Sample Paper for JEE-Mains

Subject: Physics [Paper-2]

Topics Covered

Ray Optics
Wave Optics
Dual Nature of Radiation & Matters
Nuclei
Semiconductors

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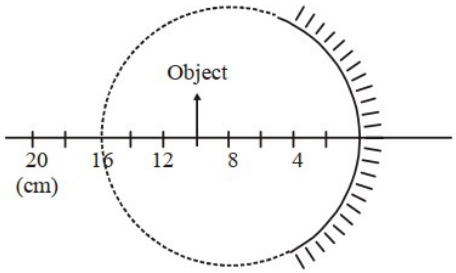
Only one option is correct.

1. A spherical mirror is obtained as shown in the figure from a hollow glass sphere. If an object is positioned in front of the mirror, what will be the nature and magnification of the image of the object? (Figure drawn as schematic and not to scale) [Reflection through Spherical Mirror]



(a) Inverted, real and magnified
(b) Erect, virtual and magnified
(c) Erect, virtual and unmagnified
(d) Inverted, real and unmagnified

2. A vessel of depth 2h is half filled with a liquid of refractive index $2\sqrt{2}$ and the upper half with another liquid of refractive index $\sqrt{2}$. The liquids are immiscible. The apparent depth of the inner surface of the bottom of vessel will be: [Refraction through Plane Surface]

(a) $\frac{h}{\sqrt{2}}$ (b) $\frac{h}{2\left(\sqrt{2}+1\right)}$ (c) $\frac{h}{3\sqrt{2}}$ (d) $\frac{3}{4}h\sqrt{2}$

3. A double convex lens has power *P* and same radii of curvature *R* of both the surfaces. The radius of curvature of a surface of a plano-convex lens made of the same material with power 1.5 *P* is : [Power of Lens]

(a) 2R (b) R /2 (c) 3R / 2 (d) R/3

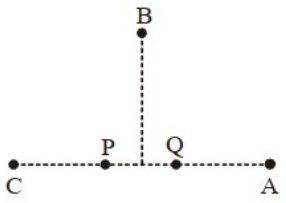
4. A thin lens made of glass (refractive index = 1.5) of focal length *f* = 16 cm is immersed in a liquid of refractive index 1.42. If its focal length in liquid is f_l, then the ratio f_l/f is closest to the integer: [Lens maker Formula]

(a) 1 (b) 9 (c) 5 (d) 17

5. The magnifying power of a telescope with tube length 60 cm is 5 (if final image is far away). What is the focal length of its eye piece? [Angular Magnification due to Telescope]

(a) 20cm (b) 40 cm (c) 30 cm (d) 10 cm

6. In the figure below, P and Q are two equally intense coherent sources emitting radiation of wavelength 20 m.The separation between P and Q is 5 m and the phase of P is ahead of that of Q by 90^0. A, B and C are three distinct points of observation, each equidistant from the midpoint of PQ. The intensities of radiation at A, B, C will be in the ratio : [Principle of Superposition]



(a) 0 : 1 : 4 (b) 2 : 1 : 0 (c) 0 : 1 : 2 (d) 4 : 1 : 0

7. Two light waves having the same wavelength λ in vacuum are in phase initially. Then the first wave travels a path L_1 through a medium of refractive index n_1 while the second wave travels a path of length L_2 through a medium of refractive index n_2. After this the phase difference between the two waves is : [Optical Path]

(a) $\frac{2\pi}{\lambda}\left(\frac{L_2}{n_1}-\frac{L_1}{n_2}\right)$ (b) $\frac{2\pi}{\lambda}\left(\frac{L_1}{n_1}-\frac{L_2}{n_2}\right)$ (c) $\frac{2\pi}{\lambda}(n_1L_1-n_2L_2)$ (d) $\frac{2\pi}{\lambda}(n_2L_1-n_1L_2)$

8. In a Young's double slit experiment, 16 fringes are observed in a certain segment of the screen when light of wavelength 700 nm is used. If the wavelength of light is changed to 400 nm, the number of fringes observed in the same segment of the screen would be : [YDSE]

(a) 24 (b) 30 (c) 18 (d) 28

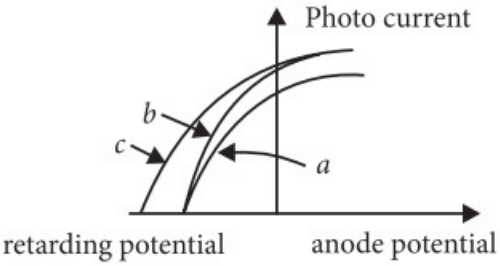
9. In a double slit experiment, when a thin film of thickness t having refractive index μ is introduced in front of one of the slits, the maximum at the centre of the fringe pattern shifts by one fringe width. The value of t is ($\approx$ is the wavelength of the light used) : [YDSE & Shifting of Fringe Pattern]

(a) $\frac{2\lambda}{(\mu-1)}$ (b) $\frac{\lambda}{2(\mu-1)}$ (c) $\frac{\lambda}{(\mu-1)}$ (d) $\frac{\lambda}{(2\mu-1)}$

10. The aperture diameter of telescope is 5m. The separation between the moon and the earth is 4×10^5 km. With light of wavelength of 5500 Å, the minimum separation between objects on the surface of moon, so that they are just resolved, is close to: [Resolving Power]

(a) 60 m (b) 20 m (c) 200 m (d) 600 m

11. The figure shows a plot of photo current versus anode potential for a photo sensitive surface for three different radiations. Which one of the following is a correct statement? [Stopping Potential+ Saturated Current]



(a) Curves (a) and (b) represent incident radiations of same frequency but of different intensities.
(b) Curves (b) and (c) represent incident radiations of different frequencies and different intensities.
(c) Curves (b) and (c) represent incident radiations of same frequency having same intensity.
(d) Curves (a) and (b) represent incident radiations of different frequencies and different intensities

12. Photoelectric effect supports quantum nature of light because: [Photoelectric effect]

(a) There is a minimum frequency below which no photoelectrons are emitted.
(b) The maximum kinetic energy of photoelectrons depends only on the frequency of light and not on its intensity
(c) Even when the metal surface is faintly illuminated the photoelectrons leave the surface immediately
(d) All of Above

13. The de-Broglie wavelength of a neutron in thermal equilibrium with heavy water at temperature *T* (kelvin) and mass *m*, is [deBroglie + Temperature]

(a) $\frac{h}{\sqrt{3mkT}}$ (b) $\frac{2h}{\sqrt{3mkT}}$ (c) $\frac{2h}{\sqrt{mkT}}$ (d) $\frac{h}{\sqrt{mkT}}$

14. An electron of mass *m* with an initial velocity $\vec{v} = v_0\hat{i}(v_0 > 0)$ enters an electric field $\vec{E} = -\vec{E}_0\hat{i}(E_0 = \text{constant} > 0)$ at *t* = 0. If λ_0 is its de-Broglie wavelength initially, then its de- Broglie wavelength at time *t* is [deBroglie + Force]

(a) $\frac{\lambda_0}{\left(1+\frac{eE_0}{mv_0}t\right)}$ (b) $\lambda_0\left(1+\frac{eE_0}{mv_0}t\right)$ (c) $\lambda_0 t$ (d) λ_0

15. The ratio of wavelengths of the last line to first line of Lyman & Balmer series is n and m respectively. Then n:m is [Series Limit]

(a) 27:20 (b) 20:27 (c) 1:4 (d) 4:1

16. How many different wavelengths may be observed in the spectrum from a hydrogen sample if the atoms are excited to states with principal quantum number n ? [Spectral Lines]

(a) n (b) $\frac{n(n-1)}{2}$ (c) $\frac{n(n+1)}{2}$ (d) $(n+1)$

17. Energy levels *A, B* and *C* of a certain atom corresponding to increasing values of energy *i.e.* $E_A < E_B < E_C$. If λ_1, λ_2 and λ_3 are wavelengths of radiations corresponding to transitions *C* to *B*, *B* to *A* and *C* to *A* respectively, which of the following relations is correct? [Energy in Bohr's Orbit]

(a) $\lambda_3 = \lambda_1 + \lambda_2$ (b) $\lambda_3 = \frac{\lambda_1\lambda_2}{\lambda_1+\lambda_2}$ (c) $\lambda_1 + \lambda_2 + \lambda_3 = 0$ (d) $\lambda_3^2 = \lambda_1^2 + \lambda_2^2$

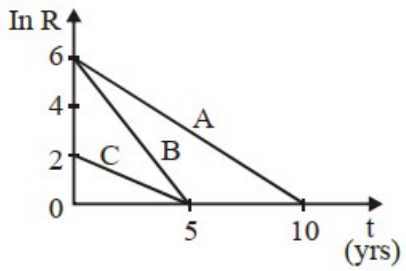
18. The magnetic moment (μ) of a revolving electron around the nucleus varies with principle quantum number n as [Bohr's Model+ Magnetic Moment]

(a) $\mu \propto n$ (b) $\mu \propto 1/n$ (c) $\mu \propto n^2$ (d) $\mu \propto 1/n^2$

19. Two isotopes P and Q of atomic weight 10 and 20, respectively are mixed in equal amount by weight. After 20 days their weight ratio is found to be 1 : 4. Isotope P has a half-life of 10 days. The half-life of isotope Q is [Half Life]

(a) zero (b) 5 days (c) 20 days (d) infinite

20. Activities of three radioactive substances A, B and C are represented by the curves A, B and C, in the figure. Then their half-lives $T_A : T_B : T_C$ are in the ratio : [Activity + Half Life]

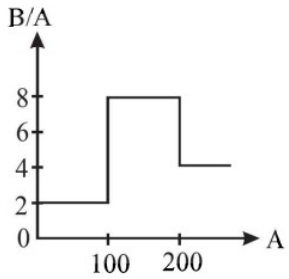


(a) 2:1:1 (b) 3:2:1 (c) 2:1:3 (d) 4:3:1

21. A radioactive nucleus can decay by two different processes. The half-life for the first process is t_1 and that for the second process is t_2. If the effective half-life t of the nucleus is t, then [Half Life-Parallel Reaction]

(a) $t = \sqrt{t_1 t_2}$ (b) $t = \frac{t_1 + t_2}{2}$ (c) $\frac{2}{t} = \frac{1}{t_1} + \frac{1}{t_2}$ (d) $\frac{1}{t} = \frac{1}{t_1} + \frac{1}{t_2}$

22. Assume that the nuclear binding energy per nucleon *B/ A versus* mass number (*A*) is as shown in the figure. Use this plot to choose the correct choice given below. [Binding Energy per nucleon]

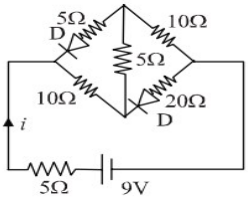


(a) Fusion of two nuclei with mass numbers lying in the range of 1 <A<50 will release energy.
(b) Fusion of two nuclei with mass numbers lying in the range of 200 < *A* < 260 will release energy.
(c) Fission of a nucleus lying in the mass range of 100 < A <200 will release energy when broken into two equal fragments.
(d) Fission of a nucleus lying in the mass range of 200 < A < 260 will release energy when broken into two equal fragments.

23. With increasing biasing voltage of a photodiode, the photocurrent magnitude : [Photodiode]
(a) remains constant (b) increases initially and after attaining certain value, it decreases
(c) Increases linearly (d) increases initially and saturates finally

24. If a semiconductor photodiode can detect a photon with a maximum wavelength of 400 nm, then its band gap energy is: Planck's constant, $h = 6.63 \times 10^{-34}$ J.s. Speed of light, $c = 3 \times 10^8$ m/s [Photodiode]
(a) 1.1 eV (b) 2.0 eV (c) 1.5 eV (d) 3.1 eV

25. The current *i* in the network is: [Forward Biased & Reverse Biased of diode]



(a) 0.2 A (b) 0.6 A (c) 0.3 A (d) 0 A

Answer Key

1. d	2. d	3. b	4. b	5. d
6. c	7. c	8. d	9. c	10. a
11. a	12. d	13. a	14. a	15. a
16. b	17. b	18. a	19. d	20. c
21. d	22. d	23. d	24. d	25. c