

# JEE Main 2023 Physics Question Paper Apr 8 Shift 2

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|----------------------|--------------------|---------------------|
| Time Allowed :3 Hour | Maximum Marks :120 | Total Questions :30 |
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## General Instructions

Read the following instructions very carefully and strictly follow them:

1. The test is of 3 hours duration.
2. The question paper consists of 30 questions. The maximum marks are 120.
3. The question paper consists of topics from Physics, having two sections.
  - (i) Section-A: This section contains 20 multiple choice questions which have only one correct answer. Each question carries 4 marks for correct answer and  $-1$  mark for wrong answer.
  - (ii) Section-B: This section contains 10 questions. The answer to each of the questions is a numerical value. Each question carries 4 marks for correct answer and  $-1$  mark for wrong answer. For Section-B, the answer should be rounded off to the nearest integer.

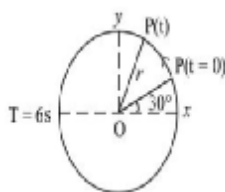
### 1. Match List I with List II

| LIST I                      | LIST II              |
|-----------------------------|----------------------|
| A. Torque                   | I. $ML^{-2}T^{-2}$   |
| B. Stress                   | II. $ML^2T^{-2}$     |
| C. Pressure gradient        | III. $ML^{-1}T^{-1}$ |
| D. Coefficient of viscosity | IV. $ML^{-1}T^{-2}$  |

Choose the correct answer from the options given below:

- (A) A-III, B-IV, C-I, D-II  
(B) A-II, B-I, C-IV, D-III  
(C) A-II, B-IV, C-I, D-III  
(D) A-IV, B-II, C-III, D-I

2. For a particle revolving round the centre O with radius  $r$  of circular path and angular velocity  $\omega$ , as shown in below figure, the projection of OP on the x-axis at time  $t$  is



- (A)  $x(t) = r \cos(\omega t)$   
(B)  $x(t) = r \cos\left(\omega t - \frac{\pi}{6}\right)$   
(C)  $x(t) = r \cos\left(\omega t + \frac{\pi}{6}\right)$   
(D)  $x(t) = r \sin\left(\omega t + \frac{\pi}{6}\right)$
- 

**3. The temperature at which the kinetic energy of oxygen molecules becomes double than its value at  $27^\circ\text{C}$  is**

- (A)  $327^\circ\text{C}$   
(B)  $627^\circ\text{C}$   
(C)  $927^\circ\text{C}$   
(D)  $1227^\circ\text{C}$
- 

**4. Work done by a Carnot engine operating between temperatures  $127^\circ\text{C}$  and  $27^\circ\text{C}$  is 2 kJ. The amount of heat transferred to the engine by the reservoir is :**

- (A) 2 kJ  
(B) 2.67 kJ  
(C) 8 kJ  
(D) 4 kJ
- 

**5. A hydraulic automobile lift is designed to lift vehicles of mass 5000 kg. The area of cross section of the cylinder carrying the load is  $250\text{ cm}^2$ . The maximum pressure the smaller piston would have to bear is [Assume  $g = 10\text{ m/s}^2$ ] :**

- (A)  $20 \times 10^{+6}\text{ Pa}$   
(B)  $2 \times 10^{+5}\text{ Pa}$   
(C)  $200 \times 10^{+6}\text{ Pa}$   
(D)  $2 \times 10^{+6}\text{ Pa}$
- 

**6. The acceleration due to gravity at height  $h$  above the earth if  $h \ll R$  (Radius of earth) is given by**

- (A)  $g' = g\left(1 - \frac{2h}{R}\right)$   
(B)  $g' = g\left(1 - \frac{h}{2R}\right)$   
(C)  $g' = g\left(1 - \frac{h^2}{2R^2}\right)$   
(D)  $g' = g\left(1 - \frac{2h^2}{R^2}\right)$
-

7. The orbital angular momentum of a satellite is  $L$ , when it is revolving in a circular orbit at height  $h$  from earth surface. If the distance of satellite from the earth centre is increased by eight times to its initial value, then the new angular momentum will be-

- (A)  $3L$
  - (B)  $4L$
  - (C)  $8L$
  - (D)  $9L$
- 

8. Given below are two statements:

Statement I : Area under velocity-time graph gives the distance travelled by the body in a given time.

Statement II : Area under acceleration-time graph is equal to the change in velocity in the given time.

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

- (A) Both Statement I and Statement II are true.
  - (B) Both Statement I and Statement II are False.
  - (C) Statement I is correct but Statement II is false.
  - (D) Statement I is incorrect but Statement II is true.
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9. The trajectory of projectile, projected from the ground is given by  $y = x - \frac{x^2}{20}$ . Where  $x$  and  $y$  are measured in meter. The maximum height attained by the projectile will be.

- (A) 5 m
  - (B)  $10\sqrt{2}$ m
  - (C) 10 m
  - (D) 200 m
- 

10. A bullet of mass 0.1 kg moving horizontally with speed  $400 \text{ ms}^{-1}$  hits a wooden block of mass 3.9 kg kept on a horizontal rough surface. The bullet gets embedded into the block and moves 20 m before coming to rest. The coefficient of friction between the block and the surface is \_\_\_\_\_. (Given  $g = 10 \text{ m/s}^2$ )

- (A) 0.25
  - (B) 0.50
  - (C) 0.65
  - (D) 0.90
-

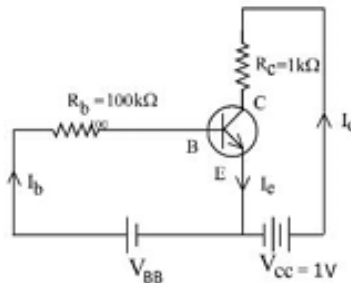
11. Electric potential at a point 'P' due to a point charge of  $5 \times 10^{-9}$  C is 50 V. The distance of 'P' from the point charge is:  
(Assume,  $\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ Nm}^2\text{C}^{-2}$ )

- (A) 90 cm
- (B) 3 cm
- (C) 9 cm
- (D) 0.9 cm

12. The power radiated from a linear antenna of length  $l$  is proportional to  
(Given,  $\lambda$  = Wavelength of wave):

- (A)  $\frac{l}{\lambda}$
- (B)  $\frac{l}{\lambda^2}$
- (C)  $\left(\frac{l}{\lambda}\right)^2$
- (D)  $\frac{l^2}{\lambda}$

13. For a given transistor amplifier circuit in CE configuration  $V_{CC} = 1 \text{ V}$ ,  $R_C = 1 \text{ k}\Omega$ ,  $R_B = 100 \text{ k}\Omega$  and  $\beta = 100$ .  
Value of base current  $I_B$  is:



- (A)  $I_B = 0.1\mu\text{A}$
- (B)  $I_B = 10\mu\text{A}$
- (C)  $I_B = 1.0\mu\text{A}$
- (D)  $I_B = 100\mu\text{A}$

14. A radio active material is reduced to  $1/8$  of its original amount in 3 days. If  $8 \times 10^{-3}$  kg of the material is left after 5 days the initial amount of the material is:

- (A) 32 g
- (B) 40 g
- (C) 256 g
- (D) 64 g

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15. In photo electric effect:

- A. The photocurrent is proportional to the intensity of the incident radiation.
- B. Maximum Kinetic energy with which photoelectrons are emitted depends on the intensity of incident light.
- C. Max. K.E with which photoelectrons are emitted depends on the frequency of incident light.
- D. The emission of photoelectrons require a minimum threshold intensity of incident radiation.
- E. Max. K.E of the photoelectrons is independent of the frequency of the incident light.

Choose the correct answer from the options given below:

- (A) A and B only
- (B) B and C only
- (C) A and C only
- (D) A and E only

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16. The width of fringe is 2 mm on the screen in a double slits experiment for the light of wavelength of 400 nm. The width of the fringe for the light of wavelength 600 nm will be:

- (A) 2 mm
- (B) 3 mm
- (C) 4 mm
- (D) 1.33 mm

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17. The waves emitted when a metal target is bombarded with high energy electrons are:

- (A) Radio Waves
- (B) Infrared rays
- (C) Microwaves
- (D) X-rays

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18. An emf of 0.08 V is induced in a metal rod of length 10 cm held normal to a uniform magnetic field of 0.4 T, when moves with a velocity of:

- (A)  $20 \text{ ms}^{-1}$
- (B)  $2 \text{ ms}^{-1}$
- (C)  $0.5 \text{ ms}^{-1}$
- (D)  $3.2 \text{ ms}^{-1}$

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

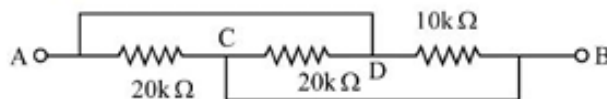
Assertion A : Electromagnets are made of soft iron.

Reason R : Soft iron has high permeability and low retentivity.

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

- (A) Both A and R are correct and R is the correct explanation of A
  - (B) Both A and R are correct but R is NOT the correct explanation of A
  - (C) A is correct but R is not correct
  - (D) A is not correct but R is correct
- 

20. The equivalent resistance between A and B as shown in figure is:



- (A) 5 k $\Omega$
  - (B) 10 k $\Omega$
  - (C) 20 k $\Omega$
  - (D) 30 k $\Omega$
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21. A guitar string of length 90 cm vibrates with a fundamental frequency of 120 Hz. The length of the string producing a fundamental frequency of 180 Hz will be \_\_\_\_\_ cm.

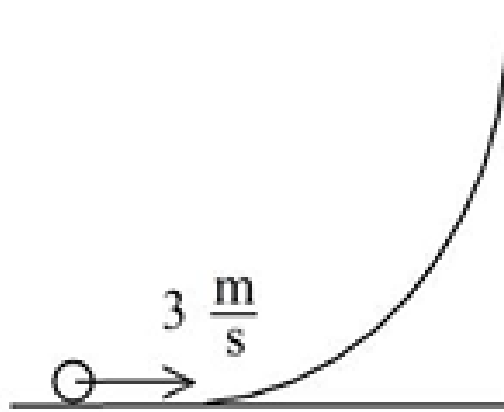
- (A) 45
  - (B) 60
  - (C) 135
  - (D) 120
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22. A steel rod of length 1 m and cross sectional area  $10^{-4} \text{ m}^2$  is heated from  $0^\circ\text{C}$  to  $200^\circ\text{C}$  without being allowed to extend or bend. The compressive tension produced in the rod is \_\_\_\_\_  $\times 10^4 \text{ N}$ . (Given Young's modulus of steel =  $2 \times 10^{11} \text{ Nm}^{-2}$ , coefficient of linear expansion =  $10^{-5} \text{ K}^{-1}$ )

- (A) 2
- (B) 4
- (C) 6
- (D) 8

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23. A hollow spherical ball of uniform density rolls up a curved surface with an initial velocity  $3 \text{ m/s}$  (as shown in figure). Maximum height with respect to the initial position covered by it will be \_\_\_\_ cm. (take  $g = 10 \text{ m/s}^2$ )



- (A) 45
- (B) 60
- (C) 75
- (D) 90

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24. A body of mass  $5 \text{ kg}$  is moving with a momentum of  $10 \text{ kg} \cdot \text{m/s}$ . Now a force of  $2 \text{ N}$  acts on the body in the direction of its motion for  $5 \text{ s}$ . The increase in the Kinetic energy of the body is \_\_\_\_ J.

- (A) 20
- (B) 30
- (C) 40
- (D) 50

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25. A  $600 \text{ pF}$  capacitor is charged by  $200 \text{ V}$  supply. It is then disconnected from the supply and is connected to another uncharged  $600 \text{ pF}$  capacitor. Electrostatic energy lost in the process is \_\_\_\_  $\mu\text{J}$ .

- (A) 3
- (B) 6
- (C) 9
- (D) 12

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26. The ratio of wavelength of spectral lines  $H_\alpha$  and  $H_\beta$  in the Balmer series is  $\frac{x}{20}$ .

The value of x is \_\_\_\_.

- (A) 20
  - (B) 25
  - (C) 27
  - (D) 30
- 

27. Two transparent media having refractive indices 1.0 and 1.5 are separated by a spherical refracting surface of radius of curvature 30 cm. The centre of curvature of surface is towards denser medium and a point object is placed on the principle axis in rarer medium at a distance of 15 cm from the pole of the surface. The distance of image from the pole of the surface is \_\_\_\_ cm.

- (A) 10
  - (B) 20
  - (C) 30
  - (D) 45
- 

28. A series combination of resistor of resistance  $100\Omega$ , inductor of inductance 1 H and capacitor of capacitance  $6.25\mu F$  is connected to an ac source. The quality factor of the circuit will be \_\_\_\_.

- (A) 2
  - (B) 4
  - (C) 5
  - (D) 8
- 

29. The ratio of magnetic field at the centre of a current carrying coil of radius r to the magnetic field at distance r from the centre of coil on its axis is  $\sqrt{x} : 1$ . The value of x is \_\_\_\_.

- (A) 2
  - (B) 4
  - (C) 8
  - (D) 16
- 

30. The number density of free electrons in copper is nearly  $8 \times 10^{28} \text{ m}^{-3}$ . A copper wire has its area of cross section  $= 2 \times 10^{-6} \text{ m}^2$  and is carrying a current of 3.2 A. The drift speed of the electrons is \_\_\_\_  $\times 10^{-6} \text{ ms}^{-1}$ .



- (A) 12.5
  - (B) 125
  - (C) 25
  - (D) 250
-