

JEE Main 2023 April 15 Shift 1 Physics Question Paper

Time Allowed :1 Hour	Maximum Marks :100	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 90 questions. The maximum marks are 300.
3. There are three parts in the question paper consisting of Physics, Chemistry and Mathematics having 30 questions in each part of equal weightage.
4. Each part (subject) has 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. In Section-B, attempt any five questions out of 10. 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.

Section A

1. Match List I with List II of Electromagnetic waves with corresponding wavelength range:

List I	List II
(A) Microwave	(I) 400 nm to 1 mm
(B) Ultraviolet	(II) 1 nm to 10^{-3} nm
(C) X-Ray	(III) 1 mm to 700 nm
(D) Infra-red	(IV) 0.1 m to 1 mm

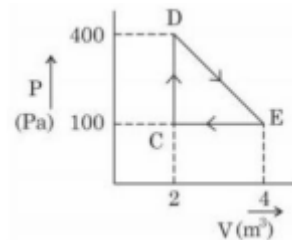
- (1) (A)-(IV), (B)-(I), (C)-(III), (D)-(II)
- (2) (A)-(IV), (B)-(I), (C)-(II), (D)-(III)
- (3) (A)-(I), (B)-(IV), (C)-(II), (D)-(III)
- (4) (A)-(I), (B)-(IV), (C)-(I), (D)-(III)

2. The electric field due to a short electric dipole at a large distance r from the center of the dipole on the equatorial plane varies with distance as:

- (1) r
- (2) $\frac{1}{r}$

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

3. A thermodynamic system is taken through cyclic process. The total work done in the process is:



- (1) 100 J
 (2) 300 J
 (3) 200 J
 (4) Zero

4. The half-life of a radioactive nucleus is 5 years. The fraction of the original sample that would decay in 15 years is:

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

5. The position vector of a particle related to time t is given by

$$r = (10t\hat{i} + 15t^2\hat{j} + 7t\hat{k}) \text{ m}$$

The direction of net force experienced by the particle is:

- (1) Positive z-axis
 (2) In x - y plane
 (3) Positive y-axis
 (4) Positive x - axis

6. The height of the transmitting antenna is 180 m and the height of the receiving antenna is 245 m. The maximum distance between them for satisfactory communication in line of sight will be:

- (1) 48 km
 (2) 104 km
 (3) 96 km
 (4) 56 km

7. A single slit of width a is illuminated by a monochromatic light of wavelength 600 nm. The value of ' a ' for which the first minimum appears at $\theta = 30^\circ$ on the screen will be:

- (1) $0.6 \mu\text{m}$
 (2) $3 \mu\text{m}$

- (3) $1.8 \mu\text{m}$
- (4) $1.2 \mu\text{m}$

8. A 12 V battery connected to a coil of resistance 6Ω through a switch, drives a constant current in the circuit. The switch is opened in 1 ms. The emf induced across the coil is 20 V. The inductance of the coil is:

- (1) 8 mH
- (2) 10 mH
- (3) 12 mH
- (4) 5 mH

9. Two identical particles each of mass 'm' go round a circle of radius 'a' under the action of their mutual gravitational attraction. The angular speed of each particle will be:

- (1) $\sqrt{\frac{Gm}{a^3}}$
- (2) $\sqrt{\frac{Gm}{4a^3}}$
- (3) $\sqrt{\frac{Gm}{2a^3}}$
- (4) $\sqrt{\frac{Gm}{8a^3}}$

10. A body is released from a height equal to the radius (r) of the earth. The velocity of the body when it strikes the surface of the earth will be:

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

11. For designing a voltmeter of range 50 V and an ammeter of range 10 mA using a galvanometer which has a coil of resistance 54 showing a full scale deflection for 1 mA as in figure.

- (1) (C) and (D)
- (2) (A) and (B)
- (3) (C) and (E)
- (4) (A) and (C)

12. Given below are two statements: Statement I: The equivalent resistance of resistors in a series combination is smaller than least resistance used in the combination. Statement II: The resistivity of the material is independent of temperature. In the light of the above statements, choose the correct answer from the options given below:

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

13. The de Broglie wavelength of an electron having kinetic energy E is λ . If the kinetic energy of the electron becomes $\frac{E}{4}$, then its de-Broglie wavelength will be:

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

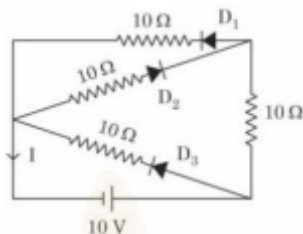
14. A vector in $x - y$ plane makes an angle of 30° with y -axis. The magnitude of y -component of vector is $2\sqrt{3}$. The magnitude of x -component of the vector will be:

- (1) 2
- (2) $\sqrt{3}$
- (3) $\frac{1}{\sqrt{3}}$
- (4) 6

15. The speed of a wave produced in water is given by $v = \lambda^a g^b \rho^c$. Where λ , g , and ρ are wavelength of wave, acceleration due to gravity, and density of water respectively. The values of a , b , and c respectively, are:

- (1) $\frac{1}{2}, 0, \frac{1}{2}$
- (2) $1, -1, 0$
- (3) $\frac{1}{2}, \frac{1}{2}, 0$
- (4) $1, 1, 0$

16. In the given circuit, the current (I) through the battery will be:



- (1) 1A
- (2) 1.5A
- (3) 2A
- (4) 2.5A

17. In a linear Simple Harmonic Motion (SHM), (A) Restoring force is directly proportional to the displacement.

(B) The acceleration and displacement are opposite in direction.

(C) The velocity is maximum at mean position.

(D) The acceleration is minimum at extreme points.

- (1) (C) and (D) only
- (2) (A), (C), and (D) only
- (3) (A), (B) and (C) only
- (4) (A), (B), (C) and (D) only

18. A wire of length L and radius r is clamped rigidly at one end. When the other end of the wire is pulled by a force f , its length increases by dL . Another wire of the same material of length $2L$ and radius $2r$ is pulled by a force $2f$. Then the increase in its length will be:

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

19. A flask contains Hydrogen and Argon in the ratio 2 : 1 by mass. The temperature of the mixture is 30°C . The ratio of average kinetic energy per molecule of the two gases ($K_{\text{argon}}/K_{\text{hydrogen}}$) is:

- (1) 2
 - (2) 39.9
 - (3) 1
 - (4) $\frac{39.9}{2}$
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20. The position of a particle related to time is given by $x = (5t^2 - 4t + 5)$ m. The magnitude of velocity of the particle at $t = 2$ s will be:

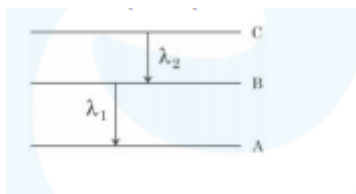
- (1) 10 m/s
 - (2) 06 m/s
 - (3) 16 m/s
 - (4) 14 m/s
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Section - B

21. An electron in a hydrogen atom revolves around its nucleus with a speed of $6.76 \times 10^6 \text{ ms}^{-1}$ in an orbit of radius $0.52 \text{ \AA}$. The magnetic field produced at the nucleus of the hydrogen atom is _____ T.

22. A 20 cm long metallic rod is rotated with 210 rpm about an axis normal to the rod passing through its one end. The other end of the rod is in contact with a circular metallic ring. A constant and uniform magnetic field 0.2 T parallel to the axis exists everywhere. The emf developed between the centre and the ring is _____ mV. (Take $\pi = 22/7$)

23. As per the given figure A, B and C are the first, second and third excited energy levels of the hydrogen atom respectively. If the ratio of the two wavelengths $\left(\frac{\lambda_1}{\lambda_2}\right)$ is $\frac{7}{4n}$, then the value of n will be _____.



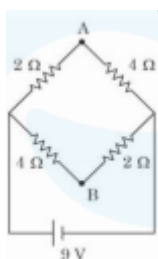
24. The refractive index of a transparent liquid filled in an equilateral hollow prism is $\sqrt{2}$. The angle of minimum deviation for the liquid will be ____.

25. A block of mass 10 kg is moving along the x-axis under the action of force $F = 5x$ N. The work done by the force in moving the block from $x = 2m$ to $x = 4m$ will be _____ J.

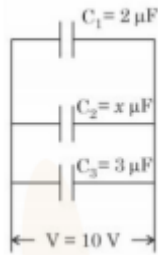
26. The fundamental frequency of vibration of a string stretched between two rigid supports is 50 Hz. The mass of the string is 18g and its linear mass density is 20 g/m. The speed of the transverse waves so produced in the string is ____ m/s.

27. A solid sphere and a solid cylinder of same mass and radius are rolling on a horizontal surface without slipping. The ratio of their radius of gyration respectively (i.e., $k_{sp} : k_{cy}$) is $2 : \sqrt{x}$. The value of x is ____.

28. A network of four resistances is connected to 9 V battery, as shown in figure. The magnitude of voltage difference between the points A and B is ____ V.



29. In the given figure the total charge stored in the combination of capacitors is $100 \mu\text{C}$. The value of x is:



30. There is an air bubble of radius 1.0 mm in a liquid of surface tension 0.075 N/m and density 1000 kg/m^3 at a depth of 10 cm below the free surface. The amount by which the pressure inside the bubble is greater than the atmospheric pressure is:
