TEST SERIES 2019-20 **TEST NO. 7**

EM WAVES & OPTICS **CONDUCTED ON 26TH JANUARY 2019**

Maximum Marks: 65 **Time Allowed: 2 hours and 30 minutes**

SECTION A

1. A charged particle oscillates about its mean position with a frequency of 109 Hz. For producing electromagnetic waves, which one is not true?
   (a) They will have frequency of 10^9 Hz.
   (b) They will have frequency of 2×10^9 Hz.
   (c) They will have a wavelength of 0.3 m.
   (d) They fall in the region of radio waves.
2. Which of the following has minimum wavelength?
   (a) Blue light
   (b) Gamma rays
   (c) Infrared rays
   (d) Microwave
3. In electromagnetic waves, the phase difference between electric and magnetic field vectors are
   (a) Zero
   (b) $\pi/4$
   (c) π
   (d) $\pi/2$
4. According to Maxwell, a changing electric field gives rise to
   (a) An electric field
   (b) An induced emf
   (c) A magnetic field
   (d) A magnetic dipole.
5. The structure of solids is investigated by using
   (a) Cosmic rays
   (b) X-rays
   (c) Gamma rays
   (d) Infrared rays
6. Which radiations are used in treatment of muscle ache?
   (a) Infrared
   (b) Ultraviolet
   (c) Microwave
   (d) X-rays
7. The length of an astronomical telescope for normal adjustment will be
   (a) fo-fe
   (b) fo+fe

(c) foXfe
(d) fo/fe

8. a metal coin is at bottom of a beaker filled with a liquid of refractive index 4/3 to a height of 6 cm. to an observer looking from above the surface of liquid, coin will appear at a depth
   (a) 1.5 cm
   (b) 6.75 cm
   (c) 4.5 cm
   (d) 7.5 cm
9. A short pulse of white light is incident from air to a glass slab at normal incidence. After travelling through the slab, the first colour to emerge is
   (a) Blue
   (b) Green
   (c) Violet
   (d) Red
10. Resolving power of a telescope can be increased by increasing
   (a) The wavelength
   (b) The diameter of the objective
   (c) The diameter of eyepiece
   (d) The focal length of eyepiece
11. Polarization of light proves
   (a) Corpuscular nature of light
   (b) Quantum nature of light
   (c) Transverse nature of light
   (d) Longitudinal wave nature of light
12. According to Huygen's principle, light is a form of
   (a) Particle
   (b) Rays
   (c) Wave
   (d) Radiation
13. Two coherent monochromatic light beams of intensities I and 4I superimpose. The maximum and minimum possible intensities in the resulting beam are:
   (a) 5I and I
   (b) 5I and 3I
   (c) 3I and I
   (d) 9I and I
14. When exposed to sunlight, thin films of oil on water often exhibit colours due to the phenomenon of
   (a) Interference
   (b) Diffraction
   (c) Dispersion
   (d) Polarization
15. Resolving power of microscope depends upon

(a) **Wavelength of light used(directly proportional)**
(b) **Wavelength of light used(inversely proportional)**
(c) **Aperture of eye piece**
(d) **Focal length of objective**

16. **What is the phase difference between two points on the same wavefront?**

17. **What is the ratio of the fringe width for bright and dark fringes in Young's double slit experiment?**

18. **Minimum angle of incidence in the denser medium for which angle of refraction becomes 90o is called……..**

19. **Blue colour of sky is due to phenomenon of…….**

20. **Optical fibre works on the principle of……**

SECTION B

21. A convex lens of focal length 25 cm is placed coaxially in contact with a concave lens of focal length 20 cm. Determine the power of the combination. Will the system be converging or diverging?

22. A beam of light converges at a point P. Now a lens is placed in the path of the convergent beam 12 cm from P. At what point does the beam converge if the lens is a convex lens of focal length 20 cm?

23. A glass prism of refracting angle 60^o and refractive index 1.5 is completely immersed in water of refractive index 1.33. Calculate the angle of minimum deviation of the prism in this situation. Use $\sin^{-1} 0.56 = 34.3^o$.

24. In a Young's double-slit experiment, the slits are separated by 0.28 mm and the screen is placed 1.4 m away. The distance between the central bright fringe and the fourth bright fringe is measured to be 1.2 cm. Determine the wavelength of light used in the experiment.

25. In a single slit experiment the slit width is made double that of the original width. What would happen to the size and intensity of central diffraction band? Give reason for your answer.

26. A parallel beam of light of 500nm falls on a narrow slit and the resulting diffraction pattern is observed on a screen 1.2m away. It is observed that the first minimum is at a distance of 3mm from the centre of the screen. Calculate the width of the slit.

27. Two Polaroids are set in crossed positions; a third Polaroid is placed between the two making an angle α with the pass axis of the first Polaroid. Write an expression for the intensity of light transmitted from the second Polaroid.

28. Light with an energy flux of 18 W/cm^2 falls on a non- reflecting surface at normal incidence. If the surface has an area of 20 cm^2, find the average force exerted on the surface during a 30 minute time span.

29. In a plane electromagnetic wave, the electric field oscillates sinusoidally at a frequency of 2.0×10^{10} Hz and amplitude 48 V m^{-1}.
(a) What is the wavelength of the wave?
(b) What is the amplitude of the oscillating magnetic field?

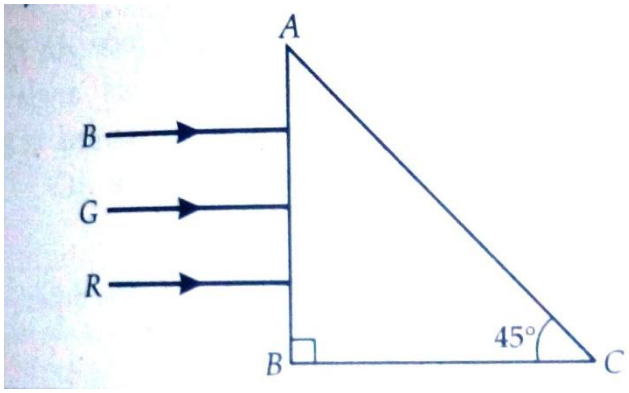
30. A compound microscope with an objective of 1.25 cm focal length and an eye piece of 5 cm. a small object is kept at 2.5 cm from the objective. If the final image is formed at infinity, find the distance between objective and eye piece.

SECTION C

31.

(a) A ray of monochromatic light is incident on one of the faces of an equilateral triangular prism of refracting angle A. trace the path of ray passing through the prism. Hence derive an expression for the refractive index of the material of the prism in terms of angle of minimum deviation and its refracting angle.

(b) Three lights rays , red(R) green (G) and blue (B) are incident on a right angled prism abc at face ab. The refractive indices of the material of the prism for red, green and blue wavelengths are 1.39, 1.44 and 1.47 respectively. Out of the three, which colour of ray will emerge out of face AC? Justify your answer. Trace the path of these rays after passing through face AB.



32.

(a) Draw a schematic labeled ray diagram of a reflecting type telescope.

(b) Write two advantages of reflecting telescope over refracting type.

(c) The objective of a telescope is of larger focal length and larger aperture. Why?

33. Draw ray diagram showing the geometry of formation of the image of a point object situated on the principal axis and on the convex side of a spherical surface of radius of curvature, R. Taking the rays as incident from a medium of refractive index, n_1 to another of refractive index, n_2 show that,

$$\frac{n2}{v} - \frac{n1}{v} = \frac{n2-n1}{R}$$

Where the symbols have their usual meaning

Use the relation to obtain the (thin) **lens maker's formula.**

34. In a Young's double slit experiment.

i. Deduce the conditions for constructive and destructive interference. Hence, write the expression for the distance between two consecutive bright or dark fringe.

ii. What change in the interference pattern do you observe, if the two slits, S_1 and S_2 are taken as point sources?

Plot a graph of the intensity distribution vs path difference in this experiment. Compare this with the intensity distribution of fringes due to diffraction at a single slit.

35.

(a) A giant refracting telescope has an objective lens of focal length 15 m. If an eye piece of focal length 1.0 cm is used and this telescope is used to view the moon, what is the diameter of the image of the moon formed by the objective lens? The diameter of the moon is 3×10^6 m and the radius of lunar orbit is 3×10^8 m.

(b) Two convex lenses of focal length 20 cm and 1 cm constitute a telescops. The telescope is focused on a point which is 1 m away from the objective. Calculate the magnification produced and the length of the tube, if the final image is formed at a distance, 25 cm from the eyepiece.

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A VERY HAPPY REPUBLIC DAY TO ALL OF US