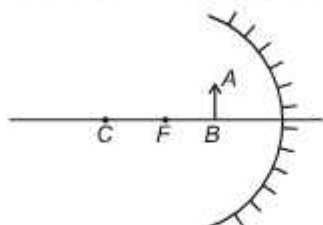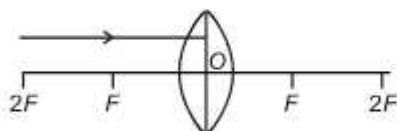# PHYSICS

1 : Light : Reflection and Refraction

1. Draw the following diagram in your answer-book and show the formation of image of the object, AB with the help of suitable rays. **[2008] ...[1M]**

2. Draw the given diagram in your answer book and complete it for the path of ray of light beyond the lens. **[2009] ...[1M]**

3. Why does a ray of light bend when it travels from one medium into another? **[2009] ...[1M]**

4. Explain why a ray of light passing through the centre of curvature of a concave mirror gets reflected along the same path. **[2010] ...[1M]**

5. What is the nature of the image formed by a concave mirror if the magnification produced by the mirror is +3? **[2010] ...[1M]**

6. For a ray of light passing through a glass slab, the lateral displacement was correctly measured as : **[2011] ...[1M]**
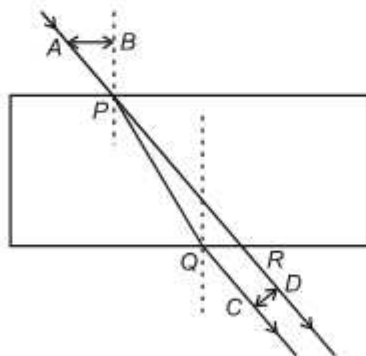
   (a) AB
   (b) PQ
   (c) CD
   (d) PR

7. To find the focal length of a concave mirror, Sita should choose which one of the following?
   [2011] ...[1M]
   (a) A mirror holder and screen holder
   (b) A screen holder and a scale
   (c) A mirror holder, a screen holder and a scale
   (d) A screen, a mirror, holders for them and a scale

8. By using a convex lens, a student obtained a sharp image of his classroom window grill on a screen. In which direction should he move the lens to focus a distant tree instead of the grill?
   [2011, 2016, 2017] ...[1M]
   (a) Towards the screen
   (b) Away from the screen
   (c) Very far away from the screen
   (d) Behind the screen

9. To determine the focal length of a convex lens by obtaining a sharp image of a distant object, the following steps were suggested which are not in proper sequence. **[2011, 2012] ...[1M]**

   I. Hold the lens between the object and the screen.

   II. Adjust the position of the lens to form a sharp image.

   III. Select a suitable distant object.

   IV. Measure the distance between the lens and the screen.

   The correct sequence of steps to determine the focal length of the lens is

   (a) III, I, II, IV
   (b) III, I, IV, II
   (c) III, IV, II, I
   (d) I, II, III, IV

10. While tracing the path of a ray of light passing through a rectangular glass slab a student tabulated his observations as given below:

Sr. No.	$\angle i$	$\angle r$	$\angle e$
I	60°	40°	61°
II	50°	36°	51°
III	40°	28°	39°
IV	30°	20°	31°

The **correct** observation is [2012, 2013] ...[1M]

(a) I   (b) II

(c) III   (d) IV

11. A student traces the path of a ray of white light through a rectangular glass slab and marks the angles of incidence ($\angle i$), refraction ($\angle r$) and emergence ($\angle e$) as shown.

[2012, 2014] ...[1M]
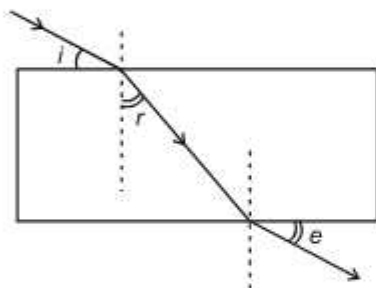
Which angle or angles have not been marked correctly?

(a) $\angle i$ only

(b) $\angle i$ and $\angle r$

(c) $\angle r$ and $\angle e$

(d) $\angle i$ and $\angle e$

12. A student obtained a sharp image of the grills of a window on a screen using a concave mirror. His teacher remarked that for getting better results a well lit distant object (preferably the Sun) should be focused on the screen. What should be done for this purpose?

[2012, 2013] ...[1M]

(a) Move the screen and the mirror towards the object

(b) Move the screen and the mirror away from the object

(c) Move the screen slightly away from the mirror

(d) Move the mirror slightly towards the screen

13. To determine focal length of a concave mirror a student obtains the image of a well lit distant object on a screen. To determine the focal length of the given concave mirror he needs to measure the distance between the

[2012]...[1M]

(a) Cannot be determined

(b) Screen and the object

(c) Mirror and the object

(d) Mirror and the screen

14. A student focussed the image of a distant object using a device 'X' on a white screen 'S' as shown in the figure. If the distance of the screen from the device is 40 cm, select the correct statement about the device.

[2013, 2014, 2015, 2017] ...[1M]
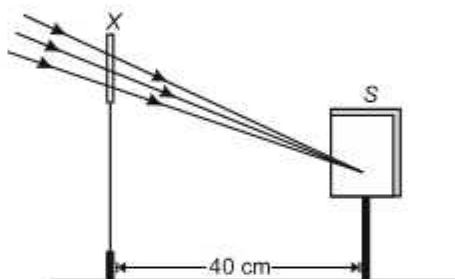
(a) The device X is a convex lens of focal length 20 cm

(b) The device X is a concave mirror of focal length 40 cm

(c) The device X is a convex mirror of radius of curvature 40 cm

(d) The device X is a convex lens of focal length 40 cm.

15. Study the following ray diagrams : [2013] ...[1M]

I.

II.

III.

IV.
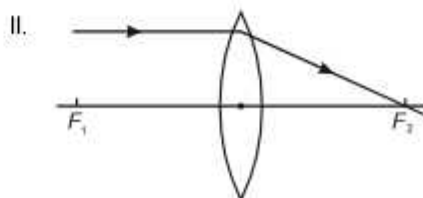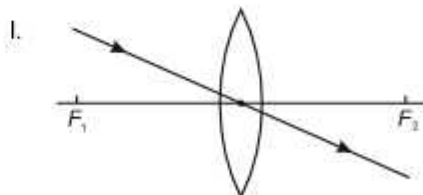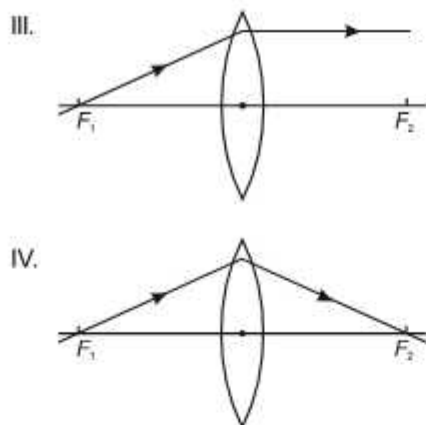
The diagrams showing the correct path of the ray after passing through the lens are :

(a) II and III only

(b) I and II only

(c) I, II and III

(d) I, II and IV

16. Out of the five incident rays shown in the figure find the three rays which are obeying the laws of refraction and may be used for locating the position of the image formed by a convex lens:

[2013, 2014] ...[1M]
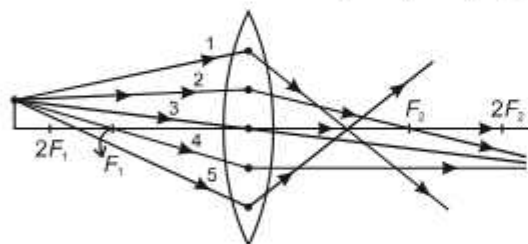
(a) 1, 2 and 3

(b) 2, 3 and 4

(c) 3, 4 and 5

(d) 1, 2 and 4

17. Select from the following the best set-up for tracing the path of a ray of light through a rectangular glass slab: [2013] ...[1M]

I.

II.

III.

IV.
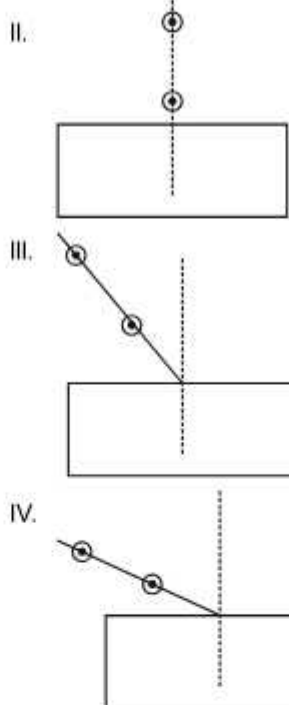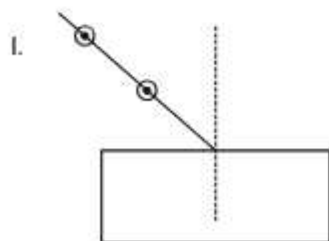
(a) I

(b) II

(c) III

(d) IV

18. In an experiment to trace the path of a ray of light through a glass prism for different values of angle of incidence a student would find that the emergent ray : [2013] ...[1M]

(a) Is parallel to the incident ray

(b) Perpendicular to the incident ray

(c) Is parallel to the refracted ray

(d) Bends at an angle to the direction of the incident ray

19. A student has obtained an image of a well-illuminated distant object on a screen to determine the focal length, F_1 of the given spherical mirror. The teacher then gave him another mirror of focal length, F_2 and asked him to obtain a focussed image of the same object on the same screen. The student found that in order to focus the same object using the second mirror, he has to move the mirror away from the screen. From this observation, it may be concluded that both the spherical mirrors given to the student were (select the correct option)

[2014] ...[1M]

(a) Concave and $F_1 < F_2$

(b) Concave and $F_1 > F_2$

(c) Convex and $F_1 < F_2$

(d) Convex and $F_1 > F_2$

20. A student is using a convex lens of focal length 10 cm to study the image formation by a convex lens for the various positions of the object. In one of his observations, he may observe that when the object is placed at a distance of 20 cm from the lens, its image is formed at (select the correct option) **[2014] ...[1M]**

(a) 20 cm on the other side of the lens and is of the same size, real and erect.

(b) 40 cm on the other side of the lens and is magnified, real and inverted.

(c) 20 cm on the other side of the lens and is of the same size, real and inverted.

(d) 20 cm on the other side of the lens and is of the same size, virtual and erect.

21. Draw a ray diagram to show the path of the reflected ray corresponding to an incident ray of light parallel to the principal axis of a convex mirror and show the angle of incidence and angle of reflection on it. **[2015] ...[1M]**

22. A student traces the path of a ray of light through a rectangular glass slab for the different values of angle of incidence. He observes all possible precautions at each step of the experiment. At the end of the experiment, on analyzing the measurements, which of the following conclusions is he likely to draw? **[2015] ...[1M]**

(a) $\angle i = \angle e < \angle r$

(b) $\angle i - \angle e < \angle r$

(c) $\angle i > \angle e > \angle r$

(d) $\angle i = \angle e > \angle r$

23. A student obtains a sharp image of the distant window (W) of the school laboratory on the screen (S) using the given concave mirror (M) to determine its focal length. Which of the following distances should he measure to get the focal length of the mirror? **[2015] ...[1M]**
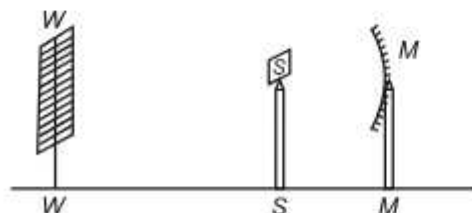
(a) MW

(b) MS

(c) SW

(d) MW − MS

24. A 4 cm tall object is placed on the principal axis of a convex lens. The distance of the object from the optical centre of the lens is 12 cm and its sharp image is formed at a distance of 24 cm from it on a screen on the other side of the lens. If the object is now moved a little away from the lens, in which way (towards the lens or away from the lens) will he have to move the screen to get a sharp image of the object on it again?

How will the magnification of the image be affected? **[2015] ...[1M]**

25. To determine the approximate value of the focal length of a given concave mirror, you focus the image of a distant object formed by the mirror on a screen. The image obtained on the screen, as compared to the object is always. **[2016] ...[1M]**

(a) Laterally inverted and diminished

(b) Inverted and diminished

(c) Erect and diminished

(d) Erect and highly diminished

26. In your laboratory you trace the path of light rays through a glass slab for different values of angle of incidence ($\angle i$) and in each case measure the values of the corresponding angle of refraction ($\angle r$) and angle of emergence ($\angle e$). On the basis of your observations your correct conclusion is **[2016] ...[1M]**

(a) $\angle i$ is more than $\angle r$, but nearly equal to $\angle e$

(b) $\angle i$ is less than $\angle r$, but nearly equal to $\angle e$

(c) $\angle i$ is more than $\angle e$, but nearly equal to $\angle r$

(d) $\angle i$ is less than $\angle e$, but nearly equal to $\angle r$

27. An object is placed at a distance of 15 cm from a concave lens of focal length 30 cm. List four characteristic (nature, position, etc.) of the image formed by the lens. **[2017] ...[1M]**

28. The laws of reflection hold true for : **[2020] ...[1M]**

(a) Plane mirrors only

(b) Concave mirrors only

(c) Convex mirrors only

(d) All reflecting surfaces

29. When an object is kept within the focus of a concave mirror, an enlarged image is formed behind the mirror. This image is **[2020] ...[1M]**

(a) Real

(b) Inverted

(c) Virtual and inverted

(d) Virtual and erect

30. In which of the following is a concave mirror used? **[2021] ...[1M]**

    (a) A solar cooker

    (b) A rear view mirror in vehicles

    (c) A safety mirror in shopping malls

   (d) In viewing full size image of distant tall buildings

31. A student wants to obtain magnified image of an object AB as on a screen. Which one of the following arrangements shows the correct position of AB for him/her to be successful?

    [2021] ...[1M]

    (a)

    (b)

    (c)

    (d)
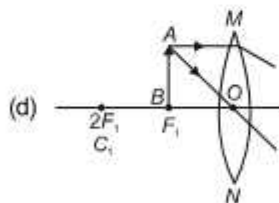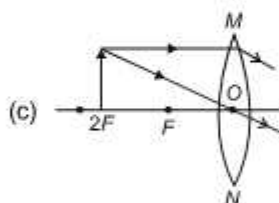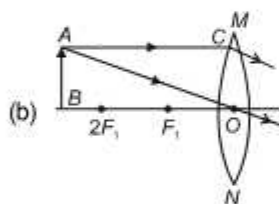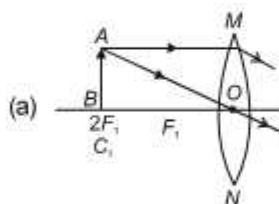
32. The following diagram shows the use of an optical device to perform an experiment of light. As per the arrangement shown, the optical device is likely to be a **[2021] ...[1M]**
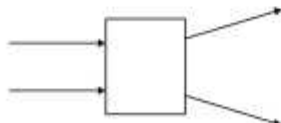
    (a) Concave mirror　　　(b) Concave lens

    (c) Convex mirror　　　(d) Convex lens

33. A ray of light starting from air passes through medium A of refractive index 1.50, enters medium B of refractive index 1.33 and finally enters medium C of refractive index 2.42. If this ray emerges out in air from C, then for which of the following pairs of media the bending of light is least? **[2021] ...[1M]**

    (a) air-A　　　　　　　(b) A-B

    (c) B-C　　　　　　　(d) C-air

34.
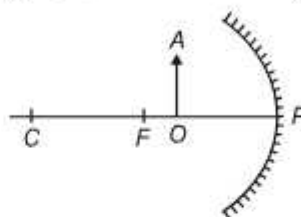
    For the diagram shown, according to the new Cartesian sign convention the magnification of the image formed will have the following specifications: **[2021] ...[1M]**

    (a) Sign - Positive, Value - Less than 1

    (b) Sign - Positive, Value - More than 1

    (c) Sign - Negative, Value - Less than 1

    (d) Sign - Negative, Value - More than 1

35.
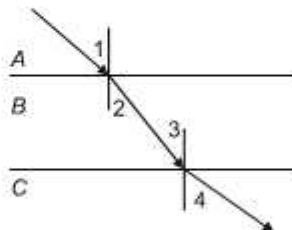
    A ray of light is incident as shown. If A, B and C are three different transparent media, then which among the following options is true for the given diagram? **[2021] ...[1M]**

    (a) $\angle 1 > \angle 4$

    (b) $\angle 1 < \angle 2$

    (c) $\angle 3 = \angle 2$

    (d) $\angle 3 > \angle 4$

36. If a lens can converge the sun rays at a point 20 cm away from its optical centre, the power of this lens is **[2021] ...[1M]**

    (a) +2 D

    (b) −2 D

    (c) +5 D

    (d) −5 D

37. The radius of curvature of a converging mirror is 30 cm. At what distance from the mirror should an object be placed so as to obtain a virtual image? **[2021] ...[1M]**

    (a) Infinity

    (b) 30 cm

    (c) Between 15 cm and 30 cm

    (d) Between 0 cm and 15 cm

38. A converging lens forms a three times magnified image of an object, which can be taken on a screen. If the focal length of the lens is 30 cm, then the distance of the object from the lens is

    [2021] ...[1M]

    (a) −55 cm   (b) −50 cm

    (c) −45 cm   (d) −40 cm

39.
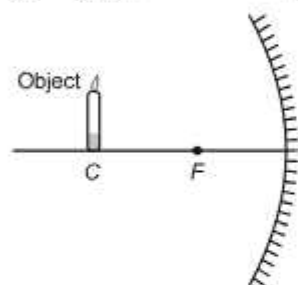
Which of the following statements is **not** true in reference to the diagram shown above?

[2021] ...[1M]

    (a) Image formed is real

    (b) Image formed is enlarged

    (c) Image is formed at a distance equal to double the focal length

    (d) Image formed is inverted

40.
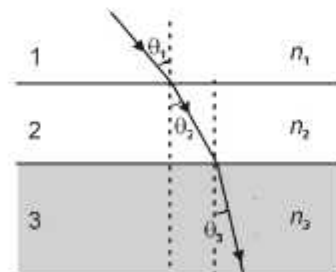
In the diagram shown above n_1, n_2 and n_3 are refractive indices of the media 1, 2 and 3 respectively. Which one of the following is true in this case? **[2021] ...[1M]**

    (a) $n_1 = n_2$ (b) $n_1 > n_2$

    (c) $n_2 > n_3$ (d) $n_3 > n_1$

41. The refractive index of medium A is 1.5 and that of medium B is 1.33. If the speed of light in air is 3×10^8 m/s, what is the speed of light in medium A and B respectively? **[2021] ...[1M]**

    (a) 2×10^8 m/s and 1.33×10^8 m/s

    (b) 1.33×10^8 m/s and 2×10^8 m/s

    (c) 2.25×10^8 m/s and 2×10^8 m/s

    (d) 2×10^8 m/s and 2.25×10^8 m/s

42. An object of height 4 cm is kept at a distance of 30 cm from the pole of a diverging mirror. If the focal length of the mirror is 10 cm, the height of the image formed is **[2021] ...[1M]**

    (a) +3.0 cm   (b) +2.5 cm

    (c) +1.0 cm   (d) +0.75 cm

Case Study Based Questions (Q.43 to Q.46) :

A compound microscope is an instrument which consists of two lenses L_1 and L_2. The lens L_1 called objective, forms a real, inverted and magnified image of the given object. This serves as the object for the second lens L_2; the eye piece. The eye piece functions like a simple microscope or magnifier. It produces the final image, which is inverted with respect to the original object, enlarged and virtual.

43. What types of lenses must be L_1 and L_2?

    [2021] ...[1M]

    (a) Both concave

    (b) Both convex

    (c) L_1 - concave and L_2 - convex

    (d) L_1 - convex and L_2 - concave

44. What is the value and sign of magnification (according to the new Cartesian sign convention) of the image formed by L_1? **[2021] ...[1M]**

    (a) Value = Less than 1 and Sign = Positive

    (b) Value = More than 1 and Sign = Positive

    (c) Value = Less than 1 and Sign = Negative

    (d) Value = More than 1 and Sign = Negative

45. What is the value and sign of (according to new Cartesian sign convention) magnification of the image formed by L_2? **[2021] ...[1M]**

    (a) Value = Less than 1 and Sign = Positive

    (b) Value = More than 1 and Sign = Positive

    (c) Value = Less than 1 and Sign = Negative

    (d) Value = More than 1 and Sign = Negative

46. If power of the eyepiece (L_2) is 5 diopters and it forms an image at a distance of 80 cm from its optical centre, at what distance should the object be? **[2021] ...[1M]**

    (a) 12 cm   (b) 16 cm

    (c) 18 cm   (d) 20 cm

47. Draw ray diagrams to represent the nature, position and relative size of the image formed by a convex lens for the object placed :

    (a) at $2F_1$.

    (b) Between F_1 and the optical centre O of lens.
    [2008] ...[2M]

48. What is the minimum number of rays required for locating the image formed by a concave mirror for an object? Draw a ray diagram to show the formation of a virtual image by a concave mirror.
    [2009] ...[2M]

49. State any four characteristics of the image of the objects formed by a plane mirror. **[2011] ...[2M]**

50. List four properties of the image formed by a concave mirror when an object is placed between the focus and pole of the mirror.
    [2012] ...[2M]

51. "A concave mirror of focal length 15 cm can form a magnified, erect as well as inverted image of an object placed in front of it." Justify this statement stating the position of the object with respect to the pole of the mirror in both the cases for obtaining the images. **[2014] ...[2M]**

52. An object of height 2.5 cm is placed at a distance of 15 cm from the optical centre 'O' of a convex lens of focal length 10 cm. Draw a ray diagram to find the position and size of the image formed. Mark optical 'O', principal focus F and height of the image on the diagram.
    [2016, 2018] ...[2M]

53. The refractive indices of glass and water with respect to air are $\frac{3}{2}$ and $\frac{4}{3}$ respectively. If speed of light in glass 2×10^8 m/s, find the speed of light in water. **[2016] ...[2M]**

54. If the image formed by a spherical mirror for all positions of the object placed in front of it is always erect and diminished, what type of mirror is it? Draw a labelled ray diagram to support your answer. **[2018] ...[2M]**

55. List four precautions which a student should observe while determining the focal length of a given convex lens by obtaining image of a distant object on a screen. **[2019] ...[2M]**

56. At what distance should an object be placed from a convex lens of focal length 18 cm to obtain an image at 24 cm from it on the other side. What will be magnifications produced in this case?
    [2010] ...[3M]

57. An object is placed between infinity and the pole of a convex mirror. Draw a ray diagram and also state the position, the relative size and the nature of the image formed. **[2011] ...[3M]**

58. What is the principle of reversibility of light? Show that the incident ray of light is parallel to the emergent ray of light when light falls obliquely on a side of a rectangular glass slab.
    [2011, 2013] ...[3M]

59. State the type of mirror preferred as
    [2012, 2013] ...[3M]

    (i) Rear view mirrors in vehicles

    (ii) Shaving mirrors.

    Justify your answer giving two reasons in each case.

60. The image of a candle flame placed at a distance of 36 cm from a spherical lens is formed on a screen placed at a distance of 72 cm from the lens. Identify the type of lens and calculate its focal length. If the height of the flame is 2.5 cm, find the height of the image.
    [2012] ...[3M]

61. A student wants to project the image of a candle flame on a screen 90 cm in front of a mirror by keeping the flame at a distance of 15 cm from its pole. **[2014] ...[3M]**

    (a) Suggest the type of mirror he should use

    (b) Determine the linear magnification in this case

    (c) Find the distance between the object and its image

    (d) Draw ray diagram to show the image formation in this case

62. Draw a ray diagram to show the path of the refracted ray in each of the following cases :

    A ray of light incident on a concave lens is
    [2014] ...[3M]

    (i) Passing through its optical centre.

    (ii) Parallel to its principal axis.

    (iii) Directed towards its principal focus.

63. An object of height 5 cm is placed perpendicular to the principal axis of a concave lens of focal length 10 cm. If the distance of the object from the optical centre of the lens is 20 cm, determine the position, nature and size of the image formed using the lens formula.

    [2015] ...[3M]

64. The image formed by a spherical mirror is real, inverted and is of magnification –2. If the image is at a distance of 30 cm from the mirror, where is the object placed? Find the focal length of the mirror. List two characteristics of the image formed if the object is moved 10 cm towards the mirror. **[2016] ...[3M]**

65. "A lens can form a magnified erect image as well as magnified inverted image of an object placed in front of it". State the nature of this lens and draw ray diagrams to justify the above statement. Mark the positions of O, F and 2F in the diagram.

    [2017] ...[3M]

66. State the laws of refraction of light. Explain the term 'absolute refractive of a medium' and write an expression to relate it with the speed of light in vacuum. **[2018] ...[3M]**

67. (A) Define the following terms in the context of a diverging mirror : **[2023] ...[3M]**

    (i) Principal focus

    (ii) Focal length

    Draw a labelled ray diagram to illustrate your answer.

    OR

    (B) An object of height 10 cm is placed 25 cm away from the optical centre of a converging lens of focal length 15 cm. Calculate the image-distance and height of the image formed.

68. The power of a lens is +4 D. Find the focal length of this lens. An object is placed at a distance of 50 cm from the optical centre of this lens. State the nature and magnification of the image formed by the lens and also draw a ray diagram to justify your answer. **[2023] ...[3M]**

69. The ability of a medium to refract light is expressed in terms of its optical density. Optical density has a definite connotation. It is not the same as mass density. On comparing two media, the one with the large refractive index is optically denser medium than the other. The other medium with a lower refractive index is optically rarer. Also the speed of light through a given medium is inversely proportional to its optical density. **[2023] ...[4M]**

    (i) Determine the speed of light in diamond if the refractive index of diamond with respect to vacuum is 2.42. Speed of light in vacuum is 3×10^8 m/s.

    (ii) Refractive indices of glass, water and carbon disulphide are 1.5, 1.33 and 1.62 respectively. If a ray of light is incident in these media at the same angle (say θ), then write the increasing order of the angle of refraction in these media.

    (iii) (A) The speed of light in glass is 2×10^8 m/s and in water is 2.25×10^8 m/s.

    (a) Which one of the two is optically denser and why?

    (b) A ray of light is incident normally at the water-glass interface when it enters a thick glass container filled with water. What will happen to the path of the ray after entering the glass? Give reason.

    OR

    (iii) (B) The absolute refractive indices of water and glass are 4/3 and 3/2 respectively. If the speed of light in glass is 2×10^8 m/s, find the speed of light in (i) vacuum and (ii) water.

70. (a) Draw a ray diagram to show the formation of image of an object placed between infinity and the optical centre of a concave lens.

    (b) A concave lens of focal length 15 cm forms an image 10 cm from the lens. Calculate

    (i) The distance of the object from the lens.

    (ii) The magnification for the image formed.

    (iii) The nature of the image formed.

    [2011] ...[5M]

71. List the sign conventions for reflection of light by spherical mirrors. Draw a diagram and apply these conventions in the determination of focal length of a spherical mirror which forms a three times magnified real image of an object placed 16 cm in front of it.

    [2012] ...[5M]

72. (a) Explain the following terms related to spherical lenses : **[2014] ...[5M]**

    (i) Optical centre

    (ii) Centres of curvature

    (iii) Principal axis

    (iv) Aperture

    (v) Principal focus

    (vi) Focal length

    (b) A converging lens has focal length of 12 cm. Calculate at what distance the object should be placed from the lens so that it forms an image at 48 cm on the other side of the lens?

73. What is meant by power of a lens? Define its SI unit. You have two lenses A and B of focal lengths +10 cm and −10 cm, respectively. State the nature and power of each lens. Which of the two lenses will form a virtual and magnified image of an object placed 8 cm from the lens? Draw a ray diagram to justify your answer.

    [2015, 2018] ...[5M]

74. One half of a convex lens of focal length 10 cm is covered with a black paper. Can such a lens produce an image of a complete object placed at a distance of 30 cm from the lens? Draw a ray diagram to justify your answer. A 4 cm tall object is placed perpendicular to its principal axis of a convex lens of focal length 20 cm. The distance of the object from the lens is 15 cm. Find the nature, position and the size of the image.   **[2015] ...[5M]**

75. It is desired to obtain an erect image of an object, using concave mirror of focal length of 12 cm.

    (i) What should be the range of distance of an object placed in front of the mirror?

    (ii) Will the image be smaller or larger than the object? Draw ray diagram to show the formation of image in this case.

    (iii) Where will the image of this object be, if it is placed 24 cm in front of the mirror? Draw ray diagram for this situation also justify your answer.

    Show the positions of pole, principal focus and the centre of curvature in the above ray diagrams.

    [2016] ...[5M]

76. (a) Define focal length of a divergent lens.

    (b) A divergent lens of focal length 30 cm forms the image of an object of size 6 cm on the same side as the object at a distance of 15 cm from its optical center. Use lens formula to determine the distance of the object from the lens and the size of the image formed.

    (c) Draw a ray diagram to show the formation of image in the above situation. **[2016] ...[5M]**

77. Analyse the following observation table showing variation of image distance (v) with object distance (u) in case of convex lens and answer the questions that follow without doing any calculations:

Sr. No.	Object Distance u (cm)	Image Distance v (cm)
1	−100	+25
2	−60	+30
3	−40	+40
4	−30	+60
5	−25	+100
6	−15	+120

   (a) What is the focal length of the convex lens? Give reason to justify your answer.

   (b) Write the serial number of the observation which is not correct. On what basis have you arrived at this conclusion?

   (c) Select an appropriate scale and draw a ray diagram for the observation at S. No. 2. Also find the approximate value of magnification.

   [2017] ...[5M]

78. (a) If the image formed by a mirror for all position of the object placed in front of it is always diminished, erect and virtual. State the type of the mirror and also draw a ray diagram to justify your answer. Write one use of such mirrors are put to and why.

    (b) Define the radius of curvature of spherical mirrors. Find the nature and focal length of a spherical mirror whose radius of curvature is +24 cm.   **[2017] ...[5M]**