NEET 2023 — Physics Question Paper with Solutions

40 Physics questions as set in the paper · answers checked by RankUp

NEET 2023

1. In a series LCR circuit, the inductance L is 10 mH, capacitance C is 1 μF and resistance R is 100 Ω. The frequency at which resonance occurs is :-

(A) 15.9 kHz
(B) 1.59 rad/s
(C) 1.59 kHz
(D) 15.9 rad/s

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2. The ratio of radius of gyration of a solid sphere of mass M and radius R about its own axis to the radius of gyration of the thin hollow sphere of same mass and radius about its axis is :-

(A) 5 : 3
(B) 2 : 5
(C) √5 : √3
(D) √3 : √5

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3. A Carnot engine has an efficiency of 50% when its source is at a temperature 327°C. The temperature of the sink is :-

(A) 15°C
(B) 100°C
(C) 200°C
(D) 27°C

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4. A bullet is fired from a gun at the speed of 280 m s^{-1} in the direction 30° above the horizontal. The maximum height attained by the bullet is
(g = 9.8 m s^{-2}, sin 30° = 0.5):-

(A) 2000 m
(B) 1000 m
(C) 3000 m
(D) 2800 m

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5. An electric dipole is placed at an angle of 30° with an electric field of intensity 2 × 10^5 N C^{-1}. It experiences a torque equal to 4 N m. Calculate the magnitude of charge on the dipole, if the dipole length is 2 cm.

(A) 6 mC
(B) 4 mC
(C) 2 mC
(D) 8 mC

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6. Given below are two statements:
Statement I : Photovoltaic devices can convert optical radiation into electricity.
Statement II : Zener diode is designed to operate under reverse bias in breakdown region.
In the light of the above statements, choose the most appropriate answer from the options given below :

(A) Both Statement I and Statement II are incorrect.
(B) Statement I is correct but Statement II is incorrect.
(C) Statement I is incorrect but Statement II is correct.
(D) Both Statement I and Statement II are correct

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7. The errors in the measurement which arise due to unpredictable fluctuations in temperature and voltage supply are :

(A) Personal errors
(B) Least count errors
(C) Random errors
(D) Instrumental errors

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8. The ratio of frequencies of fundamental harmonic produced by an open pipe to that of closed pipe having the same length is

(A) 2 : 1
(B) 1 : 3
(C) 3 : 1
(D) 1 : 2

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9. The net magnetic flux through any closed surface is :

(A) Positive
(B) Infinity
(C) Negative
(D) Zero

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10. The work functions of Caesium (Cs), potassium (K) and Sodium (Na) are 2.14 eV, 2.30 eV and 2.75 eV respectively. If incident electromagnetic radiation has an incident energy of 2.20 eV, which of these photosensitive surfaces may emit photoelectrons?

(A) Both Na and K
(B) K only
(C) Na only
(D) Cs only

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11. The minimum wavelength of X-rays produced by an electron accelerated through a potential difference of V volts is proportional to :

(A) $1/V$
(B) $1/\sqrt{V}$
(C) V^2
(D) $\sqrt{V}$

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12. A 12 V, 60 W lamp is connected to the secondary of a step down transformer, whose primary is connected to ac mains of 220 V. Assuming the transformer to be ideal, what is the current in the primary winding ?

(A) 2.7 A
(B) 3.7 A
(C) 0.37 A
(D) 0.27 A

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13. Light travels a distance x in time t_1 in air and 10x in time t_2 in another denser medium. What is the critical angle for this medium?

(A) $\sin^{-1}(10t_2/t_1)$
(B) $\sin^{-1}(t_1/10t_2)$
(C) $\sin^{-1}(10t_1/t_2)$
(D) $\sin^{-1}(t_2/t_1)$

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14. A metal wire has mass (0.4 ± 0.002) g, radius (0.3 ± 0.001) mm and length (5 ± 0.02) cm. The maximum possible percentage error in the measurement of density will nearly be :

(A) 1.3%
(B) 1.6%
(C) 1.4%
(D) 1.2%

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15. For Young's double slit experiment, two statements are given below :
Statement I : If screen is moved away from the plane of slits, angular separation of the fringes remains constant.
Statement II : If the monochromatic source is replaced by another monochromatic source of larger wavelength, the angular separation of fringes decreases.
In the light of the above statements, choose the correct answer from the options given below :

(A) Both Statement I and Statement II are false
(B) Statement I is true but Statement II is false
(C) Statement I is false but Statement II is true
(D) Both Statement I and Statement II are true

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16. Resistance of a carbon resistor determined from colour codes is (22000 ± 5%) Ω. The colour of third band must be :

(A) Green
(B) Orange
(C) Yellow
(D) Red

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17. An ac source is connected to a capacitor C. Due to decrease in its operating frequency

(A) displacement current increases.
(B) displacement current decreases.
(C) capacitive reactance remains constant.
(D) capacitive reactance decreases.

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18. A vehicle travels half the distance with speed v and the remaining distance with speed 2v. Its average speed is :

(A) 2v/3
(B) 4v/3
(C) 3v/4
(D) v/3

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19. The amount of energy required to form a soap bubble of radius 2 cm from a soap solution is nearly:
(surface tension of soap solution = 0.03 N m^{-1})

(A) 5.06×10^{-4} J
(B) 3.01×10^{-4} J
(C) 50.1×10^{-4} J
(D) 30.16×10^{-4} J

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20. The venturi-meter works on :

(A) Bernoulli's principle
(B) The principle of parallel axes
(C) The principle of perpendicular axes
(D) Huygen's principle

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21. In hydrogen spectrum, the shortest wavelength in the Balmer series is λ. The shortest wavelength in the Brackett series is :

(A) 4λ
(B) 9λ
(C) 16λ
(D) 2λ

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22. The potential energy of a long spring when stretched by 2 cm is U. If the spring is stretched by 8 cm, potential energy stored in it will be :

(A) 4U
(B) 8U
(C) 16U
(D) 2U

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23. A full wave rectifier circuit consists of two p-n junction diodes, a centre-tapped transformer, capacitor and a load resistance. Which of these components remove the ac ripple from the rectified output?

(A) p-n junction diodes
(B) Capacitor
(C) Load resistance
(D) A centre-tapped transformer

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24. The magnetic energy stored in an inductor of inductance 4 μH carrying a current of 2 A is :

(A) 4 mJ
(B) 8 mJ
(C) 8 μJ
(D) 4 μJ

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25. If $\oint_S E \cdot dS = 0$ over a surface, then:

(A) the magnitude of electric field on the surface is constant.
(B) all the charges must necessarily be inside the surface.
(C) the electric field inside the surface is necessarily uniform.
(D) the number of flux lines entering the surface must be equal to the number of flux lines leaving it.

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26. A football player is moving southward and suddenly turns eastward with the same speed to avoid an opponent. The force that acts on the player while turning is :

(A) along northward
(B) along north-east
(C) along south-west
(D) along eastward

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27. Let a wire be suspended from the ceiling (rigid support) and stretched by a weight W attached at its free end. The longitudinal stress at any point of cross-sectional area A of the wire is :

(A) W/A
(B) W/2A
(C) Zero
(D) 2W/A

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28. The angular acceleration of a body, moving along the circumference of a circle, is :

(A) along the radius towards the centre
(B) along the tangent to its position
(C) along the axis of rotation
(D) along the radius, away from centre

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29. In a plane electromagnetic wave travelling in free space, the electric field component oscillates sinusoidally at a frequency of 2.0×10^{10} Hz and amplitude 48 V m^{-1}. Then the amplitude of oscillating magnetic field is : (Speed of light in free space = 3×10^8 m s^{-1})

(A) 1.6×10^{-8} T
(B) 1.6×10^{-7} T
(C) 1.6×10^{-6} T
(D) 1.6×10^{-9} T

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30. Two bodies of mass m and 9m are placed at a distance R. The gravitational potential on the line joining the bodies where the gravitational field equals zero, will be (G = gravitational constant) :

(A) $-12Gm/R$
(B) $-16Gm/R$
(C) $-20Gm/R$
(D) $-8Gm/R$

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31. Calculate the maximum acceleration of a moving car so that a body lying on the floor of the car remains stationary. The coefficient of static friction between the body and the floor is 0.15 (g = 10 m s^{-2}).

(A) 150 m s^{-2}
(B) 1.5 m s^{-2}
(C) 50 m s^{-2}
(D) 1.2 m s^{-2}

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32. A satellite is orbiting just above the surface of the earth with period T. If d is the density of the earth and G is the universal constant of gravitation, the quantity $3\pi/(Gd)$ represents :

(A) T^2
(B) T^3
(C) $\sqrt{T}$
(D) T

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33. A horizontal bridge is built across a river. A student standing on the bridge throws a small ball vertically upwards with a velocity 4 m s^{-1}. The ball strikes the water surface after 4 s. The height of bridge above water surface is (Take g = 10 m s^{-2})

(A) 60 m
(B) 64 m
(C) 68 m
(D) 56 m

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34. Two thin lenses are of same focal lengths (f), but one is convex and the other one is concave. When they are placed in contact with each other, the equivalent focal length of the combination will be :

(A) f/4
(B) f/2
(C) Infinite
(D) Zero

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35. A wire carrying a current I along the positive x-axis has length L. It is kept in a magnetic field $\vec{B} = (2\hat{i} + 3\hat{j} - 4\hat{k})$ T. The magnitude of the magnetic force acting on the wire is :

(A) √5 IL
(B) 5 IL
(C) √3 IL
(D) 3 IL

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36. A bullet from a gun is fired on a rectangular wooden block with velocity u. When bullet travels 24 cm through the block along its length horizontally, velocity of bullet becomes u/3. Then it further penetrates into the block in the same direction before coming to rest exactly at the other end of the block. The total length of the block is :

(A) 24 cm
(B) 28 cm
(C) 30 cm
(D) 27 cm

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37. The resistance of platinum wire at 0°C is 2 Ω and 6.8 Ω at 80°C. The temperature coefficient of resistance of the wire is :

(A) 3×10^{-3} °C^{-1}
(B) 3×10^{-2} °C^{-1}
(C) 3×10^{-10} °C^{-1}
(D) 3×10^{-4} °C^{-1}

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38. 10 resistors, each of resistance R are connected in series to a battery of emf E and negligible internal resistance. Then those are connected in parallel to the same battery, the current is increased n times. The value of n is :

(A) 100
(B) 1
(C) 1000
(D) 10

NEET 2023

39. The radius of inner most orbit of hydrogen atom is 5.3×10^{-11} m. What is the radius of third allowed orbit of hydrogen atom?

(A) 1.06 Å
(B) 1.59 Å
(C) 4.77 Å
(D) 0.53 Å

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40. The half life of a radioactive substance is 20 minutes. In how much time, the activity of substance drops to (1/16)th of its initial value?

(A) 40 minutes
(B) 60 minutes
(C) 80 minutes
(D) 20 minutes

Answer key and explanations

1. Answer: (C) 1.59 kHz

$f = 1/(2\pi\sqrt{(LC)}) = 1/(2\pi\sqrt{(10^{-2} \times 10^{-6})}) = 1/(2\pi \times 10^{-4}) \approx 1592$ Hz ≈ 1.59 kHz. The angular frequency would be 10^4 rad/s, so the rad/s options are wrong in magnitude.

2. Answer: (D) √3 : √5

k_solid = √(2/5) R and k_hollow = √(2/3) R, so the ratio = √(3/5) = √3 : √5. The ratio of moments of inertia (3 : 5) is not the ratio of radii of gyration.

3. Answer: (D) 27°C

$\eta = 1 - T_2/T_1$ with $T_1 = 600$ K: $0.5 = 1 - T_2/600$, so $T_2 = 300$ K = 27°C. Using Celsius directly would wrongly give 163.5°C.

4. Answer: (B) 1000 m

$H = (u \sin\theta)^2/(2g) = (280 \times 0.5)^2/(2 \times 9.8) = 19600/19.6 = 1000$ m. Forgetting to square sin θ would give 2000 m.

5. Answer: (C) 2 mC

$\tau = q(2a)E \sin\theta$, so $q = 4/(0.02 \times 2 \times 10^5 \times 0.5) = 4/2000 = 2 \times 10^{-3}$ C = 2 mC. Omitting sin 30° gives 1 mC, and doubling it wrongly gives 4 mC.

6. Answer: (D) Both Statement I and Statement II are correct

Solar cells (photovoltaic devices) generate an emf when light falls on them, and a Zener diode is a heavily doped diode made to work in reverse breakdown as a voltage regulator. Both statements are correct.

7. Answer: (C) Random errors

Errors from irregular, unpredictable changes in experimental conditions such as temperature or supply voltage are random errors. Instrumental errors are systematic and come from imperfect instruments.

8. Answer: (A) 2 : 1

Open pipe: f = v/2L; closed pipe: f = v/4L. Their ratio is 2 : 1. The inverted ratio 1 : 2 compares closed to open.

9. Answer: (D) Zero

Gauss's law for magnetism: magnetic monopoles do not exist and field lines form closed loops, so as many lines leave a closed surface as enter it and the net flux is zero.

10. Answer: (D) Cs only

Emission needs photon energy ≥ work function. 2.20 eV exceeds only caesium's 2.14 eV; it is below potassium's 2.30 eV and sodium's 2.75 eV.

11. Answer: (A) 1/V

The shortest wavelength arises when all the electron's energy eV goes into one photon: $eV = hc/\lambda_{min}$, so $\lambda_{min} \propto 1/V$. The $1/\sqrt{V}$ dependence is for the electron's de Broglie wavelength, not the X-ray cut-off.

12. Answer: (D) 0.27 A

For an ideal transformer input power = output power = 60 W, so $I_p = 60/220 \approx 0.27$ A. The secondary current would be 60/12 = 5 A.

13. Answer: (C) $\sin^{-1}(10t_1/t_2)$

$c = x/t_1$ and $v = 10x/t_2$, so $n = c/v = t_2/(10t_1)$. $\sin C = 1/n = 10t_1/t_2$, giving $C = \sin^{-1}(10t_1/t_2)$. The expression $10t_2/t_1$ is n inverted incorrectly and exceeds 1.

14. Answer: (B) 1.6%

$\rho = m/(\pi r^2 L)$, so $\Delta\rho/\rho = \Delta m/m + 2\Delta r/r + \Delta L/L = 0.002/0.4 + 2(0.001/0.3) + 0.02/5 = 0.5\% + 0.67\% + 0.4\% \approx 1.6\%$. Forgetting the factor 2 for the radius gives about 1.2%.

15. Answer: (B) Statement I is true but Statement II is false

Angular fringe separation is λ/d, independent of the screen distance D, so Statement I is true. A larger λ increases λ/d, so Statement II is false.

16. Answer: (B) Orange

$22000\ \Omega = 22 \times 10^3\ \Omega$: the first two bands are red-red (2, 2) and the third, the multiplier 10^3, is orange; gold gives ±5%. Red as the third band would mean 2200 Ω.

17. Answer: (B) displacement current decreases.

$X_C = 1/(2\pi fC)$ increases as f decreases, so the current through the circuit, which in the gap of the capacitor is the displacement current, decreases. Capacitive reactance therefore rises, not falls or stays constant.

18. Answer: (B) 4v/3

For equal distances, $v_{avg} = 2v_1v_2/(v_1 + v_2) = 2(v)(2v)/(3v) = 4v/3$. The arithmetic mean 3v/2 would apply only for equal times.

19. Answer: (B) 3.01×10^{-4} J

A soap bubble has two surfaces, so $W = T \times 2 \times 4\pi r^2 = 0.03 \times 8\pi \times (0.02)^2 = 0.03 \times 1.005 \times 10^{-2} \approx 3.01 \times 10^{-4}$ J. Counting only one surface gives about 1.5×10^{-4} J.

20. Answer: (A) Bernoulli's principle

A venturimeter measures flow speed from the pressure drop at its constriction, which follows from Bernoulli's principle with the continuity equation. The axis theorems concern moments of inertia and Huygens' principle concerns wavefronts.

21. Answer: (A) 4λ

The series limit has $1/\lambda = R/n^2$: Balmer (n = 2) gives $1/\lambda = R/4$ and Brackett (n = 4) gives R/16. So the Brackett limit is 16/4 = 4 times λ. Taking 16λ ignores that λ already contains the factor 4.

22. Answer: (C) 16U

$U = \tfrac{1}{2}kx^2$, so increasing x from 2 cm to 8 cm (4 times) multiplies U by $4^2 = 16$. 4U would be the result of a linear dependence.

23. Answer: (B) Capacitor

The capacitor across the load charges at the peaks and discharges slowly between them, filtering out the ripple. The diodes only rectify, turning ac into pulsating dc.

24. Answer: (C) 8 μJ

$U = \tfrac{1}{2}LI^2 = \tfrac{1}{2} \times 4 \times 10^{-6} \times 2^2 = 8 \times 10^{-6}$ J = 8 μJ. The milli-joule options use the wrong prefix.

25. Answer: (D) the number of flux lines entering the surface must be equal to the number of flux lines leaving it.

Zero net flux means the enclosed charge is zero, i.e. as many field lines enter the closed surface as leave it. It says nothing about the field being constant or uniform; outside charges can still produce a non-zero, varying field on the surface.

26. Answer: (B) along north-east

$\Delta v = v(\text{east}) - v(\text{south}) = v(\text{east}) + v(\text{north})$, which points north-east; the force is along the change in momentum, hence north-east. Eastward is the final velocity, not the change in velocity.

27. Answer: (A) W/A

Treating the wire as light, the tension is W at every cross-section, so the longitudinal stress is force per area = W/A. The ceiling reaction does not double it.

28. Answer: (C) along the axis of rotation

Angular velocity and angular acceleration are axial vectors directed along the axis of rotation (by the right-hand rule). Centripetal acceleration points towards the centre and tangential acceleration along the tangent, but those are linear accelerations.

29. Answer: (B) 1.6×10^{-7} T

$B_0 = E_0/c = 48/(3 \times 10^8) = 1.6 \times 10^{-7}$ T; the frequency is not needed. The other options are off by powers of ten.

30. Answer: (B) $-16Gm/R$

At the null point, $Gm/x^2 = G(9m)/(R - x)^2$, so $R - x = 3x$ and $x = R/4$. $V = -Gm/(R/4) - 9Gm/(3R/4) = -4Gm/R - 12Gm/R = -16Gm/R$. Potential is a scalar, so both contributions add even though the fields cancel.

31. Answer: (B) 1.5 m s^{-2}

Static friction must supply ma, and its maximum is μmg, so $a_{max} = \mu g = 0.15 \times 10 = 1.5$ m s^{-2}. Multiplying μ by 1000 or dividing wrongly gives the other values.

32. Answer: (A) T^2

$T = 2\pi\sqrt{(R^3/GM)}$ with $M = (4/3)\pi R^3 d$ gives $T^2 = 4\pi^2 R^3/(G \cdot (4/3)\pi R^3 d) = 3\pi/(Gd)$. So $3\pi/(Gd)$ equals T^2, not T.

33. Answer: (B) 64 m

Taking up as positive, displacement $= ut - \frac{1}{2}gt^2 = 4 \times 4 - \frac{1}{2} \times 10 \times 16 = 16 - 80 = -64$ m, so the bridge is 64 m above the water. Ignoring the initial upward velocity's sign gives 96 m or 80 m, not 64 m.

34. Answer: (C) Infinite

$1/F = 1/f + 1/(-f) = 0$, so the combination has zero power and an infinite focal length; it behaves like a plane glass plate.

35. Answer: (B) 5 IL

$\vec{F} = IL\,\hat{i} \times (2\hat{i} + 3\hat{j} - 4\hat{k}) = IL(3\hat{k} + 4\hat{j})$, since $\hat{i} \times \hat{i} = 0$. $|F| = IL\sqrt{(3^2 + 4^2)} = 5IL$. Using the full $|B| = \sqrt{29}$ would wrongly include the component parallel to the wire.

36. Answer: (D) 27 cm

With uniform retardation a: $u^2 - u^2/9 = 2a(24)$, so $2a = u^2/27$ per cm. For the rest: $(u/3)^2 = 2a \cdot s$ gives $s = (u^2/9)/(u^2/27) = 3$ cm. Total length $= 24 + 3 = 27$ cm.

37. Answer: (B) 3×10^{-2} °C^{-1}

$R_t = R_0(1 + \alpha t)$: $\alpha = (6.8 - 2)/(2 \times 80) = 4.8/160 = 0.03 = 3 \times 10^{-2}$ °C^{-1}. (This is far larger than platinum's real value, but it is what the given data imply.)

38. Answer: (A) 100

Series: $R_s = 10R$, $I_1 = E/10R$. Parallel: $R_p = R/10$, $I_2 = 10E/R$. $n = I_2/I_1 = 100$. The answer 10 forgets that resistance both rises tenfold in series and drops tenfold in parallel.

39. Answer: (C) 4.77 Å

Bohr radius $r_n = n^2 r_1$, so $r_3 = 9 \times 0.53$ Å $= 4.77$ Å. Multiplying by 3 instead of 9 gives 1.59 Å.

40. Answer: (C) 80 minutes

$1/16 = (1/2)^4$, so four half-lives are needed: $4 \times 20 = 80$ minutes. 60 minutes would give only 1/8 of the activity.

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