

FINAL JEE-MAIN EXAMINATION – FEBRUARY, 2021

(Held On Wednesday 24th February, 2021) TIME : 3 : 00 PM to 6 : 00 PM

PHYSICS

TEST PAPER WITH ANSWER

SECTION-A

1. When a particle executes SHM, the nature of graphical representation of velocity as a function of displacement is :

- (1) circular (2) elliptical
(3) parabolic (4) straight line

Official Ans. by NTA (2)

2. Two electrons each are fixed at a distance '2d'. A third charge proton placed at the midpoint is displaced slightly by a distance x ($x \ll d$) perpendicular to the line joining the two fixed charges. Proton will execute simple harmonic motion having angular frequency : (m = mass of charged particle)

(1) $\left(\frac{2q^2}{\pi\epsilon_0 md^3}\right)^{\frac{1}{2}}$ (2) $\left(\frac{\pi\epsilon_0 md^3}{2q^2}\right)^{\frac{1}{2}}$

(3) $\left(\frac{q^2}{2\pi\epsilon_0 md^3}\right)^{\frac{1}{2}}$ (4) $\left(\frac{2\pi\epsilon_0 md^3}{q^2}\right)^{\frac{1}{2}}$

Official Ans. by NTA (3)

3. On the basis of kinetic theory of gases, the gas exerts pressure because its molecules :

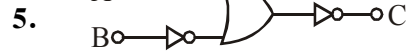
- (1) continuously lose their energy till it reaches wall.
(2) are attracted by the walls of container.
(3) continuously stick to the walls of container.
(4) suffer change in momentum when impinge on the walls of container.

Official Ans. by NTA (4)

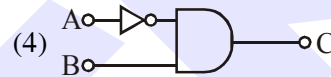
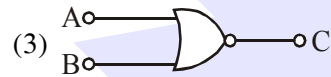
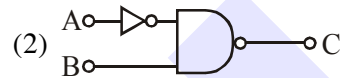
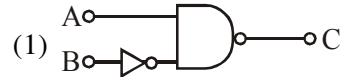
4. A soft ferromagnetic material is placed in an external magnetic field. The magnetic domains :

- (1) increase in size but no change in orientation.
(2) have no relation with external magnetic field.
(3) decrease in size and changes orientation.
(4) may increase or decrease in size and change its orientation.

Official Ans. by NTA (4)



The logic circuit shown above is equivalent to :



Official Ans. by NTA (4)

6. The period of oscillation of a simple pendulum

is $T = 2\pi\sqrt{\frac{L}{g}}$. Measured value of 'L' is 1.0 m

from meter scale having a minimum division of 1 mm and time of one complete oscillation is 1.95 s measured from stopwatch of 0.01 s resolution. The percentage error in the determination of 'g' will be :

- (1) 1.13% (2) 1.03%
(3) 1.33% (4) 1.30%

Official Ans. by NTA (1)

7. Given below are two statements :

Statement I : PN junction diodes can be used to function as transistor, simply by connecting two diodes, back to back, which acts as the base terminal.

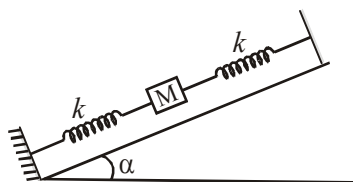
Statement II : In the study of transistor, the amplification factor β indicates ratio of the collector current to the base current.

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

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

Official Ans. by NTA (1)

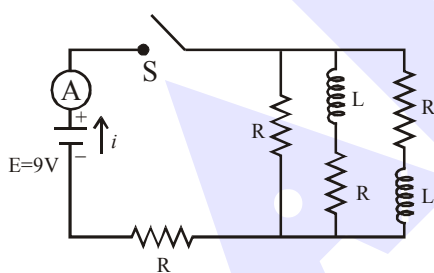
8. In the given figure, a body of mass M is held between two massless springs, on a smooth inclined plane. The free ends of the springs are attached to firm supports. If each spring has spring constant k , the frequency of oscillation of given body is :



- (1) $\frac{1}{2\pi} \sqrt{\frac{k}{2M}}$ (2) $\frac{1}{2\pi} \sqrt{\frac{2k}{Mg \sin \alpha}}$
 (3) $\frac{1}{2\pi} \sqrt{\frac{2k}{M}}$ (4) $\frac{1}{2\pi} \sqrt{\frac{k}{Mg \sin \alpha}}$

Official Ans. by NTA (3)

9. Figure shows a circuit that contains four identical resistors with resistance $R = 2.0 \Omega$, two identical inductors with inductance $L = 2.0 \text{ mH}$ and an ideal battery with emf $E = 9 \text{ V}$. The current ' i ' just after the switch 'S' is closed will be :



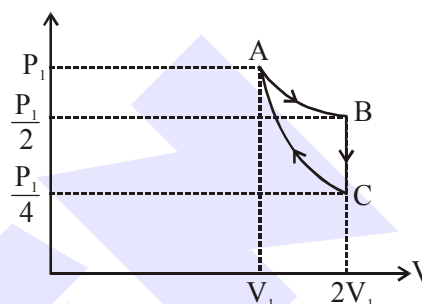
- (1) 2.25 A (2) 3.0 A
 (3) 3.37 A (4) 9 A

Official Ans. by NTA (1)

10. The de Broglie wavelength of a proton and α -particle are equal. The ratio of their velocities is :
- (1) 4 : 3 (2) 4 : 1 (3) 4 : 2 (4) 1 : 4

Official Ans. by NTA (2)

11. If one mole of an ideal gas at (P_1, V_1) is allowed to expand reversibly and isothermally (A to B) its pressure is reduced to one-half of the original pressure (see figure). This is followed by a constant volume cooling till its pressure is reduced to one-fourth of the initial value (B→C). Then it is restored to its initial state by a reversible adiabatic compression (C to A). The net workdone by the gas is equal to :



- (1) $RT \left(\ln 2 - \frac{1}{2(\gamma - 1)} \right)$ (2) $-\frac{RT}{2(\gamma - 1)}$
 (3) 0 (4) $RT \ln 2$

Official Ans. by NTA (1)

12. An X-ray tube is operated at 1.24 million volt. The shortest wavelength of the produced photon will be :
- (1) 10^{-3} nm (2) 10^{-1} nm
 (3) 10^{-2} nm (4) 10^{-4} nm

Official Ans. by NTA (1)

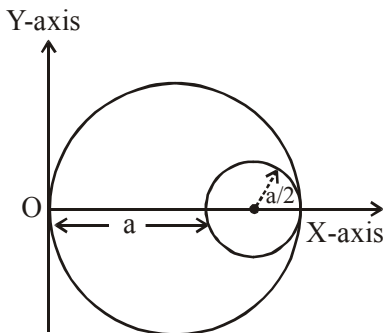
13. Which of the following equations represents a travelling wave ?
- (1) $y = A \sin(15x - 2t)$
 (2) $y = A e^{-x^2} (vt + \theta)$
 (3) $y = A e^x \cos(\omega t - \theta)$
 (4) $y = A \sin x \cos \omega t$

Official Ans. by NTA (1)

14. According to Bohr atom model, in which of the following transitions will the frequency be maximum ?
- (1) $n = 4$ to $n = 3$ (2) $n = 2$ to $n = 1$
 (3) $n = 5$ to $n = 4$ (4) $n = 3$ to $n = 2$
- Official Ans. by NTA (2)**

15. If the source of light used in a Young's double slit experiment is changed from red to violet :
- (1) consecutive fringe lines will come closer.
 - (2) the central bright fringe will become a dark fringe.
 - (3) the fringes will become brighter.
 - (4) the intensity of minima will increase.
- Official Ans. by NTA (1)**

16. A circular hole of radius $\left(\frac{a}{2}\right)$ is cut out of a circular disc of radius 'a' as shown in figure. The centroid of the remaining circular portion with respect to point 'O' will be :



- (1) $\frac{1}{6}a$ (2) $\frac{10}{11}a$ (3) $\frac{5}{6}a$ (4) $\frac{2}{3}a$

Official Ans. by NTA (3)

17. Zener breakdown occurs in a $p-n$ junction having p and n both :
- (1) lightly doped and have wide depletion layer.
 - (2) heavily doped and have narrow depletion layer.
 - (3) lightly doped and have narrow depletion layer.
 - (4) heavily doped and have wide depletion layer.

Official Ans. by NTA (2)

18. Match List - I with List - II.

| List - I | List - II |
|-----------------------------------|---------------------------------------|
| (a) Source of microwave frequency | (i) Radioactive decay on nucleus |
| (b) Source of infrared frequency | (ii) Magnetron |
| (c) Source of Gamma Rays | (iii) Inner shell electrons |
| (d) Source of X-rays | (iv) Vibration of atoms and molecules |
| | (v) LASER |
| | (vi) RC circuit |

Choose the correct answer from the options given below :

- (1) (a)-(vi), (b)-(iv), (c)-(i), (d)-(v)
- (2) (a)-(vi), (b)-(v), (c)-(i), (d)-(iv)
- (3) (a)-(ii), (b)-(iv), (c)-(vi), (d)-(iii)
- (4) (a)-(ii), (b)-(iv), (c)-(i), (d)-(iii)

Official Ans. by NTA (4)

19. A particle is projected with velocity v_0 along x -axis. A damping force is acting on the particle which is proportional to the square of the distance from the origin i.e., $ma = -\alpha x^2$. The distance at which the particle stops :

- (1) $\left(\frac{3v_0^2}{2\alpha}\right)^{\frac{1}{2}}$ (2) $\left(\frac{2v_0}{3\alpha}\right)^{\frac{1}{3}}$
- (3) $\left(\frac{2v_0^2}{3\alpha}\right)^{\frac{1}{2}}$ (4) $\left(\frac{3v_0^2}{2\alpha}\right)^{\frac{1}{3}}$

Official Ans. by NTA (4)

20. A body weighs 49 N on a spring balance at the north pole. What will be its weight recorded on the same weighing machine, if it is shifted to the equator ?

(Use $g = \frac{GM}{R^2} = 9.8 \text{ ms}^{-2}$ and radius of earth,

$R = 6400 \text{ km}$.]

- (1) 49 N (2) 48.83 N
(3) 49.83 N (4) 49.17 N

Official Ans. by NTA (2)

SECTION-B

1. A uniform metallic wire is elongated by 0.04 m when subjected to a linear force F . The elongation, if its length and diameter is doubled and subjected to the same force will be _____ cm.

Official Ans. by NTA (2)

2. A cylindrical wire of radius 0.5 mm and conductivity $5 \times 10^7 \text{ S/m}$ is subjected to an electric field of 10 mV/m. The expected value of current in the wire will be $x^3\pi \text{ mA}$. The value of x is _____.

Official Ans. by NTA (5)

3. A uniform thin bar of mass 6 kg and length 2.4 meter is bent to make an equilateral hexagon. The moment of inertia about an axis passing through the centre of mass and perpendicular to the plane of hexagon is _____ $\times 10^{-1} \text{ kg m}^2$.

Official Ans. by NTA (8)

4. Two solids A and B of mass 1 kg and 2 kg respectively are moving with equal linear momentum. The ratio of their kinetic energies

$(\text{K.E.})_A : (\text{K.E.})_B$ will be $\frac{A}{1}$, so the value of A

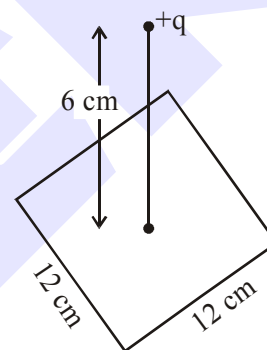
will be _____.

Official Ans. by NTA (2)

5. The root mean square speed of molecules of a given mass of a gas at 27°C and 1 atmosphere pressure is 200 ms^{-1} . The root mean square speed of molecules of the gas at 127°C and 2 atmosphere pressure is $\frac{x}{\sqrt{3}} \text{ ms}^{-1}$. The value of x will be _____.

Official Ans. by NTA (400)

6. A point charge of $+12 \mu\text{C}$ is at a distance 6 cm vertically above the centre of a square of side 12 cm as shown in figure. The magnitude of the electric flux through the square will be _____ $\times 10^3 \text{ Nm}^2/\text{C}$.



Official Ans. by NTA (226)

7. A signal of 0.1 kW is transmitted in a cable. The attenuation of cable is -5 dB per km and cable length is 20 km. The power received at receiver is 10^{-x} W . The value of x is _____.

$$[\text{Gain in dB} = 10 \log_{10} \left(\frac{P_0}{P_i} \right)]$$

Official Ans. by NTA (8)

8. A series LCR circuit is designed to resonate at an angular frequency $\omega_0 = 10^5 \text{ rad/s}$. The circuit draws 16 W power from 120 V source at resonance. The value of resistance 'R' in the circuit is _____ Ω .

Official Ans. by NTA (900)

9. Two cars are approaching each other at an equal speed of 7.2 km/hr. When they see each other, both blow horns having frequency of 676 Hz. The beat frequency heard by each driver will be _____ Hz. [Velocity of sound in air is 340 m/s.]
Official Ans. by NTA (8)
10. An electromagnetic wave of frequency 3 GHz enters a dielectric medium of relative electric permittivity 2.25 from vacuum. The wavelength of this wave in that medium will be _____ $\times 10^{-2}$ cm.
Official Ans. by NTA (667)