetic energy to the potential energy of a particle executing SHM at a distance is equal to half of its amplitude, the distance being measured from its equilibrium position will be

    a. 3 : 1 b. 4 : 1

    c. 2 : 1 d. 8 : 1

14. When two tuning forks A and B are sounded together. 4 beats per second are heard. The frequency of the fork B is 384 Hz. When one of the prongs of the fork A is filed and sounded with B. the beat frequency increases, then the frequency of the fork A is

    a. 380 Hz b. 378 Hz

    c. 379 Hz d. 389 Hz

15. A stretched string is vibrating in the second overtone, then the number of nodes and antinodes between the ends of the string are respectively

    a. 4 and 3 b. 3 and 2

    c. 3 and 4 d. 2 and 3

16. Two spheres carrying charges + 6 μC and + 9 μC separated by a distance d, experiences a force of repulsion F. When a charge of −3 μC is given to both the sphere and kept at the same distance as before, the new force of repulsion is
    a. F
    b. 3F
    c. F/3
    d. F/9

17. Pick out the statement which is incorrect.
    a. The tangent drawn to a line of force represents the direction of electric field.
    b. The electric field lines form closed loop.
    c. A negative test charge experiences a force opposite to the direction of the field.
    d. Field lines never intersect.

18. The angle between the dipole moment and electric field at any point on the equatorial plane is
    a. 0°
    b. 90°
    c. 180°
    d. 45°

19. Three point charges 3nC, 6nC and 9nC are placed at the corners of an equilateral triangle of side 0.1 in. The potential energy of the system is
    a. 8910 J
    b. 89100 J
    c. 9910 J
    d. 99100 J

20. A spherical shell of radius 10 cm is carrying a charge q. If the electric potential at distances 5 cm, 10 cm and 15 cm from the centre of the spherical shell is V_1, V_2 and V_3 respectively, then
    a. $V_1 > V_2 > V_3$
    b. $V_1 < V_2 < V_3$
    c. $V_1 = V_2 > V_3$
    d. $V_1 = V_2 < V_3$

21. A parallel plate capacitor is charged and then isolated. The effect of increasing the plate separation on charge, potential and capacitance respectively are
    a. constant, decreases, decreases
    b. increases, decreases, decreases
    c. constant, decreases, increases
    d. constant, increases, decreases

22. Four identical cells of emf E and internal resistance r are to be connected in series. Suppose if one of the cell is connected wrongly. the equivalent emf and effective internal resistance of the combination is
    a. 4E and 4r
    b. 4E and 2r
    c. 2E and 4r
    d. 2E and 2r

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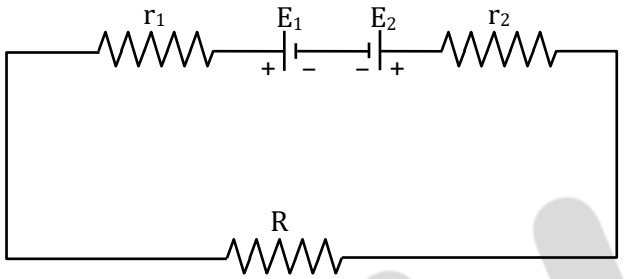
23. Three resistances 2Ω, 3Ω and 4Ω are connected in parallel. The ratio of currents passing through them when a potential difference is applied across its ends will be

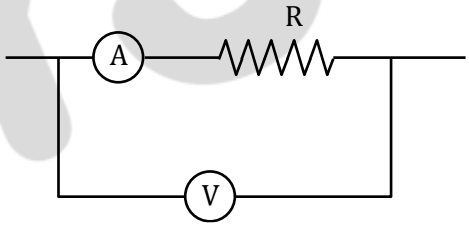
a. 6 : 3 : 2
b. 6 : 4 : 3
c. 5 : 4 : 3
d. 4 : 3 : 2

24. Two cells of emf E_1 and E_2 are joined in opposition (such that $E_1 > E_2$). If r_1 and r_2 be the internal resistances and R be the external resistance, then the terminal potential difference is



a. $\frac{E_1 + E_2}{r_1 + r_2} \times R$
b. $\frac{E_1 + E_2}{r_1 + r_2 + R} \times R$
c. $\frac{E_1 - E_2}{r_1 + r_2} \times R$
d. $\frac{E_1 - E_2}{r_1 + r_2 + R} \times R$

25. In the circuit shown below, the ammeter and the voltmeter readings are 3 A and 6 V respectively. Then the value of the resistance R is



a. 2Ω
b. > 2Ω
c. < 2Ω
d. ≥ 2Ω

26. In Wheatstones network P = 2 Ω, Q = 2 Ω, R = 2 Ω and S = 3 Ω. The resistance with which S is to be shunted in order that the bridge may be balanced is

a. 1Ω
b. 2Ω
c. 4Ω
d. 6Ω

27. The resistance of the bulb filament is 100 Ω at a temperature of 100 °C. If its temperature co-efficient of resistance be 0.005 per °C, its resistance will become 200 Ω at a temperature

a. 300°C
b. 400°C
c. 500°C
d. 200°C

28. Two concentric coils each of radius equal to 2 π cm are placed right angles to each other. If 3A and 4A are the currents flowing through the two coils respectively. The magnetic induction (in Wb m^{-2}) at the centre of the coils will be
    a. 12×10^{-5}
    b. 10^{-5}
    c. 5×10^{-5}
    d. 7×10^{-5}

29. A proton beam enters a magnetic field of 10^{-4} Wb m^{-2} normally. if the specific charge of the proton is 10^{11} C kg^{-1} and its velocity is 10^{9} ms^{-1}, then the radius of the circle described will be
    a. 0.1 m
    b. 10 m
    c. 100 m
    d. 1 m

30. A cyclotron is used to accelerate
    a. neutron
    b. only positively charged particles
    c. only negatively charged particles
    d. both positively and negatively charged particles

31. A galvanometer of resistance 50 Ω gives a full-scale deflection for a current 5×10^{4} A. The resistance that should be connected in series with the galvanometer to read 3 V is
    a. 595 Ω
    b. 5050 Ω
    c. 5059 Ω
    d. 5950 Ω

32. Two parallel wires 1 m apart carry currents of 1 A and 3 A respectively in opposite directions. The force per unit length acting between these two wires is
    a. 6×10^{-7} Nm^{-1} repulsive
    b. 6×10^{-7} Nm^{-1} attractive
    c. 6×10^{-5} Nm^{-1} repulsive
    d. 6×10^{-5} Nm^{-1} attractive

33. If there is no torsion in the suspension thread, then the time period of a magnet executing SHM is
    a. $T = \frac{1}{2\pi}\sqrt{\frac{MB}{1}}$
    b. $T = \frac{1}{2\pi}\sqrt{\frac{1}{MB}}$
    c. $T = 2\pi\sqrt{\frac{1}{MB}}$
    d. $T = 2\pi\sqrt{\frac{MB}{1}}$

34. Core of electromagnets are made of ferromagnetic material which has
    a. high permeability and low retentivity
    b. high permeability and high retentivity
    c. low permeability and high retentivity
    d. low permeability and low retentivity

35. The magnetic susceptibility of a paramagnetic material at −73 °C is 0.0075 and its value at −173 °C will be
    a. 0.0045
    b. 0.0030
    c. 0.015
    d. 0.0075

36. Two coils have a mutual inductance 0.005 H. The current changes in the first coil according to the equation $i = i_m \sin \omega t$ where $i_m = 10$ A and $\omega = 100\ \pi$ rad s^{-1}. The maximum value of the emf induced in the second coil is
    a. 2π
    b. 5π
    c. π
    d. 4π

37. An aircraft with a wingspan of 40 m flies with a speed of 1080 km/hr in the eastward direction at a constant altitude in the northern hemisphere, where the vertical component of the earth's magnetic field is 1.75×10^{-5} T. Then the emf developed between the tips of the wings is
    a. 0.5V
    b. 0.34V
    c. 0.21V
    d. 2.1V

38. In an LCR circuit, at resonance
    a. the current and voltage are in phase
    b. the impedance is maximum
    c. the current is minimum
    d. the current leads the voltage by $\pi/2$

39. A transformer is used to light 100 W –110 V lamp from 220 V mains. If the main current is 0.5 A, the efficiency of the transformer is
    a. 90%
    b. 95%
    c. 96%
    d. 99%

40. The average power dissipated in a pure inductor is
    a. $\frac{1}{2}VI$
    b. VI^2
    c. $\frac{VI^2}{4}$
    d. zero

41. If ε_0 and μ_0 are the permittivity and permeability of free space and ε and μ are the corresponding quantities for a medium, then refractive index of the medium is
    a. $\sqrt{\frac{\mu_0\varepsilon_0}{\mu\varepsilon}}$
    b. $\sqrt{\frac{\mu\varepsilon}{\mu_0\varepsilon_0}}$
    c. 1
    d. Insufficient information

42. A person wants a real image of his own, 3 times enlarged. Where should he stand in front of a concave mirror of radius of curvature 30 cm?
    a. 10 cm
    b. 30 cm
    c. 90 cm
    d. 20 cm

43. Calculate the focal length of a reading glass of a person if his distance of distinct vision is 75 cm.
    a. 25.6 cm
    b. 37.5 cm
    c. 75.2 cm
    d. 100.4 cm

44. In a Young's double slit experiment, the slit separation is 0.5 m from the slits. For a monochromatic light of wavelength 500 nm, the distance of 3^{nd} maxima from 2^{nd} minima on the other side is
    a. 2.75 mm
    b. 2.5 mm
    c. 22.5 mm
    d. 2.25 mm

45. To observe diffraction, the size of the obstacle
    a. has no relation to wavelength.
    b. should be $\lambda/2$, where λ is the wavelength.
    c. should be much larger than the wavelength.
    d. should be of the order of wavelength.

46. The polarizing angle of glass is 57°. A ray of light which is incident at this angle will have an angle of refraction as
    a. 25°
    b. 33°
    c. 43°
    d. 38°

47. Light of two different frequencies whose photons have energies 1 eV and 2.5 eV respectively, successively illuminate a metallic surface whose work function is 0.5 eV. Ratio of maximum speeds of emitted electrons will be
    a. 1 : 5
    b. 1 : 4
    c. 1 : 2
    d. 1 : 1

48. Find the de-Broglie wavelength of an electron with kinetic energy of 120 eV.
    a. 95 pm
    b. 102 pm
    c. 112 pm
    d. 124 pm

49. An α-particle of energy 5 MeV is scattered through 180° by gold nucleus. The distance of closest approach is of the order of
    a. 10^{-10} cm
    b. 10^{-12} cm
    c. 10^{-14} cm
    d. 10^{-16} cm

50. If an electron in hydrogen atom jumps from an orbit of level n = 3 to an orbit of level n = 2, the emitted radiation has a frequency (R = Rydberg constant, C = velocity of light)

a. $\frac{3RC}{27}$ b. $\frac{RC}{25}$

c. $\frac{8RC}{9}$ d. $\frac{5RC}{36}$

51. What is the wavelength of light for the least energetic photon emitted in the Lyman series of the hydrogen spectrum. (take he = 1240 eV nm)

a. 82 nm b. 102 nm

c. 122 nm d. 150 nm

52. A nucleus at rest splits into two nuclear parts having radii in the ratio 1 : 2. Their velocities are in the ratio

a. 8 : 1 b. 6 : 1

c. 4 : 1 d. 2 : I

53. The half-life of a radioactive substance is 20 minutes. The time taken between 50 % decay and 87.5 % decay of the substance will be

a. 30 minutes b. 40 minutes

c. 25 minutes d. 10 minutes

54. A radioactive decay can form an isotope of the original nucleus with the emission of particles

a. one α and four β b. one α and two β

c. one α and one β d. four α and one β

55. An LED is constructed from a pn junction based on a certain semi-conducting material whose energy gap is 1.9 eV. Then the wavelength of the emitted light is

a. 2.9×10^{-9} m b. 1.6×10^{-8} m

c. 6.5×10^{-7} m d. 9.1×10^{-5} m

56. Amplitude modulation has

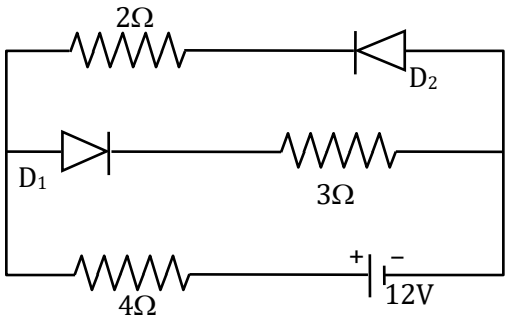
a. one carrier with two side band frequencies

b. one carrier

c. one carrier with infinite frequencies

d. one carrier with high frequency

57. The circuit has two oppositely connected ideal diodes in parallel. What is the current flowing in the circuit?



a. 1.71 A
b. 2.0 A
c. 2.31 A
d. 1.33 A

58. The input characteristics of a transistor in CE mode is the graph obtained by plotting
a. I_B against V_{BE} at constant V_{CE}
b. I_B against V_{CE} at constant V_{BE}
c. I_B against I_C at constant V_{CE}
d. I_B against I_C at constant V_{BE}

59. The given truth table is for Input Output

Input		Output
A	**B**	**Y**
0	0	1
0	1	1
1	0	1
1	1	0

a. AND gate
b. OR gate
c. NAND gate
d. NOR gate

60. The waves used for line-of-sight (LOS) communication is
a. ground waves
b. space waves
c. sound waves
d. sky waves

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ANSWER KEYS

* G – Indicates one Grace mark awarded for the question number.

1. (b)	2. (b)	3. (c)	4. (b)	5. (c)	6. (a)	7. (b)	8. (c)	9. (b)	10. (d)
11. (d)	12. (b)	13. (a)	14. (b)	15. (a)	16. (c)	17. (b)	18. (c)	19. (G)	20. (c)
21. (d)	22. (c)	23. (b)	24. (d)	25. (c)	26. (d)	27. (b)	28. (c)	29. (c)	30. (d)
31. (d)	32. (a)	33. (c)	34. (a)	35. (c)	36. (b)	37. (c)	38. (a)	39. (a)	40. (d)
41. (b)	42. (d)	43. (b)	44. (G)	45. (d)	46. (b)	47. (c)	48. (c)	49. (b)	50. (d)
51. (c)	52. (a)	53. (b)	54. (b)	55. (c)	56. (a)	57. (a)	58. (a)	59. (c)	60. (b)

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Solution

1. (b)

$E = h\nu$

$$h = \frac{E}{\nu} = \frac{\left[ML^2T^{-2}\right]}{\left[T^{-1}\right]} = ML^2T^{-1} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Moment of Inertia $I = mr^2 = [ML^2]$ ..... (2)

Dividing eq. (1) and (2)

$$\left[\frac{h}{I}\right] = \frac{\left[ML^2T^{-1}\right]}{\left[ML^2\right]} = \left[T^{-1}\right]$$

$[T^{-1}]$ = frequency of a particle.

2. (b)

Acceleration $a = \frac{\Delta v}{\Delta t}$

So, acceleration of body A = $a_A = \tan 25°$

Line B makes an angle of 50°. So its slope is equal to tan 50°.

$a_B = \tan 50°$

$a_A : a_B = \tan 25° : \tan 50°$

3. (c)

Option (3) is a correct answer not matched with answer sheet

Given R = 2H

$$\frac{v^2 \sin 2\theta}{g} = \frac{2v^2 \sin^2 \theta}{2g}$$

$\sin 2\theta = \sin^2\theta$

$2 \sin\theta \cos\theta = \sin^2\theta$

$2 \sin\theta \cos\theta = \sin\theta \sin\theta$

$$2 = \frac{\sin\theta \sin\theta}{\sin\theta \cos\theta}$$

$2 = \tan\theta$

From triangle we can say that –

$$\sin\theta = \frac{2}{\sqrt{5}}, \cos\theta = \frac{1}{\sqrt{5}}$$

$$\text{So, } R = \frac{2v^2 \sin\theta \cos\theta}{g} = \frac{2v^2}{g} \times \frac{2}{\sqrt{5}} \times \frac{1}{\sqrt{5}}$$

$$R = \frac{4v^2}{5g}$$

4. (b)

F = mg

Here m = 0.05 kg

F = 0.05 × (–9.8) = – 0.49N

F = 0.49 N vertically downwards

5. (c)

Given m = 4kg, p = 6 Ns

$$\text{K.E.} = \frac{p^2}{2m} = \frac{6\times 6}{2\times 4} = \frac{0.36}{8}$$

K.E. = 4.5 J

6. (a)

Angular velocity = $\frac{2\lambda}{60} = \frac{\lambda}{30}$

For an hour hand to complete 1 rotation i.e. 2π radians it takes 12 hrs.

So angular velocity of an hour hand = $\frac{2\lambda}{12\times 3600}$

$= \frac{\lambda}{21600}$

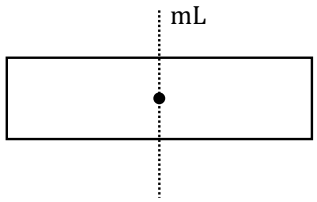
Then the ratio is

$$= \frac{\frac{\lambda}{30}}{\frac{\lambda}{21600}} = \frac{\lambda}{30}\times\frac{21600}{\lambda} = 720:1$$

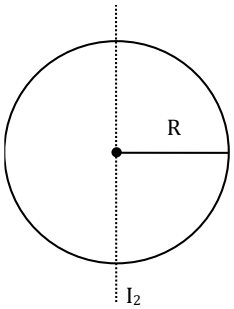
7. (b)

As we know that the value of acceleration due to gravity is independent of mass, shape, size etc. of the body and depends upon the mass and radius of the earth.

8. (c)



M.O.I. of ring about its diameter is given by $I_2 = \frac{mR^2}{2}$



$$I_1 = \frac{mL^2}{12}$$

$$L = 2\pi R \Rightarrow R = \frac{L}{2\pi}$$

$$I_2 = \frac{mR^2}{2} = \frac{1}{2}m\left(\frac{L}{2\pi}\right)^2 = \frac{mL^2}{8\pi^2}$$

$$\frac{I_1}{I_2} = \frac{mL^2}{12} \times \frac{8\pi^2}{mL} = \frac{8\pi^2}{12} = \frac{2\pi^2}{3}$$

9. (b)
The ratio of hydraulic stress to the corresponding strain is known so bulk modulus.
Bulk modulus [K] = $\frac{\text{hydraulic stress}}{\text{strain}}$

10. (d)
$T_1 = 500K$, $T_2 = 300K$
Efficiency of Carnot engine $\eta = 1 - \frac{T_2}{T_1}$

$$\eta = 1 - \frac{300}{500} = \frac{500-300}{500} = \frac{200}{500}$$

$$\eta = \frac{2}{5} = 0.4$$

So, the efficiency is 40%.

11. (d)
When water is heated from 0°C to 4°C, there is decreasing amount in volume and density increases till it is a 4°C and than volume starts increasing to 10°C.

12. (b)
(1) Ice convert into water
$Q_1 = M_1Lf = 1 \times 80 = 80$ cal
(2) Steam to convert into water
$Q_2 = M_2Lv = 1 \times 540 = 540$ cal
(3) 1g of water at 0°C into water at 100°C
$=1 \times 1 \times 100 = 100$ cal
So clearly, whole steam is not condensed. So temperature of the mixture is 100°C.

13. (a)

P.E. = $\frac{1}{2}Kx^2$

Distance is half its amplitude so

P.E. = $\frac{1}{2}K\left(\frac{A^2}{4}\right)$

K.E. = $\frac{1}{2}K\left(A^2 - x^2\right)$

$K.E. = \frac{1}{2}K\left(A^2 - \frac{A^2}{4}\right) = \frac{1}{2}K\left[\frac{4A^2 - A^2}{4}\right]$

$K.E. = \frac{1}{2}K\left[\frac{3A^2}{4}\right]$

$\frac{K.E.}{P.E.} = \frac{3}{1}$

14. (b)

Beat frequency

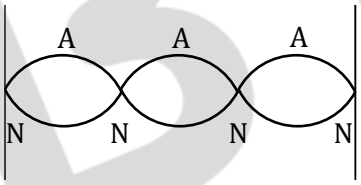
$b = |\nu_A - \nu_B|$

$4 = \nu_A - 384$

$\nu_A = 388\,Hz$

15. (a)

From figure, number of nodes and antinodes will be 4 and 3.



16. (c)

$F_1 = \frac{Kq_1q_2}{r^2} = \frac{K(9)(6)}{d^2}$

$\Rightarrow \frac{K}{d^2} = \frac{F_1}{54}$

Now charges are 3μC and 6μC

So, new force is $F_2 = \frac{K(6)(3)}{d^2} = \frac{18K}{d^2}$

Put the value of $\frac{K}{d^2}$ in F_2

$F_2 = 18 \times \frac{F_1}{54} = \frac{F}{3}$

17. (b)

Electric field lines do not form closed loop as line can never start and end on the same change.

18. (c)

The angle between electric dipole moment and electric field in the equatorial line is 180° as both of them are in opposite directions.

19. (G)

BONUS

20. (c)

Inside the spherical shell potential is same.

$V_1 = V_2$

$V \propto \frac{1}{d}$

$V_1 = V_2 > V_3$

21. (d)

From $C = \frac{\varepsilon_0 A}{d}$

When increase the plate separation capacitance decrease and by $V = \frac{Q}{C}$

V is also increase and q is constant.

22. (c)

Resistance in series connection -

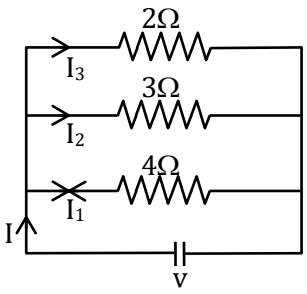
$r_{eq} = r_1 + r_2 + r_3 + r_4 = r + r + r + r = 4r$

emf in series connection –

$E_{eq} = E_1 + E_2 + E_3 - E_4$ (When one is connected wrong)

$E_{eq} = E + E + E - E = 2E$

23. (b)



Current through 4 Ω = $I_1 = \frac{V}{4}$

Current though 3Ω = $I_2 = \frac{V}{3}$

Similarly, $I_3 = \frac{V}{2}$

$$I_1 : I_2 : I_3 = \frac{V}{4} : \frac{V}{3} : \frac{V}{2}$$

$$I_1 : I_2 : I_3 = \frac{1}{4} : \frac{1}{3} : \frac{1}{2}$$

$$I_1 : I_2 : I_3 = 6 : 4 : 3$$

24. (d)

Two cells of emf E_1 and E_2 are joined in opposition $E_1 > E_2$

$$I = \frac{E_1 - E_2}{r_1 + r_2 + R}$$

V = IR

$$V = \left(\frac{E_1 - E_2}{r_1 + r_2 + R} \right) R$$

25. (c)

$R = \frac{V}{I} = \frac{6}{3} = 2\Omega$ (For ideal ammeter and voltmeter)

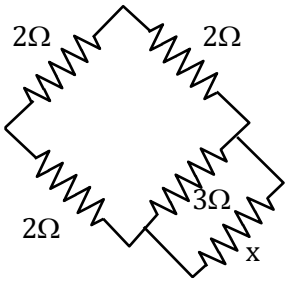
$\Rightarrow R < 2\Omega$ when A and V are infinite

3(R + r) = 6V

R + r = 2

R = 2 – r

26. (d)



$$\frac{2}{2}=\frac{2}{\frac{3x}{3+x}}$$

$$\Rightarrow 1=\frac{2}{1}\times\frac{3-x}{3x}$$

3x = 6 + 2x

X = 6Ω

27. (b)

$R = R_0(1+\alpha\Delta T)$

$200 = 100(1+0.005.(T_2-100))$

$2 = (1+0.005.T_2-0.5)$

$2 = 0.5+0.005T_2$

$$T_2=\frac{1.5}{0.005}$$

$T_2 = 300°C$

28. (c)

$$B_{net}=\sqrt{B_1^2+B_2^2}=\frac{\mu_0}{4\pi}\times\frac{2\pi}{r}\sqrt{i_1^2+i_2^2}$$

$$=10^{-7}\times\frac{2\pi}{2\pi\times10^{-2}}\sqrt{3^2+4^2}$$

$= 5 \times 10^{-5}$ wb/m^2

29. (c)

Given $B = 10^{-4}$ Wb/m^2

$Q = 10^{11}$ C/kg, $v = 10^9$ m/sec

Radius of circle described, $r = \frac{mV}{qB}$

$$r=\frac{1\times10^9}{10^{11}\times10^{-4}}=\frac{10^{13}}{10^{11}}=10^2$$

r = 100 m

30. (d)

A cyclotron is used to accelerate both positively and negatively charged particles but a neutral particle cannot be accelerated in cyclotron.

31. (d)

Give

$I_g = 5 \times 10^{-4}$

$R_G = 50\Omega$

$V = 3V$

$R = \frac{V}{I_g} - R_G$

Put all these values in this formula

$R = \frac{3}{5\times10^4} - 50$

$R = \frac{30000}{5} - 50$

$R = 6000 - 50$

$R = 5950\Omega$

32. (a)

$I_1 = 1A, I_2 = 3A, d = 1m$

$F = \frac{\mu_0}{4x}\frac{2I_1I_2}{d}$

$F = 10^{-7} \times \frac{2(1)(3)}{1}$

$F = 6 \times 10^{-7}$ N/m

Current flowing in opposite direction is repulsive in nature.

33. (c)

If there is no torsion in the suspension thread, then the time period of a magnet executing S.H.M. is = $T = 2\pi\sqrt{\frac{I}{MB}}$

34. (a)

Electromagnetic cores support the formation of a magnetic field because of high permeability and low retentivity so that the magnetic field gets demagnetized easily.

35. (c)

Given $x_1 = 0.0075$

$T_1 = -73^oC = 273-73 = 200k$

$T_2 = -173^oC = 273-173 = 100k$

$X_1 T_1 = X_2 T_2$

$(0.0075)\ (200) = X_2\ (100)$

$X_2 = 0.015$

36. (b)

$e = \frac{Mdi}{dt} = 0.005 \times \frac{d}{dt}(i_0 \sin\omega t)$

$= 0.005 \times i_0\, \omega \cos \omega t$

$e = 0.005 \times 10 \times 100\pi = 5\pi$

37. (c)

Given $B = 1.75 \times 10^{-5}$T. $\ell = 40$m

$V = 1080$ km/h $= 1080 \times \frac{5}{18} = 300$ m/sec

$E = Bv\ell$

$E = (1.75 \times 10^{-5})(300)(40)$

$E = (1.75 \times 10^{-5})12000$

$E = 2100 \times 10^{-4}$

$E = 0.21$ volt

38. (a)

For resonance condition

$X_L = X_C$

In an L-C-R circuit at resonance the current and voltage are in phase.

39. (a)

$P = VI$

Efficiency of transformer $\eta = \frac{P_o}{P_i} \times 100$

$P_o = 100$W

$P_i = V_i I_i = 220 \times 0.5 = 110$W

$\eta = \frac{100}{110} \times 100 = 90.9\%$

So, the efficiency of the transformer is 90%

40. (d)

Average power dissipated

$P_{avg} = \frac{v_0 i_0}{2} \cos\phi$

$P_{avg} = \frac{v_0 i_0}{2}\cos 90^o$

$P_{avg} = 0$

41. (b)

$\mu = \frac{C}{V}$

Here $C = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}$ and $V = \frac{1}{\sqrt{\mu\varepsilon}}$

So, $\mu = \frac{1}{\sqrt{\mu_0 \varepsilon_0}} \Big| \frac{1}{\sqrt{\mu\varepsilon}}$

$\mu = \frac{\sqrt{\mu\varepsilon}}{\sqrt{\mu_0 \varepsilon_0}} = \sqrt{\frac{\mu\varepsilon}{\mu_0 \varepsilon_0}}$

42. (d)

$f = \frac{R}{2} = \frac{-30}{2} = -15\text{cm}$

$m = \frac{-v}{u}$

$\Rightarrow -3 = \frac{-v}{u}$

$v = 3u$

By mirror formula – $\frac{1}{F} = \frac{1}{v} + \frac{1}{u}$

$\frac{1}{-15} = \frac{1}{3u} + \frac{1}{u} = \frac{1+3}{3u} = \frac{4}{3u}$

$\frac{1}{-15} = \frac{4}{3u}$

So, $\frac{4\times(-15)}{3} = -20$ cm

43. (b)

Here V= –7.5 cm

u = –D = –25 cm

It is Because of distinct vision-

Using lens formula

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

$$\frac{1}{f}=\frac{1}{-75}+\frac{1}{25}=\frac{-1+3}{75}=\frac{2}{75}$$

$$f=\frac{75}{2}=37.5\text{ cm}$$

44. (G)
Bonus

45. (d)
To observe diffraction the size of the obstacle should be of the order of wavelength because of $\lambda \approx d$.

46. (b)
Angle of incident i=57°
So, i = r = 57°
the reflected and refracted rays are mutually perpendicular to each other
So angle of refraction r' = 90°–i
r' = 90°-57°=33°

47. (c)
$h\nu = KE + \phi$
$1\text{ eV} = KE_1 + \phi$ ...(1)
$2.5\text{eV} = K_1E_2 + \phi$ ...(2)
From equation (1) and (2)
$1\text{eV} = K.E._1 + 0.5\text{ eV}$ ...(3)
$K.E._1 = 0.5\text{eV}$
$2.5\text{ eV} = K.E._2 = 0.5\text{eV}$
$K.E._2 = 2\text{eV}$ ...(4)
Dividing equation (3) and (4)

$$\frac{K.E._1}{K.E._2}=\frac{0.5}{2.0}=\frac{1}{4}$$

$$\frac{\frac{1}{2}mv_1^2}{\frac{1}{2}mv_2^2}=\frac{v_1^2}{v_2^2}=\frac{1}{4}$$

$$\frac{v_1}{v_2}=\frac{1}{2}$$

48. (c)

$$\lambda=\frac{h}{p}$$

Here $P=\sqrt{2M.K.E} = \sqrt{2\times9\times10^{-31}\times120\times1.6\times10^{-19}}$

$P = 5.88 \times 10^{-24}$ Kg MS^{-1}

So, de Broglie wavelength

$\lambda=\frac{h}{p} = \frac{6.63\times10^{-34}}{5.88\times10^{-24}} = 1.13 \times 10^{-10}$ m

$= 1.13$ Å

49. (b)

Here K.E. = P.E.

$5MeV=\frac{1}{4\pi\varepsilon_0}\frac{q_1q_2}{r}$

$5\times10^6\times e = \frac{(9\times10^9)(92e)(2e)}{r}$

$5\times10^6 = \frac{(9\times10^9)(92)(2e)}{r}$

$r = \frac{(9\times10^9)(92)(2\times1.6\times10^{-19})}{5\times10^6}$

$r = 5.3\times10^{-14}m = 5.3\times10^{-12}cm$

50. (d)

$n_1 = 2$ and $n_2 = 3$

wavelength emitted is -

$$\frac{1}{\lambda} = R\left[\frac{1}{n_1^2}-\frac{1}{n_2^2}\right]$$

$$\frac{1}{\lambda} = R\left[\frac{1}{2^2}-\frac{1}{3^2}\right]$$

$$\frac{1}{\lambda} = R\left[\frac{9-4}{36}\right] = \frac{5R}{36}$$

$$\left[v = \frac{C}{\lambda}\right]$$

So, $v = \frac{5RC}{36}$

51. (c)

Given $hc=1240$ ev nm, $R=1.09737\times10^7$ per meter

Wavelength of light for least – energetic photon emitted in Lyman series of hydrogen atom

$$\frac{1}{\lambda} = R\left(\frac{1}{n_2^2}-\frac{1}{n_1^2}\right)$$

here $n_1 = 2$ and $n_2 = 1$, $R = 0.01097$ nm^{-1}

$$\frac{1}{\lambda} = 0.01097\left[\frac{1}{1^2}-\frac{1}{2^2}\right]$$

$$\frac{1}{\lambda} = 0.01097\left[\frac{4-1}{4}\right]$$

$$\frac{1}{\lambda} = .01097\left[\frac{3}{4}\right]$$

$$\lambda = \frac{4}{0.01097 \times 3}$$

$\lambda = 121.5436$

$\lambda = 122\text{nm}$

52. (a)

By conservation of linear momentum.

$m_1v_1 = m_2v_2$

$$\frac{v_1}{v_2} = \frac{m_2}{m_1} = \left(\frac{R_2}{R_1}\right)^3$$

$$\frac{v_1}{v_2} = \left(\frac{2}{1}\right)^3 = 8:1$$

53. (b)

$T_1/2 = 20\text{min}$

$N_1 = 50$, $N_2 = 100\text{-}87.5=12.5$

$$\Delta\lambda - \frac{T}{\ell n_2}\ \ell n\left(\frac{N_1}{N_2}\right) = \frac{20}{\ell n_2}\ell n\left(\frac{50}{12.5}\right)$$

$\frac{20}{\ell n_2}\ell n$ n = 40min

54. (b)

$${}_zX^A \xrightarrow{\alpha} {}_{z-2}X^{A-4} \xrightarrow{2\beta} {}_zX^{A-4}$$

55. (c)

$E_g = 1.9$ eV, hc = 1240 eV

Wavelength = $\lambda = \frac{hc}{E_g}\text{nm}$

$$\lambda = \frac{1240}{1.9} = 652.63 \approx 650\text{nm}$$

$= 6.5 \times 10^{-7}\text{m}$

56. (a)

In amplitude modulation modulated signal has a carrier wave with two side band frequencies one is lower side band and other is upper side bad.

57. (a)

Diode D_1 is forward biased but D_2 is revered Biased. So no current flows through D_2 but current flows through D_1.

$R_{eq} = 3 + 4 = 7\Omega$

$$I = \frac{V}{R_{eq}} = \frac{12}{7} = 1.71A$$

58. (a)

Input characteristics circle is drawn between I_B and V_{EB} at constant V_{CE}.

$$R = \left[\frac{\Delta V_{BE}}{\Delta I_B}\right]_{V_{CE}=\text{constant}}$$

59. (c)

Boolean expression of NAND gate = $\overline{A.B}$

So NAND gate is right.

60. (b)

Space waves are used for the line of sight communication.