Resonance®
Educating for better tomorrow

Test Booklet Code
C4

NEET (UG) 2023

(MANIPUR)

Questions, Answer Key & Solutions | Subject : Physics

Date: 06 June, 2023 | TIME: (12:00 Noon to 03:20 PM)
Duration: 200 minutes (03 Hrs. 20 Min.) | Max. Marks: 720

Important Instructions:

1. The Answer Sheet is inside this Test Booklet. When you are directed to open the Test Booklet, take out the Answer Sheet and fill in the particulars on OFFICE Copy carefully with **blue/black** ball point pen only.
2. The test is of **3 hours 20 minutes** duration and Test Booklet contains **200** multiple-choice questions (four options with a single correct answer) from **Physics, Chemistry and Biology (Botany and Zoology). 50** questions in each subject are divided **into two Sections (A and B)** as per details given below :
   (a) **Section A** shall consist of **35 (Thirty-five)** Questions in each subject (Questions Nos – 1 to 35, 51 to 85, 101 to 135 and 151 to 185). All questions are compulsory.
   (b) **Section B** shall consist of **15 (Fifteen)** questions in each subject (Question Nos - 36 to 50, 86 to 100, 136 to 150 and 186 to 200). In Section B, a candidate needs to **attempt any 10 (Ten) questions out of 15 (Fifteen)** in each subject.
   Candidates are advised to read all 15 questions in each subject of Section B before they start attempting the question paper. In the event of a candidate attempting more than ten questions, **the first ten questions answered by the candidate shall be evaluated.**
3. Each question carries **4 marks**. For each correct response, the candidate will get 4 marks. For each incorrect response, **one mark** will be deducted from the total scores. **The maximum marks are 720.**
4. Use **Blue/Black Ball Point Pen only** for writing particulars on this page/marking responses on Answer Sheet.
5. Rough work is to be done on the space provided for this purpose in the Test Booklet only.
6. On completion of the test, the candidate **must hand over the Answer Sheet (ORIGINAL and OFFICE Copy) to the Invigilator** before leaving the Room/Hall. The candidates are allowed to take away this Test Booklet with them.
7. **The CODE for this Booklet is F6. Make sure that the CODE printed on the Original Copy of the Answer Sheet is the same as that on this Test Booklet.** In case of discrepancy, the candidate should immediately report the matter to the Invigilator for replacement of both the Test Booklet and the Answer Sheet.
8. The candidates should ensure that the Answer Sheet is not folded. Do not make any stray marks on the Answer Sheet. Do not write your Roll No. anywhere else except in the specified space in the Test Booklet/Answer Sheet.
9. Use of white fluid for correction is **NOT** permissible on the Answer Sheet.
10. Each candidate must show on-demand his/her Admit Card to the Invigilator.
11. No candidate, without special permission of the centre Superintendent or Invigilator, would leave his/her seat.
12. The candidates should not leave the Examination Hall without handing over their Answer Sheet to the Invigilator on duty and sign (with time) the Attendance Sheet twice. **Cases, where a candidate has not signed the Attendance Sheet second time, will be deemed not to have handed over the Answer Sheet and dealt with as an Unfair Means case.**
13. Use of Electronic/ Manual Calculator is prohibited.
14. The candidates are governed by all Rules and Regulations of the examination with regard to their conduct in the Examination Room/Hall. All cases of unfair means will be dealt with as per the Rules and Regulations of this examination.
15. **No part of the Test Booklet and Answer Sheet shall be detached under any circumstances.**
16. The candidates will write the Correct Test Booklet Code as given in the Test Booklet/Answer Sheet in the Attendance Sheet.
17. Compensatory time of one hour five minutes will be provided for the examination of three hours and 20 minutes duration, whether such candidate (having a physical limitation to write) uses the facility of scribe or not.

In case of any ambiguity in translation of any question, English version shall be treated as final.
प्रश्नों के अनुवाद में किसी अस्पष्टता की स्थिति में, अंग्रेजी संस्करण को ही अन्तिम माना जायेगा।

Name of the Candidate (in Capital letters): ______________________

Roll Number: in figures: | | | | | | | | | in words: ______________________

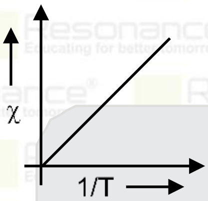
Name of Examination Centre (in Capital letters) : ______________________

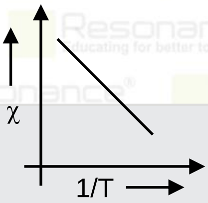
Candidate's Signature: ______________ Invigilator's Signature: ______________

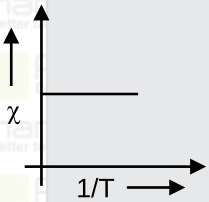
Resonance Eduventures Ltd.
Reg. Office & Corp. Office : CG Tower, A-46 & 52, IPIA, Near City Mall, Jhalawar Road, Kota (Raj.) - 324005
Ph. No.: +91-744-2777777, 2777700 | **FAX No. :** +91-022-39167222
To Know more : sms **RESO** at **56677** | **Website :** www.resonance.ac.in | **E-mail :** contact@resonance.ac.in | **CIN :** U80302RJ2007PLC024029
Toll Free : 1800 258 5555 facebook.com/ResonanceEdu twitter.com/ResonanceEdu www.youtube.com/resowatch blog.resonance.ac.in

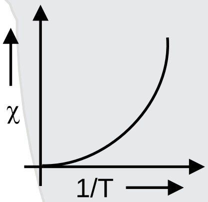
PART : PHYSICS

1. The variation of susceptibility (χ) with absolute temperature (T) for a paramagnetic material is represented as :

(1*) 

(2) 

(3) 

(4) 

Sol. Magnetic Susceptibility (X)

$X \propto \frac{1}{T}$

X Vs $\frac{1}{T}$ Graph will be straight line.

2. A bullet of mass m hits a block of mass M elastically. The transfer of energy is the maximum, when :

(1*) M = m (2) M = 2m (3) M << m (4) M >> m

Sol.

Initial velocity	$u_1 = u$	$u_2 = 0$
Final Velocity	v_1	v_2

Linear momentum conservation

$Mu = mv_1 + mv_2$ ....(1)

Elastic collision

$-\frac{(v_2 - v_1)}{(0-u)} = 1 \Rightarrow v_1 = v_2 - u$ ....(2)

From (1) & (2)

$v_2 = \frac{2mu}{M+m}$

Kinetic energy of M block (k)

$K = \frac{1}{2}Mv_2^2$

$\frac{1}{2}M \times \left(\frac{2mu}{M+m}\right)^2$

For maximum K = $\frac{dK}{dM} = 0$

It gives $\boxed{M = m}$

3. The ground state energy of hydrogen atom is –13.6 eV. The energy needed to ionized hydrogen atom from its second excited state will be :

(1) 13.6 eV (2) 6.8 eV (3*) 1.51 eV (4) 3.4 eV

Sol. Second excited state means n = 3

$$E = -13.6 \times \frac{(1)^2}{n^2} = \frac{-13.6}{(3)^2} = \frac{-13.6}{9} - 1.51$$

4. The escape velocity of a body on the earth surface is 11.2 km/s. If the same body is projected upward with velocity 22.4 km/s, the velocity of this body at infinite distance from the centre of the earth will be :

(1) $11.2\sqrt{2}$ km/s (2) Zero (3) 11.2 km/s (4*) $11.2\sqrt{3}$ km/s

Sol. $-\frac{GMm}{R} + \frac{1}{2}mv^2 = 0 + \frac{1}{2}mv_1^2$

V = 22.4 km/s

V1 = ? , $V_e = \sqrt{\frac{2Gm}{R}}$ = 11.2 km/s

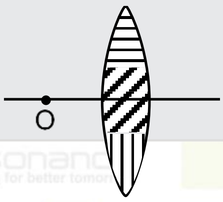
$-\frac{V_e^{\,2}}{2} + \frac{V^2}{2} = \frac{v_1^2}{2}$ $\frac{V_e^{\,2}}{2} = \frac{Gm}{R}$

$= -11.2^2 + (22.4)^2 = V_1^2$

$V_1 = (11.2)\sqrt{4-1}$

$= 11.2\sqrt{3}$

5. A lens is made up of 3 different transparent media as shown in figure. A point object O is placed on its axis beyond 2f. How many real images will be obtained on the other side ?



(1) 2 (2) 1

(3) No image will be formed (4*) 3

Sol. There are 3 different medium.

So number of image will be 3.

6. The diameter of a spherical bob, when measured with vernier callipers yielded the following values 3.33 cm, 3.32 cm, 3.34 cm, 3.33 cm and 3.32 cm.

The mean diameter to appropriate significant figures is :

(1) 3.328 cm (2) 3.3 cm (3*) 3.33 cm (4) 3.32 cm

Sol. $d_{av} = \frac{16.64}{5} = 3.328$

$= 3.33$

7. On the basis of electrical conductivity, which one of the following material has the smallest resistivity ?

(1) Germanium (2*) Silver (3) Glass (4) Silicon

Sol. Silver is good conductor so, its resistivity will be very less.

8. The mechanical quantity, which has dimensions of reciprocal of mass (M^{-1}) is :

(1) angular momentum (2) Coefficient of thermal conductivity

(3) torque (4*) gravitational constant

Sol. Gravitational constant $G = \frac{Fr^2}{m^2} \Rightarrow \frac{Kgm \times m^2}{s^2\,Kg^2} \Rightarrow \frac{Kg^{-1}m^3}{s^2}$

$= [m^{-1} L^3 T^{-2}]$

G has dimension of reciprocal of mass (M^{-1})

9. The position of a particle is given by

$\vec{r}(t) = 4t\hat{i} + 2t^2\hat{j} + 5\hat{k}$

where t is in seconds and r in metre. Find the magnitude and direction of velocity v(t), at t = 1 s, with respect to x-axis.

(1*) $4\sqrt{2}\ ms^{-1}$, 45º (2) $4\sqrt{2}\ ms^{-1}$, 60º (3) $3\sqrt{2}\ ms^{-1}$, 30º (4) $3\sqrt{2}\ ms^{-1}$, 45º

Sol. $\vec{r} = 4t\hat{i} + 2t^2\hat{j} + 5\hat{k}$ Differentiate with respect to time

$V = 4\hat{i} + 4t\hat{j} + 0$

t = 1

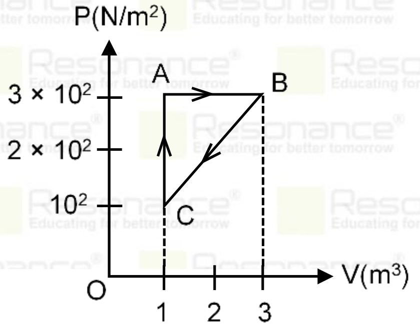
$V = 4\hat{i} + 4\hat{j}$ $|V| = \sqrt{(4)^2 + (4)^2}$

$V = 4\sqrt{2}$

$\tan\theta = \frac{4}{4} = 1$ $\theta = \tan^{-1}(1)$

$\theta = 45º$

10. For the given cycle, the work done during isobaric process is :



(1) 200 J (2) Zero (3) 400 J (4*) 600 J

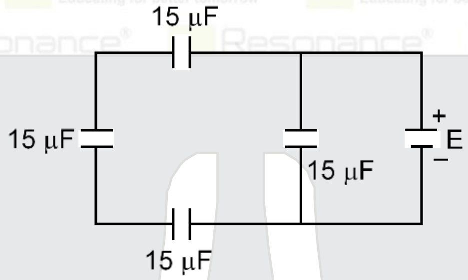
Sol. Work done is isobaric process

AB = p × ΔV

= 3×10^2 (3 – 1)

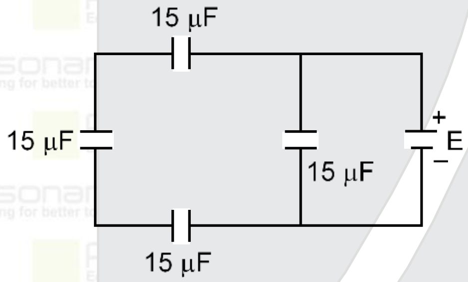
= 600 J

11. The equivalent capacitance of the arrangement shown in figure is :

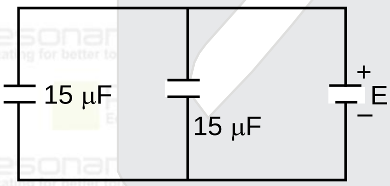


(1) 30 μF (2) 15 μF (3) 25 μF (4*) 20 μF

Sol.

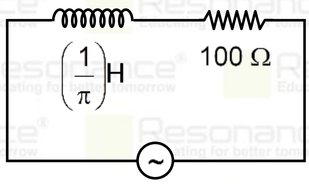


Ceq = $\frac{15}{3} = 5\mu F$



= 5 +15 = 20μF

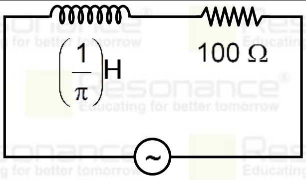
12. An ac source is connected in the given circuit. The value of ϕ will be :



V = 220 sin(100πt + ϕ)volt

(1) 60º (2) 90º (3) 30º (4*) 45º

Sol.



V = 220 sin(100πt + ϕ)volt

$\tan\phi = \frac{X_L}{R}$

$XL = wL = 100\pi \times \frac{1}{\pi} = 100\Omega$

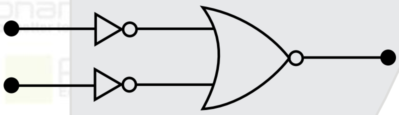
$R = 100\Omega$

$\tan\phi = \frac{100}{100} = 1$

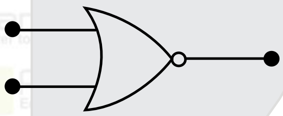
$\tan\phi = 1 \qquad \phi = \tan^{-1}(1)$

$\boxed{\phi = 45^o}$

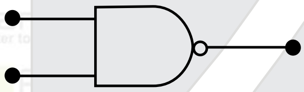
13. The given circuit is equivalent to :



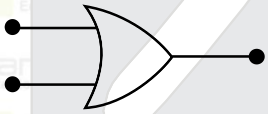
(1)



(2)

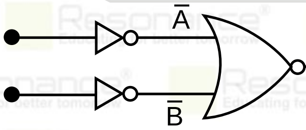


(3)



(4*)

Sol.



Equivalent

$Y = \overline{\bar{A}+\bar{B}} = \bar{\bar{A}}\cdot\bar{\bar{B}} = \boxed{A\cdot B}$

Some AND GATE

$\boxed{Y = A\cdot B}$

A	B	$Y = A\cdot B$
0	0	0

0	1	0
1	1	1
1	0	0

14. A particle moves with a velocity $(5\hat{i}-3\hat{j}+6\hat{k})ms^{-1}$ horizontally under the action of constant force $(10\hat{i}+10\hat{j}+20\hat{k})N$. The instantaneous power supplied to the particle is :

(1) 200 W (2) Zero (3) 100 W (4*) 140 W

Sol. $\vec{V}=(5\hat{i}-3\hat{j}+6\hat{k})m/s$

$\vec{F}=(10\hat{i}+10\hat{j}+20\hat{k})N$

Power = Force × Velcoity

$P=\vec{F}\cdot\vec{V}$

$P=(10\hat{i}+10\hat{j}+20\hat{k})\cdot(5\hat{i}-3\hat{j}+6\hat{k})$

P = 50 – 30 + 120

$\boxed{P=140\text{Watt}}$

15. A certain wire A has resistance 81 Ω. The resistance of another wire B of same material and equal length but of diameter thrice the diameter of A will be :

(1) 81 Ω (2*) 9 Ω (3) 729 Ω (4) 243 Ω

Sol. R = 81Ω

$R=\frac{\rho L}{A}$ = d' = 3d

$R\propto\frac{1}{A}$ Area A = 9 time ($\because$ $A\propto d^2$)

$R\propto\frac{1}{9}$ So, $R'=\frac{81\Omega}{9}$

$\boxed{R'=9\Omega}$

16. ϵ_0 and μ_0 are the electric permittivity and magnetic permeability of free space respectively. If the corresponding quantities of a medium are $2\epsilon_0$ and $1.5\ \mu_0$ respectively, the refractive index of the medium will nearly be :

(1) $\sqrt{2}$ (2*) $\sqrt{3}$ (3) 3 (4) 2

Sol. $\mu=\frac{C}{V}$ C = Velocity of light in vacuum

V = Velocity of light in medium

$$\mu=\frac{\frac{1}{\sqrt{\mu_0\varepsilon_0}}}{\frac{1}{\sqrt{(1.5\mu_0)(2\varepsilon_0)}}}$$

$$\mu=\frac{1}{\sqrt{\mu_0\varepsilon_0}}\times\frac{\sqrt{3}.\sqrt{\mu_0\varepsilon_0}}{1}$$

$\mu = \sqrt{3}$

17. The amount of elastic potential energy per unit volume (in SI unit) of a steel wire of length 100 cm to stretch it by 1 mm is (if Young's modulus of the wire = 2.0 × 10^{11} Nm^{-2})

(1) 10^{11} (2) 10^{17} (3) 10^{7} (4*) 10^{5}

Sol. $\frac{EPE}{Volume} = \frac{1}{2}$ (stress) × (Strain)

$\sigma = EY$ $\qquad \frac{1}{2}(Y)\left(\frac{\text{Change in length}}{\text{Original length}}\right)$

$Y = \frac{\sigma}{E}$ $\qquad = \frac{1}{2}(Y)\left(\frac{\Delta L}{L}\right)^2$

$= \frac{1}{2}(2\times10^{11})\left(\frac{1mm}{100cm}\right)^2$

$= \frac{1}{2}(2\times10^{11})\left(\frac{1\times10^{-3}}{100\times10^{-2}}\right)^2$

$= \frac{10^{11}\times10^{-6}}{1}$

$= 10^5$

18. The 4^{th} overtone of a closed organ pipe is same as that of 3^{rd} overtone of an open pipe. The ratio of the length of the closed pipe to the length of the open pipe is :

(1) 8 : 9 (2) 9 : 7 (3*) 9 : 8 (4) 7 : 9

Sol. $n_{COP} = (2n + 1)V_0$ $\qquad V_0 = \frac{V}{4L}$

$= (2\times4+1)\frac{V}{4L} = \boxed{\frac{9V}{4L_C}}$ …………..(1)

$N_{OOP} = (n + 1)V_0$ $\qquad V_0 = \frac{V}{2L}$

$= (3+1)\frac{V}{2L} \Rightarrow \frac{4V}{2L} = \boxed{\frac{2V}{L_0}}$ …………..(2)

Equation (2)

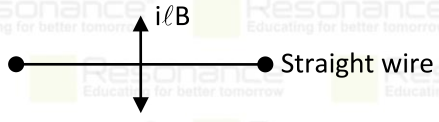
$\frac{9V}{4L_C} = \frac{2V}{L_0}$

$\frac{L_C}{L_0} = \frac{9V}{4\times2V} = \frac{9}{8}$

19. A long straight wire of length 2m and mass 250 g is suspended horizontally in a uniform horizontal magnetic field of 0.7 T. The amount of current flowing through the wire will be (g = 9.8 ms^{-2}) :

(1) 2.45 A (2) 2.25 A (3) 2.75 A (4*) 1.75 A

Sol.



$\boxed{mg = i\ell b}$ $250\times10^{-3} \times 9.8 = I \times 2\times 0.7$ $i = \dfrac{250\times10^{-3}\times 9.8}{2\times 0.7}$ $i = \dfrac{.250\times 9.8}{2\times 0.7}$ $\boxed{i = 1.75A}$	m = 250g $m = 250\times10^{-3}$kg $g = 9.8\dfrac{m}{s^2}$ ℓ = 2m B = 0.7

20. According to Gauss law of electrostatics, electric flux through a closed surface depends on :

(1) the area of the surface

(2*) the quantity of charges enclosed by the surface

(3) the shape of the surface

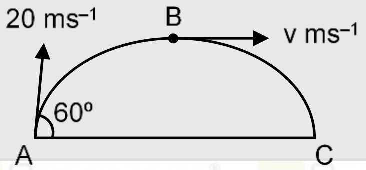
(4) the volume enclosed by the surface

Sol. According to Gauss law electric flux ϕ

$$\boxed{\phi = \frac{q_{inside}}{\varepsilon_0}}$$

So the quantity of charges enclosed by the surface.

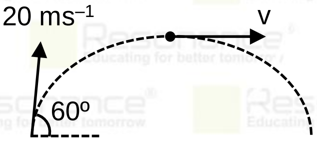
21. A ball is projected from point A with velocity 20 ms^{-1} at an angle 60º to the horizontal direction. At the highest point B of the path (as shown in figure), the velocity v ms^{-1} of the ball will be :



(1) 20 (2) $10\sqrt{3}$ (3) Zero (4*) 10

Ans. **(4)**

Sol.



$v = u\cos\theta$

$= 20\cos 60 = 20\times\frac{1}{2}$

= 10 m/s

22. Which of the following statement is not true ?

(1) Coefficient of viscosity is a scalar quantity
(2) Surface tension is a scalar quantity
(3*) Pressure is a vector quantity
(4) Relative density is a scalar quantity

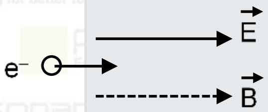
Ans. **(3)**

Sol. Pressure is a scalar quantity

23. A uniform electric field and a uniform magnetic field are acting along the same direction in a certain region. If an electron is projected in the region such that its velocity is pointed along the direction of fields, then the electron :
(1) will turn towards right of direction of motion
(2) will turn towards left of direction of motion
(3*) speed will decrease
(4) speed will increase

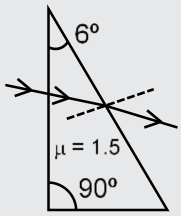
Ans. **(3)**

Sol.



Electric force will actin opposite direction of EF. e^- will retard. Speed will be decrease.

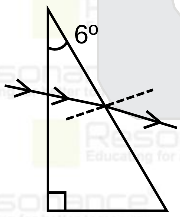
24. A horizontal ray of light in incident on the right angled prism with prism angle 6º. If the refractive index of the material of the prism is 1.5, then the angle of emergence will be :



(1*) 9º (2) 10º (3) 4º (4) 6º

Ans. **(1)**

Sol.



$\delta = (\mu - 1)A$

$\delta = (1.5 - 1)6 = 3^\circ$

$\delta = i + e - A$

$i = 0 \quad A = 6^\circ$

$3 = 0 + e - 6 \quad \Rightarrow \quad e = 9^\circ$

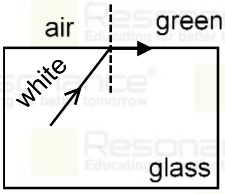
25. A p-type extrinsic semiconductor is obtained when Germanium is doped with :
(1) Antimony (2) Phosphorous (3) Arsenic (4*) Boron

Ans. **(4)**

Sol. Boron has 3 valence e^-.

For p-type Boron should be used as dopant.

26.



Which set of colours will come out in air for a situation shown in figure ?

(1*) Yellow, Orange and Red

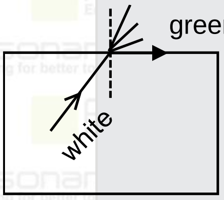
(2) All

(3) Orange, Red and Violet

(4) Blue, Green and Yellow

Ans. **(1)**

Sol.



$\mu \propto \frac{1}{\lambda}$

$\mu_R < \mu_O < \mu_Y < \mu_G$

μ sin i = 1 sin γ

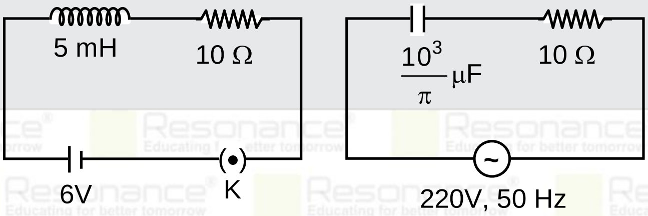
= $\mu \propto$ sin γ

$\mu_R < \mu_O < \mu_Y$

$\gamma_R < \gamma_O < \gamma_Y < \gamma_G = 90^o$

R, O, Y will escape

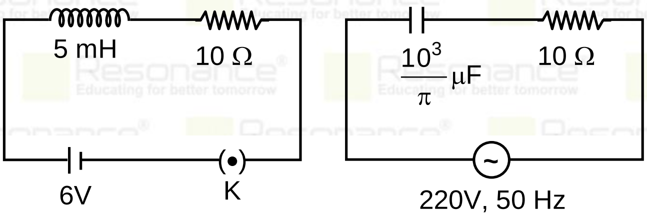
27. If Z_1 and Z_2 are the impedances of the given circuits (a) and (b) as shown in figures, then choose the correct option :



(1*) $Z_1 < Z_2$ (2) $Z_1 + Z_2 = 20\ \Omega$ (3) $Z_1 = Z_2$ (4) $Z_1 > Z_2$

Ans. **(1)**

Sol.



$Z_1 \Rightarrow$ For DC, inductor will have zero reactance

$\Rightarrow Z_1 = \sqrt{R^2 + X_L^2} = \sqrt{R^2} = R = 10\Omega$

$Z_2 \Rightarrow X_C = \frac{1}{\omega C} = \frac{1}{2\pi FC} = \frac{1}{2\pi 50 \times \frac{10^3}{\pi} \times 10^{-6}} = 10\Omega$

$Z_2 = \sqrt{R^2 + X_C^2} = \sqrt{10^2 + 10^2} = 10\sqrt{2}\,\Omega$

$\Rightarrow Z_2 > Z_1$

28. The wavelength of Lyman series of hydrogen atom appears in :

(1) visible region

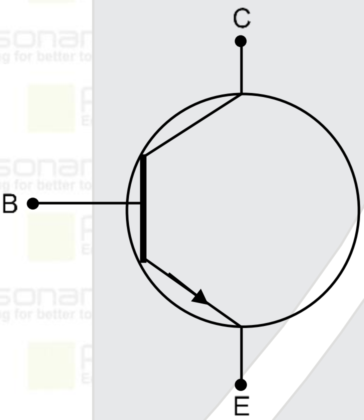
(2) far infrared region

(3*) ultraviolet region

(4) infrared region

Ans. **(3)**

Sol. Lyman series falls in uv region.

29. 

The above figure shows the circuit symbol of a transistor. Select the correct statements given below:

(A) The transistor has two segements of p-type semiconductor separated by a segment of n-type semiconductor.

(B) The emitter is of moderate size and heavily doped.

(C) The central segment is thin and lightly doped.

(D) The emitter base junction is reverse biased in common emitter amplifier circuit.

(1) (C) and (D)

(2) (A) and (D)

(3) (A) and (B)

(4*) (B) and (C)

Ans. **(4)**

Sol. Statement B and C are correct.

30. The de Broglie wavelength associated with an electron, accelerated by a potential difference of 81 V is given by :

(1) 13.6 nm

(2) 136 nm

(3) 1.36 nm
(4*) 0.136 nm

Ans. (4)

Sol. $\frac{h}{\lambda} = \sqrt{2m(qV)}$

$\frac{6.6\times10^{-34}}{\lambda} = \sqrt{2\times9\times10^{-31}\times1.6\times10^{-19}\times81}$

$\lambda = 0.136$ nm

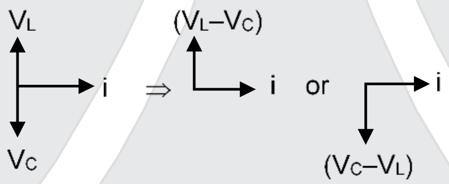
31. The maximum power is dissipated for an ac in a/an.
(1*) resistive circuit
(2) LC circuit
(3) inductive circuit
(4) capacitive circuit

Ans. (1)

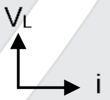
Sol. $P_{avg} = V_{rms} I_{rms} \cos\theta$

(i) Pure resistive ⟶ 

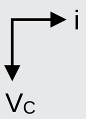
$\Rightarrow \theta = 0$ $P_{avg} = V_{rms} I_{rms} \Rightarrow$ (maximum)

(ii) LC-circuit ⟶ 

$\Rightarrow \theta = 90^o \Rightarrow P_{avg} = 0$

(iii) Pure inductive ⟶ 

$\Rightarrow \theta = 90^o, P_{avg} = 0$

(iv) Capacitive circuit ⟶ 

$\Rightarrow \theta = 90^o, P_{avg} = 0$

32. The maximum kinetic energy of the emitted photoelectrons in photoelectric effect is independent of :
(1) work function of material
(2*) intensity of incident radiation
(3) frequency of incident radiation
(4) wavelength of incident radiation

Ans. (2)

Sol. $E_P = \theta_0 + KE_{max}$

$EP - \theta_0 = KE_{max}$

$hv - \theta_0 = KE_{max} \Rightarrow$ depends on θ_0, v

$\frac{hc}{\lambda} - \theta_0 = KE_{max} \Rightarrow$ depends on λ

Intensity $\propto$ no. of e^- emitted $\propto$ photocurrent

33. Two particles A and B initially at rest, move towards each other under mutual force of attraction. At an instance when the speed of A is ν and speed of B is 3ν, the speed of centre of mass is :

(1) 2ν
(2*) Zero
(3) ν
(4) 4ν

Ans. **(2)**

Sol.

$F_{net} = 0 \Rightarrow a_{com} = 0$

$V_{com)\,initial} = V_{com)\,final}$

$\downarrow$

Rest $\rightarrow 0 = V_{com)\,final}$

34. A charge Q μC is placed at the centre of a cube. The flux coming out from any one of its faces will be (in SI unit):

(1) $\frac{Q}{\varepsilon_0} \times 10^{-6}$

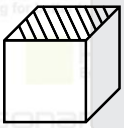
(2) $\frac{2Q}{3\varepsilon_0} \times 10^{-3}$

(3) $\frac{Q}{6\varepsilon_0} \times 10^{-3}$

(4*) $\frac{Q}{6\varepsilon_0} \times 10^{-6}$

Ans. **(4)**

Sol.



Q×10⁻¹C

$Q_{close} = \frac{q_{enclosed}}{\varepsilon_0}$

$Q_{6\ face} = \frac{(Q \times 10^{-6} C)}{\varepsilon_0}$

$Q_{1\ face} = \frac{Q \times 10^{-6}}{6\varepsilon_0}$

35. The viscous drag acting on a metal sphere of diameter 1mm, falling through a fluid of viscosity 0.8 Pa s with a velocity of 2ms^{-1} is equal to :

(1*) 15×10^{-3} N
(2) 30×10^{-3} N

(3) 1.5×10^{-3} N

(4) 20×10^{-3} N

Ans. **(1)**

Sol. $F = 6\pi\eta rv$

$F = 6 \times 3.14 \times 0.8 \times \left(\frac{1}{2} \times 10^{-3}\right) \times 2$

$= 4.8 \times 3.14 \times 10^{-3}$

$F = 15 \times 10^{-3}$ N

SECTION – B (PHYSICS)

36. If R is the radius of the earth and g is the acceleration due to gravity on the surface. Then the mean density of the earth will be :

(1) $\frac{\pi RG}{12g}$

(2) $\frac{3\pi R}{4gG}$

(3*) $\frac{3g}{4\pi RG}$

(4) $\frac{4\pi G}{3gR}$

Ans. **(3)**

Sol. $S = \frac{M}{\frac{4}{3}\pi R^3}$

$M = S \times \frac{4}{3}\pi R^3$

$g = \frac{GM}{R^4}$

$g = \frac{G \times S \times \frac{4}{3}\pi R^3}{R^2}$

$S = \frac{3g}{4\pi Rg}$

37. A copper wire of radius 1 mm contains 10^{22} free electrons per cubic metre. The drift velocity for free electrons when 10 A current flows through the wire will be (Given, charge on electron = 1.6×10^{-19}C)

(1) $\frac{6.25 \times 10^4}{\pi} ms^{-1}$

(2*) $\frac{6.25}{\pi} \times 10^3 ms^{-1}$

(3) $\frac{6.25}{\pi}\times ms^{-1}$

(4) $\frac{6.25\times10^5}{\pi}ms^{-1}$

Ans. (2)

Sol. $i = \eta eAV_d$

$10 = 10^{22} \times 1.6 \times 10^{-19} \times \pi \times (1 \times 10^{-3})^2 \times V_d$

$10 = 1.6\pi \times 10^{-3} \times V_d$

$\frac{10}{1.6\pi}\times10^3 = V_d$

$V_d = \frac{100}{16\pi}\times10^3$

$V_d = \frac{6.25}{\pi}\times10^3\ m/s$

38. An object is mounted on a wall. Its image of equal size is to be obtained on a parallel wall with the help of a convex lens placed between these walls. The lens is kept at distance *x* in front of the second wall. The required focal length of the lens will be :

(1) less than $\frac{x}{4}$

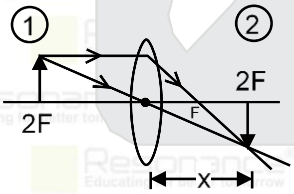
(2) more than $\frac{x}{4}$ but less than $\frac{x}{2}$

(3*) $\frac{x}{2}$

(4) $\frac{x}{4}$

Ans. (3)

Sol.



n = 2f

f = x/2

39. If a conducting sphere of radius R is charged. Then the electric field at a distance r (r > R) from the centre of the sphere would be , (V = potential on the surface of the sphere)

(1) $\frac{rV}{R^2}$

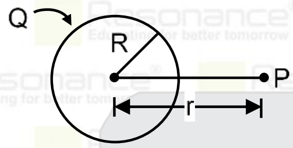
(2) $\frac{R^2V}{r^3}$

(3*) $\frac{RV}{r^2}$

(4) $\frac{V}{r}$

Ans. (3)

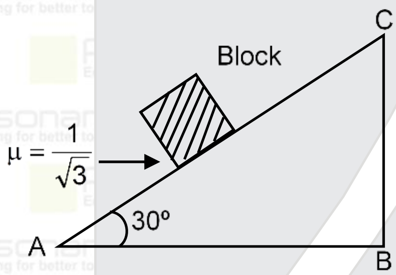
Sol.



$E_P = \frac{KQ}{r^2}$, $V_S = V = \frac{KQ}{R}$

$E_P = \frac{VR}{r^2}$

40. A block of mass 2 kg is placed on a inclined rough surface AC (as shown in figure)of coefficient of friction μ . If g = 10ms^{-2} , the net force (in N) on the block will be :



(1) $10\sqrt{3}$

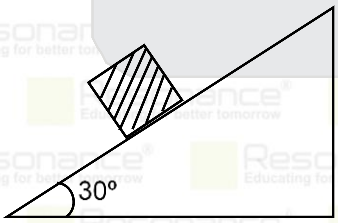
(2*) Zero

(3) 10

(4) 20

Ans. (2)

Sol.



Angle of repose

$\tan\theta_R = \mu_S$

$\tan\theta_R = \frac{1}{\sqrt{3}}$

$\theta_R = 30°$

Block not move $\rightarrow F_{net} = 0$

41. A container of volume 200 cm^3 contains 0.2 mole of hydrogen gas and 0.3 mole of argon gas. The pressure of the system at temperature 200 K (R =8.3 $JK^{-1}mol^{-1}$) will be :

(1) 6.15×10^5 Pa

(2) 6.15×10^4 Pa

(3) 4.15×10^5 Pa

(4*) 4.15×10^6 Pa

Sol. According to Dalton's partial pressure law, the total pressure in a contains due to immiscible gases is equal to the sum of partial pressure of individual gases. So,

$P_{Total} = P_{Ar} + P_{H_2}$

$$P_{Ar} = \frac{nRT}{V} = \frac{(0.3)\times 8.3\times 200}{200\times 10^{-6}} = 8.3 \times 0.3 \times 10^6 \text{ Pa}$$

$$P_{H_2} = \frac{n_2RT}{V} = \frac{(0.2)\times 8.3\times 200}{200\times 10^{-6}} = 8.3 \times 0.2 \times 10^6 \text{ Pa}$$

$P_{Total} = 8.3 \times 10^6 (0.3 + 0.2)$

$= 4.15 \times 10^6$

42. To produce an instantaneous displacement current of 2 mA in the space between the parallel plates of a capacitor of capacitance 4 μ F, , the rate of change of applied variable potential difference $\left(\frac{dV}{dt}\right)$ must be:

(1) 800 V/s

(2*) 500 V/s

(3) 200 V/s

(4) 400 V/s

Sol. Q = CV

$$\frac{dQ}{dt} = C\frac{dv}{dt} \Rightarrow i = c\frac{dv}{dt}$$

$$2mA = (4\mu F)\frac{dv}{dt}$$

$$\frac{dv}{dt} = \frac{2\times 10^{-3}}{4\times 10^{-6}} = \frac{1000}{2} = 500 \frac{v}{s}$$

43. An emf is generate by an ac generator having 100 turn coil, of loop area 1 m^2. The coil rotates at a speed of one revolution per second and placed in a uniform magnetic field of 0.05 T perpendicular to the axis of rotation of the coil. The maximum value of emf is :

(1) 3.14 V

(2*) 31.4 V

(3) 62.8 V

(4) 6.28 V

Sol. Maximum induced emf = NABW

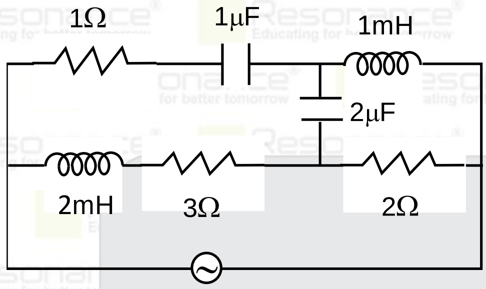
Given, N = 100, A = 1 m^2, B = 0.05T , $W = 1\frac{rev}{sec} = 2\pi\frac{rad}{sec}$

$\varepsilon_{max} = 100 \times 1 \times 0.05 \times 2\pi$

$\varepsilon_{max} = 10\pi$

$\varepsilon_{max} = 31.4$ v

44. For very high frequencies, the effective impedance of the circuit (shown in the figure) will be :

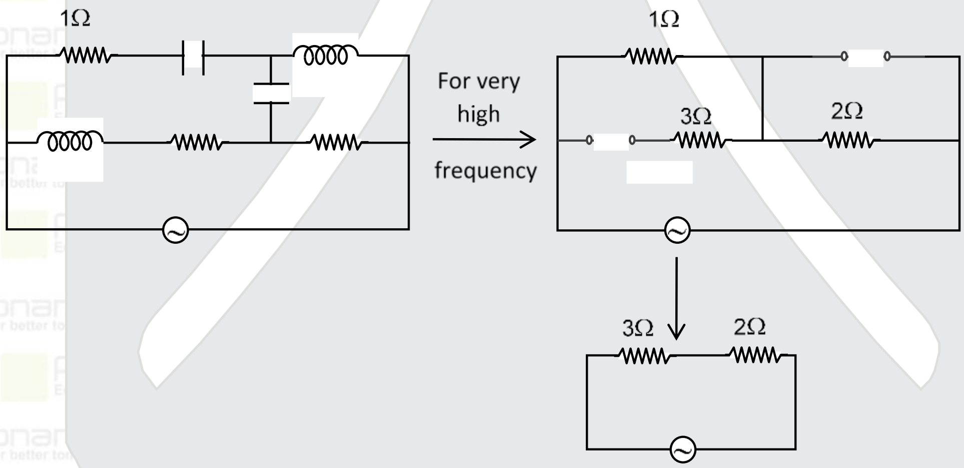


(1) 4 Ω
(2) 6 Ω
(3) 1 Ω
(4*) 3 Ω

Sol. Inductive reactance, $X_L = 2\pi fL$

Capacitive reactance, $X_C = \dfrac{1}{2\pi fC}$

So, at large frequencies inductor acts as open circuit while capacitor acts as short circuit. Therefore, circuit can be reduced as



∴ Effective impedance = 1Ω + 2Ω
= 3 Ω

45. A constant torque of 100 N-m turns a wheel of moment of inertia 300 kgm^2 about an axis passing through its centre. Starting from rest, its angular velocity after 3 s is :
(1*) 1 rad /s
(2) 5 rad / s
(3) 10 rad /s
(4) 15 rad /s

Sol. $\tau = 100$ N-m, $I = 300$ Kg m^2

$\tau = I\alpha \Rightarrow \alpha = \dfrac{\tau}{I} = \dfrac{100}{300} = \dfrac{1}{3}\dfrac{\text{rad}}{\text{s}^2}$

Starting from rest, so initial angular velocity, $\omega_O = 0$

After 3 sec, angular velocity = w

$\omega = w_0 + \alpha t$ (∵ α = constant)

$\omega = 0 + \frac{1}{3} \times 3$

$\omega = 1 \frac{\text{rad}}{\text{sec}}$

46. The emf of a cell having internal resistance 1Ω is balanced against a length of 330 cm on a potentiometer wire. When an external resistance of 2Ω is connected across the cell, the balancing length will be:

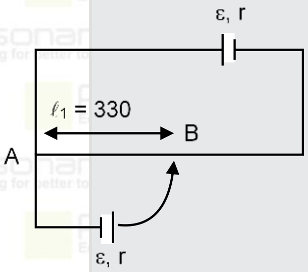
(1*) 220 cm

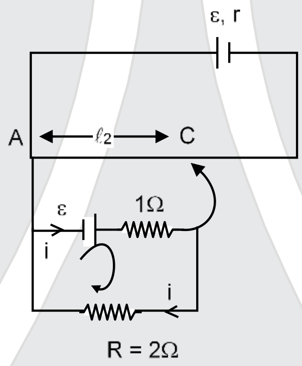
(2) 330 cm

(3) 116 cm

(4) 332 cm

Sol.





$V_{AB} = \varepsilon = x\ell_1$ ....(1)

$i = \frac{\varepsilon}{R+r} = \frac{\varepsilon}{2+1} = \frac{\varepsilon}{3}$

$V_{AC} = i\,R = \left(\frac{\varepsilon}{3}\right) \times 2 = \frac{2\varepsilon}{3}$

$V_{AC} = x\,\ell_2$

$\frac{2\varepsilon}{3} = x\,\ell_2$ ....(2)

Dividing equation (1) & (2)

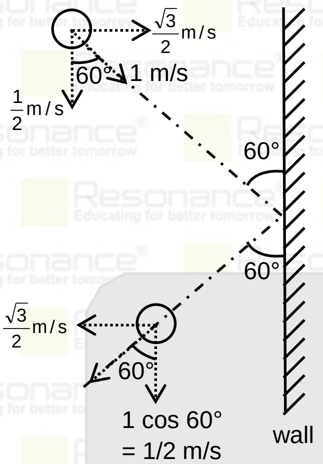
$\frac{\varepsilon}{\left(\frac{2\varepsilon}{3}\right)} = \frac{\ell_1}{\ell_2}$

$\ell_2 = \frac{2\ell_1}{3} = \frac{2 \times 330}{3} = 220\text{cm}$

47. A 1 kg object strikes a wall with velocity 1 ms^{-1} at an angle of 60º with the wall and reflects at the same angle. If it remains in contact with wall for 0.1 s, then the force exerted on the wall is :

(1) $30\sqrt{3}\,N$ (2) Zero (3*) $10\sqrt{3}\,N$ (4) $20\sqrt{3}\,N$

Sol.



Change in momentum in y-direction

$\Delta P_y = P_f - P_i$

$\Delta P_y = \left(1\times\frac{1}{2}\right) - \left(1\times\frac{1}{2}\right)$

$\Delta P_y = 0$

So, there is no force in y-direction.

Change in momentum in x-direction

$\Delta P_x = P_f - P_i$

$\Delta P_x = -1\times\frac{\sqrt{3}\,\hat{i}}{2} - \frac{\sqrt{3}\,\hat{i}}{2}$

$\Delta P_x = -\sqrt{3}\,\hat{i}\,\frac{m}{s}$

Force, $|F| = \frac{|\Delta P|}{\Delta t} = \frac{\sqrt{3}}{0.1} = 10\sqrt{3}$ N

48. The angular momentum of an electron moving in an orbit of hydrogen atom is $1.5\left(\frac{h}{\pi}\right)$. The energy in the same orbit is nearly :

(1*) –1.5 eV (2) –1.6 eV (3) –1.3 eV (4) –1.4 eV

Sol. Angular momentum, $L = \frac{nh}{2\pi}$

$1.5\left(\frac{h}{\pi}\right) = \frac{nh}{2\pi} \Rightarrow n = 3$

$E = \frac{-13.6}{n^2} = -13.6 \times \frac{1}{(3)^2} = -1.5$ eV

49. A particle is executing uniform circular motion with velocity $\vec{v}$ and acceleration $\vec{a}$. Which of the following is true ?

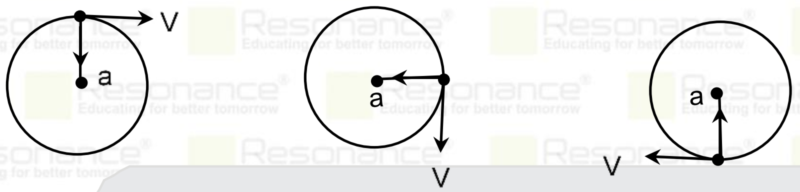
(1) $\vec{v}$ is a constant; $\vec{a}$ is not a constant

(2*) $\vec{v}$ is not a constant; $\vec{a}$ is not a constant

(3) $\vec{v}$ is a constant; $\vec{a}$ is a constant

(4) $\vec{v}$ is not a constant; $\vec{a}$ is a constant

Sol. In a uniform circular motion speed of the particle remains constant while direction of velocity and acceleration changes at every instant. So, $\vec{v}$ and $\vec{a}$ are not constant.



50. A simple pendulum oscillating in air has a period of $\sqrt{3}$ s. If it is completely immersed in non-viscous liquid, having density $\left(\frac{1}{4}\right)^{th}$ of the material of the bob, the new period will be :

(1) $2\sqrt{3}$ s (2) $\frac{2}{\sqrt{3}}$ s (3*) 2 s (4) $\frac{\sqrt{3}}{2}$ s

Sol. In air $g_{eff} = g$ $\therefore T = 2\pi\sqrt{\frac{\ell}{g}} = \sqrt{3}$ ....(1)

In non viscous liquid

$mg_{eff} = \sigma vg - \rho_L vg$

$\sigma vg_{eff} = \sigma vg - \rho_L vg$

$g_{eff} = \left(1 - \frac{\rho}{\sigma}\right) g = \left(1 - \frac{1}{4}\right) g = \frac{3g}{4}$

$T' = 2\pi\sqrt{\frac{4\ell}{3g}} = \frac{2}{\sqrt{3}}\left(2\pi\sqrt{\frac{\ell}{g}}\right)$

From equation (1)

$T' = \frac{2}{\sqrt{3}} \times \sqrt{3}$ = 2 sec