

FINAL JEE-MAIN EXAMINATION – FEBRUARY, 2021

(Held On Thursday 25th February, 2021) TIME : 9 : 00 AM to 12 : 00 NOON

PHYSICS

TEST PAPER WITH ANSWER

SECTION-A

1. Given below are two statement : one is labelled as Assertion A and the other is labelled as Reason R.

Assertion A : When a rod lying freely is heated, no thermal stress is developed in it.

Reason R : On heating the length of the rod increases.

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

- (1) Both A and R are true but R is NOT the correct explanation of A
 (2) A is false but R is true
 (3) A is true but R is false
 (4) Both A and R are true and R is the correct explanation of A

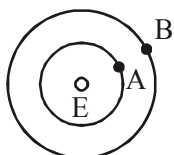
Official Ans. by NTA (1)

2. A student is performing the experiment of resonance column. The diameter of the column tube is 6 cm. The frequency of the tuning fork is 504 Hz. Speed of the sound at the given temperature is 336 m/s. The zero of the meter scale coincides with the top end of the resonance column tube. The reading of the water level in the column when the first resonance occurs is:

- (1) 13 cm (2) 16.6 cm
 (3) 18.4 cm (4) 14.8 cm

Official Ans. by NTA (4)

3. Two satellites A and B of masses 200kg and 400kg are revolving round the earth at height of 600 km and 1600 km respectively. If T_A and T_B are the time periods of A and B respectively then the value of $T_B - T_A$:

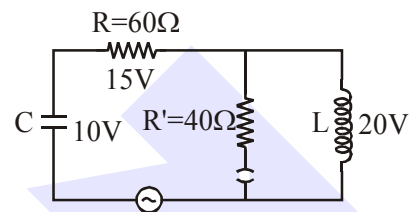


[Given : radius of earth = 6400km, mass of earth = 6×10^{24} kg]

- (1) 1.33×10^3 s (2) 3.33×10^2 s
 (3) 4.24×10^3 s (4) 4.24×10^2 s

Official Ans. by NTA (1)

4. The angular frequency of alternating current in a L-C-R circuit is 100 rad/s. The components connected are shown in the figure. Find the value of inductance of the coil and capacity of condenser.



- (1) 0.8 H and 150 μ F
 (2) 0.8 H and 250 μ F
 (3) 1.33 H and 250 μ F
 (4) 1.33 H and 150 μ F

Official Ans. by NTA (2)

5. A proton, a deuteron and an α particle are moving with same momentum in a uniform magnetic field. The ratio of magnetic forces acting on them is ____ and their speed is ____ in the ratio.

- (1) 1 : 2 : 4 and 2 : 1 : 1
 (2) 2 : 1 : 1 and 4 : 2 : 1
 (3) 4 : 2 : 1 and 2 : 1 : 1
 (4) 1 : 2 : 4 and 1 : 1 : 2

Official Ans. by NTA (2)

6. Given below are two statement :

Statement-I: A speech signal of 2 kHz is used to modulate a carrier signal of 1 MHz. The band width requirement for the signal is 4 kHz.

Statement-II : The side band frequencies are 1002 kHz. and 998 kHz.

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

Official Ans. by NTA (3)

7. If the time period of a two meter long simple pendulum is 2s, the acceleration due to gravity at the place where pendulum is executing S.H.M. is :

- (1) $\pi^2 \text{ms}^{-2}$ (2) 9.8 ms^{-2}
 (3) $2\pi^2 \text{ms}^{-2}$ (4) 16 m/s^2

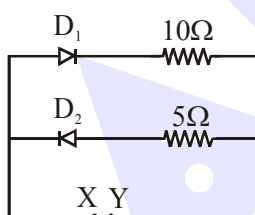
Official Ans. by NTA (3)

8. The pitch of the screw gauge is 1mm and there are 100 divisions on the circular scale. When nothing is put in between the jaws, the zero of the circular scale lies 8 divisions below the reference line. When a wire is placed between the jaws, the first linear scale division is clearly visible while 72nd division on circular scale coincides with the reference line. The radius of the wire is

- (1) 1.64 mm (2) 0.82 mm
 (3) 1.80 mm (4) 0.90 mm

Official Ans. by NTA (2)

9. A 5V battery is connected across the points X and Y. Assume D_1 and D_2 to be normal silicon diodes. Find the current supplied by the battery if the +ve terminal of the battery is connected to point X.



- (1) ~ 0.5 A (2) ~ 1.5 A
 (3) ~ 0.86 A (4) ~ 0.43 A

Official Ans. by NTA (4)

10. An α particle and a proton are accelerated from rest by a potential difference of 200 V. After this, their de Broglie wavelengths are λ_α and

λ_p respectively. The ratio $\frac{\lambda_p}{\lambda_\alpha}$ is :

- (1) 3.8 (2) 8 (3) 7.8 (4) 2.8

Official Ans. by NTA (4)

11. A diatomic gas, having $C_p = \frac{7}{2}R$ and

$C_v = \frac{5}{2}R$, is heated at constant pressure. The

ratio $dU : dQ : dW$:

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

Official Ans. by NTA (2)

12. An engine of a train, moving with uniform acceleration, passes the signal-post with velocity u and the last compartment with velocity v . The velocity with which middle point of the train passes the signal post is:

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

Official Ans. by NTA (1)

13. Match List-I with List-II :

List-I	List-II
(a) h (Planck's constant)	(i) $[M L T^{-1}]$
(b) E (kinetic energy)	(ii) $[M L^2 T^{-1}]$
(c) V (electric potential)	(iii) $[M L^2 T^{-2}]$
(d) P (linear momentum)	(iv) $[M L^2 I^{-1} T^{-3}]$

Choose the correct answer from the options given below :

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

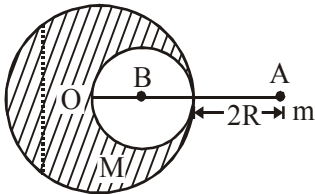
Official Ans. by NTA (2)

14. Magnetic fields at two points on the axis of a circular coil at a distance of 0.05m and 0.2 m from the centre are in the ratio 8 : 1. The radius of coil is _____.

- (1) 0.2 m (2) 0.1 m
 (3) 0.15 m (4) 1.0 m

Official Ans. by NTA (2)

15. A solid sphere of radius R gravitationally attracts a particle placed at $3R$ from its centre with a force F_1 . Now a spherical cavity of radius $\left(\frac{R}{2}\right)$ is made in the sphere (as shown in figure) and the force becomes F_2 . The value of $F_1 : F_2$ is :



- (1) 25 : 36 (2) 36 : 25
(3) 50 : 41 (4) 41 : 50

Official Ans. by NTA (3)

16. Two radioactive substances X and Y originally have N_1 and N_2 nuclei respectively. Half life of X is half of the half life of Y. After three half lives of Y, number of nuclei of both are equal.

The ratio $\frac{N_1}{N_2}$ will be equal to :

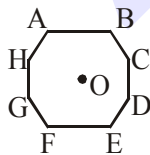
- (1) $\frac{1}{8}$ (2) $\frac{3}{1}$
(3) $\frac{8}{1}$ (4) $\frac{1}{3}$

Official Ans. by NTA (3)

17. In an octagon ABCDEFGH of equal side, what is the sum of

$$\vec{AB} + \vec{AC} + \vec{AD} + \vec{AE} + \vec{AF} + \vec{AG} + \vec{AH}$$

if, $\vec{AO} = 2\hat{i} + 3\hat{j} - 4\hat{k}$



- (1) $-16\hat{i} - 24\hat{j} + 32\hat{k}$
(2) $16\hat{i} + 24\hat{j} - 32\hat{k}$
(3) $16\hat{i} + 24\hat{j} + 32\hat{k}$
(4) $16\hat{i} - 24\hat{j} + 32\hat{k}$

Official Ans. by NTA (2)

18. Given below are two statements : one is labelled as Assertion A and the other is labelled as Reason R.

Assertion A : The escape velocities of planet A and B are same. But A and B are of unequal mass.

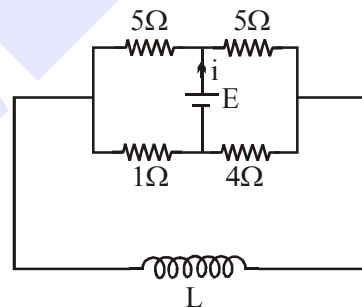
Reason R : The product of their mass and radius must be same, $M_1R_1 = M_2R_2$

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

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

Official Ans. by NTA (2)

19. The current (i) at time $t = 0$ and $t = \infty$ respectively for the given circuit is :



- (1) $\frac{18E}{55}, \frac{5E}{18}$ (2) $\frac{10E}{33}, \frac{5E}{18}$
(3) $\frac{5E}{18}, \frac{18E}{55}$ (4) $\frac{5E}{18}, \frac{10E}{33}$

Official Ans. by NTA (4)

20. Two coherent light sources having intensity in the ratio $2x$ produce an interference pattern.

The ratio $\frac{I_{\max} - I_{\min}}{I_{\max} + I_{\min}}$ will be :

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

Official Ans. by NTA (4)

SECTION-B

1. A transmitting station releases waves of wavelength 960 m. A capacitor of $2.56 \mu\text{F}$ is used in the resonant circuit. The self inductance of coil necessary for resonance is $\text{---} \times 10^{-8}$ H.

Official Ans. by NTA (10)

2. The electric field in a region is given

$$\vec{E} = \left(\frac{3}{5} E_0 \hat{i} + \frac{4}{5} E_0 \hat{j} \right) \frac{N}{C}$$

The ratio of flux of reported field through the rectangular surface of area 0.2 m^2 (parallel to $y - z$ plane) to that of the surface of area 0.3 m^2 (parallel to $x - z$ plane) is $a : b$, where $a = \text{---}$.

[Here \hat{i}, \hat{j} and \hat{k} are unit vectors along x, y and z -axes respectively]

Official Ans. by NTA (1)

3. In a certain thermodynamical process, the pressure of a gas depends on its volume as kV^3 . The work done when the temperature changes from 100°C to 300°C will be --- nR , where n denotes number of moles of a gas.

Official Ans. by NTA (50)

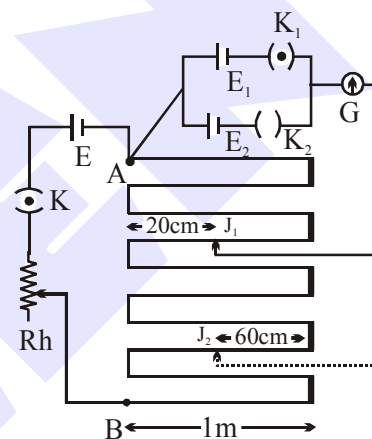
4. A small bob tied at one end of a thin string of length 1m is describing a vertical circle so that the maximum and minimum tension in the string are in the ratio $5 : 1$. The velocity of the bob at the height position is --- m/s .

(Take $g = 10 \text{ m/s}^2$)

Official Ans. by NTA (5)

5. In the given circuit of potentiometer, the potential difference E across AB (10m length) is larger than E_1 and E_2 as well. For key K_1 (closed), the jockey is adjusted to touch the wire at point J_1 so that there is no deflection in the galvanometer. Now the first battery (E_1) is replaced by second battery (E_2) for working by making K_1 open and K_2 closed. The galvanometer gives then null deflection at J_2 .

The value of $\frac{E_1}{E_2}$ is $\frac{a}{b}$, where $a = \text{---}$.



Official Ans. by NTA (1)

6. The same size images are formed by a convex lens when the object is placed at 20cm or at 10cm from the lens. The focal length of convex lens is --- cm .

Official Ans. by NTA (15)

7. 512 identical drops of mercury are charged to a potential of 2V each. The drops are joined to form a single drop. The potential of this drop is --- V .

Official Ans. by NTA (128)

8. A coil of inductance 2H having negligible resistance is connected to a source of supply whose voltage is given by $V = 3t$ volt. (where t is in second). If the voltage is applied when $t = 0$, then the energy stored in the coil after 4s is --- J .

Official Ans. by NTA (144)

9. A monoatomic gas of mass 4.0 u is kept in an insulated container. Container is moving with velocity 30 m/s. If container is suddenly stopped then change in temperature of the gas

(R = gas constant) is $\frac{x}{3R}$. Value of x is ____.

Official Ans. by NTA (3600)

Official Ans. by ALLEN (Bouns)

10. The potential energy (U) of a diatomic molecule is a function dependent on r (interatomic distance) as

$$U = \frac{\alpha}{r^{10}} - \frac{\beta}{r^5} - 3$$

where, α and β are positive constants. The equilibrium distance between two atoms will be

$$\left(\frac{2\alpha}{\beta}\right)^{\frac{a}{b}}, \text{ where } a = \text{____}.$$

Official Ans. by NTA (1)