

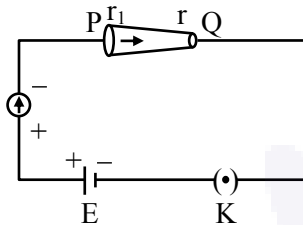
FINAL JEE–MAIN EXAMINATION – JULY, 2021

Held On Tuesday 27th July, 2021

TIME: 9:00 AM to 12:00 NOON

SECTION-A

1. In the given figure, a battery of emf E is connected across a conductor PQ of length ' l ' and different area of cross-sections having radii r_1 and r_2 ($r_2 < r_1$).



Choose the correct option as one moves from P to Q :

- (1) Drift velocity of electron increases.
- (2) Electric field decreases.
- (3) Electron current decreases.
- (4) All of these

Official Ans. by NTA (1)

2. The number of molecules in one litre of an ideal gas at 300 K and 2 atmospheric pressure with mean kinetic energy $2 \times 10^{-9}\text{ J}$ per molecules is :

- (1) 0.75×10^{11}
- (2) 3×10^{11}
- (3) 1.5×10^{11}
- (4) 6×10^{11}

Official Ans. by NTA (3)

3. The relative permittivity of distilled water is 81 . The velocity of light in it will be :

(Given $\mu_r = 1$)

- (1) $4.33 \times 10^7\text{ m/s}$
- (2) $2.33 \times 10^7\text{ m/s}$
- (3) $3.33 \times 10^7\text{ m/s}$
- (4) $5.33 \times 10^7\text{ m/s}$

Official Ans. by NTA (3)

- 4.

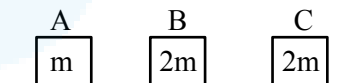
List-I	List-II
(a) MI of the rod (length L , Mass M , about an axis \perp to the rod passing through the midpoint)	(i) $8 ML^2/3$
(b) MI of the rod (length L , Mass $2M$, about an axis \perp to the rod passing through one of its end)	(ii) $ML^2/3$
(c) MI of the rod (length $2L$, Mass M , about an axis \perp to the rod passing through its midpoint)	(iii) $ML^2/12$
(d) MI of the rod (Length $2L$, Mass $2M$, about an axis \perp to the rod passing through one of its end)	(iv) $2 ML^2/3$

Choose the **correct** answer from the options given below :

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

Official Ans. by NTA (3)

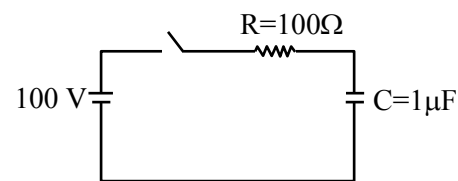
5. Three objects A , B and C are kept in a straight line on a frictionless horizontal surface. The masses of A , B and C are m , $2m$ and $2m$ respectively. A moves towards B with a speed of 9 m/s and makes an elastic collision with it. Thereafter B makes a completely inelastic collision with C . All motions occur along same straight line. The final speed of C is :



- (1) 6 m/s
- (2) 9 m/s
- (3) 4 m/s
- (4) 3 m/s

Official Ans. by NTA (4)

- 6.



A capacitor of capacitance $C=1\ \mu\text{F}$ is suddenly connected to a battery of 100 volt through a resistance $R = 100\ \Omega$. The time taken for the capacitor to be charged to get 50 V is :

[Take $\ln 2 = 0.69$]

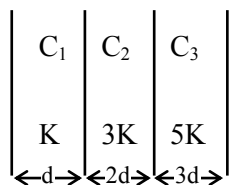
- (1) $1.44 \times 10^{-4}\text{ s}$
- (2) $3.33 \times 10^{-4}\text{ s}$
- (3) $0.69 \times 10^{-4}\text{ s}$
- (4) $0.30 \times 10^{-4}\text{ s}$

Official Ans. by NTA (3)



7. In the reported figure, a capacitor is formed by placing a compound dielectric between the plates of parallel plate capacitor. The expression for the capacity of the said capacitor will be :

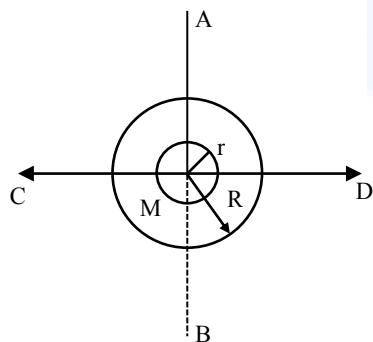
(Given area of plate = A)



- (1) $\frac{15 K\epsilon_0 A}{34 d}$ (2) $\frac{15 K\epsilon_0 A}{6 d}$
 (3) $\frac{25 K\epsilon_0 A}{6 d}$ (4) $\frac{9 K\epsilon_0 A}{6 d}$

Official Ans. by NTA (1)

8. The figure shows two solid discs with radius R and r respectively. If mass per unit area is same for both, what is the ratio of MI of bigger disc around axis AB (Which is \perp to the plane of the disc and passing through its centre) of MI of smaller disc around one of its diameters lying on its plane? Given 'M' is the mass of the larger disc. (MI stands for moment of inertia)



- (1) $R^2 : r^2$ (2) $2r^4 : R^4$
 (3) $2R^2 : r^2$ (4) $2R^4 : r^4$

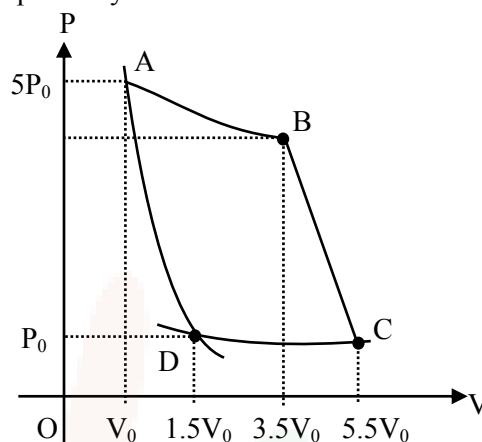
Official Ans. by NTA (4)

9. In Young's double slit experiment, if the source of light changes from orange to blue then :

- (1) the central bright fringe will become a dark fringe.
 (2) the distance between consecutive fringes will decrease.
 (3) the distance between consecutive fringes will increase.
 (4) the intensity of the minima will increase.

Official Ans. by NTA (2)

10. In the reported figure, there is a cyclic process ABCDA on a sample of 1 mol of a diatomic gas. The temperature of the gas during the process $A \rightarrow B$ and $C \rightarrow D$ are T_1 and T_2 ($T_1 > T_2$) respectively.



Choose the correct option out of the following for work done if processes BC and DA are adiabatic.

- (1) $W_{AB} = W_{DC}$ (2) $W_{AD} = W_{BC}$
 (3) $W_{BC} + W_{DA} > 0$ (4) $W_{AB} < W_{CD}$

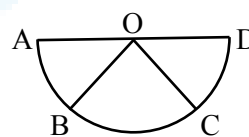
Official Ans. by NTA (2)

11. **Assertion A :** If A, B, C, D are four points on a semi-circular arc with centre at 'O' such that $|\vec{AB}| = |\vec{BC}| = |\vec{CD}|$, then

$$\vec{AB} + \vec{AC} + \vec{AD} = 4\vec{AO} + \vec{OB} + \vec{OC}$$

Reason R : Polygon law of vector addition yields

$$\vec{AB} + \vec{BC} + \vec{CD} + \vec{AD} = 2\vec{AO}$$



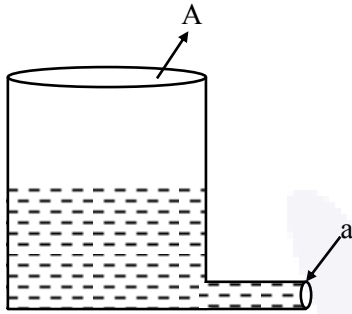
In the light of the above statements, choose the **most appropriate** answer from the options given below :

- (1) **A** is correct but **R** is not correct.
 (2) **A** is not correct but **R** is correct.
 (3) Both **A** and **R** are correct and **R** is the correct explanation of **A**.
 (4) Both **A** and **R** are correct but **R** is not the correct explanation of **A**.

Official Ans. by NTA (4)



12. A light cylindrical vessel is kept on a horizontal surface. Area of base is A . A hole of cross-sectional area ' a ' is made just at its bottom side. The minimum coefficient of friction necessary to prevent sliding the vessel due to the impact force of the emerging liquid is ($a \ll A$) :



- (1) $\frac{A}{2a}$ (2) None of these
 (3) $\frac{2a}{A}$ (4) $\frac{a}{A}$

Official Ans. by NTA (3)

13. A particle starts executing simple harmonic motion (SHM) of amplitude ' a ' and total energy E . At any instant, its kinetic energy is $\frac{3E}{4}$ then its

displacement ' y ' is given by :

- (1) $y = a$
 (2) $y = \frac{a}{\sqrt{2}}$
 (3) $y = \frac{a\sqrt{3}}{2}$
 (4) $y = \frac{a}{2}$

Official Ans. by NTA (4)

14. If ' f ' denotes the ratio of the number of nuclei decayed (N_d) to the number of nuclei at $t = 0$ (N_0) then for a collection of radioactive nuclei, the rate of change of ' f ' with respect to time is given as :

[λ is the radioactive decay constant]

- (1) $-\lambda (1 - e^{-\lambda t})$ (2) $\lambda (1 - e^{-\lambda t})$
 (3) $\lambda e^{-\lambda t}$ (4) $-\lambda e^{-\lambda t}$

Official Ans. by NTA (3)

15. Two capacitors of capacities $2C$ and C are joined in parallel and charged up to potential V . The battery is removed and the capacitor of capacity C is filled completely with a medium of dielectric constant K . The potential difference across the capacitors will now be :

- (1) $\frac{V}{K+2}$ (2) $\frac{V}{K}$
 (3) $\frac{3V}{K+2}$ (4) $\frac{3V}{K}$

Official Ans. by NTA (3)

16. A ball is thrown up with a certain velocity so that it reaches a height ' h '. Find the ratio of the two different times of the ball reaching $\frac{h}{3}$ in both the directions.

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

Official Ans. by NTA (3)

17. A 0.07 H inductor and a $12 \text{ } \Omega$ resistor are connected in series to a 220 V , 50 Hz ac source. The approximate current in the circuit and the phase angle between current and source voltage are respectively. [Take π as $\frac{22}{7}$]

- (1) 8.8 A and $\tan^{-1}\left(\frac{11}{6}\right)$
 (2) 88 A and $\tan^{-1}\left(\frac{11}{6}\right)$
 (3) 0.88 A and $\tan^{-1}\left(\frac{11}{6}\right)$
 (4) 8.8 A and $\tan^{-1}\left(\frac{6}{11}\right)$

Official Ans. by NTA (1)



3. In Bohr's atomic model, the electron is assumed to revolve in a circular orbit of radius 0.5 \AA . If the speed of electron is $2.2 \times 10^6 \text{ m/s}$, then the current associated with the electron will be _____ $\times 10^{-2} \text{ mA}$. [Take π as $\frac{22}{7}$]

Official Ans. by NTA (112)

4. A radioactive sample has an average life of 30 ms and is decaying. A capacitor of capacitance 200 \mu F is first charged and later connected with resistor 'R'. If the ratio of charge on capacitor to the activity of radioactive sample is fixed with respect to time then the value of 'R' should be _____ Ω .

Official Ans. by NTA (150)

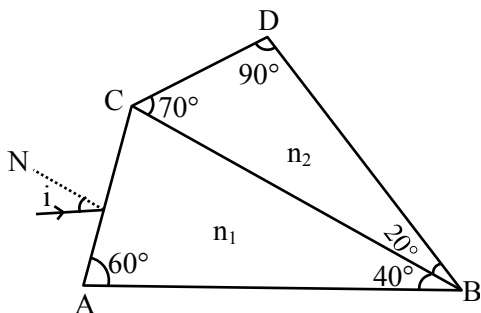
5. A particle of mass $9.1 \times 10^{-31} \text{ kg}$ travels in a medium with a speed of 10^6 m/s and a photon of a radiation of linear momentum 10^{-27} kg m/s travels in vacuum. The wavelength of photon is _____ times the wavelength of the particle.

Official Ans. by NTA (910)

6. A prism of refractive index n_1 and another prism of refractive index n_2 are stuck together (as shown in the figure). n_1 and n_2 depend on λ , the wavelength of light, according to the relation

$$n_1 = 1.2 + \frac{10.8 \times 10^{-14}}{\lambda^2} \text{ and } n_2 = 1.45 + \frac{1.8 \times 10^{-14}}{\lambda^2}$$

The wavelength for which rays incident at any angle on the interface BC pass through without bending at that interface will be _____ nm.



Official Ans. by NTA (600)

7. A stone of mass 20 g is projected from a rubber catapult of length 0.1 m and area of cross section

10^{-6} m^2 stretched by an amount 0.04 m. The velocity of the projected stone is _____ m/s. (Young's modulus of rubber = $0.5 \times 10^9 \text{ N/m}^2$)

Official Ans. by NTA (20)

8. A transistor is connected in common emitter circuit configuration, the collector supply voltage is 10 V and the voltage drop across a resistor of 1000 \Omega in the collector circuit is 0.6 V. If the current gain factor (β) is 24, then the base current is _____ μA . (Round off to the Nearest Integer)

Official Ans. by NTA (25)

9. The amplitude of upper and lower side bands of A.M. wave where a carrier signal with frequency 11.21 MHz, peak voltage 15 V is amplitude modulated by a 7.7 kHz sine wave of 5V amplitude are $\frac{a}{10} \text{ V}$ and $\frac{b}{10} \text{ V}$ respectively. Then the value of $\frac{a}{b}$ is _____.

Official Ans. by NTA (1)

10. In a uniform magnetic field, the magnetic needle has a magnetic moment $9.85 \times 10^{-2} \text{ A/m}^2$ and moment of inertia $5 \times 10^{-6} \text{ kg m}^2$. If it performs 10 complete oscillations in 5 seconds then the magnitude of the magnetic field is _____ mT. [Take π^2 as 9.85]

Official Ans. by NTA (8)