

**JEE Main April 2024**  
**Question Paper With Text Solution**  
**09 April | Shift-1**

**PHYSICS**



**JEE Main & Advanced | XI-XII Foundation | VI-X Pre-Foundation**

**Office : Piprali Road, Sikar (Raj.) | Ph. 01572-241911**  
**Website : [www.matrixedu.in](http://www.matrixedu.in) ; Email : [smd@matrixacademy.co.in](mailto:smd@matrixacademy.co.in)**

---



31. The volume of an ideal gas ( $\gamma = 1.5$ ) is changed adiabatically from 5 litres to 4 litres. The ratio of initial pressure to final pressure is :

- (1)  $\frac{16}{25}$                       (2)  $\frac{2}{\sqrt{5}}$                       (3)  $\frac{4}{5}$                       (4)  $\frac{8}{5\sqrt{5}}$

Question ID: 87827056186

Ans. Official Answer NTA (4)

Sol.

32. A light inextensible string passing over a smooth light pulley connects two blocks of masses  $m_1$  and  $m_2$ . If the acceleration of the system is  $\frac{g}{8}$ , then the ratio of the masses  $\frac{m_2}{m_1}$  is :

- (1) 5 : 3                      (2) 9 : 7                      (3) 8 : 1                      (4) 4 : 3

Question ID: 87827056181

Ans. Official Answer NTA (2)

Sol.

33. A particle of mass  $m$  moves on a straight line with its velocity increasing with distance according to the equation  $v = \alpha\sqrt{x}$ , where  $\alpha$  is a constant. The total work done by all the forces applied on the particle during its displacement from  $x = 0$  to  $x = d$ , will be :

- (1)  $2m\alpha^2d$                       (2)  $\frac{md}{2\alpha^2}$                       (3)  $\frac{m}{2\alpha^2d}$                       (4)  $\frac{m\alpha^2d}{2}$

Question ID: 87827056182

Ans. Official Answer NTA (4)

Sol.

34. A sample of 1 mole gas at temperature  $T$  is adiabatically expanded to double its volume. If adiabatic constant for the gas is  $\gamma = \frac{3}{2}$ , then the work done by the gas in the process is :

- (1)  $RT[2 + \sqrt{2}]$                       (2)  $\frac{T}{R}[2 + \sqrt{2}]$                       (3)  $RT[2 - \sqrt{2}]$                       (4)  $\frac{R}{T}[2 - \sqrt{2}]$

Question ID: 87827056185

Ans. Official Answer NTA (3)

Sol.



35. A plane EM wave is propagating along x direction. It has a wavelength of 4 mm. If electric field is in y direction with the maximum magnitude of  $60 \text{ Vm}^{-1}$ , the equation for magnetic field is :

$$(1) B_z = 60 \sin \left[ \frac{\pi}{2} (x - 3 \times 10^8 t) \right] \hat{k} \text{T}$$

$$(2) B_x = 60 \sin \left[ \frac{\pi}{2} (x - 3 \times 10^8 t) \right] \hat{i} \text{T}$$

$$(3) B_z = 2 \times 10^{-7} \sin \left[ \frac{\pi}{2} (x - 3 \times 10^8 t) \right] \hat{k} \text{T}$$

$$(4) B_z = 2 \times 10^{-7} \sin \left[ \frac{\pi}{2} \times 10^3 (x - 3 \times 10^8 t) \right] \hat{k} \text{T}$$

Question ID: 87827056191

Ans. Official Answer NTA (4)

Sol.

36. A proton, an electron and an alpha particle have the same energies. Their de-Broglie wavelengths will be compared as :

$$(1) \lambda_\alpha < \lambda_p < \lambda_e$$

$$(2) \lambda_e > \lambda_\alpha > \lambda_p$$

$$(3) \lambda_p > \lambda_e > \lambda_\alpha$$

$$(4) \lambda_p < \lambda_e < \lambda_\alpha$$

Question ID: 87827056193

Ans. Official Answer NTA (1)

Sol.

37. Given below are two statements :

**Statement (I) :** When currents vary with time, Newton's third law is valid only if momentum carried by the electromagnetic field is taken into account.

**Statement (II) :** Ampere's circuital law does not depend on Biot-Savart's law.

In the light of the above statement, choose the **correct** answer from the options given below :

(1) Both Statement I and Statement II are true

(2) Statement I is false but Statement II is true

(3) Statement I is true but Statement II is false

(4) Both Statement I and Statement II are false

Question ID: 87827056189

Ans. Official Answer NTA (3)

Sol.

38. A heavy iron bar, of weight W is having its one end on the ground and the other on the shoulder of a person. The bar makes an angle  $\theta$  with the horizontal. The weight experienced by the person is :



(1)  $W \sin \theta$

(2)  $W \cos \theta$

(3)  $W$

(4)  $\frac{W}{2}$

Question ID: 87827056180

Ans. Official Answer NTA (4)

**Matrix Ans. (Bonus)**

Sol.

39. A galvanmeter has a coil of resistance  $200\Omega$  with a full scale deflection at  $20\mu A$ . The value of resistance to be added to use it as an ammeter of range (0-20) mA is :

(1)  $0.50\Omega$

(2)  $0.20\Omega$

(3)  $0.40\Omega$

(4)  $0.10\Omega$

Question ID: 87827056197

Ans. Official Answer NTA (2)

Sol.

40. An astronaut takes a ball of mass  $m$  from earth to space. He throws the ball into a circular orbit about earth at altitude of 318.5 km. From earth's surface to the orbit, the change in total mechanical energy of the ball is

$$x \frac{GM_e m}{21R_e}. \text{ The value of } x \text{ is (take } R_e = 6370 \text{ km):}$$

(1) 12

(2) 9

(3) 10

(4) 11

Question ID: 87827056183

Ans. Official Answer NTA (4)

Sol.

41. A light emitting diode (LED) is fabricated using GaAs semiconducting material whose band gap is 1.42 eV. The wavelength of light emitted from the LED is :

(1) 875 nm

(2) 1243 nm

(3) 650 nm

(4) 1400 nm

Question ID: 87827056195

Ans. Official Answer NTA (1)

Sol.

42. A bulb and a capacitor are connected in series across an ac supply. A dielectric is then placed between the plates of the capacitor. The glow of the bulb :

(1) decreases

(2) remains same

(3) becomes zero

(4) increases



Question ID: 87827056190

Ans. Official Answer NTA (4)

Sol.

43. A particle moving in a straight line covers half the distance with speed 6 m/s. The other half is covered in two equal time intervals with speeds 9 m/s and 15 m/s respectively. The average speed of the particle during the motion is :

- (1) 10 m/s                      (2) 9.2 m/s                      (3) 8.8 m/s                      (4) 8 m/s

Question ID: 87827056179

Ans. Official Answer NTA (4)

Sol.

44. The dimensional formula of latent heat is :

- (1)  $[ML^2T^{-2}]$                       (2)  $[M^0LT^{-2}]$                       (3)  $[M^0L^2T^{-2}]$                       (4)  $[MLT^{-2}]$

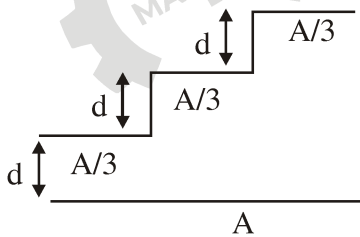
Question ID: 87827056178

Ans. Official Answer NTA (3)

Sol.

45. A capacitor is made of a flat plate of area A and a second plate having a stair-like structure as shown in figure.

If the area of each stair is  $\frac{A}{3}$  and the height is d, the capacitance of the arrangement is :



- (1)  $\frac{18\epsilon_0 A}{11d}$                       (2)  $\frac{11\epsilon_0 A}{18d}$                       (3)  $\frac{11\epsilon_0 A}{20d}$                       (4)  $\frac{13\epsilon_0 A}{17d}$

Question ID: 87827056187

Ans. Official Answer NTA (2)

Sol.

46. Given below are two statements :

**MATRIX JEE ACADEMY**

Office : Piprali Road, Sikar (Raj.) | Ph. 01572-241911

Website : www.matrixedu.in ; Email : smd@matrixacademy.co.in



**Statement (I) :** When an object is placed at the centre of curvature of a concave lens, image is formed at the centre of curvature of the lens on the other side.

**Statement (II) :** Concave lens always forms a virtual and erect image.

In the light of the above statements, choose the correct answer from the options given below :

- (1) Statement I is true but Statement II is false
- (2) Both Statement I and Statement II are true
- (3) Statement I is false but Statement II is true
- (4) Both Statement I and Statement II are false

Question ID: 87827056192

Ans. Official Answer NTA (3)

Sol.

47. One main scale division of a vernier caliper is equal to  $m$  units. If  $n^{\text{th}}$  division of main scale coincides with  $(n+1)^{\text{th}}$  division of vernier scale, the least count of the vernier caliper is :

- (1)  $\frac{n}{(n+1)}$
- (2)  $\frac{m}{(n+1)}$
- (3)  $\frac{1}{(n+1)}$
- (4)  $\frac{m}{n(n+1)}$

Question ID: 87827056196

Ans. Official Answer NTA (2)

Sol.

48. A sphere of relative density  $\sigma$  and diameter  $D$  has concentric cavity of diameter  $d$ . The ratio of  $\frac{D}{d}$ , if it just floats on water in a tank is :

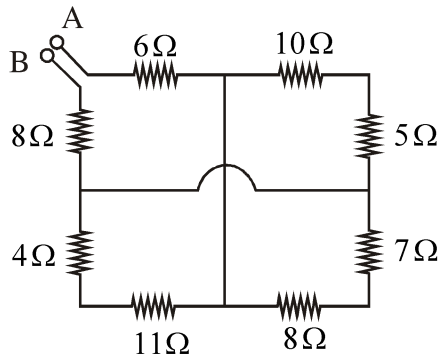
- (1)  $\left(\frac{\sigma-2}{\sigma+2}\right)^{\frac{1}{3}}$
- (2)  $\left(\frac{\sigma+2}{\sigma-2}\right)^{\frac{1}{3}}$
- (3)  $\left(\frac{\sigma-2}{\sigma}\right)^{\frac{1}{3}}$
- (4)  $\left(\frac{\sigma}{\sigma-1}\right)^{\frac{1}{3}}$

Question ID: 87827056184

Ans. Official Answer NTA (4)

Sol.

49. The equivalent resistance between A and B is :



(1) 27Ω

(2) 25Ω

(3) 18Ω

(4) 19Ω

Question ID: 87827056188

Ans. Official Answer NTA (4)

Sol.

50. The energy equivalent of 1 g of substance is :

(1)  $5.6 \times 10^{26}$  MeV(2)  $5.6 \times 10^{12}$  MeV

(3) 5.6 eV

(4)  $11.2 \times 10^{24}$  MeV

Question ID: 87827056194

Ans. Official Answer NTA (1)

Sol.

51. When a coil is connected across a 20 V dc supply, it draws a current of 5 A. When it is connected across 20 V, 50 Hz ac supply, it draws a current of 4 A. The self inductance of the coil is \_\_\_\_\_

Question ID: 87827056205

Ans. Official Answer NTA (10)

Sol.

52. In a Young's double slit experiment, the intensity at a point is  $\left(\frac{1}{4}\right)^{\text{th}}$  of the maximum intensity, the minimum distance of the point from the central maximum is \_\_\_\_\_  $\mu\text{m}$ .  
(Given :  $\lambda = 600 \text{ nm}$ ,  $d = 1.0 \text{ mm}$ ,  $D = 1.0 \text{ m}$ )

Question ID: 87827056206

Ans. Official Answer NTA (200)

Sol.



53. The position, velocity and acceleration of a particle executing simple harmonic motion are found to have magnitudes of 4 m,  $2 \text{ ms}^{-1}$  and  $16 \text{ ms}^{-2}$  at a certain instant. The amplitude of the motion is  $\sqrt{x}$ , m where  $x$  is \_\_\_\_\_.

Question ID: 87827056201

Ans. Official Answer NTA (17)

Sol.

54. A string is wrapped around the rim of a wheel of moment of inertia  $0.40 \text{ kgm}^2$  and radius 10 cm. The wheel is free to rotate about its axis. Initially the wheel is at rest. The string is now pulled by a force of 40 N. The angular velocity of the wheel after 10 s is  $x \text{ rad/s}$ , where  $x$  is \_\_\_\_\_.

Question ID: 87827056199

Ans. Official Answer NTA (100)

Sol.

55. At the centre of a half ring of radius  $R = 10 \text{ cm}$  and linear charge density  $4n \text{ C m}^{-1}$ , the potential is  $x \pi V$ . The value of  $x$  is \_\_\_\_\_.

Question ID: 87827056202

Ans. Official Answer NTA (36)

Sol.

56. A square loop of edge length 2 m carrying current of 2 A is placed with its edges parallel to the x-y axis. A magnetic field is passing through the x-y plane and expressed as  $\vec{B} = B_0 (1 + 4x) \hat{k}$ , where  $B_0 = 5 \text{ T}$ . The net magnetic force experienced by the loop is \_\_\_\_\_ N.

Question ID: 87827056204

Ans. Official Answer NTA (160)

Sol.

57. A star has 100% helium composition. It starts to convert three  ${}^4\text{He}$  into one  ${}^{12}\text{C}$  via triple alpha process as  ${}^4\text{He} + {}^4\text{He} + {}^4\text{He} \rightarrow {}^{12}\text{C} + Q$ . The mass of the star is  $2.0 \times 10^{32} \text{ kg}$  and it generates energy at the rate of  $5.808 \times 10^{30} \text{ W}$ . The rate of converting these  ${}^4\text{He}$  to  ${}^{12}\text{C}$  is  $n \times 10^{42} \text{ s}^{-1}$ , where  $n$  is \_\_\_\_\_.
- [Take, mass of  ${}^4\text{He} = 4.0026 \text{ u}$ , mass of  ${}^{12}\text{C} = 12 \text{ u}$ ]

Question ID: 87827056207





Ans. Official Answer NTA (5)

Sol.

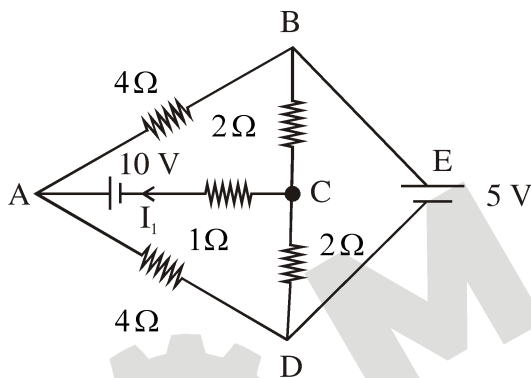
58. Two persons pull a wire towards themselves. Each person exerts a force of 200 N on the wire. Young's modulus of the material of wire is  $1 \times 10^{11} \text{ N m}^{-2}$ . Original length of the wire is 2 m and the area of cross section is  $2 \text{ cm}^2$ . The wire will extend in length by \_\_\_\_\_  $\mu\text{m}$ .

Question ID: 87827056200

Ans. Official Answer NTA (20)

Sol.

59. The current flowing through the  $1 \Omega$  resistor is  $\frac{n}{10} \text{ A}$ . The value of n is \_\_\_\_\_.



Question ID: 87827056203

Ans. Official Answer NTA (25)

Sol.

60. If  $\vec{a}$  and  $\vec{b}$  makes an angle  $\cos^{-1}\left(\frac{5}{9}\right)$  with each other, then  $|\vec{a} + \vec{b}| = \sqrt{2} |\vec{a} - \vec{b}|$  for  $|\vec{a}| = n |\vec{b}|$ . The integer value of n is \_\_\_\_\_.

Question ID: 87827056198

Ans. Official Answer NTA (3)

Sol.



**MATRIX**

**Question Paper With Text Solution (Physics)**

JEE Main April 2024 | 09 April Shift-1



---

**MATRIX JEE ACADEMY**

**Office : Piprali Road, Sikar (Raj.) | Ph. 01572-241911**

**Website : [www.matrixedu.in](http://www.matrixedu.in) ; Email : [smd@matrixacademy.co.in](mailto:smd@matrixacademy.co.in)**