Q1. In the energy-band diagram of n-type Si, the gap between the bottom of the conduction band E¢ and the donor energy level Ep is of the order of: **1 Mark**

A 10 eV **B** 1 eV **C** 0.1 eV **D** 0.01 eV

Q2. For a concave mirror of focal length 'f', the minimum distance between the object and its real image is: **1 Mark**

A zero **B** f **C** 2f **D** 4f

Q3. A biconvex lens of glass having refractive index 1.47 is immersed in a liquid. It becomes invisible and behaves as a plane glass plate. The refractive index of the liquid is: **1 Mark**

A 1.47 **B** 1.62 **C** 1.33 **D** 1.51

Q4. For a glass prism, the angle of minimum deviation will be smallest for the light of: **1 Mark**

A Red colour. **B** Blue colour. **C** Yellow colour. **D** Green colour.

Q5. The relationship between Brewester angle $'\theta'$ and the speed of light 'v' in the denser medium is: **1 Mark**

A $\mathrm{v}\tan\theta = \mathrm{c}$ **B** $\mathrm{c}\tan\theta = \mathrm{v}$
C $\mathrm{v}\sin\theta = \mathrm{c}$ **D** $\mathrm{c}\sin\theta = \mathrm{v}$

Q6. The minimum distance between an object and its real image formed by a convex lens of focal length f is: **1 Mark**

A f **B** 2f **C** $\frac{\mathrm{f}}{2}$ **D** 4f

Q7. Which of the following pairs of media has the least value of critical angle? **1 Mark**

A Glass to air **B** Glass to water **C** Diamond to water **D** Diamond to air

Q8. Larger aperture of objective lens in an astronomical telescope: **1 Mark**

A Increases the resolving power of telescope. **B** Decreases the brightness of the image.
C Increases the size of the image. **D** Decreases the length of the telescope.

Q9. Ge is doped with As. Due to doping, **1 Mark**

A the structure of Ge lattice is distorted. **B** the number of conduction electrons increases.
C the number of holes increases. **D** the number of conduction electrons decreases.

Q10. A biconvex lens of focal length f is cut into two identical plano convex lenses. The focal length of each part will be: **1 Mark**

A f **B** $\frac{\mathrm{f}}{2}$ **C** $2\mathrm{f}$ **D** $4\mathrm{f}$

Q11. A biconcave lens of power P vertically splits into two identical plano concave parts. The power of each part will be: **1 Mark**

A $2\mathrm{P}$ **B** $\frac{\mathrm{P}}{2}$
C P **D** $\frac{\mathrm{P}}{\sqrt{2}}$

Q12. A zener diode has: **1 Mark**

A Heavily doped p-side and lightly doped n-side. **B** Heavily doped n-side and lightly doped p-side.
C Heavily doped n-side as well as p-side. **D** Lightly doped n-side as well as p-side.

Q13. The resolving power of a telescope can be increased by increasing: **1 Mark**

A Wavelength of light. **B** Diameter of objective.
C Length of the tube. **D** Focal length of eyepiece.

Q14. The focal length of the objective of a compound microscope is: **1 Mark**

A Greater than the focal length of eyepiece.
B Lesser than the focal length of eyepiece.
C Equal to the focal length of eyepiece.
D Equal to the length of its tube.

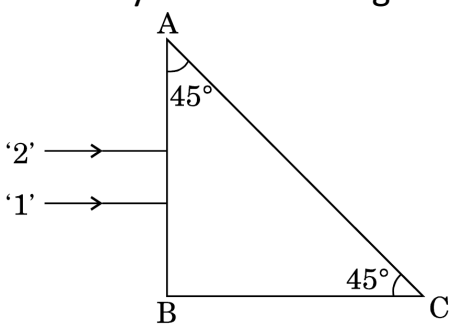
Q15. When an intrinsic semiconductor is doped with a small amount of trivalent impurity, then: **1 Mark**

A its resistance increases.
B it becomes a p-type semiconductor.
C there will be more free electrons than holes in the semiconductor.
D dopant atoms become donor atoms.

Q16. Differentiate between 'diffusion current' and 'drift current' Explain their role in the formation of p-n junction. **2 Marks**

Q17. What is meant by energy band gap in a solid? Draw the energy band diagrams for a conductor, an insulator and a semiconductor. **2 Marks**

Q18. Two monochromatic rays of light are incident normally on the face AB of an isosceles right-angled prism ABC. The refractive indices of the glass prism for the two rays '1' and '2' are respectively 1.3 and 1.5 Trace the path of these rays after entering through the prism. **2 Marks**



Q19. Describe, with the help of a circuit diagram, the working of a photodiode. **2 Marks**

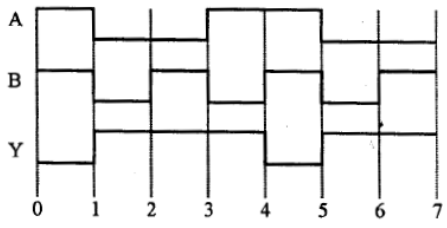
Q20. For a CE transistor amplifier, the audio signal voltage across the collector resistance of $2\mathrm{k}\Omega$ is 2V. If the current amplification factor of the transistor is 100, calculate the input signal voltage and the base current, given the base resistance as $1\mathrm{k}\Omega$. **2 Marks**

Q21. For paraxial rays, show that the focal length of a spherical mirror is one-half of its radius of curvature. **2 Marks**

Q22. With the help of a circuit diagram, explain briefly how a p-n junction diode works as a half-wave rectifier. **2 Marks**

Q23. Draw typical output characteristics of an n-p-n transistor in CE configuration. Show how these characteristics can be used to determine output resistance. **2 Marks**

Q24. The following figure shows the input waveforms (A, ,B) and the output waveform (Y) of a gate. Identify the gate, write its truth table and draw its logic symbol. **2 Marks**

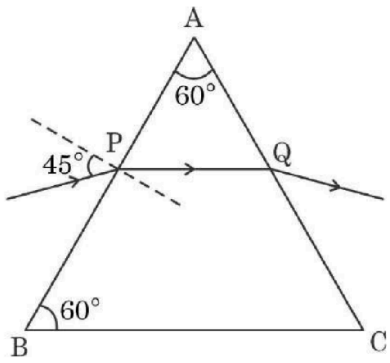


Q25. Find the intensity at a point on a screen in Young's double slit experiment where the interfering waves of equal intensity have a path difference of (i) $\lambda/4$, and (ii) $\lambda/3$. **2 Marks**

Q26. How can you differentiate whether a pattern is produced by a single slit or double slits? Derive the expression for the angular position of (i) bright and (ii) dark fringes produced in a single slit diffraction. **3 Marks**

Q27. A diver looking up through water $\left(\mu = \frac{4}{3}\right)$ sees the outside world contained in a circular area on the surface of water. If the diver's eyes are $\sqrt{7}\mathrm{m}$ below the surface of water, then calculate the area of the circle. **3 Marks**

Q28. A ray of light is incident on a prism at an angle of 45° and passes symmetrically as shown in the figure. Calculate: **3 Marks**



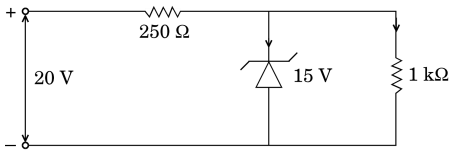
1. The angle of minimum deviation.
2. The refractive index of the material of the prism, and.
3. The angle of refraction at the point P.

Q29. A beam of light consisting of two wavelengths 600nm and 500nm is used in a Young's double slit experiment. The slit separation is 1.0mm and the screen is kept 0.60m away from the plane of the slits. **3 Marks**

Calculate:

1. The distance of the second bright fringe from the central maximum for wavelength 500nm, and.
2. The least distance from the central maximum where the bright fringes due to both the wavelengths coincide.

Q30. Give reason to explain why n and p regions of a Zener diode are heavily doped. Find the current through the Zener diode in the circuit given below: (Zener breakdown voltage is 15V) **3 Marks**



Q31. **5 Marks**

1. Define the term ‘resolving power of a telescople’. How will the resolving power be effected with the increase in:
   1. Wavelength of light used.
   2. Diameter of the objective lens.

   Justify your answers.
2. A screen is placed 80cm from an object. The image of the object on the screen is formed by a convex lens placed between them at two different locations separated by a distance 20cm. Determine the focal length of the lens.

Q32. **5 Marks**

1. An object is placed in front of a concave mirror. It is observed that a virtual image is formed. Draw the ray diagram to show the image formation and hence derive the mirror equation $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$.
2. An object is placed 30cm in front of a plano-convex lens with its spherical surface of radius of curvature 20cm. If the refractive index of the material of the lens is 1.5, find the position and nature of the image formed.

Q33. **5 Marks**

1. State Huygens principle. A plane wave is incident at an angle i on a reflecting surface. Construct the corresponding reflected wavefront. Using this diagram, prove that the angle of reflection is equal to the angle of incidence.
2. What are the coherent sources of light? Can two independent sodium lamps act like coherent sources? Explain.
3. A beam of light consisting of a known wavelength 520 nm and an unknown wavelength λ used in Young's double slit experiment produces two interference patterns such that the fourth bright fringe of unknown wavelength coincides with the fifth bright fringe of known wavelength. Find the value of λ.

Q34. Write two points of difference between an interference pattern and a diffraction pattern. Name any two factors on which the fringe width in a Young’s double-slit experiment depends. In Young’s double-slit experiment, the two slits are separated by a distance equal to 100 times the wavelength of light that passes through the slits. Calculate: **5 Marks**

1. the angular separation in radians between the central maximum and the adjacent maximum.
2. the distance between these two maxima on a screen 50cm from the slits.