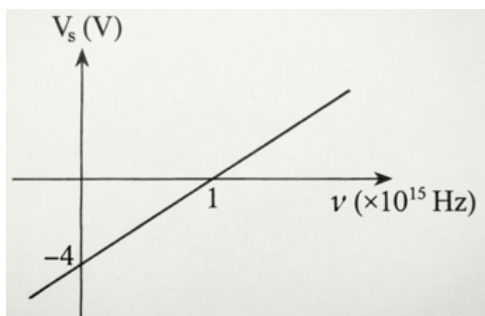


Physics

1. In a photoelectric experiment both lithium (work function = 2.5 eV) and tungsten (work function = 4.5 eV) metals were illuminated by an ultraviolet light of same wavelength. If the stopping potential for tungsten is measured to be 2.0 V, the value of the stopping potential for lithium will be

A) 6 V B) 4 V
C) 8 V D) 2 V

2. The figure shows the results obtained during a photoelectric effect experiment where the stopping potential V_s is plotted against the frequency ν of the incident radiation. The work function of the metal is



close to

A) -4 eV B) 1 eV
C) 6 eV D) 4 eV

3. Light described by the equation

$$E = (120 \text{ V/m}) [\sin(3.14 \times 10^{15} s^{-1}t) + \sin(12.56 \times 10^{15} s^{-1}t)]$$

is incident on a metal surface. The work function of the metal is 2.28 eV. The maximum kinetic energy of the photoelectrons will be

A) 2 eV B) 4 eV
C) 6 eV D) 8 eV

4. Photons with an energy of 9.4 eV strike a clean sodium plate, causing the emission of photoelectrons with a maximum velocity of $1.5 \times 10^6 \text{ m/s}$. The work function of the sodium plate is

A) 2 eV B) 3 eV
C) 5 eV D) 6 eV

5. Given that the work-function of a metal is 3 eV and that photons of 28 eV are incident on it, the maximum velocity of emitted electrons is approximately

A) $2 \times 10^6 \text{ m/s}$ B) $4 \times 10^6 \text{ m/s}$
C) $1 \times 10^6 \text{ m/s}$ D) $3 \times 10^6 \text{ m/s}$

6. The work function of a substance is 3.1 eV. The longest wavelength of light that can cause photoelectron emission from this substance is approximately

A) 600 nm B) 400 nm
C) 200 nm D) 800 nm

7. Photo-energy of 7.8 eV is incident on a surface of work function 2.8 eV. What is the stopping potential for the emitted photoelectrons?

A) -2 V B) -5 V
C) -7 V D) -9 V

8. Light of two different frequencies whose photons have energies 1.8 eV and 4.2 eV respectively, successively illuminates a metal of work function 0.6 eV. The ratio of maximum kinetic energies of the emitted electrons will be

A) 1 : 4 B) 1 : 2
C) 1 : 5 D) 1 : 3

9. Photoelectric emission is observed from a metallic surface for frequencies ν_1 and ν_2 of the incident light rays ($\nu_1 > \nu_2$). If the maximum values of kinetic energy of the photoelectrons emitted in the two cases are in the ratio of $k : 1$, then the threshold frequency of the metallic surface is

A) $\frac{\nu_1 - \nu_2}{k - 1}$ B) $\frac{k\nu_1 - \nu_2}{k - 1}$
C) $\frac{k\nu_2 - \nu_1}{k + 1}$ D) $\frac{\nu_2 - \nu_1}{k - 1}$

10. When green light incident on a surface no electrons are emitted while blue light can emit. If yellow light is incident on the surface then

A) Photons are emitted B) No electrons are emitted
C) Electrons of higher energy are emitted D) Electrons of lower energy are emitted

11. The work functions of metals A and B are in the ratio 1 : 3. If light of frequencies f and $3f$ are incident on the surfaces of A and B respectively, the ratio of the maximum kinetic energies of photoelectrons emitted is (f is greater than threshold frequency of A, $3f$ is greater than threshold frequency of B)

A) 1 : 1 B) 1 : 2
C) 1 : 3 D) 1 : 4

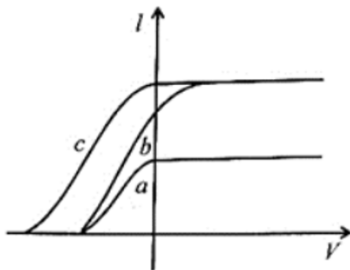
12. When a metal surface is illuminated by light of wavelength 400 nm and 250 nm the maximum velocities of the photoelectrons ejected are v and $2v$ respectively. The work function of the metal is (h = Planck's constant, c = velocity of light in air)

- A) $2hc \times 10^6 J$ B) $1.5hc \times 10^6 J$
C) $hc \times 10^6 J$ D) $0.5hc \times 10^6 J$

13. The work functions of metals A and B are in the ratio 1 : 2 . If light of frequencies f and $2f$ are incident on the surfaces of A and B respectively, the ratio of the maximum kinetic energies of photoelectrons emitted is (f is greater than threshold frequency of A, $2f$ is greater than threshold frequency of B)

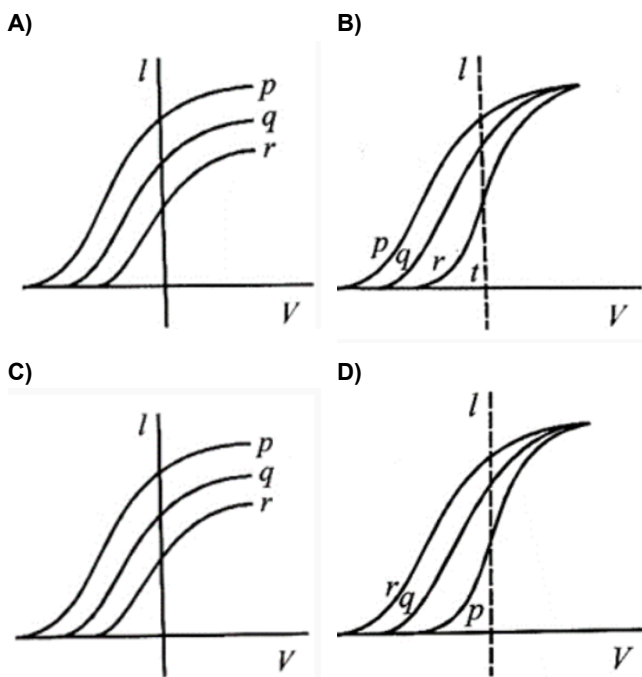
- A) 1:1 B) 1:2
C) 1:3 D) 1:4

14. The figure shows the variation of photocurrent with anode potential for a photosensitive surface for three different radiations. Let I_a, I_b and I_c be the intensities and f_a, f_b and f_c be the frequencies for the curves a, b, and c respectively

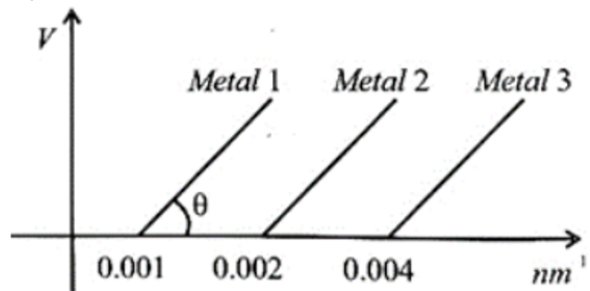


- A) $f_a = f_b$ and $I_a \neq I_b$ B) $f_a = f_c$ and $I_a = I_c$
C) $f_a = f_b$ and $I_a = I_b$ D) $f_b = f_c$ and $I_b = I_c$

15. Photoelectric effect experiments are performed using three different metal plates p, q, and r having work function $\phi_p = 2.0 eV$, $\phi_q = 2.5 eV$ and $\phi_r = eV$, respectively. A light beam containing wavelengths of 550 nm, 450 nm and 350 nm with equal intensities illuminates each of the plates. The correct I-V graph for the experiment is



16. The graph between $1/\lambda$ and stopping potential (V) of three metal having work function ϕ_1, ϕ_2 and ϕ_3 in an experiment of photoelectric is plotted as shown in the figure. Which of the following statement (s) is/are correct? (Here, λ is the wavelength of the incident ray).



- A) Ratio of work functions $\phi_1 : \phi_2 : \phi_3 = 1 : 2 : 4$ B) Ratio of work functions $\phi_1 : \phi_2 : \phi_3 = 4 : 2 : 1$
C) $\tan \theta$ is directly proportional to hc/e where h is Planck's constant and c is the speed of light. D) The violet colour light can eject photoelectrons from metal 2 and 3

17. Photon of Frequency ν incident on a Photo Sensitive Metal with work function ϕ . Knocks out electron in a direction perpendicular to the Metal surface. A Magnetic field is applied parallel to the surface. Find the radius of trajectory of electron.

- A) $\frac{mv}{eB}$ B) $\frac{\sqrt{2m(h\nu-\phi)}}{eB}$
C) $\frac{\sqrt{m(h\nu-\phi)}}{eB}$ D) $\frac{\sqrt{m(h\nu-\phi)}}{2eB}$

18. The work function of a metal is $2.0 eV$ and the wavelength of incident photon is $3.1 \times 10^{-7} m$. Find maximum kinetic energy of photo electrons.

- A) 4 eV B) 1 eV
C) 3 eV D) 2 eV

19. The work function of a metal is $2.0 eV$ and the wavelength of incident photon is $2.48 \times 10^{-7} m$. Find maximum kinetic energy of photo electrons.

- A) 2 eV B) 4 eV
C) 1 eV D) 3 eV

20. The work function of a metal is 3 eV if 2480 Å wavelength of light is incident on the metal. Is there any photo electric effect?

- A) Yes, with maximum kinetic energy 4 eV B) No, because $E < \phi$
C) Yes, with maximum kinetic energy 2 eV D) Data insufficient

21. The work function of a metal is 2.5 eV if 6000 Å wavelength of light is incident on the metal. Is there any photo electric effect?

- A) Yes, with maximum kinetic energy 0.43 eV B) Yes, with maximum kinetic energy 2.07 eV
C) Data insufficient D) No, because $E < \phi$

22. In a photo cell 3 unit photo electric current is flowing, the distance between source and cathode is 6 unit. Now distance between source and cathode becomes 2 unit. What will be photo electric current now?
- A) 6 units B) 27 units
C) 12 units D) 54 units
23. In a photo cell 2 unit photo electric current is flowing, the distance between source and cathode is 6 unit. Now distance between source and cathode becomes 2 unit. What will be photo electric current now?
- A) 8 units B) 18 units
C) 24 units D) 36 units
24. The wavelength of photons in two cases are 6200 Å and 3100 Å respectively what is difference in stopping potential for these two?
- A) 4 V B) 1 V
C) 2 V D) 3 V
25. The wavelength of photons in two cases are 6200 Å and 2480 Å respectively what is difference in stopping potential for these two?
- A) 2 V B) 3 V
C) 5 V D) 1 V
26. Threshold frequency of a surface is ν_0 . It is illuminated by $2\nu_0$ frequency, then maximum speed of photo electrons is V m/sec. What will be maximum speed if incident frequency is $10\nu_0$?
- A) $9V$ B) $4V$
C) $3V$ D) $2V$
27. Threshold frequency of a surface is ν_0 . It is illuminated by $4\nu_0$ frequency, then maximum speed of photo electrons is V m/sec. What will be maximum speed if incident frequency is $13\nu_0$?
- A) $3V$ B) $4V$
C) $V/2$ D) $2V$
28. When incident wavelength is λ , stopping potential is $4V_0$. If incident wavelength is 2λ then stopping potential is V_0 . Find out threshold wavelength in terms of λ .
- A) 2λ B) 6λ
C) 3λ D) 8λ
29. When incident wavelength is λ , stopping potential is $5V_0$. If incident wavelength is 3λ then stopping potential is V_0 . Find out threshold wavelength in terms of λ .
- A) 9λ B) 6λ
C) 2λ D) 12λ
30. A metallic surface of work function $h\nu$ is illuminated by a radiation beam of frequency 3ν . Stopping potential observed is X . What will be stopping potential if the surface is illuminated by radiations of 7ν frequency?
- A) $2.0X$ B) $1.5X$
C) $3.0X$ D) $2.5X$
31. A metallic surface of work function $2h\nu$ is illuminated by a radiation beam of frequency 6ν . Stopping potential observed is X . What will be stopping potential if the surface is illuminated by radiations of 10ν frequency?
- A) $2.5X$ B) $1.5X$
C) $3.0X$ D) $2.0X$
32. A monochromatic light incident on metal 'A' having threshold frequency ν_0 . It emits photo electrons of maximum kinetic energy K . Now incident frequency is made two times and fall on a metal 'B' having threshold frequency $3\nu_0$. What will maximum kinetic energy of photo electrons emitted by metal 'B'?
- A) $2K + h\nu_0$ B) $2K - h\nu_0$
C) $3K - h\nu_0$ D) $K - 3h\nu_0$
33. A monochromatic light incident on metal 'A' having threshold frequency ν_0 . It emits photo electrons of maximum kinetic energy K . Now incident frequency is made four times and fall on a metal 'B' having threshold frequency $3\nu_0$. What will maximum kinetic energy of photo electrons emitted by metal 'B'?
- A) $4K - h\nu_0$ B) $4K + h\nu_0$
C) $3K + h\nu_0$ D) $K + 4h\nu_0$
34. Power of a radiator is 50 watt and its λ is 663 nm. Calculate No. of photon emitted in 10 hrs.
- A) 3.0×10^{24} B) 6.0×10^{24}
C) 2.0×10^{22} D) 9.0×10^{24}
35. Power of a radiator is 200 watt and its λ is 500 nm. Calculate No. of photon emitted in 5 hrs.
- A) 4.5×10^{24} B) 3.6×10^{22}
C) 9.0×10^{24} D) 2.0×10^{20}
36. A source S_1 is producing 10^{15} photon/s of wavelength 5000 Å. Another source S_2 is producing 1.02×10^{15} photon/s of wavelength 2550 Å. Calculate ratio of power of S_2 to power of S_1 .
- A) 2 : 1 B) 1 : 1
C) 1 : 2 D) 1.02 : 1
37. A source S_1 is producing 10^{15} photon/s of wavelength 5000 Å. Another source S_2 is producing 2.04×10^{15} photon/s of wavelength 5100 Å. Calculate ratio of power of S_2 to power of S_1 .
- A) 1 : 2 B) 1 : 1
C) 2 : 1 D) 2.04 : 1
38. In a photo-electric experiment frequency of incident light is tripled and its intensity is doubled. How much time the photon current is obtained?
- A) $3/2$ times B) $2/3$ times
C) 6 times D) $1/6$ times

39. In a photo-electric experiment frequency of incident light is made four times and its intensity is doubled. How much time the photon current is obtained?

- A) 2 times B) 8 times
C) $1/2$ times D) $1/8$ times

40. The power of a bulb is 90 milliwatt and the wavelength of light is 6600 Å. Calculate the number of photons/second emitted by the bulb?

- A) 1.5×10^{17} photon/sec B) 3.0×10^{17} photon/sec
C) 6.0×10^{17} photon/sec D) 3.0×10^{16} photon/sec

41. The power of a bulb is 100 milliwatt and the wavelength of light is 5000 Å. Calculate the number of photons/second emitted by the bulb?

- A) 1.8×10^{17} photon/sec B) 5.0×10^{16} photon/sec
C) 3.2×10^{18} photon/sec D) 2.5×10^{17} photon/sec

42. A beam of electromagnetic wave of power 30 watt is incident normally on a surface, which absorb 20% power and remaining power is reflected. Calculate force exerted on a surface.

- A) 1.0×10^{-7} N B) 3.6×10^{-7} N
C) 1.8×10^{-7} N D) 9.0×10^{-8} N

43. A beam of electromagnetic wave of power 20 watt is incident normally on a surface, which absorb 50% power and remaining power is reflected. Calculate force exerted on a surface.

- A) 5.0×10^{-8} N B) 1.0×10^{-7} N
C) 2.0×10^{-7} N D) 6.7×10^{-8} N

44. A 60 W sodium lamp radiates energy uniformly in all directions. The lamp is located at the centre of a large sphere that absorbs all the sodium light, which is incident on it. The wavelength of the sodium light is 660 nm. (a) What is the energy per photon associated with the sodium light? (b) At what rate are the photons delivered to the sphere?

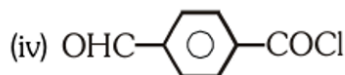
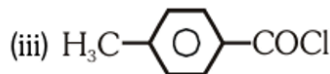
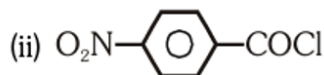
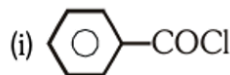
- A) $E = 2.48 \times 10^{-19}$ J, B) $E = 3.01 \times 10^{-19}$ J,
 $n = 2.4 \times 10^{20}$ photons/s $n = 2.0 \times 10^{20}$ photons/s
C) $E = 4.12 \times 10^{-19}$ J, D) $E = 1.80 \times 10^{-19}$ J,
 $n = 1.5 \times 10^{20}$ photons/s $n = 3.2 \times 10^{20}$ photons/s

45. A 60 W sodium lamp radiates energy uniformly in all directions. The lamp is located at the centre of a large sphere that absorbs all the sodium light, which is incident on it. The wavelength of the sodium light is 663 nm. (a) What is the energy per photon associated with the sodium light? (b) At what rate are the photons delivered to the sphere?

- A) $E = 2.0 \times 10^{-19}$ J, B) $E = 3.0 \times 10^{-19}$ J,
 $n = 3.0 \times 10^{20}$ photons/s $n = 2.0 \times 10^{20}$ photons/s
C) $E = 4.0 \times 10^{-19}$ J, D) $E = 1.5 \times 10^{-19}$ J,
 $n = 1.5 \times 10^{20}$ photons/s $n = 4.0 \times 10^{20}$ photons/s

Chemistry

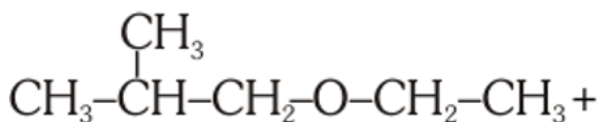
46. Consider the following compounds:



The correct order of reactivity towards hydrolysis is:

- A) (i) > (ii) > (iii) > (iv) B) (iv) > (ii) > (i) > (iii)
C) (ii) > (iv) > (i) > (iii) D) (ii) > (iv) > (iii) > (i)

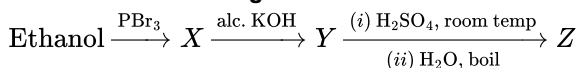
47. In the reaction:



HI $\rightarrow$... which of the following compounds will be formed:

- A) $\text{CH}_3 - \overset{\text{CH}_3}{\underset{|}{\text{CH}}} - \text{CH}_3 + \text{CH}_3 - \text{CH}_2 - \text{OH}$ B) $\text{CH}_3 - \overset{\text{CH}_3}{\underset{|}{\text{CH}}} - \text{CH}_2 - \text{OH} + \text{CH}_3 - \text{CH}_3$
C) $\text{CH}_3 - \overset{\text{CH}_3}{\underset{|}{\text{CH}}} - \text{CH}_2 - \text{OH} + \text{CH}_3 - \text{CH}_2 - \text{I}$ D) $\text{CH}_3 - \overset{\text{CH}_3}{\underset{|}{\text{CH}}} - \text{CH}_2 - \text{I} + \text{CH}_3 - \text{CH}_2 - \text{OH}$

48. Consider the following reaction:



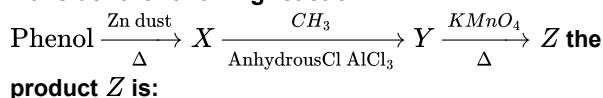
the product Z is:

- A) $\text{CH}_3\text{CH}_2\text{OH}$ B) $\text{CH}_2 = \text{CH}_2$
C) $\text{CH}_3\text{CH}_2 - \text{O} - \text{CH}_2 - \text{CH}_3$ D) $\text{CH}_3\text{CH}_3 - \text{CH}_2 - \text{O} - \text{SO}_3\text{H}$

49. Propionic acid with Br_2/P yields a dibromo product. Its structure would be:

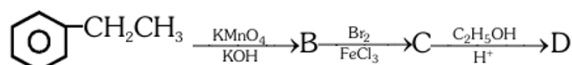
- A) B) $\text{CH}_2\text{Br} - \text{CHBr} - \text{COOH}$
C) D) $\text{CH}_2\text{Br} - \text{CH}_2 - \text{COBr}$

50. Consider the following reaction:

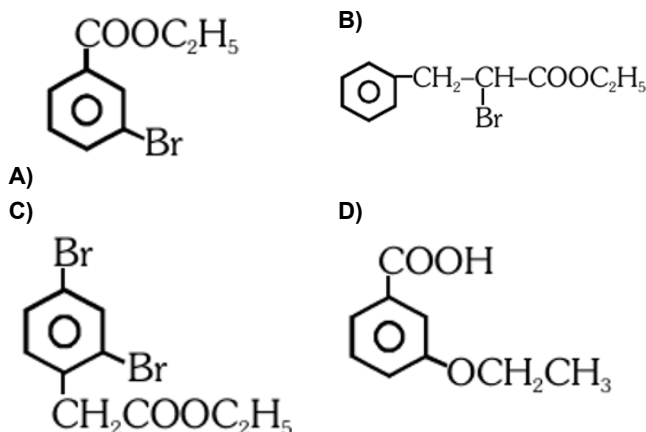


- A) Benzene
B) Toluene
C) Benzaldehyde
D) Benzoic acid

51. In a set of reactions, ethyl benzene yielded a product D:



'D' would be :-



52. When glycerol is treated with excess of HI, it produces:

- A) Allyl iodide
B) Propene
C) Glyceryl triiodide
D) 2-Iodopropane

53. Match the compounds given in List-I with their characteristic reactions given in List-II. Select the correct option.

List-I (Compounds)

- (a) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{NH}_2$
(b) $\text{CH}_3\text{C}\equiv\text{CH}$
(c) $\text{CH}_3\text{CH}_2\text{COOCH}_3$
(d) $\text{CH}_3\text{CH}(\text{OH})\text{CH}_3$

List-II (Reactions)

- (i) Alkaline hydrolysis
(ii) With KOH (alcohol) and CHCl_3 produces bad smell
(iii) Gives white ppt. with ammonical AgNO_3
(iv) With Lucas reagent cloudiness appears after 5 minutes

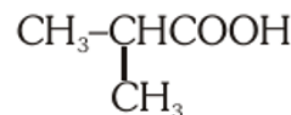
- A) (a)-(iii), (b)-(ii), (c)-(i), (d)-(iv)
B) (a)-(ii), (b)-(iii), (c)-(i), (d)-(iv)
C) (a)-(iv), (b)-(ii), (c)-(iii), (d)-(i)
D) (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)

54. Clemmensen reduction of a ketone is carried out in the presence of which of the following?

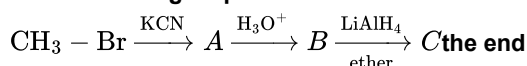
- A) Glycol with KOH
B) Zn - Hg with conc. HCl
C) LiAlH_4
D) H_2 and Pt as catalyst

55. An organic compound 'A' on treatment with NH_3 gives 'B' which on heating gives 'C'. 'C' when treated with Br_2 in the presence of KOH produces ethylamine. Compound 'A' is:

- A) $\text{CH}_3\text{CH}_2\text{COOH}$
B) CH_3COOH
C) $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$
D)



56. In the following sequence of reactions:



product (C) is:

- A) Acetaldehyde
B) Ethyl alcohol
C) Acetone
D) Methane

57. CH_3CHO and $\text{C}_6\text{H}_5\text{CH}_2\text{CHO}$ can be distinguished chemically by:

- A) Tollens' reagent test
B) Fehling solution test
C) Benedict test
D) Iodoform test

58. Among the following sets of reactants, which one produces anisole?

- A) $\text{CH}_3\text{CHO} + \text{RMgX}$
B) $\text{C}_6\text{H}_5\text{OH} + \text{NaOH} + \text{CH}_3\text{I}$
C) $\text{C}_6\text{H}_5\text{OH} + \text{neutral FeCl}_3$
D) $\text{C}_6\text{H}_5-\text{CH}_3 + \text{CH}_3\text{COCl} + \text{AlCl}_3$

59. Which of the following will not be soluble in sodium hydrogen carbonate?

- A) 2,4,6-Trinitrophenol
B) Benzoic acid
C) o-Nitrophenol
D) Benzenesulphonic acid

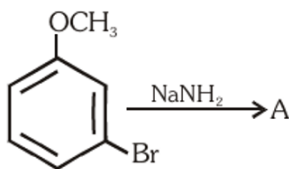
60. Reaction of phenol with chloroform in the presence of dilute sodium hydroxide finally introduces which one of the following functional groups?

- A) $-\text{CHCl}_2$
B) $-\text{CHO}$
C) $-\text{CH}_2\text{Cl}$
D) $-\text{COOH}$

61. The heating of phenyl-methyl ether with HI produces:

- A) Iodobenzene
B) Phenol
C) Benzene
D) Ethyl chloride

62. Identify *A* and predict the type of reaction in the following transformation:



- A) and elimination addition reaction
- B) and cine substitution reaction
- C) and cine substitution reaction
- D) and substitution reaction

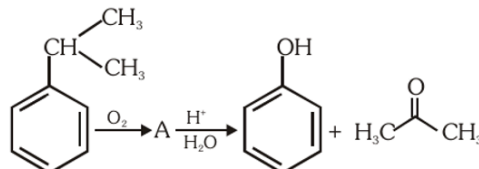
63. Compound *A*, $\text{C}_8\text{H}_{10}\text{O}$, is found to react with NaOI (produced by reacting *Y* with NaOH) and yields a yellow precipitate with characteristic smell. *A* and *Y* are respectively:

- A) and I_2
- B) and I_2
- C) and I_2
- D) and I_2

64. The compound *A* on treatment with Na gives *B*, and with PCl_5 gives *C*. *B* and *C* react together to give diethyl ether. *A*, *B* and *C* are in the order:

- A) $\text{C}_2\text{H}_5\text{OH}$, C_2H_6 , $\text{C}_2\text{H}_5\text{Cl}$
- B) $\text{C}_2\text{H}_5\text{OH}$, $\text{C}_2\text{H}_5\text{Cl}$, $\text{C}_2\text{H}_5\text{ONa}$
- C) $\text{C}_2\text{H}_5\text{Cl}$, C_2H_6 , $\text{C}_2\text{H}_5\text{OH}$
- D) $\text{C}_2\text{H}_5\text{OH}$, $\text{C}_2\text{H}_5\text{ONa}$, $\text{C}_2\text{H}_5\text{Cl}$

65. The structure of intermediate *A* in the oxidation of cumene to phenol is:



- (1)
- (2)
- (3)
- (4)

- A) 1
- B) 2
- C) 3
- D) 4

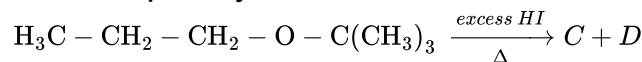
66. The reaction that does not give benzoic acid as the major product is:

- A) $\xrightarrow{\text{K}_2\text{Cr}_2\text{O}_7}$ $\xrightarrow[\text{(ii) H}_3\text{O}^+]{\text{(i) NaOCl}}$
- B)
- C) $\xrightarrow[\text{(Pyridinium chlorochromate)}]{\text{PCC}}$ $\xrightarrow{\text{KMnO}_4/\text{H}^+}$
- D)

67. When vapours of a secondary alcohol are passed over heated copper at 573 K, the product formed is:

- A) a carboxylic acid
- B) an aldehyde
- C) a ketone
- D) an alkene

68. The major products *C* and *D* formed in the following reaction respectively are:



- A) $\text{H}_3\text{C}-\text{CH}_2-\text{CH}_2-\text{I}$ and $\text{I}-\text{C}(\text{CH}_3)_3$
- B) $\text{H}_3\text{C}-\text{CH}_2-\text{CH}_2-\text{OH}$ and $\text{I}-\text{C}(\text{CH}_3)_3$
- C) $\text{H}_3\text{C}-\text{CH}_2-\text{CH}_2-\text{I}$ and $\text{HO}-\text{C}(\text{CH}_3)_3$
- D) $\text{H}_3\text{C}-\text{CH}_2-\text{CH}_2-\text{OH}$ and $\text{HO}-\text{C}(\text{CH}_3)_3$

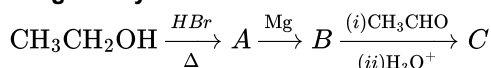
69. Methanol can be distinguished from ethanol by the following except:

- A) Reaction with iodine and alkali
- B) Reaction with salicylic acid and H_2SO_4
- C) Reaction with Lucas reagent
- D) Boiling point

70. Ethanol on heating with acetic acid in the presence of a few drops of sulphuric acid gives the smell of:

- A) Oil of wintergreen B) Oil of mustard
C) An ester D) Oil of bitter almonds

71. The compounds A, B and C in the reaction sequence are given by the set:

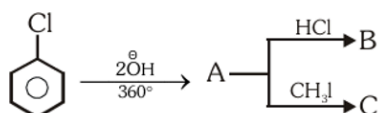


- A) $\text{CH}_3\text{CH}_2\text{Br}$, $\text{CH}_3\text{CH}_2\text{MgBr}$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
B) $\text{CH}_3\text{CH}_2\text{Br}$, $\text{CH}_3\text{CH}_2\text{MgBr}$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$
C) $\text{CH}_3\text{CH}_2\text{Br}$, $\text{CH}_3\text{CH}_2\text{MgBr}$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$
D) $\text{CH}_3\text{CH}_2\text{Br}$, $\text{CH}_3\text{CH}_2\text{MgBr}$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$

72. Which of the following reactions will not lead to a phenol?

- A) $\text{C}_6\text{H}_5\text{SO}_3\text{Na} + \text{NaOH} \xrightarrow[(\text{ii})\text{H}^+]{(\text{i})\text{Fuse}/\Delta}$
B) $\text{C}_6\text{H}_5\text{N}_2\text{Cl} + \text{H}_2\text{O} \xrightarrow{\text{Boil}}$
C) $\text{C}_6\text{H}_5\text{ONa} + \text{RX} \xrightarrow{\text{Heat}}$
D) $\text{C}_6\text{H}_5\text{COONa} + \text{NaOH}(\text{CaO}) \xrightarrow{\text{Heat}}$

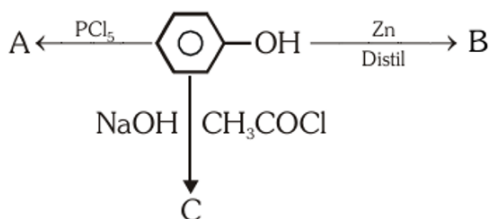
73. The structures of the compounds / ions A, B and C in the reaction sequence are given by the set:



- (1) $\text{C}_6\text{H}_5\text{OH}$, $\text{C}_6\text{H}_5\text{Cl}$, $\text{C}_6\text{H}_5\text{CH}_3$
(2) $\text{C}_6\text{H}_5\text{O}^-$, $\text{C}_6\text{H}_5\text{OH}$, $\text{C}_6\text{H}_5\text{OCH}_3$
(3) $\text{C}_6\text{H}_5\text{O}^-$, $\text{C}_6\text{H}_5\text{Cl}$, $\text{C}_6\text{H}_5\text{I}$
(4) $\text{C}_6\text{H}_5\text{O}^-$, $\text{C}_6\text{H}_5\text{OH}$, $\text{C}_6\text{H}_5\text{I}$

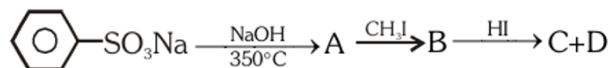
- A) 1 B) 2
C) 3 D) 4

74. The compounds A, B and C in the above reaction sequence are:



- A) Chlorobenzene, benzene, methyl benzoate
B) Triphenyl phosphate, benzene, phenyl acetate
C) Benzyl chloride, benzene, phenyl acetate
D) Benzyl chloride, benzene, phenylacetyl chloride

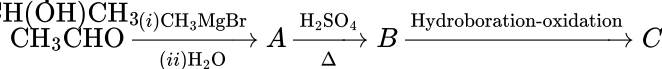
75. In the reaction sequence:



A, B, C and D are given by the set:-

- A) Sodium phenate, anisole, $\text{C}_6\text{H}_5\text{I}$, CH_3OH
B) Sodium phenate, phenetole, $\text{C}_2\text{H}_5\text{I}$, $\text{C}_6\text{H}_5\text{OH}$
C) Sodium phenate, anisole, $\text{C}_6\text{H}_5\text{OH}$, CH_3I
D) Sodium phenate, phenetole, $\text{C}_6\text{H}_5\text{I}$, $\text{C}_2\text{H}_5\text{OH}$

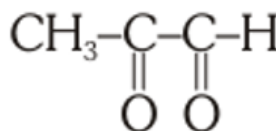
76. Compound A and C in the following reaction sequence are:



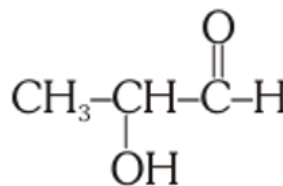
- A) Identical B) Functional isomer
C) Positional isomer D) Optical isomer

77. Which of the following aldehydes does not form iodoform on heating with iodine and alkali?

- A) $\text{CH}_3\text{COCH}_2\text{CH}_3$ B) ICH_2CHO



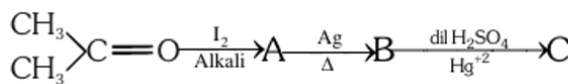
- C) $\text{CH}_3\text{CH}_2\text{CHO}$ D) $\text{CH}_3\text{CH}(\text{OH})\text{CHO}$



78. Which of the following statements is wrong?

- A) All methyl ketones give a positive iodoform test
B) Acetaldehyde is the only aldehyde that gives iodoform test
C) All secondary alcohols give positive iodoform test
D) Any alcohol that can be oxidized to an acetyl group gives a positive iodoform test

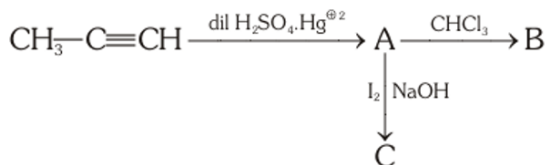
79. The compounds A, B and C in the reaction sequence:



are given by the set:-

- A) CHI_3 , $\text{H}_2\text{C}=\text{CH}_2$, $\text{CH}_3\text{CH}_2\text{CH}_3$
B) CHI_3 , $\text{HC}\equiv\text{CH}$, CH_3CHO
C) CHI_3 , $\text{CH}_3\text{C}\equiv\text{CH}$, CH_3COCH_3
D) CHI_3 , $\text{CH}_3\text{CH}(\text{OH})\text{CH}_3$, $\text{CH}_3\text{C}(=\text{O})\text{CH}_3$

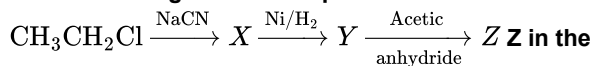
80. In the reaction sequence:



A, B and C are given by the set:

- A) $\text{CH}_3\text{CH}_2\text{CHO}$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$
 B) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$
 C) CH_3COCH_3 , $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$
 D) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$

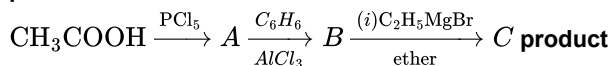
81. In the following reaction sequence:



above reaction sequence is:

- A) $\text{CH}_3\text{CH}_2\text{CH}_2\text{NHCOCH}_3$
 B) $\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$
 C) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CONHCH}_3$
 D) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CONHCOCH}_3$

82. In a set of the given reactions, acetic acid yielded a product C:



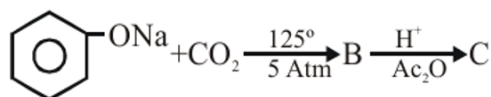
C would be:

- A) $\text{CH}_3\text{CH}(\text{OH})\text{C}_2\text{H}_5$
 B) $\text{CH}_3\text{COC}_6\text{H}_5$
 C) $\text{CH}_3\text{CH}(\text{OH})\text{C}_6\text{H}_5$
 D) $\text{CH}_3\text{C}(\text{OH})(\text{C}_2\text{H}_5)\text{C}_6\text{H}_5$

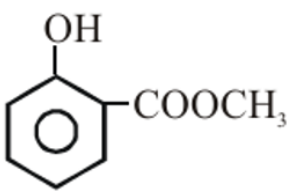
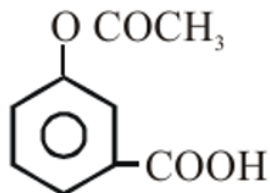
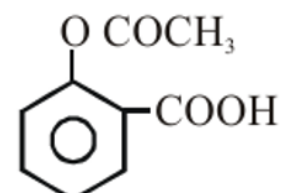
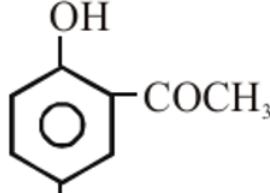
83. Sodium ethoxide has reacted with ethanoyl chloride. The compound that is produced in the above reaction is:

- A) Ethyl chloride
 B) Ethyl ethanoate
 C) Diethyl ether
 D) 2-Butanone

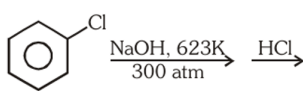
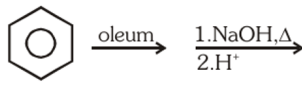
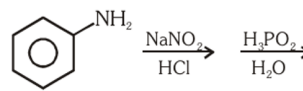
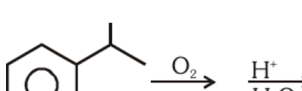
84. Sodium phenoxide when heated with CO_2 under pressure at 125°C yields a product which on acetylation produces C:



The major product C would be:

- A) 
 B) 
 C) 
 D) 

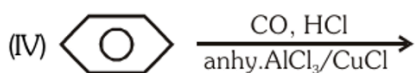
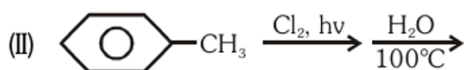
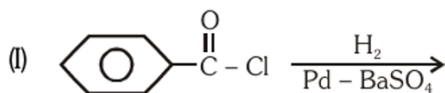
85. Which of the following reaction sequences does not give phenol?

- A) 
 B) 
 C) 
 D) 

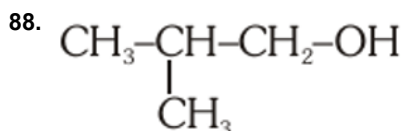
86. Which of the following reactions does not give aldehyde as major product?

- A) $\text{RCH}_2\text{OH} \xrightarrow[\text{HCl}]{\text{CrO}_3, \text{pyridine}} \text{RCHO}$
 B) $\text{RCH}_2\text{OH} \xrightarrow[\text{CrO}_3]{\text{anhy.}} \text{RCHO}$
 C) $\text{RCH}_2\text{OH} \xrightarrow[573\text{K}]{\text{Cu}} \text{RCHO}$
 D) $\text{RCH}_2\text{OH} \xrightarrow[\text{H}^+]{\text{KMnO}_4} \text{RCHO}$

87. Which of the following can be used to prepare benzaldehyde?



- A) I, II
C) I, III, IV
B) II, III, IV
D) I, II, III, IV



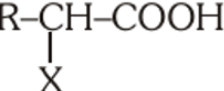
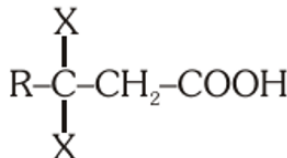
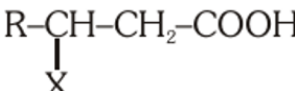
is obtained from which of the following methods?

- A) $\text{CH}_3\text{CH}_2\text{CH}_2\text{Cl} + \text{H}_2\text{O}$
C) $\text{H-CHO}, \text{CH}_3\text{-CH(MgBr)}, \text{H}_2\text{O}$
B) $\text{CH}_3\text{CHO} + \text{CH}_3\text{-CH}_2\text{MgBr} + \text{H}_2\text{O}$
D) $\text{CH}_3\text{-CH(CH}_3\text{)-CH}_2\text{-NH}_2 + \text{HNO}_2$

89. Which of the following substrates gives the same product on reduction with DIBAL-H?

- A) $\text{CH}_3 - (\text{CH}_2)_4 - \text{CN}$
and
 $\text{CH}_3 - (\text{CH}_2)_5 - \text{COOH}$
C) $\text{CH}_3 - (\text{CH}_2)_4 - \text{COOH}$
and
 $\text{CH}_3 - (\text{CH}_2)_4 - \text{COCH}_3$
B) $\text{CH}_3 - (\text{CH}_2)_4 - \text{CN}$
and
 $\text{CH}_3 - (\text{CH}_2)_4 - \text{COOC}_2\text{H}_5$
D) $\text{CH}_3 - (\text{CH}_2)_5 - \text{COOH}$
and
 $\text{CH}_3(\text{CH}_2)_4 - \text{COOC}_2\text{H}_5$

90. The product formed during Hell-Volhard-Zelinsky reaction is:

- A) 
C) 
B) $\text{R} - \text{CH}_2 - \text{COX}$
D) 

Botany

91. Why does the inactive Bt toxin protein produced by *Bacillus thuringiensis* not kill the bacterium itself?

- A) It is stored within impermeable bacterial endospores.
C) The bacterium possesses a specific cytoplasmic antitoxin.
B) It is produced as an inactive protoxin requiring an alkaline pH for activation.
D) The toxin gene is only transcribed in the presence of host vascular sap.

92. The inactive protoxin of *Bacillus thuringiensis* gets converted into active toxin in the insect gut due to:

- A) Acidic pH of the insect midgut
C) High temperature inside the insect haemolymph
B) Action of bacterial intracellular proteases
D) Alkaline pH of the insect gut which solubilizes the crystals

93. Which of the following genes encodes proteins that control cotton bollworms?

- A) cryIAb and cryIAc
C) cryIAb and cryIIAb
B) cryIAc and cryIIAb
D) cryIIAc and cryIAb

94. In RNA interference (RNAi), the silencing of a specific mRNA is triggered by the presence of:

- A) Single-stranded circular RNA molecule
C) Ribosomal RNA complex
B) Double-stranded RNA (dsRNA) molecule
D) Transfer RNA adapter sequence

95. Transgenic tobacco plants resistant to *Meloidogyne incognita* were developed by introducing DNA that produces what in the host cells?

- A) A direct toxic crystal protein
C) Both sense and anti-sense RNA of the nematode gene
B) only sense strand
D) double stranded DNA

96. RNA interference (RNAi) takes place as a method of cellular defense in:

- A) All prokaryotic organisms
C) Only transgenic solanaceous plants
B) All eukaryotic organisms
D) Viruses and protozoans only

97. In 1983, which company successfully prepared two DNA sequences corresponding to human insulin chains A and B to produce Humulin?

- A) Biocon Ltd.
C) Genentech
B) Eli Lilly
D) Pfizer

98. Recombinant insulin chains A and B, produced separately in *E. coli*, are joined together artificially by creating:

- A) Hydrogen bonds
C) Peptide bonds
B) Disulfide bonds
D) Glycosidic linkages

99. Adenosine deaminase (ADA) deficiency can be permanently cured if the functional gene is introduced into cells at what stage?

- A) Adult bone marrow stage
- B) Early embryonic stages
- C) Circulating lymphocyte
- D) Geriatric treatment phase stage in adults

100. Why is periodic infusion of genetically engineered lymphocytes not a permanent cure for ADA deficiency?

- A) Cells undergo rapid lysis in the liver.
- B) The cells are not immortal, requiring repeated infusions.
- C) The retroviral vector is rejected by host antibodies.
- D) Integrated cDNA undergoes structural silencing.

101. The exploitation of bio-resources by multinational companies without authorized consensus or compensation is known as:

- A) Bioprospecting
- B) Biopiracy
- C) Bio-remediation
- D) Bio-mining

102. How many documented varieties of Basmati rice are estimated to be grown traditionally within India?

- A) 7 varieties
- B) 27 varieties
- C) 200,000 varieties
- D) 50 varieties

103. In 1997, an American firm obtained patent rights on Basmati rice through which legal institution?

- A) European Patent Office
- B) US Patent and Trademark Office
- C) Indian Patent Registry
- D) World Intellectual Property Organization

104. Which of the following is an example of using a transgenic modification to enhance the nutritional profile of a staple crop?

- A) Flavr Savr tomato
- B) Golden Rice
- C) Bt Corn
- D) Herbicide-tolerant soybean

105. The toxic crystal protein synthesized by *Bacillus thuringiensis* is active against which order of insects?

- A) Lepidopterans, Coleopterans, and Dipterans
- B) Hymenopterans and Odonata
- C) Hemiptera and Orthoptera
- D) Neuroptera only

106.

What mechanism causes active Bt toxin molecules to induce death in susceptible target insect larvae?

- A) Coagulation of blood cells in the heart
- B) Creating pores in the midgut epithelial lining leading to cell swelling and lysis
- C) Neurotoxic block at neuromuscular junctions
- D) Complete starvation by blocking salivary secretion

107.

Green Revolution practices succeeded in increasing food supply significantly, primarily due to:

- A) The widespread deployment of transgenic animal lines
- B) Improved crop varieties, agrochemicals, and better management
- C) Exclusive organic farming practices
- D) Complete elimination of all phytophagous insect species

108.

Which of the following is NOT an advantage of Genetically Modified (GM) crops?

- A) Increased tolerance to abiotic stresses like drought or cold
- B) Reduced reliance on chemical pesticides
- C) Increased post-harvest losses to feed local soil microfauna
- D) Enhanced efficiency of mineral usage by the plant

109.

The source of the double-stranded RNA (dsRNA) molecule that triggers gene silencing within an organism can be:

- A) Infection by viruses with RNA genomes
- B) Transposons that replicate via an RNA intermediate
- C) Artificial synthesis or introduction of matching strands
- D) All of the above

110.

The primary clinical symptom seen in young pediatric patients suffering from severe ADA deficiency is:

- A) Brittle bone structural defects
- B) Severe combined immunodeficiency due to lack of functional T and B lymphocytes
- C) Inability to digest proteinaceous diets
- D) Excessive internal hemorrhaging from poor clotting

111.

Which mechanism was used to synthesize human insulin in *E. coli* without having to process the complex C-peptide chain?

- A) Synthesizing the complete pro-insulin and treating it with human stomach acid
- B) Cloning and expressing DNA sequences for chains A and B separately, then mixing them in vitro
- C) Using a mutated *E. coli* that cleaves the C-peptide naturally
- D) Injecting pro-insulin directly into human blood for processing

Which of the following is a classic example of a pest-resistant transgenic plant crop?

- A) Bt Cotton** **B) Golden Rice**
C) Rosie Potato **D) High-iron wheat**

113.

The production of transgenic crops has helped reduce the use of harmful chemical pesticides. This is an example of:

- A)** Environmental bioremediation
- B)** Pest-resistant crop engineering
- C)** Abiotic stress tolerance enhancement
- D)** Post-harvest loss mitigation

114.

Before recombinant DNA technology, therapeutic insulin was typically extracted from the pancreas of slaughtered cattle and pigs. What was a major limitation of this method?

- A)** The insulin was completely non-functional in humans.
- B)** It caused severe allergic reactions and foreign protein sensitivities in many patients.
- C)** It instantly raised blood glucose levels.
- D)** Animal insulin lacked disulfide bonds entirely.

115.

The introduction of vitamin-A-enriched Golden Rice aims to combat which global public health challenge?

- A) Severe protein-energy malnutrition**
- B) Night blindness and childhood blindness in developing populations**
- C) Widespread gluten sensitivities**
- D) Iron deficiency anemia**

116.

Match the items in Column I with their correct applications/descriptions in Column II:

Column I	Column II
A. cryIAc	i. Controls Corn Borer
B. cryIAb	ii. First clinical gene therapy host cells
C. Lymphocytes	iii. Excised during maturation of pro-insulin
D. C peptide	iv. Controls Cotton Bollworms

- A)** A-iv, B-i, C-ii, D-iii
B) A-i, B-iv, C-ii, D-iii
C) A-iv, B-i, C-iii, D-ii
D) A-ii, B-i, C-iv, D-iii

117.

Match the following regulatory bodies and biopiracy targets:

Column I	Column II
A. GEAC	i. 30 globally , 12 in india
B. Basmati Rice	ii. Evaluates the safety of GM crops for public use
C. Meloidogyne incognita	iii. 27 documented varieties exist in India
D. Therapeutic drugs	iv. Root-knot nematode of tobacco plants

- A)** A-ii, B-iii, C-iv, D-i
B) A-ii, B-iv, C-iii, D-i
C) A-iii, B-ii, C-iv, D-i
D) A-iv, B-iii, C-ii, D-i

118.

Consider the following statements regarding Bt toxin:
Statement I: The toxic Bt protein exists as inactive protoxins in *Bacillus thuringiensis*. **Statement II:** The inactive protoxin is converted into an active toxin due to the acidic pH of the insect midgut which solubilizes the crystals.

- A)** Both Statement I and Statement II are correct.
- B)** Both Statement I and Statement II are incorrect.
- C)** Statement I is correct but Statement II is incorrect.
- D)** Statement I is incorrect but Statement II is correct.

119.

Read the following statements about RNA interference (RNAi): Statement I: RNAi takes place in all eukaryotic organisms as a method of cellular defense. Statement II: It involves silencing of a specific mRNA due to a complementary double-stranded RNA (dsRNA) molecule that prevents translation.

- A)** Both Statement I and Statement II are correct.
- B)** Both Statement I and Statement II are incorrect.
- C)** Statement I is correct but Statement II is incorrect.
- D)** Statement I is incorrect but Statement II is correct.

120.

Evaluate the statements regarding genetically engineered insulin: Statement I: Eli Lilly, an American company, prepared two DNA sequences corresponding to chains A and B of human insulin in 1983. Statement II: These separate chains were produced in Escherichia coli plasmids and then extracted and combined by creating peptide bonds artificially.

- A)** Both Statement I and Statement II are correct.
- B)** Both Statement I and Statement II are incorrect.
- C)** Statement I is correct but Statement II is incorrect.
- D)** Statement I is incorrect but Statement II is correct.

121.

Assertion (A): The first clinical gene therapy in 1990 was given to a four-year-old girl with an adenosine deaminase (ADA) deficiency. **Reason (R):** The lymphocytes from the blood of the patient were grown in a culture outside the body and a functional ADA cDNA was introduced into them using a retroviral vector.

- A)** Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
- B)** Both Assertion (A) and Reason (R) are true but Reason (R) is NOT the correct explanation of Assertion (A).
- C)** Assertion (A) is true but Reason (R) is false.
- D)** Assertion (A) is false but Reason (R) is true.

122.

Assertion (A): Genetically modified plants can reduce post-harvest losses and enhance the nutritional value of food. Reason (R): Golden rice is a transgenic variety of rice enriched with Vitamin A (beta-carotene).

- A)** Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
B) Both Assertion (A) and Reason (R) are true but Reason (R) is NOT the correct explanation of Assertion (A).
C) Assertion (A) is true but Reason (R) is false.
D) Assertion (A) is false but Reason (R) is true.

123.

Assertion (A): RNA interference is an effective strategy to protect tobacco plants from the root-knot nematode *Meloidogyne incognita*. Reason (R): *Agrobacterium* vectors are used to introduce nematode-specific genes into the host plant, which produce both sense and anti-sense RNA to form double-stranded RNA (dsRNA).

- A)** Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
B) Both Assertion (A) and Reason (R) are true but Reason (R) is NOT the correct explanation of Assertion (A).
C) Assertion (A) is true but Reason (R) is false.
D) Assertion (A) is false but Reason (R) is true.

124.

Why does the inactive Bt toxin protein produced by *Bacillus thuringiensis* not kill the bacterium itself?

- A)** It is stored within the bacterial endospore which is impermeable to toxins.
B) It is produced as an inactive protoxin that requires an alkaline pH to become active.
C) The bacterium possesses a specific antitoxin molecule in its cytoplasm.
D) The toxin gene is only transcribed in the presence of plant vascular sap.

125.

The inactive protoxin of *Bacillus thuringiensis* gets converted into active toxin in the insect gut due to:

- A)** Acidic pH of the insect midgut
B) Action of bacterial proteases
C) High temperature inside the insect haemolymph
D) Alkaline pH of the insect gut which solubilizes the crystals

126.

Transgenic tobacco plants resistant to *Meloidogyne incognita* were developed by introducing DNA that produces what in the host cells?

- A)** double stranded DNA
B) only sense strand RNA
C) Both sense and anti-sense RNA of the nematode gene
D) only anti sense strand RNA

127.

Which of the following statements regarding RNA interference in host plants is correct?

- A)** The nematode parasite can no longer physically infect the transgenic host plant root tissue.
B) The transgenic host plant completely stops transcription of all of its own housekeeping genes.
C) The nematode's genomic DNA is permanently cleaved by plant restriction endonucleases.
D) The complementary sense and antisense RNA form dsRNA that silences the specific mRNA of the parasite.

128.

Mature human insulin differs from pro-insulin because pro-insulin contains an extra polypeptide stretch called:

- A)** Chain C peptide which forms disulfide linkages
B) C-peptide that is removed during maturation
C) Leader sequence required for plasmid replication
D) A-chain extension fragment

129.

In 1983, Eli Lilly prepared two DNA sequences corresponding to human insulin chain A and chain B, and introduced them in plasmids of which organism for production?

- A)** *Agrobacterium tumefaciens*
B) *Escherichia coli*
C) *Saccharomyces cerevisiae*
D) *Bacillus thuringiensis*

130.

Assertion (A): Chain A and Chain B of human insulin produced via recombinant *E. coli* are combined by creating disulfide bonds. Reason (R): Natural human insulin is synthesized as a single polypeptide which requires C-peptide removal.

- A)** Both (A) and (R) are true and (R) is the correct explanation of (A).
B) Both (A) and (R) are true but (R) is not the correct explanation of (A).
C) (A) is true but (R) is false.
D) (A) is false but (R) is true.

131.

Adenosine deaminase (ADA) deficiency is caused due to the deletion of the gene for the enzyme adenosine deaminase, which is crucial for:

- A)** Proper functioning of the immune system
B) Synthesis of red blood cells in bone marrow
C) Digestion of purine-rich dietary components
D) Regulation of blood glucose levels

132.

In the first clinical gene therapy given in 1990 to a 4-year-old girl with ADA deficiency, the procedure involved:

- | | |
|---|--|
| A) Oral administration of recombinant ADA enzyme daily | B) Periodic infusion of genetically engineered lymphocytes carrying functional ADA cDNA |
| C) Bone marrow transplantation from a healthy chimpanzee | D) Injection of retroviral vectors directly into the spleen |

133.

Why are enzyme replacement therapy and lymphocyte infusion not considered permanent cures for ADA deficiency?

- | | |
|---|--|
| A) The patient develops an immunity against the retroviral vector. | B) The transferred lymphocytes are not immortal and require periodic re-infusion. |
| C) The ADA cDNA gets integrated into lethal host oncogenes. | D) The functional enzyme gets degraded instantly in the stomach. |

134.

The term 'biopiracy' refers to:

- | | |
|---|--|
| A) Stealing laboratory equipment from pharmaceutical corporations | B) Illegal trading of endangered transgenic plants across international borders |
| C) The use of bio-resources by multinational companies without proper authorization and compensation | D) Unauthorized gene editing inside medical research facilities |

135.

An American company got patent rights on Basmati rice through an American patent and trademark office, which was an example of exploiting:

- | | |
|---|---|
| A) Indian traditional varieties that were semi-dwarf and hybridised with local varieties | B) Wild rice varieties from the Amazon basin |
| C) Genetically modified golden rice lines | D) Synthetic diploid rice mutants created in the USA |

Zoology.

136.

Select the correct statement about the Big Bang theory.

- | | |
|--|---|
| A) It talks of a many huge explosions unimaginable in physical terms. | B) The universe expanded and hence, the temperature increased. Hydrogen and Helium formed sometime later. |
| C) The gases condensed under gravitation and formed the galaxies of the present day universe. | D) In the solar system of the Milky Way galaxy, earth was supposed to have been formed about 4.5 million years back. |

137.

Select the correct statement among the following.

- | | |
|--|---|
| A) Some scientists believe that life came from outside. | B) Early Greek thinkers thought units of life called spores were transferred to different planets including earth. |
| C) 'Panspermia' is still a favourite idea for some astronomers. | D) All of these |

138.

For a long time it was also believed that life came out of decaying and rotting matter like straw, mud, etc. This was the theory of _____.

- | | |
|--------------------------------------|----------------------------------|
| A) Biogenesis | B) Spontaneous generation |
| C) Non-Spontaneous generation | D) Both A and B |

139.

Select the incorrect statement among the following.

- | | |
|--|--|
| A) Louis Pasteur by careful experimentation demonstrated that life comes only from pre-existing life. | B) Louis Pasteur showed that in presterilised flasks, life did not come from killed yeast while in another flask open to air, new living organisms arose from 'killed yeast'. |
| C) Spontaneous generation theory was dismissed by Louis Pasteur. | D) Louis Pasteur answered how the first life form came on earth. |

140.

How many statements are incorrect among the following? i. Oparin of England and Haldane of Russia proposed that the first form of life could have come from pre-existing non-living organic molecules (e.g.RNA, protein, etc.) and that formation of life was preceded by chemical evolution ii. The conditions on earth were – high temperature, volcanic storms, reducing atmosphere containing CH₄, O₂, etc. iii. In 1952, S.L. Miller, an American scientist created similar conditions in a laboratory scale iv. S.L. Miller created electric discharge in a closed flask containing CH₄, H₂, NH₃ and water vapour at 8000C. v. With limited evidence, the first part of the conjectured story, i.e., chemical evolution was more or less accepted.

- | | |
|-------------|-------------|
| A) 2 | B) 3 |
| C) 4 | D) 5 |

141.

In S.L. Miller's electric discharge experiment, he observed formation of _____.

- | | |
|-----------------------|-----------------------|
| A) Amino sugar | B) Glucosamine |
| C) Amino acid | D) Proteins |

142.

Select the incorrect statement among the following.

- A) We have no idea about how the first self replicating metabolic capsule of life arose.
- B) The first non-cellular forms of life could have originated 3 billion years back. They would have been giant molecules (RNA, Protein, Polysaccharides, etc.). These capsules reproduced their molecules perhaps.
- C) The first cellular form of life did not possibly originate till about 2 million years ago. These were probably single-cells.
- D) All life forms were in water environment only. This version of biogenesis, i.e., the first form of life arose slowly through evolutionary forces from non-living molecules is accepted by majority.

143.

Chemical evolution refers to-

- A) Formation of diverse inorganic molecules from organic constituents
- B) Formation of diverse organic molecules from radioactive constituents
- C) Formation of diverse organic molecules from inorganic constituents
- D) Formation of diverse non-reducing molecules from inorganic constituents

144.

Special creation theory has three connotations.

Select the correct connotation among the following.

- A) All living organisms (species or types) that we see today were created as such.
- B) The diversity was always the same since creation and will be the same in future also.
- C) Earth is about 40000 years old
- D) Both (A) and (B)

145.

Select the correct statement among the following.

- A) All the ideas of Special creation theory were strongly challenged during the eighteenth century.
- B) Based on observations made during a sea voyage in a sail ship called H.M.S. Beagle round the world, Charles Darwin concluded that existing living forms share similarities to varying degrees not only among themselves but also with life forms that existed millions of years ago. Many such life forms do exist anymore.
- C) There had been extinctions of different life forms in the years gone by just as new forms of life arose at same periods of history of earth.
- D) Any population has built in variation in characteristics.

146.

How many statements among the following are incorrect? i. Those characteristics which enable some to survive better in natural conditions (climate, food, physical factors, etc.) would outbreed others that are less-endowed to survive under such natural conditions. ii. The fitness, according to Darwin, refers ultimately and only to reproductive fitness. iii. Those who are better fit in an environment leave more progeny than others. These, therefore, will survive more and hence are selected by nature. Darwin called it natural selection and implied it as a mechanism of evolution. iv. Alfred Wallace, a physicist worked in Malay Archipelago. v. The geological history of earth closely correlates with the physical history of earth.

- A) 3
- B) 4
- C) 2
- D) 1

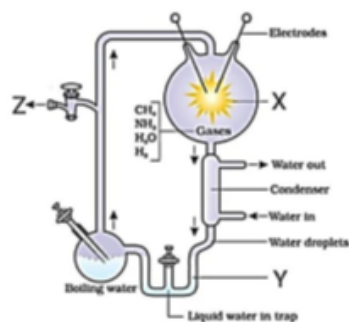
147.

The history of Earth can be studied in terms of-

- A) Epochs
- B) Periods
- C) Eras
- D) All of these

148.

Select the correct option about the given figure.



- A) The given figure represents diagrammatic representation of Miller's Experiment.
- B) X- Vacuum pump
- C) Y – Water containing inorganic compounds
- D) Z – Spark discharge

149.

Fossils are _____

- A) The preserved remains of the past life forms.
- B) Mineralized form of hard body parts such as bones, teeth, etc.
- C) Found mainly in the layers of sedimentary rocks.
- D) all of these

150.

Consider the following statements about fossils: (a) Rock sediments of different ages contain fossils of life forms that died during the formation of that particular layer of sediment. (b) Fossil records are based on the sequence of occurrence of fossils in various strata of sedimentary rocks. Select the correct option.

- A) Both (a) and (b) are true.
- B) (a) is true but (b) is false.
- C) Both (a) and (b) are false.
- D) (a) is false but (b) is true.

151.

Which of the following represents the paleontological evidence of evolution?

- | | |
|--|---------------------------------------|
| A) Preserved remains of Dinosaurs obtained from sedimentary rocks. | B) Presence of homologous structures. |
| C) Presence of analogous structures. | D) Presence of vestigial parts. |

152.

Fossils serve as one of the evidence of evolution because (a) Fossil records show that various groups of organisms dominated earth during the different course of evolution. (b) Many organisms are extinct today. (c) Certain groups of organisms are restricted to a certain geological time period. Select the option with all correct statements.

- | | |
|-----------------|---------------|
| A) Only a | B) Only b |
| C) Both b and c | D) a, b and c |

153.

Embryological support for evolution was proposed by _____ based upon the observation of certain features during embryonic stage common to all vertebrates that are absent in adult.

- | | |
|------------------|------------------|
| A) Ernst Mayr | B) JBS Haldane |
| C) Ernst Haeckel | D) Charles Lyell |

154.

Sweet potato is a ____ (I) ____ modification whereas potato is a ____ (II) ____ modification.

- | | |
|-----------------|------------------|
| A) (I)- Stem | B) (II)- Root |
| C) Both A and B | D) None of these |

155.

Consider the following statements: (a) Comparative anatomical and morphological details of different but related organisms demonstrate a basic similarity. (b) The same structures in different organisms are derived from a common ancestor. Choose the correct option.

- | | |
|--------------------------------|----------------------------------|
| A) Both (a) and (b) are true. | B) (a) is true but (b) is false. |
| C) Both (a) and (b) are false. | D) (a) is false but (b) is true. |

156.

The similar structures with different functions present in different species because of their common ancestry is known as _____

- | | |
|-------------------------|--------------------------|
| A) Analogous structures | B) Homologous structures |
| C) Vestigial organs | D) Homoplasy |

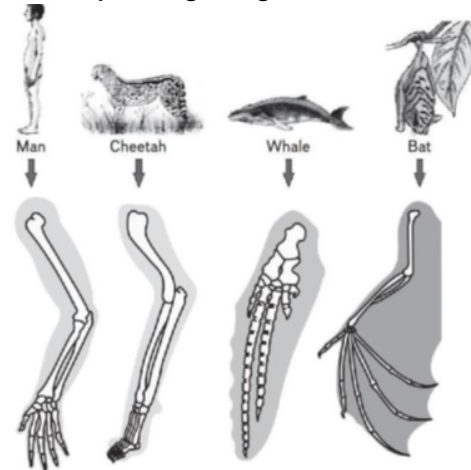
157.

Presence of homologous structures in different but related organisms is the result of _____

- | | |
|-------------------------|------------------------|
| A) Common ancestry | B) Divergent evolution |
| C) Convergent evolution | D) Both A and B |

158.

The image shows the forelimbs of a whale, bat, cheetah and human (all mammals). Choose the correct option regarding the same.



- | | |
|---|--|
| A) The basic similarities in the arrangement of bones in forelimbs of whales, bats, cheetahs and humans reflect their common ancestry | B) The forelimbs of whales, bats, cheetahs and humans are analogous structures |
| C) The image represents structures that evolved from convergent evolution. | D) The image represents vestigial structures. |

159.

Which of the following structures represent homology?

- | | |
|---|--------------------------------------|
| A) Wings of butterflies and birds | B) Eyes of octopus and mammals |
| C) Thorns and tendrils of Bougainvillea and Cucurbita | D) Flippers of penguins and dolphins |

160.

Which of the following structures is homologous to the wing of a bird?

- | | |
|-------------------------|------------------------------|
| A) Wing of a moth | B) Hind limb of the rabbit |
| C) Flipper of the whale | D) The dorsal fin of a shark |

161.

Independent evolution of structures with similar functions but different anatomy in distantly related organisms is known as _____

- | | |
|-------------------------|------------------------|
| A) Convergent evolution | B) Divergent evolution |
| C) Homology | D) Mutation |

162.

The process of _____ evolution develops similar features in organisms with separate ancestries.

- | | |
|--------------|---------------|
| A) Divergent | B) Convergent |
| C) Homology | D) Speciation |

163.

Analogous structures are a result of _____

- | | |
|--------------------------|------------------------|
| A) stabilizing selection | B) divergent evolution |
| C) convergent evolution | D) shared ancestry |

164.

Match Column-I with Column-II.

Column-I

- (a) Cactus spine and pea tendril
- (b) Wings of insects and birds
- (c) Hind limb bones of whales
- (d) Darwin's finches

Column-II

- (1) Analogous structures
- (2) Vestigial structures
- (3) Natural selection
- (4) Homologous structures

Select the correct option.

- A) A-1, B-4, C-2, D-3
- B) A-4, B-1, C-2, D-3
- C) A-4, B-2, C-1, D-3
- D) A-4, B-1, C-3, D-2

165.

The wings of a bird and the wings of an insect are

- A) homologous structures and represent divergent evolution
- B) phylogenetic structures and represent divergent evolution
- C) analogous structures and represent convergent evolution
- D) homologous structures and represent convergent evolution

166.

Which of the following examples does not represent analogous organs?

- A) Eyes of octopus and mammals.
- B) Sweet potato and potatoes.
- C) The spine of barberry and thorns of hawthorn.
- D) Eyes of cave-dwelling animals.

167.

Select the incorrect match from the following options.

- A) Tendrils and passionflower and thorns of pomegranate – homologous organs.
- B) Tendrils of Vitis and thorns of Carissa – homologous organs.
- C) Tendrils of balloon vine and bulbils of Agave – homologous organs.
- D) Scale leaves of onion and spines of Opuntia – analogous organs.

168.

Industrial melanism is an example of

- A) Neo Darwinism
- B) Natural selection
- C) Mutation
- D) Neo Lamarckism

169.

The given image shows white-winged and dark-winged moths.



I

II

(a) Image I represents the survival advantage of white winged moths in unpolluted areas. (b) Image II represents the survival advantage of dark winged moths in polluted areas. Select the correct option.

- A) Both (a) and (b) are true.
- B) (a) is true but (b) is false.
- C) Both (a) and (b) are false.
- D) (a) is false but (b) is true.

170.

Match Column-I with Column-II.

Column-I

- (a) Common proteins and genes present in diverse organisms
- (b) Vertebrates heart or brain
- (c) Animal husbandry and plant breeding
- (d) Industrial melanism

Column-II

- (1) Artificial selection
- (2) Anatomical evidence of evolution
- (3) Natural selection
- (4) Biochemical evidence of evolution

Select the correct option.

- A) A-1, B-4, C-2, D-3
- B) A-4, B-1, C-2, D-3
- C) A-4, B-2, C-1, D-3
- D) A-4, B-1, C-3, D-2

171.

Which of the following serves as an indicator of atmospheric pollution?

- A) Lichens
- B) Rhizopus
- C) Penicillin
- D) Lycopodium

172.

Assertion: Archaeopteryx is a dead connecting link between reptiles and birds. Reason: Archaeopteryx is the earliest known bird.

- A) Both Assertion and Reason are true and Reason is correct explanation of Assertion.
- B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.
- C) Assertion is true, but Reason is false.
- D) Assertion is false, but Reason is true.

173.

Assertion: Evolution is not a directed process in the sense of determinism. Reason: Evolution is based on chance events that occur in nature.

- A) Both Assertion and Reason are true and Reason is correct explanation of Assertion.
- B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.
- C) Assertion is true, but Reason is false.
- D) Assertion is false, but Reason is true.

174.

The mechanism of adaptive radiation was first explained by

- A) Darwin
- B) Morgan
- C) Lamarck
- D) Hugo de Vries

175.

Consider the following statements. (a) Darwin compared the animals and plant species of Galapagos Islands with those of mainland of South America. (b) He found observable and distinct similarities and differences among them. (c) Flora and fauna of the Galapagos Islands do not exhibit resemblances to that of the South American mainland. Select the correct option.

- A) Both (a) and (b) are true.
- B) (a) is true but (b and c) are false.
- C) Both (a) and (b) are false.
- D) All are false.

176.

Lamarck was a _____.

- A) French zoologist
- B) German botanist
- C) French naturalist
- D) British botanist

177.

Diversification of single ancestral species into many species in a relatively short period of time is called

- A) Artificial selection
- B) Adaptive radiation
- C) Homology
- D) Natural selection

178.

Adaptive radiation occurs when

- A) lineages of an ancestral species encounter an empty niche.
- B) populations of a species exhibit random mating.
- C) gene flow between the populations of a species continues.
- D) adaptive radiation does not occur in nature.

179.

Darwin's finches are an example of

- A) adaptive radiation
- B) microevolution
- C) genetic drift
- D) gene flow

180.

Evolution of different species in a given area starting from a point and spreading to other geographical areas is known as

- A) Adaptive radiation
- B) Natural selection option
- C) Migration option
- D) Divergent evolution

ANSWER KEY

Physics

1.	2	13.	2	25.	2	37.	3
2.	4	14.	1	26.	3	38.	2
3.	3	15.	2	27.	4	39.	3
4.	2	16.	1	28.	3	40.	2
5.	4	17.	2	29.	2	41.	4
6.	2	18.	4	30.	3	42.	3
7.	2	19.	4	31.	4	43.	2
8.	4	20.	3	32.	2	44.	2
9.	3	21.	4	33.	2	45.	2
10.	2	22.	2	34.	2		
11.	3	23.	2	35.	3		
12.	1	24.	3	36.	1		

Chemistry

46.	3	58.	2	70.	3	82.	4
47.	3	59.	3	71.	3	83.	2
48.	1	60.	2	72.	3	84.	3
49.	1	61.	2	73.	2	85.	3
50.	4	62.	4	74.	2	86.	4
51.	1	63.	3	75.	3	87.	4
52.	4	64.	4	76.	3	88.	3
53.	4	65.	2	77.	3	89.	2
54.	2	66.	3	78.	3	90.	1
55.	1	67.	3	79.	2		
56.	2	68.	1	80.	3		
57.	4	69.	3	81.	1		

Botany

91.	2	103.	2	115.	2	127.	4
92.	4	104.	2	116.	1	128.	2
93.	2	105.	1	117.	1	129.	2
94.	2	106.	2	118.	3	130.	1
95.	3	107.	2	119.	1	131.	1
96.	2	108.	2	120.	3	132.	2
97.	2	109.	4	121.	2	133.	2
98.	2	110.	2	122.	2	134.	3
99.	2	111.	2	123.	1	135.	1
100.	2	112.	1	124.	2		
101.	2	113.	2	125.	4		
102.	2	114.	2	126.	3		

Zoology

136.	4	139.	4	142.	3	145.	2
137.	4	140.	2	143.	3	146.	3
138.	2	141.	1	144.	4	147.	4

148.	1	157.	3	166.	4	175.	1
149.	4	158.	1	167.	4	176.	3
150.	1	159.	3	168.	2	177.	2
151.	1	160.	3	169.	1	178.	1
152.	4	161.	1	170.	3	179.	1
153.	3	162.	2	171.	1	180.	1
154.	4	163.	3	172.	4		
155.	1	164.	2	173.	1		
156.	2	165.	3	174.	1		

SOLUTIONS

Q1.

Answer: B

Explanation:

From Einstein's photoelectric equation, $hc/\lambda = \phi + eV_s$. Since the incident wavelength is same for both metals, the photon energy is same: $\phi_W + eV_W = \phi_{Li} + eV_{Li}$. Thus $eV_{Li} = 4.5 + 2.0 - 2.5 = 4.0$ eV, which gives $V_{Li} = 4$ V.

Q2.

Answer: D

Explanation:

From Einstein's photoelectric equation, $eV_s = h\nu - \phi$, so the straight line is $V_s = \frac{h}{e}\nu - \frac{\phi}{e}$. The intercept on the V_s axis equals $-\frac{\phi}{e}$, which from the graph is -4 V, giving $\phi = 4$ eV. This is confirmed by the threshold frequency intercept $\nu_0 = 1 \times 10^{15}$ Hz, since $\phi = h\nu_0 \approx 4.1$ eV.

Q3.

Answer: C

Explanation:

The light contains two frequency components; the photon with the higher frequency $\nu = \omega/2\pi = 2 \times 10^{15}$ Hz carries energy $h\nu = 8.28$ eV, so the maximum kinetic energy is $K_{max} = h\nu - \phi = 8.28 - 2.28 = 6$ eV.

Q4.

Answer: B

Explanation:

The maximum kinetic energy of the photoelectrons is $K_{max} = \frac{1}{2}mv_{max}^2 \approx 6.4$ eV, so by Einstein's photoelectric equation the work function is $\phi = E - K_{max} = 9.4 - 6.4 = 3$ eV.

Q5.

Answer: D

Explanation:

The kinetic energy of the fastest electron is $K_{max} = E - \phi = 28 - 3 = 25$ eV $= 4.0 \times 10^{-18}$ J, and using $K_{max} = \frac{1}{2}mv^2$ this gives $v \approx 3 \times 10^6$ m/s.

Q6.

Answer: B

Explanation:

The longest (threshold) wavelength corresponds to a photon whose energy exactly equals the work function: $\lambda_0 = \frac{hc}{\phi} = \frac{1240 \text{ eV}\cdot\text{nm}}{3.1 \text{ eV}} = 400 \text{ nm}$.

Q7.

Answer: B

Explanation:

The maximum kinetic energy of the photoelectrons is $K_{max} = E - \phi = 7.8 - 2.8 = 5.0$ eV, and since $eV_s = K_{max}$, the stopping potential has magnitude 5 V, i.e. -5 V in the retarding sign convention.

Q8.

Answer: D

Explanation:

Using $K = E - \phi$, the two maximum kinetic energies are $K_1 = 1.8 - 0.6 = 1.2$ eV and $K_2 = 4.2 - 0.6 = 3.6$ eV, so the ratio is $K_1 : K_2 = 1.2 : 3.6 = 1 : 3$.

Q9.

Answer: C

Explanation:

Writing $K_1 = h(v_1 - v_0)$ and $K_2 = h(v_2 - v_0)$ with $\frac{K_1}{K_2} = \frac{k}{1}$ gives $v_1 - v_0 = k(v_2 - v_0)$, which solves to $v_0 = \frac{kv_2 - v_1}{k-1}$.

Q10.

Answer: B

Explanation:

Photoemission requires the incident frequency to exceed the threshold frequency. Since green light (higher frequency than yellow) fails to eject electrons, the threshold frequency lies above green, and yellow light, having still lower frequency (and lower photon energy), cannot cause emission.

Q11.

Answer: C

Explanation:

Taking $\phi_A = \phi$ and $\phi_B = 3\phi$, we get $K_A = hf - \phi$ and $K_B = 3hf - 3\phi = 3(hf - \phi)$, so the ratio $K_A : K_B = 1 : 3$.

Q12.

Answer: A

Explanation:

By using $E = W_0 + K_{max} \Rightarrow \frac{hc}{\lambda} = W_0 + \frac{1}{2}mv^2$
 $\frac{hc}{400 \times 10^{-9}} = W_0 + \frac{1}{2}mv^2 \dots (1)$ And $\frac{hc}{250 \times 10^{-9}} = W_0 + \frac{1}{2}m(2v)^2$
 $\dots (2)$ From equation (1) and (2) $W_0 = 2hc \times 10^6$ J

Q13.

Answer: B

Explanation:

By using $E = W_0 + K_{max} \Rightarrow E_A = hf = W_A + K_A$ and $E_B = h(2f) = W_B + K_B$ So, $\frac{1}{2} = \frac{W_A + K_A}{W_B + K_B} \dots (i)$ also it is given that $\frac{W_A}{W_B} = \frac{1}{2} \dots (ii)$ From equation (i) and (ii) we get $\frac{K_A}{K_B} = \frac{1}{2}$

Q14.

Answer: A

Explanation:

Analyze the photoelectric equation relating stopping potential (V_s) and incident frequency (f), given by $eV_s = hf - \Phi$. The stopping potential determines the frequency of the incident radiation. Observe that curves a and b intersect the stopping potential axis at the same negative potential, meaning their frequencies are equal ($f_a = f_b$). Note that the saturation photocurrent (I_{sat}) depends on light intensity. Curves a and b have different saturation current plateaus, indicating different intensities ($I_a \neq I_b$). Combine these properties to write the relation for curves a and b : $f_a = f_b$ and $I_a \neq I_b$. Conclude that the correct option matching this condition is Option 1.

Q15.

Answer: B

Explanation:

Calculate the maximum energy (minimum wavelength, $\lambda_{min} = 350 \text{ nm}$) of the incident light beam to find the maximum energy of photons: $E_{max} = \frac{hc}{\lambda_{min}}$ Determine the threshold wavelength (λ_0) or maximum work function scenario for each metal plate: For plate p ($\Phi_p = 2.0 \text{ eV}$): $\lambda_{0p} = \frac{hc}{\Phi_p} \approx 620 \text{ nm}$ For plate q ($\Phi_q = 2.5 \text{ eV}$): $\lambda_{0q} = \frac{hc}{\Phi_q} \approx 496 \text{ nm}$ For plate r ($\Phi_r = 1 \text{ eV}$): $\lambda_{0r} = \frac{hc}{\Phi_r} \approx 1240 \text{ nm}$ Analyze which wavelengths can cause emission for each plate: Plate r emits photoelectrons for all three wavelengths (550 nm, 450 nm, 350 nm). Plate p emits photoelectrons for 450 nm and 350 nm. Plate q emits photoelectrons only for 350 nm. Evaluate the stopping potentials (V_s) corresponding to the highest energy incident photon ($\lambda = 350 \text{ nm}$) for each metal: $eV_s = \frac{hc}{\lambda} - \Phi$ Since $\Phi_r < \Phi_p < \Phi_q$, the stopping potentials follow the order: $|V_{sr}| > |V_{sp}| > |V_{sq}|$ Match the resulting saturation currents and stopping potentials to Option 2, where the correct threshold and maximum kinetic energy boundaries are properly depicted.

Q16.

Answer: A

Explanation:

Write Einstein's photoelectric equation relating stopping potential (V), work function (Φ), and wavelength (λ): $eV = \frac{hc}{\lambda} - \Phi \implies V = \left(\frac{hc}{e}\right)\frac{1}{\lambda} - \frac{\Phi}{e}$ Identify the x-intercept from the given graph where $V = 0$, which corresponds to the reciprocal of the threshold wavelength ($\frac{1}{\lambda_0}$): For Metal 1: $\frac{1}{\lambda_{01}} = 0.001 \text{ nm}^{-1}$ For Metal 2: $\frac{1}{\lambda_{02}} = 0.002 \text{ nm}^{-1}$ For Metal 3: $\frac{1}{\lambda_{03}} = 0.004 \text{ nm}^{-1}$ Relate the work functions using $\Phi = \frac{hc}{\lambda_0}$: $\Phi_1 : \Phi_2 : \Phi_3 = \frac{1}{\lambda_{01}} : \frac{1}{\lambda_{02}} : \frac{1}{\lambda_{03}}$ Substitute the values from the intercepts: $\Phi_1 : \Phi_2 : \Phi_3 = 0.001 : 0.002 : 0.004 = 1 : 2 : 4$ Conclude that the ratio of work functions is 1 : 2 : 4, making Option 1 the correct statement.

Q17.

Answer: B

Explanation:

Use Einstein's photoelectric equation to find the maximum kinetic energy K_{max} of the emitted electron: $K_{max} = h\nu - \Phi$ Relate the maximum kinetic energy to the electron velocity v and mass m :

$\frac{1}{2}mv^2 = h\nu - \Phi \implies v = \sqrt{\frac{2(h\nu - \Phi)}{m}}$ Recall the formula for the radius r of a charged particle moving in a uniform magnetic field B perpendicular to its velocity: $r = \frac{mv}{eB}$ Substitute the velocity expression into the radius formula: $r = \frac{m}{eB} \sqrt{\frac{2(h\nu - \Phi)}{m}}$ Simplify the expression to obtain the final radius of the trajectory: $r = \frac{\sqrt{2m(h\nu - \Phi)}}{eB}$ which corresponds to Option 2.

Q18.

Answer: D

Explanation:

The photon energy is $E = \frac{hc}{\lambda} = \frac{1240 \text{ eV}\cdot\text{nm}}{310 \text{ nm}} = 4.0 \text{ eV}$, so the maximum kinetic energy is $K_{max} = E - \phi = 4.0 - 2.0 = 2 \text{ eV}$.

Q19.

Answer: D

Explanation:

The photon energy is $E = \frac{hc}{\lambda} = \frac{1240 \text{ eV}\cdot\text{nm}}{248 \text{ nm}} = 5 \text{ eV}$, so by Einstein's photoelectric equation $K_{max} = E - \phi = 5 - 2 = 3 \text{ eV}$.

Q20.

Answer: C

Explanation:

The photon energy is $E = \frac{hc}{\lambda} = \frac{1240 \text{ eV}\cdot\text{nm}}{248 \text{ nm}} = 5 \text{ eV}$, which exceeds the work function $\phi = 3 \text{ eV}$, so emission occurs with $K_{max} = E - \phi = 5 - 3 = 2 \text{ eV}$.

Q21.

Answer: D

Explanation:

The incident photon energy is $E = \frac{hc}{\lambda} = \frac{1240 \text{ eV}\cdot\text{nm}}{600 \text{ nm}} \approx 2.07 \text{ eV}$, which is less than the work function $\phi = 2.5 \text{ eV}$, so no photoelectric emission takes place.

Q22.

Answer: B

Explanation:

The saturation photocurrent is proportional to the light intensity at the cathode, and intensity from a point source obeys the inverse square law, so $i_2 = i_1 \left(\frac{d_1}{d_2}\right)^2 = 3 \times \left(\frac{6}{2}\right)^2 = 27$ units.

Q23.

Answer: B

Explanation:

The photoelectric current is proportional to the light intensity, which follows the inverse square law $I \propto \frac{1}{d^2}$, so the current increases by a factor $\left(\frac{6}{2}\right)^2 = 9$, giving $2 \times 9 = 18$ units.

Q24.

Answer: C

Explanation:

Since $eV_s = \frac{hc}{\lambda} - \phi$, the work function cancels in the difference: $\Delta V = \frac{hc}{e} \left(\frac{1}{\lambda_2} - \frac{1}{\lambda_1}\right) = 1240 \times \left(\frac{1}{310} - \frac{1}{620}\right) = 2 \text{ V}$.

Q25.

Answer: B

Explanation:

Since $eV_s = \frac{hc}{\lambda} - \phi$, the work function cancels in the difference: $\Delta V_s = \frac{hc}{e} \left(\frac{1}{\lambda_2} - \frac{1}{\lambda_1}\right) = 5.0 - 2.0 = 3 \text{ V}$.

Q26.

Answer: C

Explanation:

Since $\frac{1}{2}mv^2 = h(\nu - \nu_0)$, the kinetic energies in the two cases are $h\nu_0$ and $9h\nu_0$; because speed scales as the square root of kinetic energy, the new speed is $\sqrt{9}V = 3V$.

Q27.

Answer: D

Explanation:

The kinetic energies are $K_1 = h(4\nu_0 - \nu_0) = 3h\nu_0$ and $K_2 = h(13\nu_0 - \nu_0) = 12h\nu_0$, so the kinetic energy becomes 4 times, and since $K \propto v^2$, the speed becomes $\sqrt{4} = 2$ times, i.e. $2V$.

Q28.

Answer: C

Explanation:

Writing $eV_s = \frac{hc}{\lambda} - \frac{hc}{\lambda_0}$ for both cases and subtracting eliminates λ_0 , giving $eV_0 = \frac{hc}{6\lambda}$; substituting back yields $\frac{hc}{\lambda_0} = \frac{hc}{3\lambda}$, so $\lambda_0 = 3\lambda$.

Q29.

Answer: B

Explanation:

Using Einstein's equation for both cases, $5eV_0 = \frac{hc}{\lambda} - \frac{hc}{\lambda_0}$ and $eV_0 = \frac{hc}{3\lambda} - \frac{hc}{\lambda_0}$, subtraction gives $eV_0 = \frac{hc}{6\lambda}$, and substituting back yields $\lambda_0 = 6\lambda$.

Q30.

Answer: C

Explanation:

From Einstein's equation, $eX = h(3\nu) - h\nu = 2h\nu$, and for the new frequency $eX' = h(7\nu) - h\nu = 6h\nu$, so $X' = \frac{6h\nu}{2h\nu} X = 3.0X$.

Q31.

Answer: D

Explanation:

From Einstein's equation, $eX = 6h\nu - 2h\nu = 4h\nu$ and $eX' = 10h\nu - 2h\nu = 8h\nu$, so the stopping potential doubles: $X' = \frac{8h\nu}{4h\nu} X = 2.0X$.

Q32.

Answer: B

Explanation:

From metal A, $K = h\nu - h\nu_0$, so $h\nu = K + h\nu_0$. For metal B with frequency 2ν : $K_B = 2h\nu - 3h\nu_0 = 2(K + h\nu_0) - 3h\nu_0 = 2K - h\nu_0$.

Q33.

Answer: B

Explanation:

From metal A, $K = h\nu - h\nu_0$ gives $h\nu = K + h\nu_0$; for metal B, $K' = 4h\nu - 3h\nu_0 = 4(K + h\nu_0) - 3h\nu_0 = 4K + h\nu_0$.

Q34.

Answer: B

Explanation:

Each photon carries $E = \frac{hc}{\lambda} = 3.0 \times 10^{-19} J$, and the total energy radiated in 10 hrs is $W = Pt = 1.8 \times 10^6 J$, so the number of photons is $N = \frac{W}{E} = 6.0 \times 10^{24}$.

Q35.

Answer: C

Explanation:

Each photon carries $E = \frac{hc}{\lambda} \approx 3.98 \times 10^{-19} J$, and the total energy radiated in 5 hrs is $W = Pt = 3.6 \times 10^6 J$, so the number of photons is $N = \frac{W}{E} \approx 9.0 \times 10^{24}$.

Q36.

Answer: A

Explanation:

Power equals photons per second times energy per photon, $P = \frac{Nhc}{\lambda}$, so $\frac{P_2}{P_1} = \frac{N_2}{N_1} \times \frac{\lambda_1}{\lambda_2} = 1.02 \times \frac{5000}{2550} = 2$, i.e. $P_2 : P_1 = 2 : 1$.

Q37.

Answer: C

Explanation:

Power is $P = \frac{nhc}{\lambda}$, so $\frac{P_2}{P_1} = \frac{n_2}{n_1} \times \frac{\lambda_1}{\lambda_2} = 2.04 \times \frac{5000}{5100} = 2$, giving the ratio 2 : 1.

Q38.

Answer: B

Explanation:

The photocurrent depends on the number of photons arriving per second, $n = \frac{I}{h\nu}$; with intensity $2I$ and frequency 3ν , the photon rate becomes $\frac{2I}{3h\nu} = \frac{2}{3}n$, so the current is 2/3 times the original.

Q39.

Answer: C

Explanation:

The photocurrent depends on the number of photons arriving per second, $n = \frac{I}{h\nu}$; with intensity $2I$ and frequency 4ν , the photon rate becomes $\frac{2I}{4h\nu} = \frac{1}{2} \times \frac{I}{h\nu}$, so the current is halved.

Q40.

Answer: B

Explanation:

Each photon carries $E = \frac{hc}{\lambda} \approx 3.01 \times 10^{-19} J$, so the emission rate is $n = \frac{P}{E} = \frac{90 \times 10^{-3}}{3.01 \times 10^{-19}} \approx 3.0 \times 10^{17}$ photon/sec.

Q41.

Answer: D

Explanation:

Each photon carries $E = \frac{hc}{\lambda} \approx 3.98 \times 10^{-19} J$, so the emission rate is $n = \frac{P}{E} = \frac{0.1}{3.98 \times 10^{-19}} \approx 2.5 \times 10^{17}$ photon/sec.

Q42.

Answer: C

Explanation:

The absorbed power transfers momentum at rate $\frac{P_{abs}}{c}$ while the reflected power transfers momentum at rate $\frac{2P_{ref}}{c}$, so the total force is $F = \frac{6+2 \times 24}{3 \times 10^8} = 1.8 \times 10^{-7} N$.

Q43.

Answer: B

Explanation:

The absorbed part transfers momentum at rate $\frac{P_{abs}}{c}$ and the reflected part at rate $\frac{2P_{ref}}{c}$, so $F = \frac{10}{c} + \frac{2 \times 10}{c} = \frac{30}{3 \times 10^8} = 1.0 \times 10^{-7} N$.

Q44.

Answer: B

Explanation:

The energy per photon is

$E = \frac{hc}{\lambda} = \frac{6.63 \times 10^{-34} \times 3 \times 10^8}{660 \times 10^{-9}} \approx 3.01 \times 10^{-19} J$, and since the sphere absorbs all the light, the photon rate is $n = \frac{P}{E} = \frac{60}{3.01 \times 10^{-19}} \approx 2.0 \times 10^{20}$ photons/s.

Q45.

Answer: B

Explanation:

Each photon carries

$$E = \frac{hc}{\lambda} = \frac{6.63 \times 10^{-34} \times 3 \times 10^8}{663 \times 10^{-9}} = 3.0 \times 10^{-19} \text{ J}, \text{ and since the}$$

sphere absorbs all the light, the photon delivery rate is

$$n = \frac{P}{E} = \frac{60}{3.0 \times 10^{-19}} = 2.0 \times 10^{20} \text{ photons/s.}$$

Q46.

Answer: C

Explanation:

Hydrolysis of acyl chlorides proceeds via nucleophilic addition-elimination. Electron-withdrawing groups increase reactivity by decreasing electron density on the carbonyl carbon and stabilizing the negative charge in the tetrahedral transition state.

Q47.

Answer: C

Explanation:

Cleavage of unsymmetrical ethers with HI containing primary alkyl groups proceeds via an S_N2 mechanism. The iodide nucleophile preferentially attacks the less sterically hindered ethyl group.

Q48.

Answer: A

Explanation:

Ethanol converts to ethyl bromide (*X*), which undergoes dehydrohalogenation to ethene (*Y*), and subsequent acid-catalyzed hydration regenerates ethanol (*Z*).

Q49.

Answer: A

Explanation:

The Hell-Volhard-Zelinsky (HVZ) reaction halogenates carboxylic acids exclusively at the α -position. Excess bromine substitutes both α -hydrogens to give 2,2-dibromopropanoic acid.

Q50.

Answer: D

Explanation:

Phenol is deoxygenated by zinc dust to benzene (*X*), alkylated to toluene (*Y*), and strongly oxidized by KMnO_4 to benzoic acid (*Z*).

Q51.

Answer: A

Explanation:

Oxidation of ethylbenzene gives benzoic acid (*B*), which directs electrophilic bromination to the meta-position (*C*), and subsequent esterification yields ethylm-bromobenzoate (*D*).

Q52.

Answer: D

Explanation:

Glycerol reacts with excess HI via substitution, loss of I_2 from vicinal diiodides, addition of HI, and Markovnikov addition to yield 2-iodopropane.

Q53.

Answer: D

Q54.

Answer: B

Explanation:

Clemmensen reduction converts carbonyl groups ($> \text{C} = \text{O}$) of aldehydes and ketones into methylene groups ($> \text{CH}_2$) using amalgamated zinc ($\text{Zn} - \text{Hg}$) and concentrated HCl.

Q55.

Answer: A

Explanation:

Ethylamine ($\text{CH}_3\text{CH}_2\text{NH}_2$) is formed by Hofmann bromamide degradation of propanamide (*C*), which is obtained from ammonium propanoate (*B*) derived from propanoic acid (*A*).

Q56.

Answer: B

Explanation:

Nucleophilic substitution of methyl bromide by cyanide gives acetonitrile (*A*), which hydrolyzes to acetic acid (*B*), and reduction with LiAlH_4 yields ethanol (*C*).

Q57.

Answer: D

Explanation:

Acetaldehyde (CH_3CHO) contains a $\text{CH}_3\text{C} = \text{O}$ unit and gives a positive iodoform test, whereas phenylacetaldehyde ($\text{C}_6\text{H}_5\text{CH}_2\text{CHO}$) lacks this group and gives a negative test.

Q58.

Answer: B

Explanation:

Phenol reacts with NaOH to form sodium phenoxide, which undergoes Williamson ether synthesis with methyl iodide to form anisole.

Q59.

Answer: C

Explanation:

Sodium hydrogen carbonate (NaHCO_3) is a weak base that dissolves carboxylic acids, sulphonic acids, and strongly acidic phenols like picric acid, but not weakly acidic phenols like o-nitrophenol.

Q60.

Answer: B

Explanation:

In the Reimer-Tiemann reaction, phenol reacts with chloroform and base via dichlorocarbene intermediate to introduce a formyl group ($-\text{CHO}$) at the ortho position.

Q61.

Answer: B

Explanation:

The aryl-oxygen bond has partial double-bond character due to resonance and resists nucleophilic cleavage; nucleophilic attack by iodide occurs selectively on the methyl group.

Q62.

Answer: D

Explanation:

Reaction of o-bromoanisole with strong base NaNH_2 proceeds via elimination to a benzyne intermediate, followed by addition of NH_2^- to give cine-substitution product *m*-methoxyaniline.

Q63.

Answer: C

Explanation:

Reagent *Y* is iodine (I_2). The positive iodoform test forming yellow CHI_3 precipitate requires a $CH_3CH(OH)-$ structural unit, uniquely present in 1-phenylethanol.

Q64.

Answer: D

Explanation:

Ethanol (*A*) reacts with sodium to form sodium ethoxide (*B*), and with PCl_5 to form ethyl chloride (*C*); *B* and *C* react via Williamson synthesis to yield diethyl ether.

Q65.

Answer: B

Explanation:

Autoxidation of cumene (isopropylbenzene) with air forms cumene hydroperoxide as intermediate *A*, which upon acid cleavage gives phenol and acetone.

Q66.

Answer: C

Explanation:

Pyridinium chlorochromate (PCC) is a mild oxidizing agent that selectively oxidizes primary alcohols to aldehydes (benzaldehyde) without further oxidation to benzoic acid.

Q67.

Answer: C

Explanation:

Catalytic dehydrogenation of secondary alcohols over heated copper catalyst at 573 K removes two hydrogen atoms to produce ketones.

Q68.

Answer: A

Explanation:

With excess HI under heating, both alkyl-oxygen bonds of aliphatic ethers are cleaved to convert both alkyl fragments into their corresponding alkyl iodides.

Q69.

Answer: C

Explanation:

Both methanol and ethanol are primary alcohols and do not produce turbidity with Lucas reagent at room temperature; hence Lucas reagent cannot distinguish between them.

Q70.

Answer: C

Explanation:

Acid-catalyzed esterification of ethanol with acetic acid produces ethyl acetate, an ester with a characteristic pleasant fruity smell.

Q71.

Answer: C

Explanation:

Ethanol converts to ethyl bromide (*A*), then to ethylmagnesium bromide (*B*), which undergoes nucleophilic addition with acetaldehyde to give sec-butanol (*C*).

Q72.

Answer: C

Explanation:

Reaction C is Williamson Ether Synthesis, which produces an ether (C_6H_5OR) rather than phenol.

Q73.

Answer: B

Explanation:

Alkaline hydrolysis of chlorobenzene yields phenoxide ion (*A*), which upon acidification gives phenol (*B*), and upon methylation gives anisole (*C*).

Q74.

Answer: B

Explanation:

Phenol reacts with PCl_5 to form triphenyl phosphate (*A*), with zinc dust to form benzene (*B*), and with acetyl chloride to form phenyl acetate (*C*).

Q75.

Answer: C

Explanation:

Alkali fusion of sodium benzenesulphonate gives sodium phenate (*A*), which alkylates to anisole (*B*), and cleavage with HI yields phenol (*C*) and methyl iodide (*D*).

Q76.

Answer: C

Explanation:

Grignard addition to acetaldehyde gives propan-2-ol (*A*), which dehydrates to propene (*B*), and hydroboration-oxidation converts propene to propan-1-ol (*C*). Propan-2-ol and propan-1-ol are positional isomers.

Q77.

Answer: C

Explanation:

Propanal (CH_3CH_2CHO) lacks a $CH_3C=O$ or $CH_3CH(OH)-$ structural unit and cannot undergo the iodoform reaction.

Q78.

Answer: C

Explanation:

Only secondary alcohols containing a $CH_3CH(OH)-$ unit (like propan-2-ol) give a positive iodoform test; secondary alcohols like pentan-3-ol give a negative test.

Q79.

Answer: B

Explanation:

Acetone forms iodoform (*A*), which dehalogenates with silver powder to ethyne (*B*), and hydration of ethyne yields acetaldehyde (*C*).

Q80.

Answer: C

Explanation:

Hydration of propyne yields acetone (A), which undergoes nucleophilic addition with chloroform to give chloretone (B), and haloform reaction with $I_2/NaOH$ to give iodoform (C).

Q81.

Answer: A

Explanation:

Ethyl chloride reacts with $NaCN$ to give propanenitrile (X), reduction gives propan-1-amine (Y), and acetylation with acetic anhydride gives N-propylacetamide (Z).

Q82.

Answer: D

Explanation:

Acetic acid converts to acetyl chloride (A), Friedel-Crafts acylation gives acetophenone (B), and nucleophilic addition of ethylmagnesium bromide followed by hydrolysis yields 2-phenylbutan-2-ol (C).

Q83.

Answer: B

Explanation:

Nucleophilic acyl substitution between sodium ethoxide and ethanoyl chloride (acetyl chloride) yields ethyl ethanoate (ethyl acetate).

Q84.

Answer: C

Explanation:

The Kolbe-Schmitt reaction converts sodium phenoxide to salicylic acid, which upon acetylation with acetic anhydride forms aspirin (2-acetoxybenzoic acid).

Q85.

Answer: C

Explanation:

Reduction of benzenediazonium chloride with phosphinic acid (H_3PO_2) replaces the diazonium group with hydrogen to yield benzene, not phenol.

Q86.

Answer: D

Explanation:

Acidified $KMnO_4$ is a strong oxidizing agent that oxidizes primary alcohols completely to carboxylic acids ($RCOOH$).

Q87.

Answer: D

Explanation:

All four listed reaction pathways (Rosenmund reduction, side-chain chlorination/hydrolysis, Etard-type oxidation with CrO_3/Ac_2O , and Gattermann-Koch reaction) prepare benzaldehyde.

Q88.

Answer: C

Explanation:

Nucleophilic addition of isopropylmagnesium bromide to formaldehyde followed by hydrolysis produces isobutyl alcohol (2-methylpropan-1-ol).

Q89.

Answer: B

Explanation:

DIBAL-H selectively reduces nitriles and esters containing the same 6-carbon acyl chain to the corresponding 6-carbon aldehyde, hexanal.

Q90.

Answer: A

Explanation:

The Hell-Volhard-Zelinsky (HVZ) reaction selectively halogenates carboxylic acids at the α -position to form α -halocarboxylic acids.

Q91.

Answer: B

Q92.

Answer: D

Q93.

Answer: B

Q94.

Answer: B

Q95.

Answer: C

Q96.

Answer: B

Q97.

Answer: B

Q98.

Answer: B

Q99.

Answer: B

Q100.

Answer: B

Q101.

Answer: B

Q102.

Answer: B

Q103.

Answer: B

Q104.

Answer: B

Q105.
Answer: A

Q106.
Answer: B

Q107.
Answer: B

Q108.
Answer: B

Q109.
Answer: D

Q110.
Answer: B

Q111.
Answer: B

Q112.
Answer: A

Q113.
Answer: B

Q114.
Answer: B

Q115.
Answer: B

Q116.
Answer: A

Q117.
Answer: A

Q118.
Answer: C

Q119.
Answer: A

Q120.
Answer: C

Q121.
Answer: B

Q122.
Answer: B

Q123.
Answer: A

Q124.
Answer: B

Q125.
Answer: D

Q126.
Answer: C

Q127.
Answer: D

Q128.
Answer: B

Q129.
Answer: B

Q130.
Answer: A

Q131.
Answer: A

Q132.
Answer: B

Q133.
Answer: B

Q134.
Answer: C

Q135.
Answer: A

Q136.
Answer: D

Q137.
Answer: D

Q138.
Answer: B

Q139.
Answer: D

Q140.
Answer: B

Q141.
Answer: A

Q142.
Answer: C

Q143.
Answer: C

Q144.
Answer: D

Q145.
Answer: B

Q146.
Answer: C

Q147.
Answer: D

Q148.
Answer: A

Q149.
Answer: D

Q150.
Answer: A

Q151.
Answer: A

Q152.
Answer: D

Q153.
Answer: C

Q154.
Answer: D

Q155.
Answer: A

Q156.
Answer: B

Q157.
Answer: C

Q158.
Answer: A

Q159.
Answer: C

Q160.
Answer: C

Q161.
Answer: A

Q162.
Answer: B

Q163.
Answer: C

Q164.
Answer: B

Q165.
Answer: C

Q166.
Answer: D

Q167.
Answer: D

Q168.
Answer: B

Q169.
Answer: A

Q170.
Answer: C

Q171.
Answer: A

Q172.
Answer: D

Q173.
Answer: A

Q174.
Answer: A

Q175.
Answer: A

Q176.
Answer: C

Q177.
Answer: B

Q178.
Answer: A

Q179.
Answer: A

Q180.
Answer: A