

NEET Physics Sample Paper 03

A) **Subject:** Physics

B) **Total Questions:** 45 Questions (All Compulsory)

C) **Marking Scheme & Rules:**

- Correct Answer: +4 marks
- Incorrect Answer: -1 mark (Negative marking)
- Unattempted Question: 0 marks
- Multiple Answers: Treated as incorrect, attracting -1 mark

Q1. The dimensions of $\frac{1}{2}\epsilon_0 E^2$ (where ϵ_0 is permittivity of free space and E is electric field) are:

- A. $[MLT^{-1}]$
B. $[ML^2T^{-2}]$
C. $[ML^{-1}T^{-2}]$
D. $[ML^2T^{-1}]$

Q2. A particle starting from rest moves with a constant acceleration. If it covers a distance x in the first 2 seconds, the distance it covers in the next 2 seconds is:

- A. x
B. $2x$
C. $3x$
D. $4x$

Q3. A bullet of mass 0.04 kg moving with a speed of 90 m/s enters a heavy wooden block and is stopped after a distance of 60 cm. The average resistive force exerted by the block on the bullet is:

- A. 180 N
B. 270 N
C. 360 N
D. 540 N

Q4. A position-dependent force $F = 7 - 2x + 3x^2$ newtons acts on a small body of mass 2 kg and displaces it from $x = 0$ to $x = 5$ m. The work done in joules is:

- A. 70

- B. 135
- C. 270
- D. 35

Q5. A thin circular ring of mass M and radius R is rotating about its axis with an angular speed ω . Two particles, each of mass m , are attached gently to the opposite ends of a diameter of the ring. The angular speed of the ring will now become:

- A. $\frac{\omega M}{M+m}$
- B. $\frac{\omega M}{M+2m}$
- C. $\frac{\omega(M-2m)}{M+2m}$
- D. $\frac{\omega(M+2m)}{M}$

Q6. The escape velocity from the Earth is approximately 11.2 km/s. If a planet has twice the radius of the Earth and the same mean density, the escape velocity from its surface will be:

- A. 11.2 km/s
- B. 22.4 km/s
- C. 5.6 km/s
- D. 44.8 km/s

Q7. For a given material, the Young's modulus is 2.4 times its modulus of rigidity. The Poisson's ratio of the material is:

- A. 0.2
- B. 0.5
- C. 1.2
- D. 0.4

Q8. A small spherical ball of radius r falls from rest in a viscous liquid. As a result, heat is produced due to viscous force. The rate of production of heat when the ball attains its terminal velocity is proportional to:

- A. r^2
- B. r^3
- C. r^4
- D. r^5

Q9. An ideal gas undergoes an isothermal expansion from state (P_1, V_1) to (P_2, V_2) . The work done by the gas is:

- A. Zero
- B. $P(V_2 - V_1)$
- C. $nRT \ln(V_2/V_1)$
- D. $nRT(V_2/V_1 - 1)$

Q10. The mean free path of gas molecules is inversely proportional to:

- A. Temperature
- B. Volume
- C. Square of the diameter of the molecule
- D. Square root of the mass of the molecule

Q11. The displacement of a particle executing SHM is given by $y = 0.5 \sin(100\pi t + \pi/4)$ in meters. The frequency of oscillation is:

- A. 100π Hz
- B. 50 Hz
- C. 25 Hz
- D. 0.5 Hz

Q12. An electric dipole is placed at an angle of 30° with an electric field of intensity 2×10^5 N/C. It experiences a torque equal to 4 N m. The charge on the dipole, if the dipole length is 2 cm, is:

- A. 8 mC
- B. 2 mC
- C. 5 mC
- D. 7 mC

Q13. A capacitor of 4 mF is charged to 400 V and then its plates are connected through a resistance of 1 k Ω . The heat produced in the resistance is:

- A. 0.16 J
- B. 0.32 J
- C. 0.64 J

D. 1.28 J

Q14. The resistance of a wire is 10Ω . It is stretched so that its length becomes three times. Assuming there is no change in density on stretching, the new resistance will be:

A. 30Ω

B. 90Ω

C. 10Ω

D. 3.33Ω

Q15. In the given circuit, if the potential at point A is 10 V , what is the potential at point B if a current of 2 A flows from A to B through a 3Ω resistor?

A. 13 V

B. 4 V

C. 7 V

D. 16 V

Q16. A long straight wire carries a current of 35 A . The magnitude of the magnetic field B at a point 20 cm from the wire is:

A. $3.5 \times 10^{-5} \text{ T}$

B. $7.0 \times 10^{-6} \text{ T}$

C. $3.5 \times 10^{-5} \text{ T}$

D. $4.4 \times 10^{-5} \text{ T}$

Q17. The coercivity of a certain bar magnet is $4 \times 10^3 \text{ A/m}$. The magnet is placed inside a solenoid of 60 cm length and 500 turns. The current required to demagnetize the magnet is:

A. 2.4 A

B. 4.8 A

C. 6.0 A

D. 3.2 A

Q18. A circular coil of 100 turns and radius 10 cm is placed in a uniform magnetic field of 0.1 T normal to the plane of the coil. If the coil is rotated by 180° in 0.1 s , the average induced EMF is:

A. 0.314 V

- B. 6.28 V
- C. 3.14 V
- D. Zero

Q19. In an AC circuit, $V = 100 \sin(100t)$ volts and $I = 100 \sin(100t + \pi/3)$ mA. The power dissipated in the circuit is:

- A. 10^4 W
- B. 10 W
- C. 2.5 W
- D. 5.0 W

Q20. Which of the following has the minimum wavelength?

- A. X-rays
- B. γ -rays
- C. Ultraviolet rays
- D. Cosmic rays

Q21. A convex lens of focal length 20 cm and a concave lens of focal length 10 cm are placed in contact. The power of the combination is:

- A. +5 D
- B. -5 D
- C. +10 D
- D. -10 D

Q22. Two coherent sources of intensity ratio 1 : 4 produce an interference pattern. The ratio of maximum to minimum intensity will be:

- A. 1 : 4
- B. 5 : 3
- C. 9 : 1
- D. 25 : 9

Q23. When light of wavelength 300 nm falls on a photoelectric emitter, photoelectrons are liberated. For another emitter, light of wavelength 600 nm is sufficient for liberating photoelectrons. The ratio of the work functions of the two emitters is:

- A. 1 : 2
- B. 2 : 1
- C. 4 : 1
- D. 1 : 4

Q24. The ratio of the radius of the $n = 1$ orbit to the $n = 2$ orbit for a hydrogen atom is:

- A. 1 : 2
- B. 1 : 4
- C. 4 : 1
- D. 2 : 1

Q25. To get an output $Y = 1$ from the following logic circuit, the inputs must be:[Logic Gate: An AND gate with inputs A and B]

- A. $A = 0, B = 1$
- B. $A = 1, B = 0$
- C. $A = 1, B = 1$
- D. $A = 0, B = 0$

Q26. Two bodies of masses 1 kg and 3 kg have position vectors $\hat{i} + 2\hat{j} + \hat{k}$ and $-3\hat{i} - 2\hat{j} + \hat{k}$ respectively. The center of mass of this system has a position vector:

- A. $-2\hat{i} - \hat{j} + \hat{k}$
- B. $-2\hat{i} - \hat{j} + \hat{k}$
- C. $2\hat{i} + \hat{j} - \hat{k}$
- D. $-\hat{i} + \hat{j} + \hat{k}$

Q27. A body of mass M hits a wall normally with a velocity v and rebounds with the same velocity. The change in momentum of the body is:

- A. Zero
- B. Mv
- C. $-2Mv$
- D. $-Mv$

Q28. The potential energy of a particle in a conservative field is given by $U = a/r^2 - b/r$, where a and b are positive constants and r is the distance of the particle from the center of the field. For equilibrium, the value of r is:

- A. a/b
- B. $2a/b$
- C. $b/2a$
- D. b/a

Q29. A constant torque of 1000 N m turns a wheel of moment of inertia 200 kg m^2 about an axis through its center. Its angular acceleration is:

- A. 2 rad/s^2
- B. 5 rad/s^2
- C. 10 rad/s^2
- D. 1 rad/s^2

Q30. If the mass of a satellite is doubled and the radius of its orbit is doubled, its orbital velocity will:

- A. Remain same
- B. Become $1/\sqrt{2}$ times
- C. Become 2 times
- D. Become $1/2$ times

Q31. The excess pressure inside a soap bubble of radius R is P . The excess pressure inside another soap bubble of radius $2R$ made of the same soap solution is:

- A. $P/4$
- B. $P/2$
- C. $2P$
- D. $4P$

Q32. A refrigerator works between 4°C and 30°C . The coefficient of performance is nearly:

- A. 1.5
- B. 10.6
- C. 10.6

D. 1.1

Q33. Two strings A and B of the same material are under the same tension. If the radius of A is double that of B , the ratio of the fundamental frequency of A to that of B is:

A. 1 : 4

B. 1 : 2

C. 2 : 1

D. 4 : 1

Q34. A charge q is enclosed by a Gaussian spherical surface of radius R . If the radius is doubled, the outward electric flux will:

A. Be doubled

B. Be halved

C. Remain unchanged

D. Be quadrupled

Q35. In a Wheatstone bridge, all four arms have equal resistance R . If the resistance of the galvanometer is also R , the equivalent resistance of the combination as seen by the battery is:

A. $R/4$

B. $R/2$

C. R

D. $2R$

Q36. A galvanometer of resistance $100\ \Omega$ gives full-scale deflection for $10\ \text{mA}$ current. To use it as an ammeter of $1\ \text{A}$ range, the resistance of the shunt required is:

A. $1.11\ \Omega$

B. $1.01\ \Omega$

C. $0.11\ \Omega$

D. $9.9\ \Omega$

Q37. A thin diamagnetic rod is placed vertically between the poles of an electromagnet. When the current in the electromagnet is switched on, the diamagnetic rod:

A. Is pushed up, out of the horizontal magnetic field

- B. Is pulled down into the field
- C. Remains stationary
- D. Starts rotating

Q38. A transformer having efficiency of 90% is working on 200 V and 3 kW power supply. If the current in the secondary coil is 6 A, the voltage across the secondary coil and the current in the primary coil respectively are:

- A. 300 V, 15 A
- B. 450 V, 15 A
- C. 450 V, 13.5 A
- D. 600 V, 15 A

Q39. The amplitude of the magnetic field part of a harmonic electromagnetic wave in vacuum is $B_0 = 510$ nT. What is the amplitude of the electric field part of the wave?

- A. 1.7×10^{-6} V/m
- B. 153 V/m
- C. 1.53×10^{-7} V/m
- D. 170 V/m

Q40. An object is placed at 10 cm in front of a concave mirror of radius of curvature 15 cm. The magnification of the image is:

- A. -3
- B. -3
- C. +3
- D. -1.5

Q41. In a Young's double slit experiment, the distance between the slits is 1 mm and the distance to the screen is 1 m. If the slit separation is halved and the screen distance is doubled, the fringe width becomes:

- A. Same
- B. 2 times
- C. 4 times
- D. 1/4 times

Q42. The de Broglie wavelength of an electron moving with a velocity of 1.5×10^7 m/s is approximately:

- A. 0.48 \AA
- B. 0.48 \AA
- C. 0.24 \AA
- D. 1.2 \AA

Q43. The ratio of the wavelengths of the longest wavelength lines in the Lyman and Balmer series of hydrogen spectrum is:

- A. 3 : 23
- B. 5 : 27
- C. 27 : 5
- D. 9 : 4

Q44. The mass defect in a particular nuclear reaction is 0.3 g. The amount of energy liberated is:

- A. 2.7×10^7 J
- B. 2.7×10^{13} J
- C. 9×10^{10} J
- D. 3×10^8 J

Q45. The current gain of a common emitter transistor is 100. If the collector current changes by 1 mA, the emitter current change will be:

- A. 1 mA
 - B. 1.01 mA
 - C. 0.01 mA
 - D. 100 mA
-

Solutions

- (C) The expression $\frac{1}{2}\epsilon_0 E^2$ represents the energy density of an electric field. Since energy density is energy per unit volume, its dimensions are calculated as $[ML^2T^{-2}]/[L^3]$, which simplifies to $[ML^{-1}T^{-2}]$.
- (C) Using $s = \frac{1}{2}at^2$, the distance in 2 seconds is $x = 2a$. In 4 seconds, the total distance is $8a = 4x$. Therefore, the distance covered in the next 2 seconds is $4x - x = 3x$.
- (B) Using the work-energy theorem, the work done by the resistive force equals the change in kinetic energy ($F \cdot d = \frac{1}{2}mv^2$). Solving $F \times 0.6 = 0.5 \times 0.04 \times 90^2$ gives an average force of 270 N.
- (B) Work done is the integral of force with respect to displacement from $x = 0$ to $x = 5$. Integrating $(7 - 2x + 3x^2)$ yields $[7x - x^2 + x^3]$, which evaluates to $(35 - 25 + 125) = 135$ J.
- (B) According to the law of conservation of angular momentum, $I_1\omega_1 = I_2\omega_2$. Adding two masses m at radius R changes the moment of inertia from MR^2 to $(M + 2m)R^2$, resulting in the new angular speed $\frac{\omega M}{M+2m}$.
- (B) Escape velocity is proportional to $R\sqrt{\rho}$. Since the density remains constant and the radius is doubled, the escape velocity also doubles. Thus, the new escape velocity is $11.2 \times 2 = 22.4$ km/s.
- (A) The relationship between Young's modulus (Y), modulus of rigidity (G), and Poisson's ratio (σ) is $Y = 2G(1 + \sigma)$. Substituting $Y = 2.4G$ gives $2.4 = 2(1 + \sigma)$, which simplifies to $\sigma = 0.2$.
- (D) The rate of heat production is equal to the power dissipated by the viscous force ($F \cdot v$). Since the viscous force $F \propto rv$ and terminal velocity $v \propto r^2$, the power is proportional to $r \cdot r^2 \cdot r^2 = r^5$.
- (C) In an isothermal process, the temperature of the ideal gas remains constant. The work done during expansion is derived by integrating PdV using the ideal gas law, resulting in the expression $nRT \ln(V_2/V_1)$.
- (C) The mean free path of a gas molecule is defined as the average distance traveled between collisions. It is mathematically given by $\lambda = 1/(\sqrt{2}n\pi d^2)$, showing an inverse proportionality to the square of the molecular diameter.
- (B) The angular frequency ω is given as 100π rad/s. Since frequency $f = \omega/2\pi$, we calculate $100\pi/2\pi = 50$ Hz. This represents the number of complete cycles performed by the particle every second.
- (B) Torque on a dipole is $\tau = pE \sin \theta = (q \cdot 2l)E \sin \theta$. Substituting $\tau = 4$, $2l = 0.02$, $E = 2 \times 10^5$, and $\sin 30^\circ = 0.5$, we solve for q , finding it to be 0.002 C or 2 mC.
- (B) The energy stored in the capacitor is $U = \frac{1}{2}CV^2$. Calculating $0.5 \times 4 \times 10^{-6} \times 400^2$ gives 0.32 J. When discharged through a resistor, all of this stored electrical energy is converted into heat energy.

14. **(B)** For a wire of constant volume, resistance is proportional to the square of its length ($R \propto L^2$). Since the length is tripled, the resistance increases by $3^2 = 9$ times, making the new resistance $10 \times 9 = 90 \Omega$.
15. **(B)** Following the direction of current from A to B , the potential at B is the potential at A minus the IR drop. Thus, $V_B = 10 \text{ V} - (2 \text{ A} \times 3 \Omega) = 10 - 6 = 4 \text{ V}$.
16. **(C)** The magnetic field due to a long straight wire is $B = \mu_0 I / 2\pi r$. Substituting $I = 35$ and $r = 0.2$, we get $(4\pi \times 10^{-7} \times 35) / (2\pi \times 0.2)$, which simplifies to $3.5 \times 10^{-5} \text{ T}$.
17. **(B)** To demagnetize the bar, the magnetic intensity H of the solenoid must equal the coercivity. Using $H = (N/L)I$, we have $4000 = (500/0.6) \times I$. Solving for I gives $4000 \times 0.6/500 = 4.8 \text{ A}$.
18. **(B)** The induced EMF is $e = -N\Delta\phi/\Delta t$. The change in flux $\Delta\phi$ is $2BA$ because the coil rotates 180° . Calculating $2 \times 100 \times 0.1 \times \pi \times 0.1^2/0.1$ results in an average EMF of 6.28 V .
19. **(C)** Power in an AC circuit is $P = V_{rms}I_{rms} \cos \phi$. Substituting $V_{rms} = 100/\sqrt{2}$, $I_{rms} = 0.1/\sqrt{2}$ (converting mA to A), and $\cos 60^\circ = 0.5$, we get $50 \times 0.1 \times 0.5 = 2.5 \text{ W}$.
20. **(B)** In the electromagnetic spectrum, gamma rays have the highest frequency and the highest energy per photon. Consequently, they possess the shortest (minimum) wavelength compared to X-rays, ultraviolet rays, and all other forms of electromagnetic radiation.
21. **(B)** Power of the combination is $P = P_1 + P_2$. Calculating $P_1 = 1/0.2 = +5 \text{ D}$ and $P_2 = 1/(-0.1) = -10 \text{ D}$, the total power is $5 - 10 = -5 \text{ D}$. The combination acts as a diverging lens.
22. **(C)** The ratio of maximum to minimum intensity is $(\sqrt{I_1} + \sqrt{I_2})^2 / (\sqrt{I_1} - \sqrt{I_2})^2$. With an intensity ratio of $1 : 4$, this becomes $(1 + 2)^2 / (1 - 2)^2 = 9/1$, giving a ratio of $9 : 1$ for the interference pattern.
23. **(B)** The work function is inversely proportional to the threshold wavelength ($\Phi = hc/\lambda$). Since the threshold wavelengths are 300 nm and 600 nm , the ratio of their work functions is $600 : 300$, which is exactly $2 : 1$.
24. **(B)** In the Bohr model of the hydrogen atom, the radius of the n^{th} electron orbit is proportional to n^2 . Therefore, the ratio of the radius for $n = 1$ to the radius for $n = 2$ is $1^2 : 2^2$, which is $1 : 4$.
25. **(C)** An AND gate is a basic logic gate that performs logical multiplication. It produces a high output (1) if and only if all of its inputs are high (1). If any input is low (0), the output remains low.
26. **(B)** $R_{cm} = \frac{1(\hat{i}+2\hat{j}+\hat{k})+3(-3\hat{i}-2\hat{j}+\hat{k})}{4} = -2\hat{i} - \hat{j} + \hat{k}$.
27. **(C)** $\Delta p = p_{final} - p_{initial} = (-Mv) - (Mv) = -2Mv$.
28. **(B)** For equilibrium, $dU/dr = -2ar^{-3} + br^{-2} = 0$, which simplifies to $r = 2a/b$.

29. (B) $\alpha = \tau/I = 1000/200 = 5 \text{ rad/s}^2$.
30. (B) $v = \sqrt{GM/R}$; if radius R is doubled, orbital velocity becomes $1/\sqrt{2}$ times the original.
31. (B) $P = 4T/R$; if radius R is doubled, excess pressure becomes $P/2$ due to inverse proportionality.
32. (C) $\beta = T_L/(T_H - T_L) = 277/(303 - 277) = 277/26 \approx 10.6$.
33. (B) $f \propto 1/r$; if the radius of string A is double that of B , its frequency is halved (1 : 2).
34. (C) According to Gauss's Law, electric flux depends only on the enclosed charge, not the surface radius.
35. (C) For a balanced bridge where all branches are R , equivalent resistance $R_{eq} = (2R \times 2R)/(2R + 2R) = R$.
36. (B) $S = \frac{I_g G}{I - I_g} = \frac{0.01 \times 100}{1 - 0.01} = \frac{1}{0.99} \approx 1.01 \Omega$.
37. (A) Diamagnetic materials are repelled by magnetic fields, moving from stronger field regions to weaker ones.
38. (B) $I_p = 3000/200 = 15\text{A}$; $V_s = (0.9 \times 3000)/6 = 450\text{V}$.
39. (B) $E_0 = c \cdot B_0 = (3 \times 10^8) \cdot (510 \times 10^{-9}) = 153 \text{ V/m}$.
40. (B) $1/v = 1/(-7.5) - 1/(-10) \Rightarrow v = -30$; Magnification $m = -v/u = -(-30)/(-10) = -3$.
41. (C) $\beta = \lambda D/d$; doubling D and halving d results in 4 times the original fringe width.
42. (B) $\lambda = h/mv = (6.63 \times 10^{-34})/(9.1 \times 10^{-31} \times 1.5 \times 10^7) \approx 0.48 \text{ \AA}$.
43. (B) $\lambda_L/\lambda_B = [R(1/4 - 1/9)]/[R(1 - 1/4)] = (5/36)/(3/4) = 5/27$.
44. (B) $E = \Delta mc^2 = (0.3 \times 10^{-3} \text{ kg}) \cdot (3 \times 10^8 \text{ m/s})^2 = 2.7 \times 10^{13} \text{ J}$.
45. (B) $\Delta I_e = \Delta I_c + \Delta I_c/\beta = 1 + 1/100 = 1.01 \text{ mA}$.