EXERCISE # 02

SECTION : (A) - Single Correct Options

902. A ^7Li target is bombarded with a proton beam current of 10^{-5} A for 1 hrs to produce ^7Be of activity 1.4×10^8 disintegration per second. If 1000 protons are required to produce one ^7Be radioactive nucleus, then the half life period of ^7Be is (Take ln2 = 0.7)

(A) 1.125×10^6 sec (B) 1.526×10^6 sec (C) 1.625×10^4 sec (D) 15.26×10^6 sec

903. The electron in hydrogen atom makes transition from the M shell to L shell. The ratio of the magnitude of initial to final acceleration of the electron is

(A) 9 : 4 (B) 81 : 16 (C) 4 : 9 (D) 16 : 81

904. A convex lens focuses a distant object 40 cm from it on a screen placed 10 cm away from it. A glass plate (μ = 1.5) and thickness 3 cm inserted between the lens and the screen. Then the position of the object from the lens such that its image is again focused on the screen______.

(A) 72 cm (B) 62 cm (C) 36 m (D) 24 cm

905. An object is kept in front of a concave mirror at a distance of (200 ± 0.04) m and its image is formed in front of the mirror at a distance (3.00 ±0.03) m. then the focal of the mirror is

(A) (1.20 ± 0.04) m (B) (1.4 ± 0.04)m (C) (1.20 ± 0.05) m (D) (1.2 ± 0.03) m

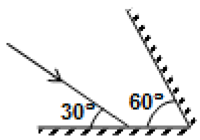
906. The electric field of a light wave at a point is E = (100 N/c) sin $(3 \times 10^{15}t)$ sin $(6 \times 10^{15}t)$ where t is time in seconds. This light falls on a metal surface having work function of 2 eV, then maximum possible kinetic energy of photoelectrons is about

(A) 16 eV (B) 7 eV (C) 6 eV (D) 4 eV

907. Current in a X-ray tube operating at 40 kV is 10 mA. 1% of the total kinetic energy of electrons hitting the target is converted into X-rays. Then the heat produced in the target per second is

(A) 396 J (B) 4J (C) 400 J (D) cannot be determined.

908. Two plane mirrors are at an angle 60° and an incident ray falls on the first mirror as shown in the figure. What is the smallest angle between the incident ray and the ray obtained each from the two mirrors?



(A) 0° (B) 90° (C) 120° (D) 150°

909. The electron in a hydrogen atom makes a transition $n_1 \rightarrow n_2$ where n-$_1$ and n_2 are the principal quantum numbers of the two states. Assume the Bohr model to be valid. The time period of the electron in the initial state is eight times that in the final state. Then the ratio n_1:n_2 is

(A) 1:2 (B) 2:1 (C) 4:1 (D) 1:4

910. A nitrogen nucleus ${}_{7}^{14}N$ absorbs a neutron and can transform into lithium nucleus ${}_{3}^{7}Li$ under suitable conditions after emitting:

(A) 4 protons and 3 neutrons
(B) 5 protons and 1 beta particle
(C) 2 alpha particles and 2 gamma photons
(D) 2 alpha particles, 4 protons and 2 beta particles.

911. White light is used to illuminate the two slits in a young's double slit experiment. The separation between the slits is b and the screen is at a distance d ($\gg$ b) from the slits. At a point on the screen directly in front of one of the slits, certain wavelengths are missing. Some of these missing wavelengths are:

(A) $\lambda = \frac{4b^2}{d}$
(B) $\lambda = \frac{2b^2}{d}$
(C) $\lambda = \frac{b^2}{3d}$
(D) $\lambda = \frac{b^2}{4d}$

912. The minimum separation between a real object and its real image in a convex lens of focal length f is

(A) 4 f
(B) 3 f
(C) f
(D) 2 f

913. When a real image is formed for a real object in a convex lens, then the intensity is I. When the upper half of lens is covered by opaque material then the intensity is I_1 and when the lower half is covered and upper is uncovered then intensity is I_2. Then

(A) $I = I_1 = I_2$
(B) $I > I_1 > I_2$
(C) $I < I_1 < I_2$
(D) $I > I_1 = I_2$

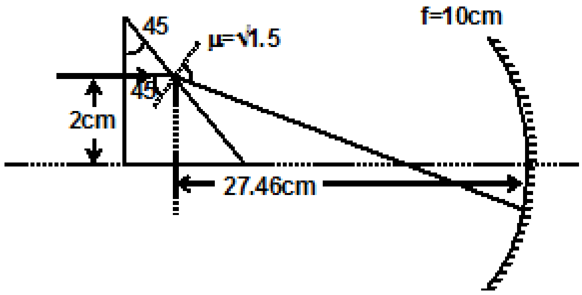
914. When a metallic surface is illuminated with monochromatic light of wavelength l, the stopping potential is $5V_0$. When the same surface is illuminated with light of wavelength 3l, the stopping potential is V_0. The work function of the metallic surface is :

(A) $\frac{hc}{6\lambda}$
(B) $\frac{hc}{5\lambda}$
(C) $\frac{hc}{4\lambda}$
(D) $\frac{2hc}{4\lambda}$

915. An object moves along the axis of a concave mirror of focal length f. Position of object varies as $x = f/2 \sin \omega t$ from a point on x axis at a distance of $\frac{3f}{2}$. Time after which position of image will coincide with position of object is

(A) $\frac{\pi}{2\omega}$
(B) $\frac{2\pi}{\omega}$
(C) $\frac{2\pi}{3\omega}$
(D) $\frac{3\pi}{2\omega}$

916. A ray of light falls normally on a right angled prism whose $\mu = \sqrt{1.5}$ and prism angle is 45^0. After passing through prism it falls on a concave mirror which is at a distance of 27.46 cm from point at of emergence of prism. What is the net deviation if focal length of mirror is 10 cm. ($\sqrt{3} = 1.73$)



(A) 15^0
(B) 60^0
(C) 90^0
(D) 180^0

SECTION : (B) - More Than One Correct Options

917. Which of the following statements is/are correct about the refraction of light from a plane surface when light ray is incident in denser medium. [C is critical angle]

(A) The maximum angle of deviation during refraction is $\frac{\pi}{2} - C$, when angle of incidence is C.

(B) The maximum angle of deviation for all angle of incidences is $\pi - 2C$, when angle of incidence is slightly greater than C.

(C) If angle of incidence is less than C then deviation increases if angle of incidence is also increased.

(D) If angle of incidence is greater than C then angle of deviation decreases if angle of incidence is increased.

918. According to Bohr's atomic model

(A) Orbital speed of electron is independent of electronic mass

(B) The angular momentum of electron in stationary orbit is an integral multiple of $\frac{h}{2\pi}$ (Planck constant)

(C) The magnetic field at the centre is proportional to $\frac{1}{n^4}$ (where n is principal quantum number)

(D) The magnetic field at the centre is proportional to $\frac{1}{n^5}$ (where n is principal quantum number)

919. In which of the following situations, out of deutron and α-particle, the α-particle has smaller de-Broglie wavelength? The two particles are

(A) Move with the same speed
(B) Move with the same linear momentum
(C) Move with the same kinetic energy
(D) Accelerated through same potential

920. Choose the correct statement(s) in case of photoelectric effect

(A) The number of emitted photoelectrons is proportional to the intensity of incident light

(B) Photoelectric current is proportional to frequency of light

(C) Photoelectric emission will take place or not, depends on the intensity of light

(D) The velocity of emmitted photoelectrons does not depends on intensity of light

921. In Young's double slit experiment, slits are arranged in such a way that besides central bright fringe there are only two bright fringes on either side of it. The slit separation d for given condition cannot be (λ is wavelength of light used for experiment)

(A) $\frac{\lambda}{4}$
(B) $\frac{\lambda}{8}$
(C) $\frac{3\lambda}{2}$
(D) $\frac{\lambda}{2}$

922. In Bohr's model of the hydrogen atom, let R, V, T and E represent the radius of the orbit, speed of the electron, time period of revolution of the electron and the total energy of the electron respectively. The quantities proportional the quantum number n are

(a) VR
(b) RE
(c) V/ E
(d) T/R

923. An image of a bright square is obtained on a screen with the aid of a convergent lens. The distance between the square and the lens is 40 cm. The area of the image is nine time larger than that of the square. Select the correct statement(s) :

(a) Image is formed at a distance 120 cm from lens.

(b) Image is formed at a distance 360 cm from lens.

(c) Focal length of lens is 30 cm.

(d) Focal length of lens is 36 cm.

924. The following four statements are regarding well defined observable interference pattern. Select the correct statement(s) :

(a) Condition for sustained interference : The two waves should have same frequency.

(b) Condition for observation : The separation between light sources should be as small as possible.

(c) Condition for good contrast : The amplitudes of interfering waves should be equal or at least very nearly equal.

(d) Condition for good contrast : Slit width must be very narrow (considerably less than the fringe width).

925. When an electron jumps from n = 6 to n =2 in hydrogen like atom:

(a) total ten emission lines will be obtained
(b) angular momentum will increase by three times
(c) kinetic energy will increased nine times
(d) Potential energy will increase three times

926. A neutron collides head on with a stationary hydrogen atom in ground state. Which of the following statement is/are correct ? (Assume that mass of hydrogen atom is nearly equal to mass of neutron and energy of ground state of hydrogen atom is, –13.6 eV).

(a) If kinetic energy of the neutron is less than 13.6 eV, collision must be elastic
(b) If kinetic energy of the neutron is greater than 20.4 eV, collision may be inelastic
(c) Inelastic collision may take place only when kinetic energy of the neutron is 10.2 eV
(d) For perfectly inelastic collision minimum kinetic energy of the neutron should be 10.2 eV.

927. A beam of ultraviolet light of all wavelengths passes through hydrogen gas at room temperature, in the x-direction. Assume that all photons emitted due to electron transititons inside the gas emerge in the y-direction. Let A and B denote the lights emerging from the gas in the x- and y-directions respectively.

(a) some of the incident wavelengths will be absent in A.

(b) Only those wavelength will be present in B which are absent in A.

(c) B will contain some visible light.

(d) B will contain some infrared light.

928. At a point on the screen in YDSE experiment 3 rd maxima is observed at t =0. Now screen is slowly moved with constant speed away from the slits is such a way that the centre of slits and centre of screen lie on same line always and at t = 1 sec the intensity at that point is observed (3/4)th of maximum intensity in between 2nd and 3rd maxima. The speed of screen will be (D = separation between the screen and slits d = separation between the slits, d << D, $\lambda = 5000\overset{0}{\mathrm{A}}$)

(a) $\frac{5D}{13}$ (b) $\frac{13D}{5}$ (c) $\frac{17D}{5}$ (d) $\frac{D}{17}$

929. In which of the following cases the heavier of the two particle has a smaller de Broglie wavelength ? The two particles

(a) move with the same speed

(b) move with the same linear momentum

(c) move with the same kinetic energy

(d) have the same change of potential energy in a conservative field.

930. In radioactive decay match the following:

Table -1	Table -3
(A) Emission of 2 α and 3 β - particles	(P) No change in atomic number
(B) Emission of 3 α and 2 β -particles	(Q) Atomic number decreases by four
(C) Emission of 2 α and 4 β -Particles	(R) Atomic number decreases by one
(D) Emission of γ -decay	(S) Mass number decreases by eight
	(T) Mass number decreases by twelth

(a) A-(R,S) (b) B-(Q,T) (c) C-(Q) (d) D-(P)

931. The deviation produced by a prism depends on

(a) The angle of incidence of light on its face (b) The refracting angle of prism

(c) The refractive index of the prism (d) The wavelength of the light used.

932. For a certain radioactive substance, it is observed that after 4 hours, only 6.25% of the original sample is left undecayed. If follows that

(a) the half life of the sample is 1 hour

(b) The mean life of the sample is 1/ln2 hour

(c) The decay constant of the sample is ln 2 hour^{-1}

(d) After a further 4 hours, the amount of the substance left over would by only 0.39% of the original amount.

933. When a wave is reflected from a mirror, there is no change in its

(a) amplitude (b) frequency (c) wavelength (d) velocity

934. The focal length of a lens depends on

(a) The object and the image distance (b) The refractive index of the material

(c) The radius of curvature of the surfaces (d) The wavelength of light used

935. An electron in H atom first jumps from second excited state to first excited state and then from first excited state to ground state. Let the ratio of wavelength, momentum and energy of photons emitted in these two cases a, b and c respectively. Then:

(a) $a = \frac{9}{4}$ (b) $b = \frac{5}{27}$ (c) $c = \frac{5}{27}$ (d) $c = \frac{1}{a}$

936. A small mirror is suspended by a thread. A short pulse of monochromatic light rays is incident normally on the mirror and gets reflected. Which of the following statements is/are correct?

(a) Mirror will begin to oscillate

(b) Wavelength of reflected rays will be greater than that of incident rays.

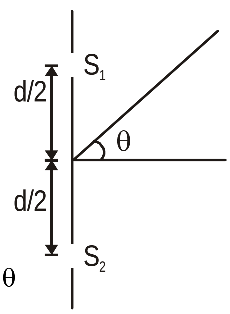
(c) Wavelength of reflected rays may be less than that of incident rays.

(d) There will be no effect of short pulse on mirror.

937. An electron with kinetic energy = EeV collides with a hydrogen atom in the ground state. The collision will be elastic for

(a) no value of E (b) for E < 10.2 eV (c) for E < 13.6 eV (d) only for E < 3.4 eV

938. In an interference arrangement similar to Young's double-slit experiment, the slits S_1 and S_2 are illuminated with coherent microwave sources, each of frequency 10^6 Hz. The sources are synchronized to have zero phase difference. The slits are separated by a distance d = 150.0 m. The intensity I (θ) is measured as a function of θ, where θ is defined as shown. If I_0 is the maximum intensity, then I (θ) for $0 \leq \theta \leq 90^\circ$ is given by



(a) I (θ) = I_0/ 2 for θ = 30° (b) I (θ) = I_0 / 4 for θ = 0°

(c) I (θ) = I_0 for θ = 0° (d) I (θ) is constant for all values of θ

SECTION : (C) -Passage Type Questions

PASSAGE 01:

While discussing Bohr's atomic model, we consider the nucleus to be at rest. This is true when the mass of the nucleus is very large compared to mass of an electron.

When the nucleus is of finite mass, both the nucleus and electron are in circular motion about their centre of mass. If M and m be the mass of nucleus and electron then force of interaction between nucleus and electron = $F = M\omega^2 r_1 = m\omega^2 r_2$

Or $$F\left(\frac{M+m}{Mm}\right) = \omega^2 (r_1 + r_2)$$

Or $$F = \frac{Mm}{M+m}\omega^2 (r_1 + r_2) = \mu\omega^2 r$$

where μ is the reduced mass and $r = r_1 + r_2$. Therefore, the nucleus of finite mass may be supposed to be infinite mass provided the electron mass is replaced by its reduced mass.

939. In the finite mass model

(A) Angular momentum of electron and nucleus is same

(B) Linear momentum of electron and nucleus is same

(C) Energy and momentum of electron and nucleus is same

(D) Time period and momentum of electron and nucleus is different

940. If E_1 is the energy of 'electron + nucleus' in Bohr's model when nucleus is stationary and E_2 is the energy when nucleus is moving then E_1/E_2 is

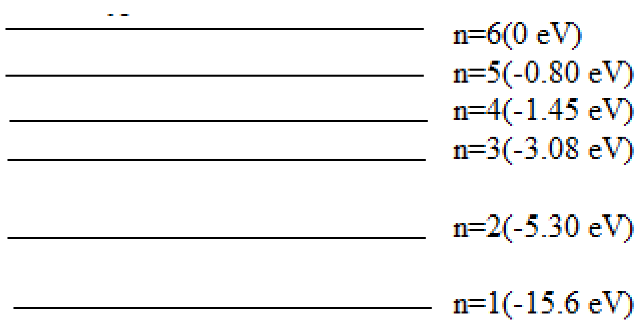
(A) $\frac{M+m}{M}$ (B) $\frac{M}{m}$ (C) $\frac{m}{M}$ (D) $\frac{M-m}{M}$

941. In previous if R_1 and R_2 are the Rydberg's constant then R_1/R_2 is

(A) $\frac{M+m}{M}$ (B) $\frac{M}{m}$ (C) $\left(\frac{M+m}{M}\right)^2$ (D) $\frac{M-m}{M}$

PASSAGE 02:

The energy levels of a hypothetical one electron atom are shown in figure



942. Find the ionization potential of this atom

(a) 15.6 eV (b) 13.5eV (c) 12.2 eV (d) 10.7 eV

943. Find the short wavelength limit of the series terminating at n=2

(a) 2339 $\overset{0}{A}$ (b) 3224 $\overset{0}{A}$ (c) 3452 $\overset{0}{A}$ (d) 7685 $\overset{0}{A}$

944. Find the excitation potential for the state n=3

(a) 10.2 V (b)12.52 V (c) 13.7 V (d) 15.3 V

945. Find the wave number of the photon emitted for the transition n=3 to n=1

(a)1.009×10^{-7} m^{-1} (b) 2.409×10^{-7} m^{-1} (c) 3.098×10^{-7} m^{-1} (d)5.009×10^{-7} m^{-1}

946. What is the minimum energy that an electron will have after interacting with this atom in the ground state if the initial kinetic energy of the electron is 6 eV

(a) 2eV (b) 8eV (c) 4eV (d) 6eV

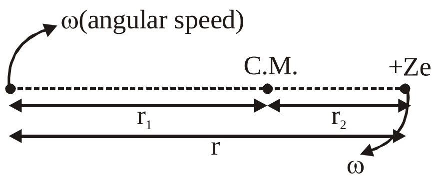
947. What is the minimum energy that an electron will have after interacting with this atom in the ground state if the initial kinetic energy of the electron is 11 eV

(a)0.2eV (b) 0.4eV (c) 0.7eV (d) 0.5eV

PASSAGE 03:

A hydrogen–like ion is formed when an atom loses all but one of its electrons so that it consists of a single electron moving around a nucleus of charge +Ze. Bohr's model of atom, though it is far from being adequate, is still quite useful and successful in giving an account of hydrogen atom and hydrogen–like ions (uni–electron system). Using Bohr's theory, energy of electron moving in the n^{th} orbit of a orbit of a hydrogen like ion having a nuclear charge +Ze can be expressed as

$$E_n = -\frac{mZ^2e^4}{3\varepsilon_0^2h^2n^2}$$



(m, e – mass and charge of electron; $_0$ – absolute permittivity of space; h – Planck's constant)

This expression is valid if the nucleus is assumed to be at rest. In deriving the energy expression given above, we use an approximation that nucleus being extremely massive than the electron, the center of mass of the system will be extremely close to the nucleus, so that, motion of electron can then be visualized as taking place around the nucleus. However, it is more appropriate to visualize the motion of both – the electron and the nucleus. In fact, the electron and the nucleus, both orbit around their center of mass under the mutual electric force, as shown in the figure. If we consider the motion of nucleus also, the energy given by the expression above, has to be modified and thus needs some correction. With m as the mass of electron and M that of nucleus, consider the situation shown in the figure and answer the following questions

948. Distance of electron from the centre of mass, r_1 is

(a) $\frac{r}{2}$ (b) $\frac{m}{M+m}r$ (c) $\frac{M}{M+m}r$ (d) $\frac{mM}{m+M}$

949. Kinetic energy of the nucleus will be

(a) $\frac{Mr^2\omega^2}{2}$ (b) $\frac{Mm}{2(M+m)}r^2\omega^2$ (c) $\frac{M^2m}{2(M+m)^2}r^2\omega^2$ (d) $\frac{Mm^2}{2(M+m)^2}r^2\omega^2$

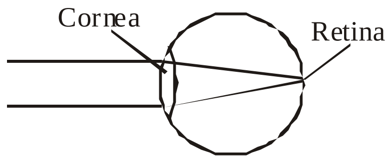
950. Total kinetic energy of the system (nucleus + electron) is

(a) $\frac{Mm}{2(M+m)}r^2\omega^2$ (b) $\frac{(M+m)r^2\omega^2}{2}$ (c) $\frac{Mm^2}{2(M+m)^2}r^2\omega^2$ (d) $\frac{M^2m}{2(M+m)^2}r^2\omega^2$

PASSAGE 4:

The figure shows a simplified model of the eye that is based on the assumption that all the refraction of the light entering the eye occurs at the location of the cornea. In this model, the converging lens of the eye (eye–lens), located at the cornea, has a fixed focal length of 2 cm. Parallel rays coming from a very distant object are refracted by this lens to produce a focused image on the retina. The retina, then, transmits electrical impulses to the brain through the optic nerve

Two common defects of vision are myopia and hyperopia. Myopia, sometimes referred to as nearsightedness, occurs when the lens of the eye focusses the image of a distant object in front of the retina. Hyperopia, sometimes referred to as farsightedness, occurs when the cornea focusses the image of a nearby object behind the retina. Both these problems can be corrected by introducing an artificial lens in front of the eye so that the two lens system produces a focussed image on the retina.



If an object is so far away from the lens system that its distance may be taken as infinite, then the following relationship holds : $\frac{1}{f_e}+\frac{1}{f_1-x}=\frac{1}{v}$, where f_e is the focal length of the eye–lens, f_1 is the focal of the correcting artificial lens; x is the distance from the correcting lens to the cornea, and v is the image distance measured from the cornea. (Note : The index of refraction is 1.0 for air and 1.5 for glass which is used for the correcting lens)

951. How far away should the retina be from the cornea (eye–lens) for normal vision ?

(a) 0.5 cm (b) 1.0 cm (c) 2.0 cm (d) 4.0 cm

952. For a distant object, the image produced by the cornea is :

(a) real and inverted (b)real and upright (c) virtual and inverted (d)virtual and upright

953. What kind of lens would be suitable to correct myopia and hypermetropia respectively? (Note: Assume that the correctiong lens is at the focal point of the cornea so that $x = f_c$).

(a) Converging, Converging (b) Converging, Diverging

(c) Diverging, Diverging (d) Diverging, Converging.

PASSAGE 5:

A point object is placed on the optic axis of an equiconvex glass lens of focal length 7.5 cm. The distance of object from the lens is 20 cm as shown in figure.

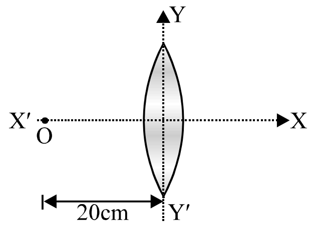


Fig. I

954. The lens is split into two halves along the plane YY′ and right half is shifted towards right by 30 cm keeping the left half fixed at its position as shown in figure II. What is the shift in the location of the final image?

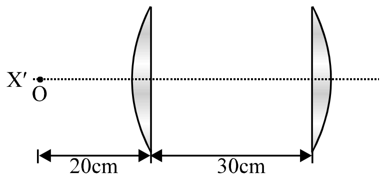


Fig. II

(a) 28 cm (b) 48 cm (c) 62 cm (d) 10cm

955. The right half lens is further displaced perpendicular to line XX′ by 6 mm as shown in figure III. What is further shift of image from its earlier position (position in figure II)?

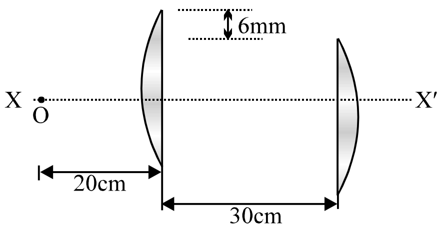


Fig. III

(a) 6 mm (b) 4 mm (c) 3 mm (d) 2mm

956. The two halves are grouped together as shown in figure II and the space between the lenses is filled with water as shown in figure IV. What is shift in position of image from its position of figure (II) ($\mu_g = 3/2$, $\mu_w = 4/3$) ?

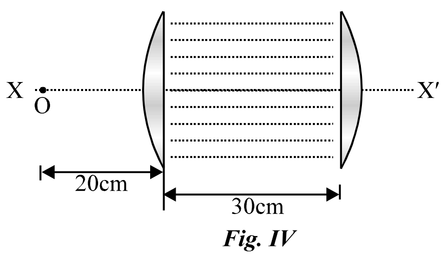
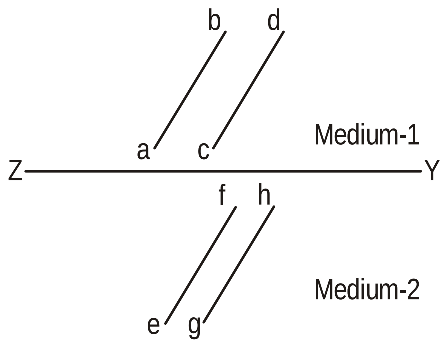


Fig. IV

(a) 7.5 cm (b) 10.7 cm (c) 0.7 cm (d) 17.5 cm

PASSAGE 06:

The figure shows a surface XY separating two transparent media. medium-1 and medium-2. The lines *ab* and *cd* represent wavefronts of a light wave travelling in medium-1 and incident on XY. The lines *ef* and *gh* represent wavefronts of the light wave in medium-2 after refraction.



957. Light travels as a

(a) parallel beam in each medium

(b) convergent bem in each medium

(c) divergent beam in each medium

(d) divergent beam in one medium and covergent beam in the other medium

958. The phases of the light wave at *c*, *d*, *e* and *f* are ϕ_c, ϕ_d, ϕ_e and ϕ_f respectively. It is given that $\phi_c \neq \phi_f$

(a) ϕ_c cannot be equal to ϕ_d

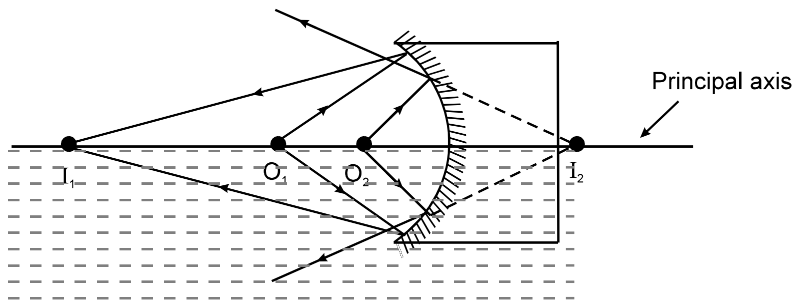
(b) ϕ_d can be equal to ϕ_e

(c) $(\phi_d - \phi_f)$ is equal to $(\phi_c - \phi_e)$

(d) $(\phi_d - \phi_c)$ is not equal to $(\phi_f - \phi_e)$

PASSAGE 07:

A block with a concave mirror of radius of curvature 1m attached to one of its sides floats, with exactly half of its length immersed in water and the other half exposed to air.



Any ray originating from an object O_1 and O_2 (as shown in figure) floating on the surface of water first gets reflected by the mirror. This then gets refracted by the water surface if the image formed by reflection is real (I_1). If the image is virtual (I_2), then the reflected ray never encounters the air-water interface and hence there is no refraction. The image for the next three questions refers to the final image, formed after both the reflection and refraction (if it occurs at all) has taken place.

959. The final image formed is unique (i.e. only one image is formed) if the point object floats on the surface of water at a distance x in front of the mirror where

(A) x is less than 50 cm

(B) x is less than 1m

(C) x is between 50 cm and 1m

(D) for any value of x

960. There is no refraction of light rays reflected from the mirror if the point object floats on the surface of water at a distance x in front of the mirror where

(A) x is less than 50 cm

(B) x is less than 1m

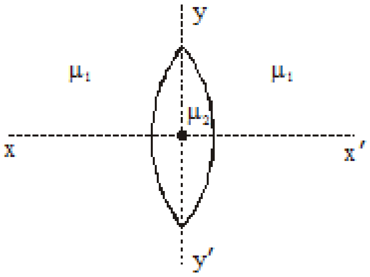
(C) x is between 50 cm and 1m

(D) for any value of x

SECTION : (D) - Matrix Match

961.

. A equi convex lens of refractive index μ_2 and focal length f (in air) is kept in medium of refractive index μ_1.

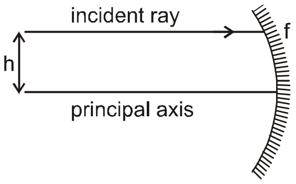
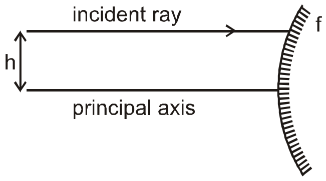
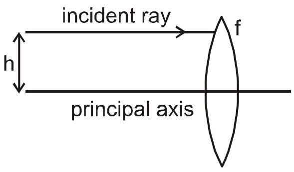
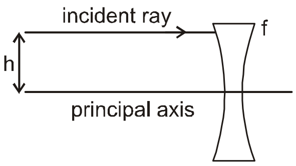


Column A		Column B	
a)	If lens is cut in two equal parts by a plane yy′. ($\mu_1 = 1$)	(p)	Lens will act as a glass slab.
b)	If lens is cut in two equal parts by a plane xx′. ($\mu_1 = 1$)	(q)	Lens will be converging and focal length will change.
c)	If $\mu_1 = \mu_2$.	(r)	Lens will be converging and focal length will remain same.
d)	If $\mu_1 > \mu_2$.	(s)	Lens will be diverging and focal length will change.

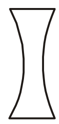
962. Select the correct characteristics of the image of a real object formed by a lens of focal length f from the choices given below :

Nature of lens and Position		**Characteristics of the image observed :**	
(i)	Lens is converging and 2f away from the object	**(A)**	virtual, erect, diminished
(ii)	Lens is converging and between f and 2f from the object	**(B)**	virtual, erect, magnified.
(iii)	Lens is diverging and distant f from the object.	**(C)**	real, inverted, diminished
(iv)	Lens is converging and less than f from the object.	**(D)**	real, inverted, magnified
		(E)	real, inverted, same size.

963. A ray is parallel to principal axis and at a distance h from principal axis as shown in each situation of column-I. The focal length of mirror or lens in each situation of column-I is f (h < < f). Match each situation in column-I with the ***magnitude of deviation of incident ray produced*** in column-II.

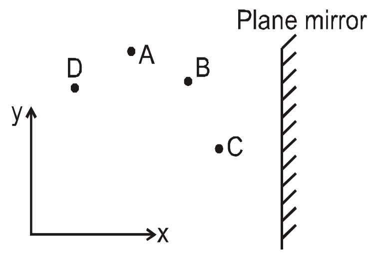
Column-I	Column-II
(A) 	(p) $180^\circ - \frac{h}{f}$
(B) 	(q) $180^\circ - \frac{2h}{f}$
(C) 	(r) $\frac{h}{f}$
(D) 	(s) $\frac{2h}{f}$

964. In each situation of column-I, an incident wavefront and its corresponding reflected or refracted wavefront is shown. In column-II the optical instrument used for reflection or refraction is given. Always take the optical instrument to the right of incident wavefront. The incident wavefront is moving towards right. Match each pair of incident and reflected/refracted wavefront in column-I with the correct optical instrument given in column-II.

Column-I Incident wavefront / Reflected/Refracted Wavefront	Column-II Optical instrument used
(A) 	(p) 
(B) 	(q) 
(C) 	(r) 
(D) 	(s) 

965. Four particles are moving with different velocities in front of stationary plane mirror (lying in y-z plane). At t = 0, velocity of A is $\vec{v}_A = \hat{i}$, velocity of B is $\vec{v}_B = -\hat{i} + 3\hat{j}$, velocity of C is $\vec{v}_C = 5\hat{i} + 6\hat{j}$, velocity of D is $\vec{v}_D = 3\hat{i} - \hat{j}$. Acceleration of particle A is $\vec{a}_A = 2\hat{i} + \hat{j}$ and acceleration of particle C is $\vec{a}_C = 2t\hat{j}$. The particle B and D move with uniform velocity (Assume no collision to take place till t = 2 seconds). All quantities are in S.I. Units. Relative velocity of image of object A with respect to object A is denoted by $\vec{V}_{A',A}$. Velocity of images relative to corresponding objects are given in column I and their values are given in column II at t = 2 second. Match column I with corresponding values in column II and indicate your answer by darkening appropriate bubbles in the 4 × 4 matrix given in OMR.

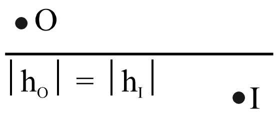
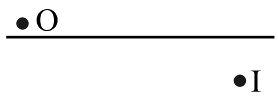
Column I	Column II
(A) $\vec{V}_{A',A}$	(p) $2\hat{i}$
(B) $\vec{V}_{B',B}$	(q) $-6\hat{i}$
(C) $\vec{V}_{C',C}$	(r) $-12\hat{i} + 4\hat{j}$
(D) $\vec{V}_{D',D}$	(s) $-10\hat{i}$



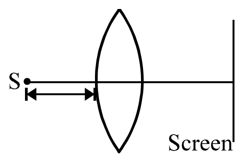
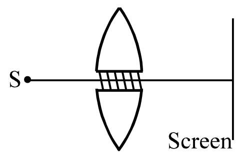
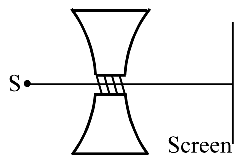
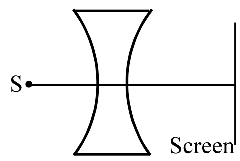
966. Match the column :

	Column-I		Column-II
(A)	A transparent piece of glass used for the dispersion of white light	(p)	Angle of prism
(B)	The angle between incident ray and emergent ray, when refraction takes place through a prism.	(q)	Spectrum
(C)	The angle between two refracting surfaces of a prism.	(r)	Dispersion
(D)	A band of colours formed on the screen when white light passes through prism	(s)	Prism
(E)	The phenomenon due to which white light splits into seven colours on passing through the prism.	(t)	Angle of deviation

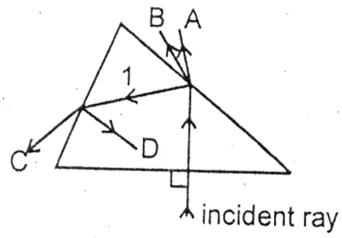
967. In **Column I** are shown four diagrams of real object point O, image point I and principal axis have been sketched. Select the proper optical system from **Column II** which can produce the required image. (Image may be real or virtual)

	Column I		**Column II**
(A)		(P)	Diverging lens
(B)		(Q)	Converging lens
(C)		(R)	Concave mirror
(D)		(S)	Convex mirror

968. Light from source S ($|u| < |f|$) falls on lens and screen is placed on the other side. The lens is formed by cutting it along principal axis into two equal parts and are joined as indicated in column II.

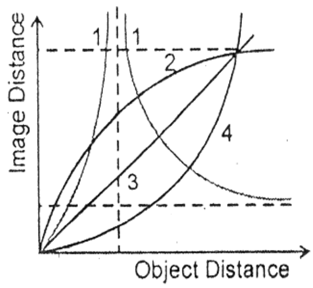
	Column I		**Column II**
(A)	Plane of image move towards screen if $\lvert f \rvert$ is increased	(P)	 Small portion of each part near pole is removed. The remaining parts are joined
(B)	Images formed will be virtual	(Q)	 The two parts are separated slightly The gap is filled by opaque material
(C)	Separation between images increase if $\lvert u \rvert$ decreases	(R)	 The two parts are separated slightly The gap is filled by opaque material
(D)	Interference pattern can be obtained if screen is suitably positioned	(S)	 Small portion of each part near pole is removed. The remaining parts are joined

969. A white light ray is incident on a glass prism, and it create four refracted rays A,B,C and D. Match the refracted rays with the colours given (1 & D are rays due to total internal reflection)



	Ray		Colour
(A)	A	(P)	Red
(B)	B	(Q)	greeen
(C)	C	(R)	yellow
(D)	D	(S)	blue

970. A small particle is placed at the pole of a concave mirror and then moved along the principal axis to a large distance. During the motion, the distance between the pole of the mirror and the image is measured. The procedure is then repeated with a convex mirror, a concave lens and a convex lens. The graph is plotted between image distance versus object distance. Match the curves shown in the graph with the mirror of lens that is corresponding to it. (Curve 1 has two segments)



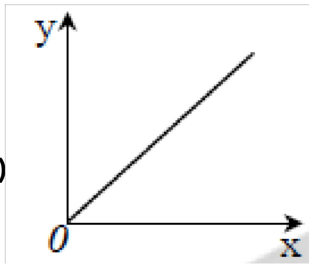
	Lens/Mirror		Curve
(A)	Converging lens	(P)	1
(B)	Converging Mirror	(Q)	2
(C)	Diverging Lens	(R)	3
(D)	Diverging Mirror	(S)	4

971. A nucleus X, initially at rest, undergoes alpha-decay according to the equation. ${}^{A}_{92}X \rightarrow {}^{238}_{Z}Y + \alpha$ .The α particle produced in the above process is found to move in a circular track of radius 0.11m in a uniform magnetic field of 3 Tesla. Given that m(Y) = 228.03u; $m({}^{1}_{0}n) = 1.009u$; $m({}^{4}_{2}He) = 4.003u$ & $m({}^{1}_{1}H) = 1.008u$

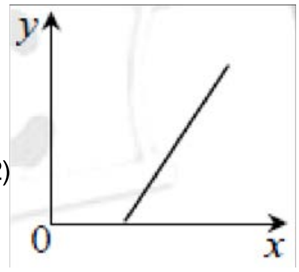
	List-I		**List-II**
A.	value of A	p.	90
B.	value of Z	q.	232
C.	the energy(in MeV) released during the process	r.	1823.2
D.	the binding energy of the parent nucleus(in MeV)	s.	5.3

972. The graphs given apply to a convex lens of focal length *f*, producing a real image at a distance v from the optical centre when self, luminous object is at distance u from the optical centre. The modulus of magnification is *m*. Identify the following graphs (Assume best fit approximation) with the first named quantity being plotted along *y*-axis.

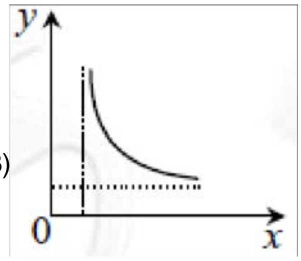
(P) $|v|$ against $|u|$

(1) 

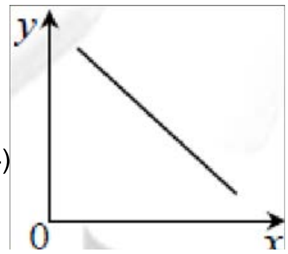
(Q) $\frac{1}{|v|}$ against $\frac{1}{|u|}$

(2) 

(R) m against $|v|$

(3) 

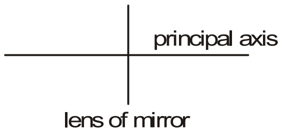
(S) $(m + 1)$ against $\frac{|v|}{f}$

(4) 

973.

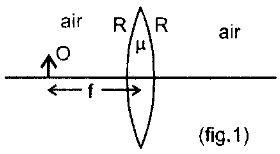
Column-I		**Column-II**	
(A)	In refraction	(p)	Speed of wave does not change
(B)	In reflection	(q)	Wavelength is decreased
(C)	In refraction from rarer to denser medium	(r)	Frequency does not change
(D)	In reflection from a denser medium	(s)	Phase change os π takes place

974. Column - I gives certain situations regarding a point object and its image formed by an optical instrument. The possible optical instruments are concave and convex mirrors or lenses as given in Column - II . Same side of principal axis means both image and object should either be above the principal axis or both should be below the principal axis a shown in figure. Same side of optical instrument means both image and object should be either left of the optical instrument or both should be on right of optical instrument or both should be on right of the optical instrument as shown in figure. Match the statements in column - I with corresponding statements in column - II



	Column I	Column II
(A)	If point object and its image are on same side of principal axis and opposite sides of the optical instrument then the optical instrument is	(p) Concave mirror
(B)	If point object and its image are on opposite side of principal axis and same sides of the side of principal axis and same sides of the optical instrument then the optical instrument is	(q) Convex mirror
(C)	If point object and its image are on same side of principal axis and same sides of the optical instrument then the optical instrument is	(r) Concave lens
(D)	If point object and its image are on opposite side of principal axis and apposite sides of the optical instrument then the optical instrument is	(s) Convex lens

975. An object O (real) is placed at focus of an equi-biconvex lens as shown in figure 1. The refractive index is $\mu = 1.5$ and the radius of curvature of either surface of lens is R. The lens is surrounded by air. In each statement of column - 1 some changes are made to situation given above and information regarding final image of column - 1. Match the statements in column 1 with resulting image in column- II

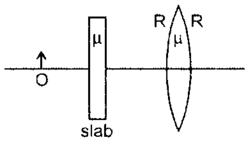


Column - I

(A) If the refractive index of the lens is doubled (that is, made 2μ) then

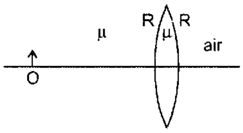
(B) If the radius of curvature is doubled (that is, made 2R) then

(C) If a glass slab of refractive index $\mu = 1.5$



(D) If the left side of lens is filled with a medium

of refractive index m = 1.5 as shown, then



Column - II

(p) final image is real

(q) final image is virtual

(r) final image becomes smaller in size in comparison to size of image before the change was made

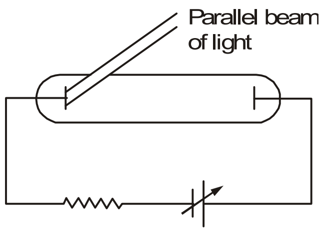
(s) final image is of same size of object.

(t) final image is of large size of object

976 An object O is kept perpendicular to the principal axis of a spherical mirror. Each situation (A, B, C, and D) gives object coordinate u in centimeters with sign the type of mirror, and then the distance (centimeters, without sign) between the focal point and the pole of the mirror, On the right side information regarding the image is given. Correctly match the situations on the left side with the images described on the right side.

Situation	**u**	**Mirror**	**Image**
A	–18	Concave, 12	(P) Real, Errect, Enlarged
B	–12	Concave, 18	(Q) Virtual, Errect, Diminished
C	–8	Convex, 10	(R) Real Inverted, Enlarged
D	–10	Convex, 8	(S) Virtual, Erract, Enlarged

977. In the shown experimental setup to study photoelectric effect, two conducting electrodes arcenclosed in an evacuated glass-tube as shown. A parallel beam of monochromatic light, falls on photosensitive electrodes. The emf of battery shown is high enough such that all photoelectrons ejected from left electrode will reach the right electrode. Under initial conditions photoelectrons are emitted. As changes are made in each situation of column I ; Match the statements in column I with with results in column II.

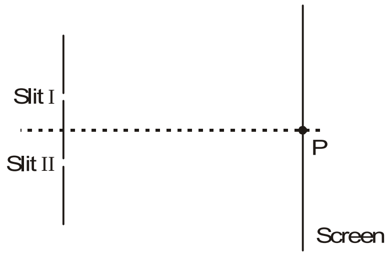


	Column I		**Column II**
(A)	If frequency of incident light is increased keeping number of photons per second constant	(p)	magnitude of stopping potential will increase
(B)	If frequency of incident light is increased and number of photons per second is decreased	(q)	current through circuit may stop
(C)	If work function of photo sensitive electrode is increased	(r)	maximum kinetic energy of ejected photoelectrons will increase
(D)	If number of photons per second of incident light is increased keeping its frequency constant	(s)	saturation current will increase
		(t)	saturation current will decrease

978. In column-I, consider each process just before and just after it occurs. Initial system is isolated from all other bodies. Consider all product particles (even those having rest mass zero) in the system. Match the system in colum in column-I with the result they produce in column-II.

	Column-I		**Column - II**
(A)	Spontaneous radioactive decay of an uranium nucleus initially at rest as given by reaction ${}^{238}_{92}U \rightarrow {}^{234}_{90}Th + {}^{4}_{2}He + ...$	(p)	Number of protons is increased
(B)	Frsion reaction of two hydrogen nuclei as given by reaction ${}^{1}_{1}H + {}^{1}_{1}U \rightarrow {}^{2}_{1}H...$	(q)	Momentum is conserved
(C)	Fission of U^{235} nucleus initiated by a thermal neutron as given by reaction ${}^{1}_{0}n + {}^{235}_{92}U \rightarrow {}^{144}_{56}Ba + {}^{89}_{36}Kr + 3\,{}^{1}_{0}n + ...$	(r)	Mass is converted to energy or vice versa
(D)	β–decay (negative beta decay)	(s)	Charge is conserved

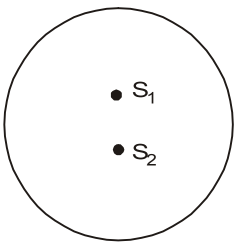
979. A double slit interference pattern is produced on a screen as shown in the figure, using monochromatic light of wavelength 500nm. Point P is the location of the central bright fringe, that is produced when light waves arrive in phase without any path difference. A choice of three strips A, B and C of transparent materials with different thicknesses and refractive indices is available, as shown in the table, these are placed over one or both of the slits, singularly or in conjunction, causing the interference pattern to be shifted across the screen from the original pattern. In the column-I, how the strips have been placed, is mentioned whereas in the column-II, order of the fringe at point P on klthe screen that will be produced due to the placement of the strip (s), is shown. Correctly match both the column.



Film	A	B	C
Thickness (in μm)	5	1.5	0.25
Refractive Index	1.5	2.5	2

	Column - I		**Column - II**
(A)	Only strip B is placed over slit-I	(p)	First Bright
(B)	Strip A is placed over slit-I and strip C is placed over slit-II	(q)	Fourth Dark
(C)	Strip A is placed over the slit-I and strip B and strip C are placed over the slit-II in conjunction.	(r)	Fifth Dark
(D)	Strip A and strip C are placed over slit-I (in conjuction) and strip B is placed over sli $\frac{\sqrt{3}}{2}$ t-II.	(s)	Central Bright

980. Two coherent point sources of light having wavelength λ are seperated by a distance d. A circle is drawn in space surrounding both the point sources as shown. The plane of circle contains both the point sources. The distance d between both the sources is given in coulmn - I and the total number of corresponding points of maximum intensity and minimum intensity on the periphery of the shown circle are given in column-II. Match each situation of column-I with the results in column-II.



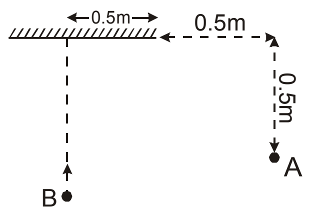
	Column - I	**Column-II**
(A)	d = 99.4 λ	(p) 398 points of maximum intensity
(B)	d = 99.6 λ	(q) 400 points of maximum intensity
(C)	d = 100 λ	(r) 396 points of maximum intensity
(D)	d = 100.4 λ	(s) 400 points of maximum intensity

SECTION : (E) - Integer Type

981. A single electron orbits around a stationary nucleus of charge +Ze, where Z is a constant and *e* is the magnitude of the electronic charge. It requires 47.2 eV to excite the electron from the second Bohr orbit to the third Bohr orbit. Find the value of Z

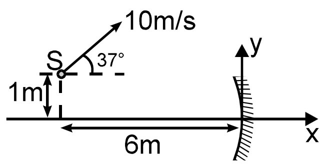
982. In a sample of rock, the ratio of ^{206}Pb to ^{238}U nuclei is found to be 0.5. The age of the rock is $4.5\times10^9\,\dfrac{\ln\frac{X}{Y}}{\ln 2}$ year. The value of X + Y is: (Assume that all the ^{206}Pb in the rock was produced due to the decay of ^{238}U present, when the rock was formed initially and $T_{1/2}(^{238}U) = 4.5\times10^9$ year)

983. A man 'A' stands at the position shown in the figure and a second man 'B' approaches the mirror along the line perpendicular to it which passes through its centre. At what distance (in cm) from the mirror will 'B' be at the moment when 'A' and 'B' first see each other in the mirror.

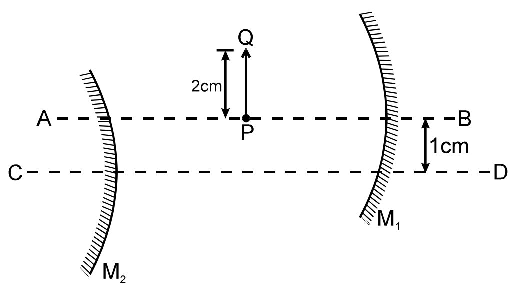


984. A point object is 10 cm away from a plane mirror, while the eye of an observer (pupil diameter 5.0 mm) is 20 cm away. Assuming both the eye and point to be on the same line perpendicular to the mirror, the area of the mirror used in observing the reflection of the point is **π/X cm². The value of X is:**

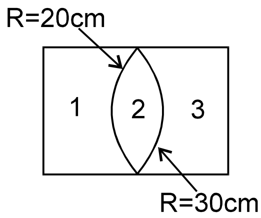
985. A point source S is moving with a speed of 10 m/s in x-y plane as shown in the figure. The radius of curvature of the concave mirror is 4m. The velocity vector of the image formed by paraxial rays is $X\hat{i}+Y\hat{j}$. The value of |X+Y| is:



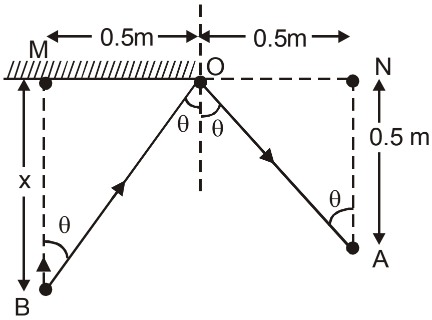
986. In the figure shown M_1 and M_2 are two spherical mirrors of focal length 20 cm each. AB and CD are their principal axes respectively which are separated by 1 cm. PQ is an object of height 2 cm and kept at distance 30 cm from M_1. The separation between the mirrors is 50 cm. Consider two successive reflections first on M_1 then on M_2. Find the size of the 2nd image.



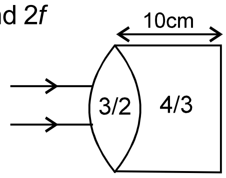
987. $n_1 = n_3 = 3/2$ and $n_2 = 4/3$. The lenses are thin and the whole arrangement is placed in air. The magnitude of focal length (in cm) of the system is __________



988. A neutron is scattered through ($\equiv$ deviation from its old direction) θ degree in an elastic collision with an initially stationary deutron. If the neutron loses $\frac{2}{3}$ of its initial K.E. to the deutron then find the value of θ. (In atomic mass unit, the mass of a neutron is 1u and mass of a deutron is 2u).



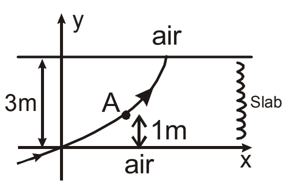
989. A parallel paraxial beam of light is incident on the arrangement as shown. $\mu_A = 3/2$, $\mu_B = 4/3$, the two spherical surfaces are very close and each has a radius of curvature 10 cm. The point where the rays are focussed. is at a distance "*f*" cm from point of entry. Find 2*f*



990. Two plane mirrors are placed with reflecting surfaces parallel and facing to each other. A point object is placed between them at a distance 5cm from first mirror and 3 cm from second mirror. Find the distance (in cm) between the 3rd image behind first mirror and the 3rd image behind the second mirror.

991. An interference pattern is obtained by using a Fresnel's biprism. If the fringe width is 4 mm when air is the surrounding medium, then find the fringe width (in mm) if water is the surrounding medium. Keeping the same source. Assume $n_{glass} = 1.5$, $n_{water} = 4/3$, $n_{air} = 1$.

992. A ray of light travelling in air is incident at grazing angle on a slab of 3m thickness with variable refractive index, $n(y) = [k\,y^{3/2} + 1]^{1/2}$ where $k = 1\ m^{-3/2}$ and follows path as shown. What is the total deviation produced by the slab when the ray is at A (y = 1m), in degrees ?



993. A bomb at rest explodes into three fragments with pieces have masses in the ratio 2 : 3 : 6. It is observed that pieces other than lightest piece fly perpendicular to each other and have same de Broglie wavelengths. If kinetic energy of the heaviest and lightest pieces are k_1 and k_2, what is value of $\frac{k_2}{k_1}$?

994. To generate a power of 3.2 MW, the number of fissions of U^{235} per minute is 6×10^x. The Value of X is:(Energy released per fission = 200 MeV, 1 eV = 1.6×10^{-19} J)

995. If in nuclear reactor using U^{235} as fuel, the power output is 4.8 MW, the number of fissions per second is $1.5K \times 10^Y$(Energy released per fission of U^{235} = 200 MeV watts, e eV = 1.6×10^{-19} J). Value of K + Y:

996. Half-life of a substance is 20 minutes. What is the time(in minutes) between 33% decay and 67% decay?

997. In an experiment to determine e/m using Thomson's method, electrons from the cathode accelerate through a potential difference of 1.5 kV. The beam coming out of the anode enters crossed electric and magnetic field of strengths 2×10^4 V/m and 8.6×10^{-4} T respectively. The value of $\frac{e}{m}$ of electron will be $Y \times 10^{10}$ C/kg. The value of Y is:

998. Power of a convex lens is + 5D (m_g= 1.5). When this lens is immersed in a liquid of refractive index m, it acts like a divergent lens of focal length 100 cm. Then refractive index of the liquid will be 5/X. The value of X is:

999. Eye piece of an astronomical telescope has focal length of 5 cm. If angular magnification in normal adjustment is 10, then distance (in cm) between eye piece and objective should be

1000. An achromatic convergent doublet has power of +2D. If power of convex lens is + 5D, then ratio of the dispersive powers of a convergent and divergent lenses will be X/Y. The value of X + Y is:

END OF MODULE

AnswerKey

Qs.	Ans.	Qs.	Ans.
		951	C
902	A	952	A
903	D	953	D
904	A	954	A
905	C	955	B
906	D	956	C
907	A	957	A
908	C	958	C
909	B	959	D
910	C	960	A
911	C	961	A-(Q),B-(R),C-(P),D-(S)
912	A	962	i-E,ii-D,iii-A,iv-B
913	D	963	A-(P),B-(P),C-(R),D-(R)
914	A	964	A-(PR),B-(QS),C-(QR),D-(PS)
915	D	965	A-(S),B-(P),C-(S),D-(Q)
916	D	966	A-s,B-t,C-p,D-q,E-r
917	ABCD	967	A-(Q),B-(R),C-(P),D-(S)
918	ABD	968	A-(PQ),B-(PQRS),C-(RS),D-(P)
919	ACD	969	A-(P),B-(R),C-(Q),D-(S)
920	AD	970	A-(P),B-(P),C-(Q),D-(Q)
921	ABCD	971	A-(Q),B-(P),C-(S),D-(R)
922	ACD	972	A-(3),B-(4),C-(2),D-(1)
923	AC	973	A-(R),B-([R),C-(QR),D-(PRS)
924	ABCD	974	A-(PQ),B-(PQ),C-(RS),D-(RS)
925	AC	975	A-(PR),B-(QR),C-(QR),D-(QR)
926	AB	976	A-(R),B-(S),C-(Q),D-(Q)
927	ACD	977	A-(PR),B-(PRT),C-(Q),D-(S)
928	AD	978	A-(PRS),B-(QRS),C-(QRS),D-(PQRS)
929	ACD	979	A-(R),B-(R),C-(S),D-(P)
930	ABD	980	A-(PR),B-(PS),C-(QS),D-(S)
931	ABCD	981	5
932	ABCD	982	5
933	BCD	983	50
934	BCD	984	144
935	BCD	985	6
936	AB	986	8
937	BC	987	72
938	AC	988	90
939	B	989	35
940	A	990	48
941	A	991	12
942	A	992	45
943	A	993	6
944	B	994	18
945	A	995	18
946	D	996	20
947	C	997	18
948	C	998	3
949	D	999	55
950	A	1000	8