विध्न विचारत भीरु जन, नहीं आरम्भे काम,
विपति देख छोड़े तुरंत मध्यम मन कर श्याम।
पुरुष सिंह संकल्प कर, सहते विपति अनेक,
'बना' न छोड़े ध्येय को, रघुबर राखे टेक।।

रचितः मानव धर्म प्रणेता
सद्गुरु श्री रणछोड़दासजी महाराज

OPTICS

Some questions (Assertion–Reason type) are given below. Each question contains STATEMENT – 1 (Assertion) and STATEMENT – 2 (Reason). Each question has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct. So select the correct choice :

Choices are :

(A) Statement – 1 is True, Statement – 2 is True; Statement – 2 **is** a correct explanation for Statement – 1.
(B) Statement – 1 is True, Statement – 2 is True; Statement – 2 **is NOT** a correct explanation for Statement – 1.
(C) Statement – 1 is True, Statement – 2 is False.
(D) Statement – 1 is False, Statement – 2 is True.

356. **STATEMENT – 1** Light can show interference.
STATEMENT – 2 Light can show diffraction.

357. **STATEMENT – 1**
For observing traffic at our back, we prefer to use a convex mirror.
STATEMENT – 2
A convex mirror has a more larger field of view than a plane mirror or concave mirror.

358. **STATEMENT – 1**
Spherical aberration is a defect of a spherical mirror, in which not all rays focus at a single point.
STATEMENT – 2
The laws of reflection are not valid for all rays.

359. **STATEMENT – 1**
In passing through a lens or prism, the phase difference between two waves does not change.
STATEMENT – 2
The optical path lengths of all rays are same.

360. **STATEMENT – 1**
A convex lens may be diverging.
STATEMENT – 2
The nature of a lens depends upon the refractive incides of the material of lens and surrounding medium besides geometry.

361. **STATEMENT – 1** The power of a thin lens does not depend upon the surrounding medium.
STATEMENT – 2 Power of a thin lens $= \frac{\mu}{f}$.

362. **STATEMENT – 1**
If white light is used in YDSE, coloured fringes are obtained.
STATEMENT – 2
The fringe width is proportional to the wavelength (color) of light.

363. **STATEMENT – 1**
When a sound wave in air is reflected from a wall, it does not suffer a phase charge.

STATEMENT – 2
For sound waves, air is denser as compare to wall.

364. **STATEMENT – 1**
The two slits in YDSE are illuminated by two different sodium lamps emitting light of same wavelength. No interference pattern will be observed.

STATEMENT – 2
Two independent light sources (except LASER) cannot be coherent.

365. **STATEMENT – 1** A virtual image can be photographed.

STATEMENT – 2 Only a real image can be formed on a screen.

366. **STATEMENT – 1**
The focal length of a lens does not depend on the medium in which it is submerged.

STATEMENT – 2
$\frac{1}{f} = \frac{\mu_2 - \mu_1}{\mu_1}\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$.

367. **STATEMENT – 1**
The minimum slit separation d for interference to produce at least one maximum other than central maximum in YDSE is 3λ.

STATEMENT – 2
For a maximum, path difference = $n\lambda$. The maximum value of path difference = d, slit separation.

368. **STATEMENT – 1**
In calculating the disturbance produced by a pair of superimposed incoherent wave trains, you can add their intensities.

STATEMENT – 2
$I_1 + I_2 + 2\sqrt{I_1 I_2}\cos\delta$. The average value of $\cos\delta = 0$ for incoherent waves.

369. **STATEMENT – 1**
A single lens cannot be free from chromatic aberration.

STATEMENT – 2
When light passes through single lens dispersion must occur.

370. **STATEMENT – 1**
Superposition takes place only between those waves emitted by coherent sources.

STATEMENT – 2
All coherent sources emit energy in proper order.

371. **STATEMENT – 1**
When a glass prism is immersed in water, the deviation caused by prism decreases.

STATEMENT – 2
Refractive index of glass prism relative to water is less than relative to air.

372. **STATEMENT – 1**
An air bubble in water shines.

STATEMENT – 2
When light is incident from water to air, total internal reflection takes place at outer surface of bubble.

373. **STATEMENT – 1**
Thin films such as soap bubble or thin layer of oil spread on water show beautiful colors when illuminated by white light.

STATEMENT – 2
It is due to interference of Sun's light reflected from upper and lower surfaces of the film.

374. **STATEMENT – 1**
In YDSE central fringe is always a bright fringe.

STATEMENT – 2
If path difference at central fringe is zero then it will be a bright fringe.

375. **STATEMENT – 1**
When white light passes through a prism, deviation of violet light is more than green light.

STATEMENT – 2
In a prism average deviation is measured as deviation of yellow light.

376. **STATEMENT – 1**
A real object is kept on principle axis of mirror. Size of image measured is equal to size of object. The mirror must be plane mirror.

STATEMENT – 2
For a plane mirror magnification is unity.

377. **STATEMENT – 1 :** Different colours travel with different speed in vacuum

STATEMENT – 2 : Wavelength of light depends on refractive index of medium.

378. **STATEMENT – 1 :** We can not produce a real image by plane or convex mirrors under any circumstances.

STATEMENT – 2 : The focal length of a convex mirror is always taken as positive.

379. **STATEMENT – 1 :** A fish inside a pond will see a person standing outside taller than he is actually.

STATEMENT – 2 : Light bend away from the normal as it enters water from air.

380. **STATEMENT – 1 :** Hollow prism forms no spectra as a solid equilateral prism of glass.

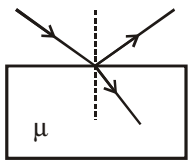
STATEMENT – 2 : Neglecting the thickness of hollow glass surface. The media is same. So dispersion is not to take place.

381. **STATEMENT – 1 :** In Young's double slit experiment if whole set up is immersed in a liquid then fringe width is decreased.

STATEMENT – 2 : Wavelength of light entering in a liquid increases.

382. **STATEMENT – 1 :** A light ray is incident on a glass slab. Some portion of it is reflected and some is refracted. Refracted and reflected rays are always perpendicular to each other.

STATEMENT – 2 : Angle of incidence is equal to angle of reflection.



383. **STATEMENT – 1 :** The critical angle in case of total internal reflection depends on the pair of medium chosen.

STATEMENT – 2 : The critical angle in case of total internal reflection is independent of pair of medium chosen.

384. **STATEMENT – 1 :** If we increase the separation, between slits, then angular fringe width decreases.

STATEMENT – 2 : Angular fringe width increases by increasing slit separation.

385. **STATEMENT – 1 :** A concave mirror has f = 40 cm in air. It has f = 30 cm in water.

STATEMENT – 2 : Focal length of mirror is independent of medium.

386. **STATEMENT – 1 :**Air bubble in glass medium behaves as concave lens.

STATEMENT – 2 : Lens formula is $\frac{1}{f}=\left(\frac{\mu_{lens}}{\mu_{med}}-1\right)\left[\frac{1}{R_1}-\frac{1}{R_2}\right]$.

387. **STATEMENT – 1 :** Interference phenomena is based upon conservation of energy principle.

STATEMENT – 2 : All the bright fringes are of the same intensity in YDSE.

388. **STATEMENT – 1 :** Angular width of central maximum in YDSE is independent of D i.e., distance between source and screen.

STATEMENT – 2 : Fringe width of central maximum is double of the first maxima on the screen.

389. **STATEMENT – 1 :** In Young's double slit experiment interference pattern disappears when one of the slits is closed.

STATEMENT – 2 : Interference occurs due to superimposition of light wave from two coherent sources.

390. **STATEMENT – 1 :** Power of a lens depends on nature of material of lens, medium in which it is placed and radii of curvature of its surface.

STATEMENT – 2 : It follows the relation

$$p=\frac{1}{f}=\left(\frac{\mu_2}{\mu_1}-1\right)\left[\frac{1}{R_1}-\frac{1}{R_2}\right]$$

391. **STATEMENT – 1 :** Law of reflection is applicable for all type of mirrors.

STATEMENT – 2 : Rays which are parallel to principle axis are known as paraxial rays.

392. **STATEMENT – 1 :** In Young's double slit experiment if intensity of each source is I_0 these minimum and maximum intensity is zero and $4I_0$ respectively.

STATEMENT – 2 : In Young's double slit experiment energy conservation is not followed.

393. **STATEMENT – 1 :** Image formed by a convex mirror is always smaller in size.

STATEMENT – 2 : It is always virtual.

394. **STATEMENT – 1 :** Fringe width depends upon refractive index of the medium.

STATEMENT– 2 : Refractive index changes optical path of ray of light forming fringe pattern.

395 **STATEMENT – 1 :** The images formed by total internal reflections are much brighter than those formed by mirrors or lenses.

STATEMENT – 2 : There is no loss of intensity in total internal reflection.

396. **STATEMENT – 1 :** In Young's experiment, the fringe width for dark fringes is same as that of the white fringes.

STATEMENT – 2 : In Young's double slit experiment the fringes are performed with a source of white light, then only black and bright fringes are observed.

397. **STATEMENT – 1 :** The focal length of lens does not change when red light is replaced by blue light.

STATEMENT – 2 : The focal length of lens depends on the colour of light used.

398. **STATEMENT – 1 :** A convex lens of focal length f(μ = 1.5) behaves as a diverging lens when immersed in carbon di-sulphide of higher refractive index (μ = 1.65).

STATEMENT – 2 : The focal length of lens does not depend on the colour of light used.

399. **STATEMENT – 1 :** When a light wave travels from a rarer to a denser medium, it loses speed. The reduction in speed implies a reduction in energy carried by the light wave.

STATEMENT – 2 : The energy of a wave is proportional to wave frequency.

400. **STATEMENT – 1 :** In interference all the fringes are of same width.

STATEMENT – 2 : In interference , fringe width is independent of position of fringe.

Hint & Solution

356.	(B)						
357.	(A)	358.	(C)	359.	(C)	360.	(A)
361.	(D)	362.	(D)	363.	(A)	364.	(A)
365.	(B)	366.	(D)	367.	(D)	368.	(A)
369.	(A)	370.	D	371.	(A)	372.	(A)
373.	(A)	374.	(D)	375.	(B)	376.	(D)
377.	(D)	378.	(D)	379.	(C)	380.	(A)
381.	(C)	382.	(D)	383.	(C)	384.	(C)
385.	(D)	386.	(A)	387.	(C)	388.	(C)
389.	(A)	390.	(A)	391.	(C)	392.	(C)
393.	(B)	394.	(B)	395.	(A)	396.	(C)
397.	(D)	398.	(B)	399.	(D)	400.	(A)

356. Conceptual.

357. The nature of the image formed due to a convex mirror does not change with changing distance of the object. It is always virtual, error and smaller.

363. Since reflection is at a boundary the other side of which is rarer.
$\therefore$ no phase change.

365. The rays of light are diverging out from a virtual image. These can be easily converged onto the film of a concave lens by convergent action of its lens.

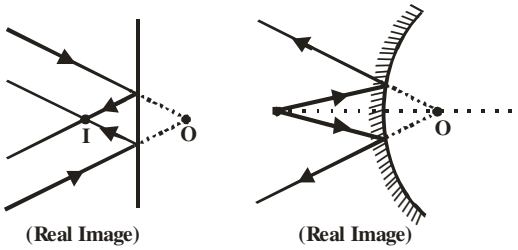
366. As can be seen from the expression of f, it depends upon the refractive index of the medium in which the lens is submerged.

367. $\Delta x = d = n\lambda$
For $n = 1$, $d = \lambda$ and we will have three maximum.

368. Average value of $\cos\delta = t = \dfrac{\int_{t}^{t=T}\cos(\phi_1-\phi_2)dt}{T} = 0$. Here ϕ_1 and ϕ_2 are constantly randomly, fluctuating phases of the two wave trains and integral is taken over a long time (relative to periods of the individual waves).

377. The velocity of light of different colours (all wavelength) is same in vacuum and $\mu \propto \dfrac{1}{\lambda}$.

378. We can produce a real image by plane or convex mirror.



(Real Image) (Real Image)

Focal length of convex mirror is taken positive

379. Since light bends towards normal on entering water from air.

381. $\beta' = \dfrac{\lambda_n D}{d}$

$\lambda_m = \dfrac{\lambda_{air}}{\mu} \Rightarrow \quad \beta' = \dfrac{\lambda_{air} D}{d\,\mu}$; $\beta' = \dfrac{\beta}{\mu}$.

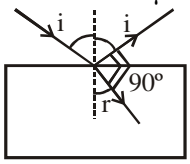
382. $1 \times \sin i = \mu \sin r$

$= \mu \sin (90 - i)$

$\sin i = \mu \cos i$

$\Rightarrow \quad \tan i = \mu$

So reflected and reflected rays are perpendicular if $\tan i = \mu$.



383. $\theta_C = \sin^{-1}(1/\mu)$.

and μ is taken relative, hence it depends on pair of medium chosen.

384. Angular fringe width is inversely proportional to separation both slits.

386. For air bubble glass medium is denser and $\dfrac{\mu_i}{\mu_{glass}} = \dfrac{1}{\left(\frac{3}{2}\right)}$ is < 1 value.

388. Angular width $\theta = \dfrac{\text{fringe width}}{D}$

$\theta = \dfrac{\lambda}{d}$.

389. When one of the slits is closed, there appears general illumination from a single source. Interference does not take place.

390. Both statement I and statement II are true and correct explanation.

391. Rays which are near and parallel to principal axis are known as paraxial rays.

392. In Young's double slit experiment energy remains conserved.

394. Wavelength in a medium of refractive index μ

$\lambda' = \dfrac{\lambda}{\mu}$ where λ is wavelength in air.

Fringe width $\omega = \dfrac{\lambda D}{d}$.

395. 100% of incident light is reflected back into the same medium, and there is no loss of intensity, while in reflection from mirrors and refraction from lenses, there is always some loss of intensity. Therefore, images formed by total internal reflection are much brighter than those formed by mirrors or lenses.

396. In Young's experiments fringe width for dark and white fringes are same while in Young's double slit experiment when a white light as a source is used the central fringe is bright around which few colored fringes are observed on either side.

397. The focal length of a Lens is given by formula $\frac{1}{f}=(\mu-1)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$.

As $\mu_b>\mu_R \ \therefore f_b<f_r$

Therefore focal length of lense decreases when red light is replaced by blue light.

398. Since $\mu=\frac{\mu_g}{\mu_{cs}}=\frac{1.5}{1.65}\angle 1$

From $\frac{1}{f}=(\mu-1)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)\Rightarrow f<0$

Therefore the lens behaves as a diverging lens.
Hence (B) is correct option.

399. When a light wave travels from a rarer to a denser medium it loses speed, but energy carried by the wave does not depend on its speed.

400. As given in the expression fringe width $\beta=\frac{\lambda D}{d}$, fringe width β is independent of 'n' (position).