Zagazig University
Faculty of Science
Physics Department
First Semester 2025/2026
Final Exam.

Geometrical Optics (Phys. 103)
First year
Date: 31 / 12 / 2025
Time: 120 min.
Marks: 60

Answer All the Questions

MULTI CHOICE QUESTIONS (35 point):

1.	**The absolute refractive index of the oil is defined as the ratio of the velocity of light in ..... to the velocity of light in .....**	
	a) glass – vacuum.	b) oil – vacuum.
	c) vacuum – oil.	vacuum – glass.
2.	**Light travels from air to a medium of refractive index μ. If the angle of incidence is twice the angle of refraction, then the angle of incidence will be .....** [sin(2x) = 2sin(x)cos(x)]	
	a) $2\sin^{-1}(\frac{\mu}{2})$	b) $\sin^{-1}(\frac{\mu}{2})$
	$2\cos^{-1}(\frac{\mu}{2})$	d) $\cos^{-1}(\frac{\mu}{2})$
3.	**For all transparent material substances, the absolute refractive index is**	
	Greater than 1 .	b) Less than 1.
	c) Equal to 1 .	d) None of the previous answer.
4.	**Assume that a convex lens has a focal length of +20 cm. The optical power of the lens for an object placed at a distance of 5 cm is,**	
	a) 4 D	5 D
	c) 20 D	d) 10 D
5.	**A beam of light travels from a medium of higher optical density to a medium of lower optical density. If the angles of incidence, reflection, and refraction are θ_1, θ_2, and θ_3, respectively, then**	
	$\theta_1 = \theta_2$.	b) $\theta_1 = \theta_3$.
	c) $\theta_1 - \theta_2$.	d) $\theta_2 = \theta_3$.
6.	**Mirrors form images by ..... of light into their smooth, reflective surfaces.**	
	a) diffraction	refraction
	c) reflection	d) None of the previous answers
7.	**If the angle between two mirrors is 90° , the reflected beam returns to the source parallel to its original path. This phenomenon is called**	
	Retroreflection.	b) Specular reflection.
	c) Diffuse reflection.	d) None of the previous answers.
8.	**When an object is placed in between the center of curvature and the focus of a concave mirror, the image magnification is .....**	
	a) equal to 1 .	b) smaller than 1 .
	c) tends to zero .	larger than 1 .
9.	**A ray of light travels from a rarer medium to a denser medium. If the angle of incidence is zero, the angle of refraction will be .....**	
	equal to the angle of incidence.	b) equal to the angle of reflection.
	both a) and b) are correct.	d) None of the previous answers.
10.	**Light travels from a rarer medium 1 to a denser medium 2. The angles of incidence and refraction are respectively 45° and 30°. Calculate the refractive index of the first medium with respect to the second medium.**	
	a) $\sqrt{2}/3$	b) $3/\sqrt{2}$
	c) $1/\sqrt{2}$	d) $\sqrt{3}/2$

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11.	A light ray travels from an optically rarer medium to an optically denser one, if the angle of incidence and refraction at the point of incidence are θ_1 and θ_2 respectively, the angle of deviation in terms of θ_1 and θ_2 is	
	a) $\theta_1 = \theta_2$.	b) $\theta_1 - \theta_2$.
	c) $\theta_1 + \theta_2$.	d) $\theta_2 - \theta_1$.
12.	The wavelength ratio of medium 1 to medium 2 is equivalent to the ratio of the speed of light in ..... to	
	a) medium - vacuum.	b) medium 1 - medium 2.
	c) vacuum - medium.	d) medium 2 - medium 1.
13.	If the reflecting surface is smooth, the incident rays will be:	
	a) Refracted in various directions.	b) Reflected in various directions.
	Reflected parallel to each other.	d) Refracted parallel to each other.
14.	The speed of light in media M_1 and M_2 is $1.8*10^8$ and $2.4*10^8$, respectively. and the light ray enters from M_1 to M_2 at an incidence angle 0. If the ray suffers total internal reflection, the value of the critical angle will be	
	$= \sin^{-1}(\frac{3}{4})$	b) $> \sin^{-1}(\frac{4}{3})$
	c) $> \sin^{-1}(\frac{3}{4})$	d) $< \sin^{-1}(\frac{3}{4})$
15.	An object located at infinity from a biconvex lens forms an image at	
	a) the focal point of the mirror.	the focal point of the lens.
	c) greater than the focal point of the mirror.	d) greater than the focal point of the lens.
16.	A ray of light travels from a rarer medium to a denser medium. If the angle of incidence is 50°, the angle of reflection will be	
	a) greater than 50°.	b) less than 50° .
	equal to 50° .	d) none of the previous answers.
17.	If an object is placed in front of a converging lens at a distance less than f_1, the image produced by the lens will be:	
	Virtual, erect and magnified.	b) Real, inverted and magnified.
	c) Virtual, inverted and magnified.	d) Real, inverted and diminished.
18.	The equation $f = \frac{p+q}{q*p}$ is called:	
	a) Thin lens equation.	b) Mirror equation.
	both a) and b) are correct.	d) None of the previous answer.
19.	A monochromatic ray of light passes from air to glass. The wavelength of light in air is λ, the speed of light in air is c, and in glass it is v. If the refractive index of glass is 1.5, the wavelength of light in glass is	
	a) $\lambda/0.5$	$\lambda/1.5$
	c) $1.5/\lambda$	d) None of the previous answers
20.	If you have a spherical mirror that has a radius of curvature of 30 cm. The image position for an object located at a distance of 15 cm from the mirror will be at	
	a) Zero.	b) +30 cm.
	Infinity.	d) +15 cm.
21.	A short-sighted person sees the far objects distorted as their images are formed	
	a) on the retina.	b) behind the retina
	in front of the retina.	d) in front of the lens

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22.	A person with normal vision sees nearby objects clearly at a minimum distance of about	
	a) 25 cm.	b) 20 cm.
	c) 10 cm	d) 5 cm.
23.	Far-sightedness person is the person who	
	a) sees the near objects clearly.	b) sees the far and near objects unclearly.
	c) sees the far and near objects clearly.	d) sees the far objects clearly.
24.	A biconvex thin spherical lens has radii of 100 cm and 25 cm. The lens is made of glass with an index of 1.5 and is immersed in air. The focal length of the lens is	
	a) 37.5 cm	b) 62.5 cm
	c) 40 cm	50 cm
25.	The characteristics of biconvex lens are:	
	a) Thick in the middle.	b) Thinn at the edges.
	c) A converging lens.	All of the previous answer.
26.	Suppose a convex lens formed an image of an object located at infinity. The magnification of the image will be	
	a) greater than 1.	tends to 0.
	c) less than 1.	d) tends to infinity.
27.	The lens maker's equation can be written as:	
	$f = \frac{1}{(n-1)}\left(\frac{R_2 - R_1}{R_1 R_2}\right)$	$f = (n-1)\left(\frac{R_2 - R_1}{R_1 R_2}\right)$
	c) $f = \frac{1}{(n-1)}\left(\frac{R_1 R_2}{R_2 - R_1}\right)$	d) $f = (n-1)\left(\frac{R_1 R_2}{R_2 - R_1}\right)$
28.	When monochromatic light passes through a prism, it is refracted and emerges from the prism	
	as a single ray.	b) as seven spectra.
	c) both a) and b) are correct.	d) none of the previous answer.
29.	The principle on which the optical fiber is based is the	
	a) Total internal refraction.	b) Total internal reflection.
	Total external refraction.	d) None of the previous answers.
30.	A light ray of frequency 900 THz traveling through air is incident into a smooth, flat slab of glass at an angle of 30° to the normal. The frequency of this light in the glass will be: ($n_1 = 1$ for air and $n_2 = 1.5$ for glass)	
	900 THz.	b) 600 THz
	c) 30 THz.	d) 1350 THz.
31.	The power of a pane of window glass is equal to	
	a) Infinity.	b) The thickness of the glass.
	c) Zero.	Impossible to determine.
32.	The image formed by a plane mirror is always	
	a) Real and erect.	b) Real and inverted.
	virtual and erect.	d) virtual and inverted.
33.	If light travels in a medium of refractive index 1.4 through a distance of 200 m in a given time interval, then how much distance will it cover in a medium of refractive index 1.75 during this period?	
	160 m	b) 200 m
	c) 490 m	d) 250 m

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34.	A ..... is used to correct the short-sightedness.	
	a) convex lens	b) convex mirror
	c) concave mirror	d) concave lens
35.	A ..... is used to correct the long-sightedness.	
	a) convex lens	b) convex mirror
	c) concave mirror	d) concave lens

TRUE OR FALSE STATEMENTS (14 point):

1.	Both lenses and mirrors suffer spherical and chromatic aberrations.	( )
2.	If half of a convex lens is covered, its focal length will increase.	( )
3.	Objects viewed underwater with the eye appear blurred and out of focus.	( )
4.	If a converging mirror is placed in oil, its focal length will change.	( )
5.	Convex lens of short focal length causes more bending of light rays passing through it than a convex lens of long focal length.	( )

Essay Part:

Q_1: Prove that the image distance (q) equals the object distance (p) for a plane mirror.

Q_2: Discuss the six ray diagrams for the converging lens.

Q3: Give a detailed explanation of the total internal reflection.

With my best regards

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