IIT JEE-NEET RAY OPTICS-ELECTROCHEMISTRY

DURATION: 2 Hours 0 Minutes   **DATE: 2025-06-24**

SYLLABUS

Physics: Ray Optics And Optical Instruments.

Chemistry: Electrochemistry.

(Physics)

1. An equiconvex lens is made of glass of refractive index 1.5 and has a focal length of 10 cm in air. The lens is cut into two equal halves along a plane perpendicular to its principal axis to yield two plano-convex lenses. The two pieces are glued such that the convex surfaces touch each other. If this combination lens is immersed in water of refractive index 4/3 its focal length (in cm) is

A) 5   B) 10

C) 20   D) 40

2. A ray of light falls on a prism ABC ($AB = BC$) and travels as shown in Figure. The refractive index of the prism material should be greater than

A) 4/3   B) $\sqrt{2}$

C) 1.5   D) $\sqrt{3}$

3. A ray of light is incident at the glass–water interface at an angle i, it emerges finally parallel to the surface of water, then the value of μ_g would be

A) (4/3) sin i   B) 1/sin i

C) 4/3   D) 1

4. A diver at a depth of 12 m in water $(\mu = 4/3)$ sees the sky in a cone of semi-vertical angle

A) $\sin^{-1}(4/3)$ B) $\tan^{-1}(4/3)$

C) $\sin^{-1}(3/4)$ D) $90°$

5. Two point white dots are 1mm apart on a black paper. They are viewed by eye of pupil diameter 3 mm. Approximately, what is the maximum distance at which dots can be resolved by the eye ? [Take wavelength of light = 500 nm]

A) 6 m   B) 3 m

C) 5 m   D) 1 m

6. There is an equiconvex glass lens with radius of each face as R and $_a\mu_g$ = 3/2 and $_a\mu_w$ = 4/3. If there is water in object space and air in image space, then the focal length is

A) 2 R   B) R

C) 3 R/2   D) R^2

7. An object is placed at 10 cm from a concave mirror of radius of curvature 15 cm, then

A) it forms an erect image   B) it forms a small and inverted image

C) it forms a point image   D) it forms a magnified, real and inverted image

8. A beam of monochromatic light is incident on the face of the refracting equilateral prism the angle of incidence being 55°. If the angle of emergence is 46°, then the angle of minimum deviation is

A) 41°   B) > 41°

C) < 41°   D) ≥ 41°

9. The relation between lateral magnification m, object distance u, and focal length f of a spherical mirror is

A) $m = \frac{f-u}{f}$

B) $m = \frac{f}{f+u}$

C) $m = \frac{f+u}{f}$

D) $m = \frac{f}{f-u}$

10. Light travels through a glass plate of thickness t and having refractive index μ. If c be the velocity of light in vacuum, the time taken by the light to travel this thickness of glass is

A) $\frac{1}{\mu c}$

B) $t\,\mu\,c$

C) $\frac{\mu t}{c}$

D) $\frac{tc}{\mu}$

11. The focal length of the objective and the eyepiece of telescope are 50 cm and 5 cm respectively. If the telescope is focussed for distinct vision on a scale distant 2m from its objective, then its magnifying power will be:

A) −4

B) −8

C) +8

D) −2

12. An object is placed at the focus of convex mirror. If its focal length is 20 cm, the distance of mirror is

A) 10 cm

B) 20 cm

C) 40 cm

D) None of these

13. A lens has focal length 10 cm. An object is placed 15 cm in front of it. Where should a convex mirror be placed, so that image is formed at the object itself, when focal length of convex mirror is 12 cm?

A) 6 cm from lens

B) 8 cm from lens

C) 5 cm from lens

D) 4 cm from lens

14. In an astronomical telescope in normal adjustment, a straight black line of length L is drawn on the objective lens. The eyepiece forms a real image of this line. The length of this image is l. The magnification of the telescope is

A) $\frac{L}{l}$

B) $\frac{L}{l} + 1$

C) $\frac{L}{l} - 1$

D) $\frac{L+l}{L-l}$

15. An object O is placed in front of a small plane mirror M_1 and a large convex mirror M_2 of focal length f. The distance between O and M_1 is x, and the distance between M_1 and M_2 is y. The images of O formed by M_1 and M_2 coincide. The magnitude of f is
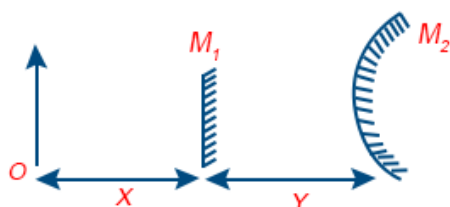
A) $\frac{x^2 - y^2}{2y}$

B) $\frac{x^2 + y^2}{2y}$

C) $x-y$

D) $\frac{x^2 + y^2}{x-y}$

16. When an object is place at a distance of 25 cm from a mirror, the magnification is m_1. The object is moved 15 cm further away with respect to the earlier position, and the magnification becomes m_2.

If $m_1/m_2 = 4$, the focal length of the mirror is:

A) 10 cm

B) 30 cm

C) 15 cm

D) 20 cm

17. Colour blindness can be cured by using

A) Concave lens

B) Convex lens

C) Spherical lens

D) Not curable at all

18. A man runs towards a mirror at a speed 15 m/s The speed of the image relative to the man is

A) $15\ ms^{-1}$

B) $30\ ms^{-1}$

C) $35\ ms^{-1}$

D) $20\ ms^{-1}$

19. Which one of the following statements is correct

A) In vacuum, the speed of light depends upon frequency

B) In vacuum, the speed of light does not depend upon frequency

C) In vacuum, the speed of light is independent of frequency and wavelength

D) In vacuum, the speed of light depends upon wavelength

20. if the focal length of the eyepiece of a telescope is doubled, its magnifying power (m) will be

A) $2m$

B) $3m$

C) $\frac{m}{2}$

D) $4m$

21. Which of the following is true for rays coming from infinity?
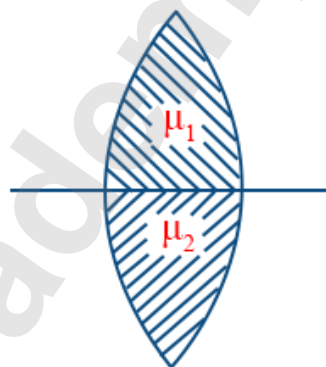
A) Two images are formed

B) Continuous image is formed between focal points of upper and lower lens

C) One image is formed

D) None of the above

22. A thin glass(refractive index 1.5) lens has optical power of −5D in air. Its optical power in a liquid medium with refractive index 1.6 will be

A) 1 D

B) −1 D

C) 25 D

D) −25 D

23. The critical angle of a medium with respect to air is $45°$. The refractive index of medium is

A) 1.41

B) 1.2

C) 1.5

D) 2

24. A convex lens of focal length 12 cm is placed in contact with a plane mirror. if the object is placed at 20 cm from the lens, the position of final image is
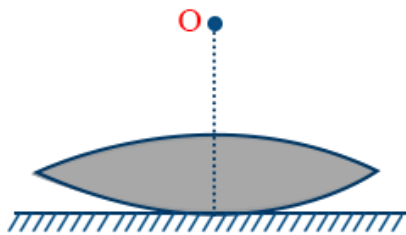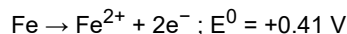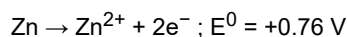

A) 30 cm above lens   **B)** 30 cm below lens

C) 20 cm above lens   **D)** 8.6 cm below lens

25. If the angle of incidence is twice the angle of refraction in a medium of refractive index 'μ' then the angle of incidence is
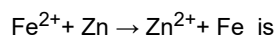
A) $\cos^{-1}\left(\frac{\mu}{2}\right)$ **B)** $\sin^{-1}\left(\frac{\mu}{2}\right)$

C) $2\sin^{-1}\left(\frac{\mu}{2}\right)$ **D)** $2\cos^{-1}\left(\frac{\mu}{2}\right)$

(Chemistry)

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26. The standard oxidation potential $E°$ for the half reactions are as

$Zn \rightarrow Zn^{2+} + 2e^-$; $E^0 = +0.76$ V

$Fe \rightarrow Fe^{2+} + 2e^-$; $E^0 = +0.41$ V

The emf for the cell reaction

$Fe^{2+} + Zn \rightarrow Zn^{2+} + Fe$ is

A) +1.17 V   **B)** −0.35 V

C) +0.35 V   **D)** 0.117 V

27. If a steady current of 15.0 A is passed through an aqueous solution of $CuSO_4$, how many minutes will it take to deposit 0.250 mol of Cu at the cathode, assuming 100% efficiency?

A) 3.217×10^3 **B)** 1.1613×10^3

C) 53.62   **D)** 0.893

28. The equivalent conductances of two strong electrolytes at infinite dilution in H_2O (Where ions move freely through a solution) at 25°C are given below

$\wedge^o_{CH_3COONa} = 91.0 Scm^2/equiv$

$\wedge^o_{HCl} = 426.2 Scm^2/equiv$

What additional information / quantity one needed to calculate A° of an aqueous solution of acetic acid?

A) ∧° of NaCl   **B)** ∧° of CH_3COOK

C) The limiting equivalent conductance of H⁺ $\left(\lambda^o_{H_+}\right)$ **D)** ∧° of chloroacetic acid $(ClCH_2COOH)$

29. Assume that during electrolysis of $AgNO_3$, only H_2O is electrolysis and O_2 is formed as

$2H_2O \rightarrow 4H^+ + O_2 + 4e^-$
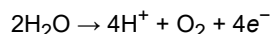
O_2 formed at NTP due to passage of 2 A of current for 965 is

A) 0.112 L   **B)** 0.224 L

C) 11.2 L   **D)** 22.4 L

30. The cell constant of a solution, whose specific conductance and observed conductance are same, is equal to

A) 1   **B)** 0

C) 10   **D)** 100

31. The conductivity of 0.01 mol/dm³ aqueous acetic acid at 300 K is 19.5×10^{-5} ohm⁻¹ cm⁻¹ and limiting molar conductivity of acetic acid at the same temperature is 390 ohm⁻¹ cm² mol⁻¹. The degree of dissociation of acetic acid is

A) 0.05   **B)** 0.5×10^{-2}

C) 5×10^{-7} **D)** 5×10^{-3}

32. Given, $E^o_{cr^{3+}/Cr} = -0.74V$;

$E^o_{Mno_4^-/Mn^{2+}} = 1.51V$

$E^o_{cr_2o_7^{2-}/cr^{3+}} = 1.33V$;

$E^o_{Cl/Cl^-} = 1.36V$

Based on the date given above, strongest oxidising agent will be

A) Cl   **B)** Cr^{3+}

C) Mn^{2+} **D)** MnO_4^-

33. Consider the following substances

$Al(s)$, $Pb(s)$, $Br_2(l)$, $I^-(aq)$: $Cu^{2+}(aq)$, $MnO_4^-(aq)$
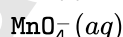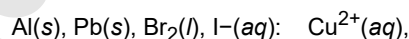
Which can be reduced by Fe^{2+}?

A) Cu^{2+} , Br_2 , MnO_4^- **B)** Cu^{2+} , MnO_4^-

C) Br_2, Cu^{2+} **D)** Br_2 , MnO_4^-

34. Chemical formula of rust is

A) $Fe_2O_3 \cdot H_2O$ **B)** $Fe_2O_3 \cdot 5H_2O$

C) $Fe_2O_3 \cdot xH_2O$ **D)** None of these

35. Consider the following reaction

$A_2B_3(g) \longrightarrow 2A(g) + 3B(g)$
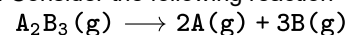
If initial concentration of $A_2B_3(g)$ is C, find α

A) $\left(\frac{k_{eq}}{27\ C^4}\right)^{1/5}$ **B)** $\left(\frac{k_{eq}}{C^4}\right)^{1/5}$

C) $\left(\frac{k_{eq}}{108\ C^4}\right)^{1/5}$ **D)** $\left(\frac{k_{eq}}{4\ C^4}\right)^{1/5}$

36. The resistance of the cell containing KCl solution at 23°C was found to be 55 Ω. Its cell constant is 0.616 cm⁻¹. The conductivity of KCl solution $(\Omega^{-1}$ cm⁻¹) is

A) 1.21×10^{-3} **B)** 1.12×10^{-2}

C) 1.12×10^{-3} **D)** 1.21×10^{-2}

37. Why is it important to apply an opposing potential in certain electrochemical processes?

A) To increase the cell potential   **B)** To decrease the cell potential

C) To control the cell potential and prevent damage

D) To reverse the direction of the cell reaction

38. The electrical resistance of a column of 0.02 mol L^{-1} of a solution of diameter 2 cm and length 75 cm is 4×10^3 Ω. The molar conductivity of the solution is

A) 123.0 S cm^2 mol^{-1}

B) 298.5 S cm^2 mol^{-1}

C) 425.5 S cm^2 mol^{-1}

D) 597.0 S cm^2 mol^{-1}

39. For molar concentration of HA being 0.08 M, the Λ_m value is 75 mho cm^2 mol^{-1}. What is the value of acid dissolution constant K_a if Λ_m^o is 300 mho cm^2 mol^{-1} at 25°C ?

A) 0.67

B) 0.067

C) 0.0067

D) 0.6077

40. The given cell reaction takes place in a voltaic cell.
$$Sn^{+2}{}_{(aq)} + Cu_{(s)} \rightarrow Sn_{(s)} + Cu^{+2}{}_{(aq)}$$
The standard reduction potentials of Sn^{+2}/Sn and Cu^{+2}/Cu are −0.136 Volts and 0.34 volts respectively.
The standard cell potential of the given voltaic cell is

A) −0.204 volts

B) −0.476 volts

C) +0.204 volts

D) +0.476 volts

41. Consider two half cells based on the reaction $Ag^+{}_{(aq)} + e \rightarrow Ag_{(s)}$. The left half cell contain Ag^+ ions at unit concentration, and the right half cell initially had the same concentration of Ag^+ ions, but just enough $NaCl_{(aq)}$ had been added to completely precipitate the $Ag^+{}_{(aq)}$ as $AgCl$. If the emf of the cell is 0.29V, then $\log_{10} K_{sp}$ would have been

A) 9.804

B) −9.804

C) −4.902

D) 10.004

42. When same quantity of electricity is passed through aqueous $AgNO_3$ and H_2SO_4 solutions connected in series 5.04×10^{-2} g of H_2 is liberated. What is the mass of silver (in grams) deposited? (Eq. wts. of hydrogen = 1.008, silver = 108)

A) 54

B) 0.54

C) 5.4

D) 10.8

43. The standard *EMF* for the given cell reaction $Zn + Cu^{2+} \rightarrow Cu + Zn^{2+}$ is 1.10V at 25°C. The *EMF* for the cell reaction, when 0.1M Cu^{2+} and 0.1M Zn^{2+} solutions are used, at 25°C is

A) 1.10V

B) 0.110V

C) −1.10V

D) −0.110V

44. In the process of electrolysis, positively charged particles i.e. i move toward the negative electrode called ii. The negatively charged particles i.e. iii move toward the positive electrode called iv. The information in which alternative completes the given statement correctly?

A) i-anions ii-anode iii-cations iv-cathode

B) i-cations ii-cathode iii-anions iv-anode

C) i-anions ii-cathode iii-cations iv-anode

D) i-cations ii-anode iii-anions iv-cathode

45. CH$_3$COOH is titrated with NaOH solution. Which is true statement?

A) Conductance decreases up to equivalence point, after which it increases

B) Conductance increases up to equivalence point, after which it decreases

C) Conductance first increases (but not rapidly) up to equivalence point and then increases rapidly after equivalence point

D) None of the above

46. What is the electrochemical equivalent (in a coulomb^{-1}) of silver?

A) 108F

B) 108/F

C) F/108

D) 1/108F

47. Bruce is having problems with his car battery and decides to fix the battery himself. He notices that the battery is labeled "Lead-Acid battery". Below this label, battery cells are represented as $Pb, PbSO_4 \mid H_2SO_4 \mid PbO_2, Pb$.
He observes that the electrodes are partially swollen and the concentration of electrolyte is lower than normal. The battery is also discharged. Which of the following schematic diagrams represents the recharging of the car battery?

A)

B)

C)

D)

48. On dilution, conductivity i and molar conductivity ii. The information in which alternative completes the given statement?

A) i-increases ii-decreases

B) i-decreases ii-increases

C) i-increases ii-also increases

D) i-decreases ii-also decreases

49. Faraday's second law can be represented as

A) $E = mc^2$

B) $E = fz$

C) $E = hv$

D) $E = zct$

50. Half-cell reaction for a half-cell
$$Hg(l) + 2OH^-(aq) \rightarrow HgO(s) + H_2O(l) + 2e^-$$
This half-cell is reversible to

A) $H_2O(l)$

B) $HgO(s)$

C) $OH^-(aq)$

D) All are correct