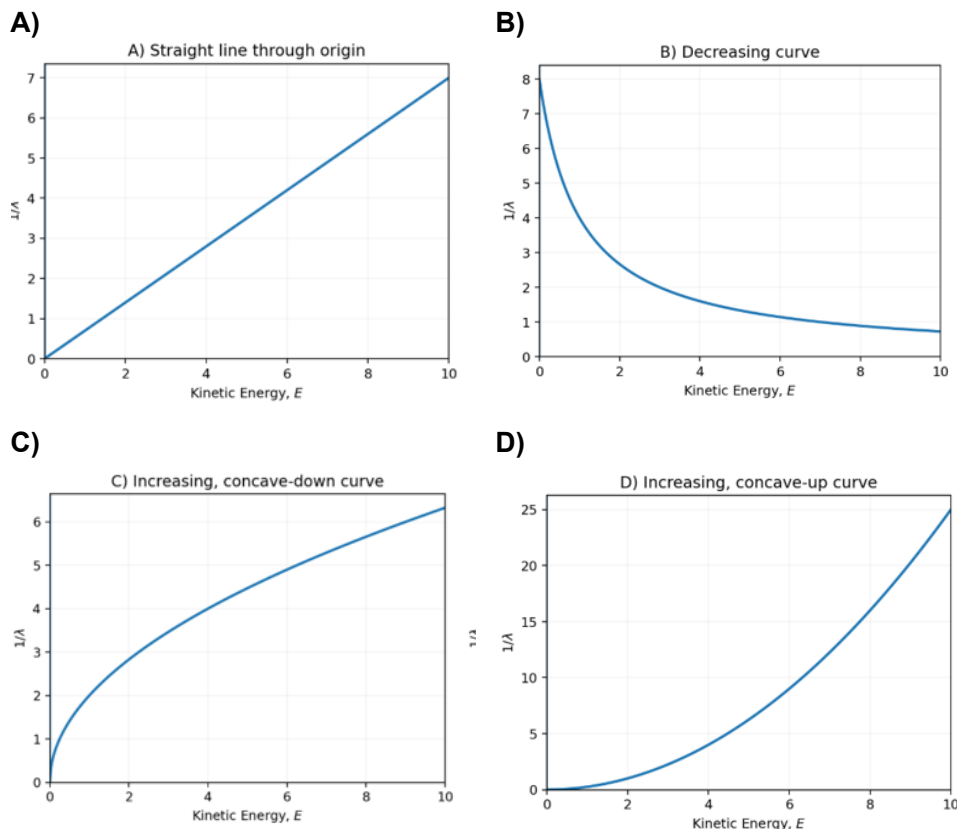


- A)** $c\sqrt{2m/E}$ **B)** $c\sqrt{2mE}$
C) $\frac{1}{c}\sqrt{E/2m}$ **D)** $\sqrt{E/2m}$

6. The graph which shows the variation of $\left(\frac{1}{\lambda}\right)$ and the kinetic energy E of a non-relativistic free particle is:



7. If c is the velocity of light in free space, the correct statements about photon among the following are: A. The energy of a photon is $E = h\nu$, where ν is the frequency of light. B. The velocity of a photon in free space is c . C. The momentum of a photon is $p = \frac{h}{\lambda}$. D. A photon possesses no electric charge. E. In a photon-electron collision, only total energy is conserved while total momentum is not conserved. Choose the correct answer from the options given below:

- A) A, B, C and D only
B) A, C and E only
C) B, C and D only
D) A, B and E only

8. When light of wavelength 248 nm is incident on a photosensitive surface, the maximum kinetic energy of the emitted photoelectrons is 2 eV. The work function of the surface (in eV) is: (Take $hc = 1240$ eV nm)

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

9. The work functions of Caesium (Cs), potassium (K) and Sodium (Na) are 1.95 eV, 2.29 eV and 2.75 eV respectively. If incident electromagnetic radiation has an incident energy of 2.50 eV, which of these photosensitive surfaces may emit photoelectrons?

- A) Na only
B) Cs only
C) Both K and Na
D) Both Cs and K

10. Match List-I with List-II.

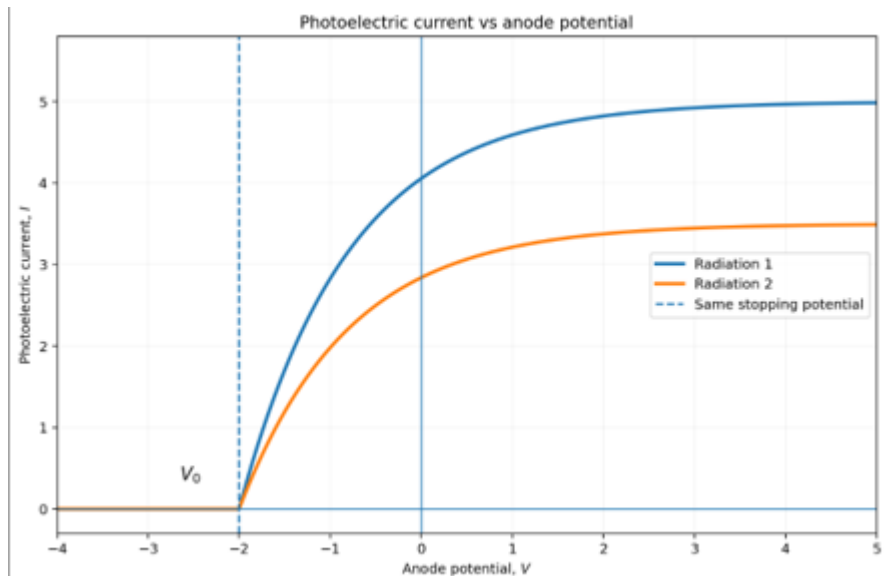
List-I	List-II
A. $p = \frac{h}{\lambda}$	I. Energy of photon
B. Photoelectric effect	II. Matter wave
C. $E = h\nu$	III. Particle nature of light
D. Electron diffraction	IV. Momentum of photon

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

11. The light rays having photons of energy 5.5 eV are falling on a metal surface having a work function of 2.5 eV. The stopping potential of the surface is
- A) 8 V
B) 3 eV
C) 5 V
D) 3 V
12. An electromagnetic wave of wavelength λ is incident on a photosensitive surface of negligible work function. The de-Broglie wavelength of the photoelectron (mass m) emitted from the surface is λ_d . If the wavelength of the incident wave is changed to 4λ , then the new de-Broglie wavelength of the photoelectron is:
- A) $4\lambda_d$
B) $\lambda_d/2$
C) $2\lambda_d$
D) $\lambda_d/4$
13. An electron of mass m with an initial velocity $\vec{v} = v_0\hat{i}$ ($v_0 > 0$) enters an electric field $\vec{E} = E_0\hat{i}$ ($E_0 = \text{constant} > 0$) at $t = 0$. If λ_0 is its de-Broglie wavelength initially, then its de-Broglie wavelength at time t is
- A) $\lambda_0 \left(1 - \frac{eE_0}{mv_0}t\right)$
B) $\frac{\lambda_0}{\left(1 + \frac{eE_0}{mv_0}t\right)}$
C) λ_0
D) $\frac{\lambda_0}{\left(1 - \frac{eE_0}{mv_0}t\right)}$
14. When the light of frequency $2\nu_0$ (where ν_0 is threshold frequency), is incident on a metal plate, the maximum velocity of electrons emitted is v_1 . When the frequency of the incident radiation is increased to $10\nu_0$, the maximum velocity of electrons emitted from the same plate is v_2 . The ratio of v_1 to v_2 is
- A) 1 : 9
B) 1 : 3
C) 3 : 1
D) 9 : 1

15. The de-Broglie wavelength of a neutron in thermal equilibrium with heavy water at a temperature T (kelvin) is λ_1 . When the temperature is raised to $4T$, the de-Broglie wavelength of the neutron becomes λ_2 . The ratio λ_1/λ_2 is
- A) 4
B) 8
C) 2
D) 16
16. An electron of mass m and a photon have same energy E . The ratio of de-Broglie wavelengths associated with them, $\lambda_{\text{photon}}/\lambda_{\text{electron}}$, is
- A) $\frac{1}{c} \left(\frac{E}{2m} \right)^{\frac{1}{2}}$
B) $\left(\frac{E}{2m} \right)^{\frac{1}{2}}$
C) $c(2mE)^{\frac{1}{2}}$
D) $c \left(\frac{2m}{E} \right)^{\frac{1}{2}}$
17. When a metallic surface is illuminated with radiation of wavelength λ , the stopping potential is V . If the same surface is illuminated with radiation of wavelength 3λ , the stopping potential is $\frac{V}{5}$. The threshold wavelength for the metallic surface is
- A) 6λ
B) 4λ
C) 8λ
D) 12λ
18. A photoelectric surface is illuminated successively by monochromatic light of wavelength λ and $\lambda/3$. If the maximum kinetic energy of the emitted photoelectrons in the second case is 4 times that in the first case, the work function of the surface of the material is (h = Planck's constant, c = speed of light)
- A) $\frac{hc}{2\lambda}$
B) $\frac{hc}{3\lambda}$
C) $\frac{2hc}{\lambda}$
D) $\frac{hc}{\lambda}$
19. A certain metallic surface is illuminated with monochromatic light of wavelength λ . The stopping potential for photo-electric current for this light is $4V_0$. If the same surface is illuminated with light of wavelength 2λ , the stopping potential is V_0 . The threshold wavelength for this surface for photo-electric effect is
- A) 2λ
B) 6λ
C) 3λ
D) $\frac{\lambda}{3}$

20. The graph shows the variation of photoelectric current with anode potential for two different radiations incident on the same photosensitive metal. The two curves have the same stopping potential but different saturation currents. Which statement is correct?

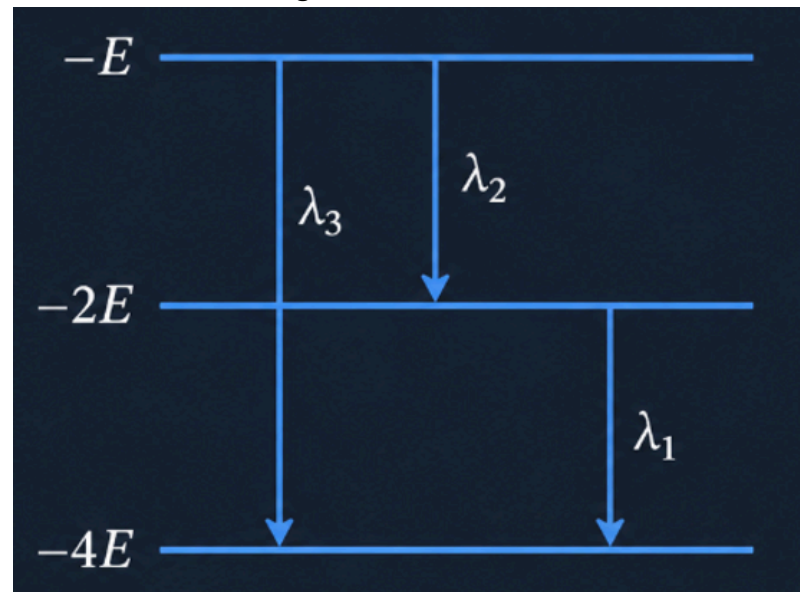


- A) The radiations have the same frequency but different intensities.
 B) The radiations have different frequencies and the same intensity.
 C) The radiations have the same frequency and the same intensity.
 D) The radiations have different frequencies and different stopping potentials.

21. A particle of mass m is moving around the origin with an attractive force $F = kr$ ($k = \text{constant}$) pulling it towards the origin. If Bohr model is used to describe its motion, the radius of the n^{th} orbit and the particle's speed v in the orbit depend on n as

- A) $r \propto n^2; v \propto n^{-1}$
 B) $r \propto n^{2/3}; v \propto n^{1/3}$
 C) $r \propto n^{3/2}; v \propto n^{-1/2}$
 D) $r \propto n^{1/2}; v \propto n^{1/2}$

22. Some energy levels of a molecule are shown below. The wavelengths of the transitions are λ_1 , λ_2 , and λ_3 as indicated. Which of the following relations is correct?



- A) $\lambda_1 > \lambda_2 > \lambda_3$
 B) $\lambda_2 = 2\lambda_1$, $\lambda_1 = \frac{3}{2}\lambda_3$
 C) $\lambda_3 = 2\lambda_1$, $\lambda_2 = 3\lambda_1$
 D) $\lambda_1 = 2\lambda_2$, $\lambda_3 = 2\lambda_1$

23. Match List I with List II:

List I (Spectral Lines of Hydrogen for transitions from) | List II (Wavelengths (nm))

- A. $n_2 = 4$ to $n_1 = 3$ | I. 1093.9
 B. $n_2 = 5$ to $n_1 = 3$ | II. 1875.2
 C. $n_2 = 6$ to $n_1 = 3$ | III. 1005.0
 D. $n_2 = 7$ to $n_1 = 3$ | IV. 1281.9

Choose the correct answer from the options given below:

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

24. The ground state energy of hydrogen atom is -13.6 eV. The energy needed to ionize hydrogen atom from one of its excited states is found to be 0.85 eV. The principal quantum number n of this excited state is

- A) 4
B) 3
C) 5
D) 6

25. The ground state energy of a hydrogen-like atom is -144 eV. The angular momentum of an electron moving in an orbit of this atom is $2\left(\frac{h}{\pi}\right)$. The energy in the same orbit is

- A) -36 eV
B) -16 eV
C) -4 eV
D) -9 eV

26. The radius of inner most orbit of hydrogen atom is 5.3×10^{-11} m. If the radius of a certain allowed orbit of hydrogen atom is measured to be 8.48×10^{-10} m, then the principal quantum number n of this orbit is

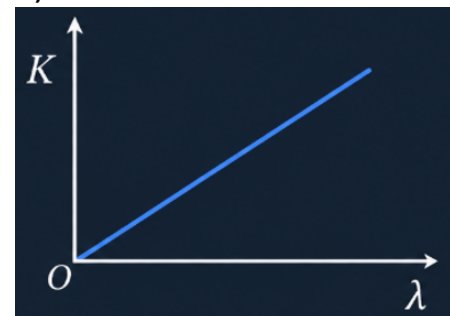
- A) 3
B) 5
C) 4
D) 6

27. Let R_1 be the radius of the sixth stationary orbit and R_2 be the radius of the second stationary orbit of an electron in Bohr's model. The ratio $\frac{R_1}{R_2}$ is :

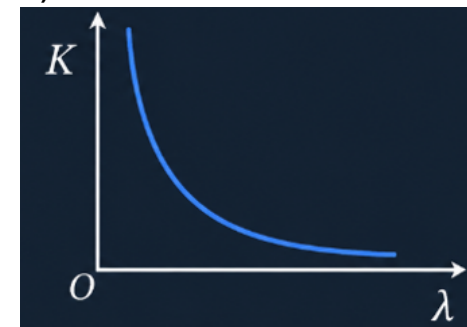
- A) 3
B) 6
C) 12
D) 9

28. The graph which shows the variation of the kinetic energy K of a non-relativistic particle with its associated de Broglie wavelength λ is:

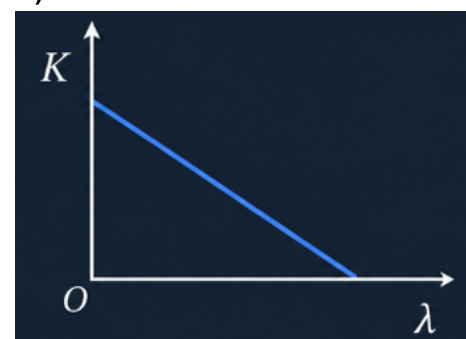
A)



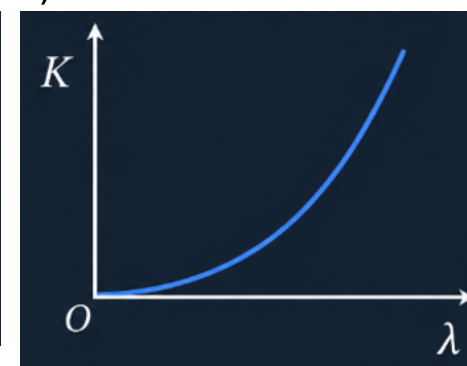
B)



C)



D)



29. Let T_1 and T_2 be the energy of an electron in the second and third excited states of hydrogen atoms, respectively. According to the Bohr's model of an atom, the ratio $T_1 : T_2$ is

- A) 9 : 16
B) 4 : 9
C) 16 : 9
D) 9 : 4

30. For which one of the following, Bohr model is not valid?

- A) Singly ionised helium atom (He^+)
B) Doubly ionised lithium atom (Li^{2+})
C) Deuterium atom
D) Singly ionised lithium atom (Li^+)

- A)** 3 eV, -6 eV
C) -6 eV, 12 eV

- B) 6 eV, -12 eV**
D) 12 eV, -24 eV

32. The ratio of potential energy to the total energy of an electron in a Bohr orbit of the hydrogen atom, is

- A) 2 : 1**
- B) 1 : 2**
- C) 1 : 1**
- D) -2 : 1**

33. The ratio of wavelengths of the last line of Paschen series and the last line of Lyman series is

- A) 3**
- B) 6**
- C) 9**
- D) 12**

34. If an electron in a hydrogen atom jumps from the 4^{th} orbit to the 2^{nd} orbit, it emits a photon of wavelength λ . When it jumps from the 2^{nd} orbit to the 1^{st} orbit, the corresponding wavelength of the photon will be

- A)** 4λ
- B)** $\frac{\lambda}{2}$
- C)** 2λ
- D)** $\frac{\lambda}{4}$

35. In the spectrum of hydrogen, the ratio of the longest wavelength in the Balmer series to the longest wavelength in the Paschen series is

- A)** $\frac{20}{7}$
- B)** $\frac{7}{20}$
- C)** $\frac{27}{5}$
- D)** $\frac{5}{27}$

36. Consider 2^{nd} orbit of Li^{2+} (Lithium), using non-relativistic approach, the speed of electron in this orbit will be [given $K = 9 \times 10^9$ constant, $Z = 3$ and h (Planck's Constant) = 6.6×10^{-34} J s, $e = 1.6 \times 10^{-19}$ C]

- A)** 1.64×10^6 m/s **B)** 6.58×10^6 m/s
C) 3.29×10^6 m/s **D)** 2.18×10^6 m/s

37. Hydrogen atom in ground state is excited by a monochromatic radiation of $\lambda = 950 \text{ \AA}$. Number of spectral lines in the resulting spectrum emitted will be

- A) 6** **B) 10**
C) 3 **D) 15**

38. An electron in hydrogen atom makes a transition $n_1 \rightarrow n_2$ where n_1 and n_2 are principal quantum numbers of the two states. Assuming Bohr's model to be valid, the time period of the electron in the initial state is twenty seven times that in the final state. The possible values of n_1 and n_2 are

- A)** $n_1 = 6$ and $n_2 = 2$ **B)** $n_1 = 8$ and $n_2 = 2$
C) $n_1 = 4$ and $n_2 = 2$ **D)** $n_1 = 9$ and $n_2 = 2$

39. Ratio of longest wave lengths corresponding to Paschen and Balmer series in hydrogen spectrum is

- A) $\frac{7}{20}$ B) $\frac{27}{5}$
C) $\frac{5}{27}$ D) $\frac{20}{7}$

40. The transition from the state $n = 4$ to $n = 1$ in a hydrogen like atom results in ultraviolet radiation. Infrared radiation will be obtained in the transition from

- A) $2 \rightarrow 1$** **B) $5 \rightarrow 4$**
C) $4 \rightarrow 2$ **D) $3 \rightarrow 1$**

41. Electron in hydrogen atom first jumps from second excited state to first excited state and then from first excited to the ground state. The ratio of the wavelengths $\lambda_1 : \lambda_2$ emitted in the two cases is

- A)** $\frac{5}{27}$ **B)** $\frac{20}{7}$
C) $\frac{27}{5}$ **D)** $\frac{7}{20}$

42. The wavelength of the first line of Lyman series for hydrogen atom is equal to that of the third line of Paschen series for a hydrogen like ion. The atomic number Z of hydrogen like ion is

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

43. The energy of a hydrogen atom in the ground state is -13.6 eV. The ratio of the energy of a He^+ ion in its ground state to the energy of a hydrogen atom in its first excited state is

- A) 4
B) 8
C) 2
D) 16

44. The total energy of electron in the ground state of a hydrogen like atom is -100 eV. The kinetic energy of an electron in the first excited state is

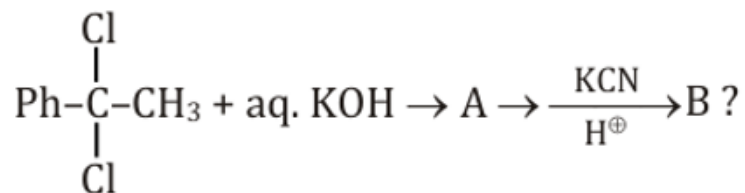
- A) 50 eV
B) 100 eV
C) 25 eV
D) 20 eV

45. Ionization potential of hydrogen atom is 13.6 eV. Hydrogen atoms in the ground state are excited by monochromatic radiation of photon energy 12.75 eV. According to Bohr's theory, the spectral lines emitted by hydrogen will be

- A) three
B) ten
C) two
D) six

Chemistry

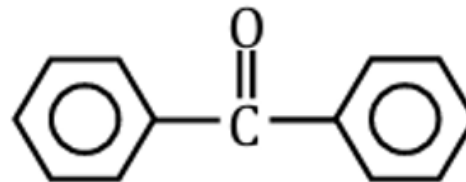
46.



Given

- A) 50% d + 50% l
B) 80% d + 20% l
C) Meso compound
D) Optically active

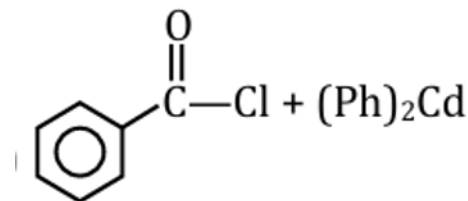
47.



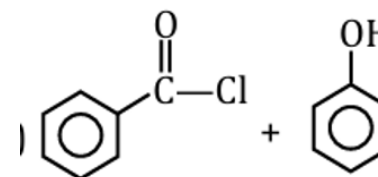
can be obtained by which of

the following reactions?

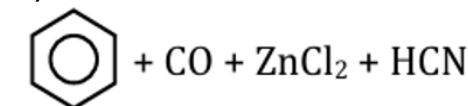
A)



B)

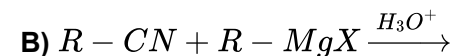
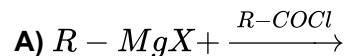


C)

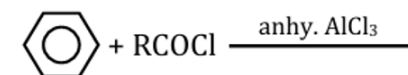


D) None of the above

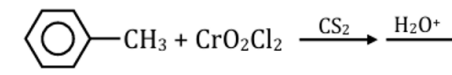
48. Which of the following reactions will not give a ketone?



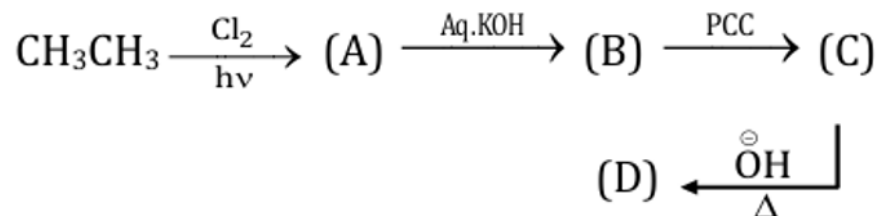
C)



D)



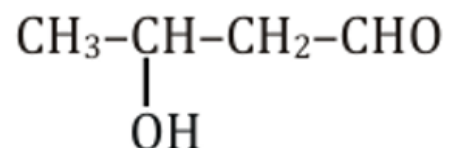
49. In the reaction sequence:



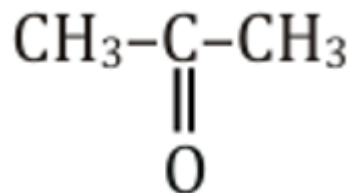
, the product (D) is:

A) $\text{CH}_2 = \text{CH}_2$

B)

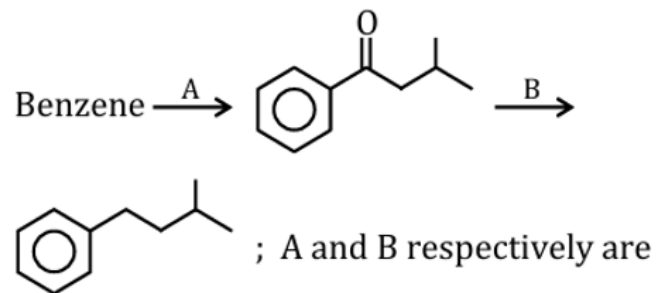


D) $\text{CH}_3 - \text{CH} = \text{CH} - \text{CHO}$

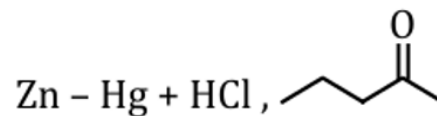


C)

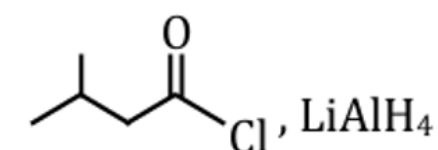
50.



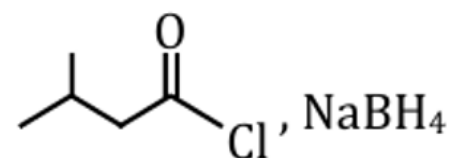
A)



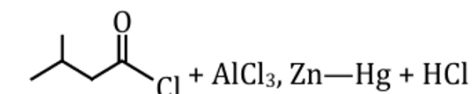
B)



C)

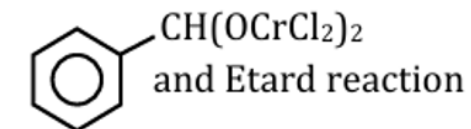


D)

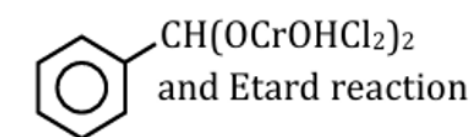


51. Select the structure of chromium complex formed by the reaction of toluene with chromylchloride followed by hydrolysis to give benzaldehyde and also the name of the reaction

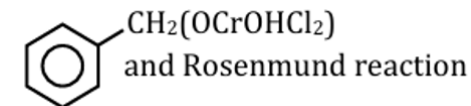
A)



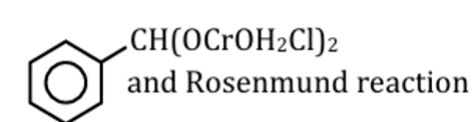
B)



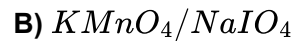
C)



D)

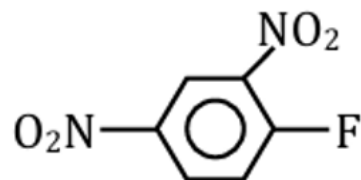
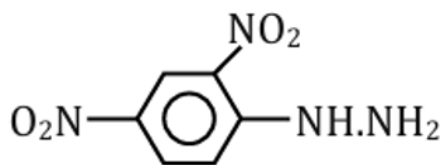


52. Brady's reagent is:

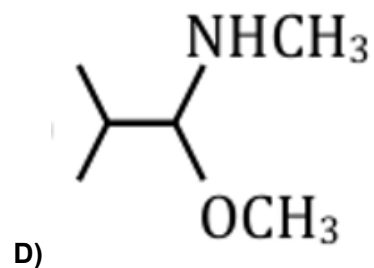
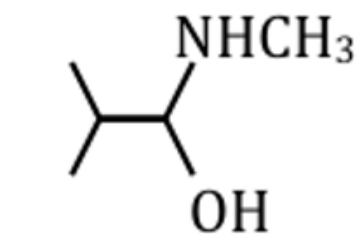
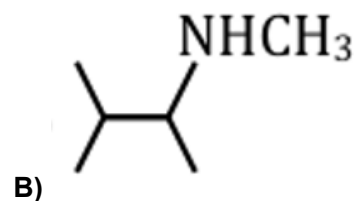
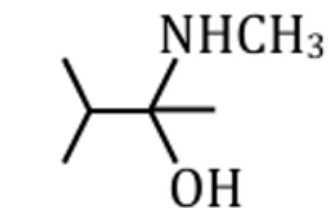
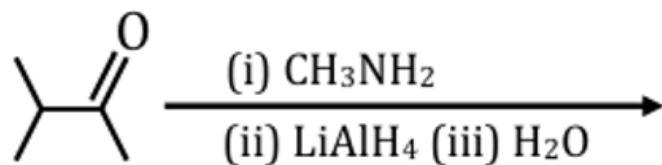


C)

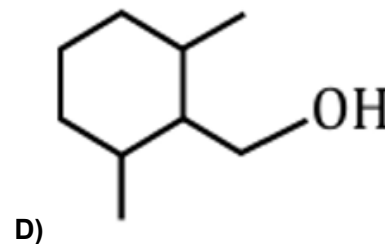
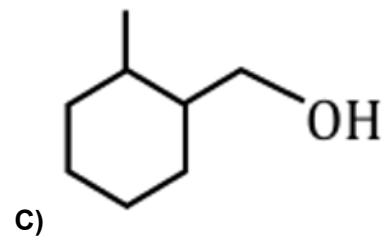
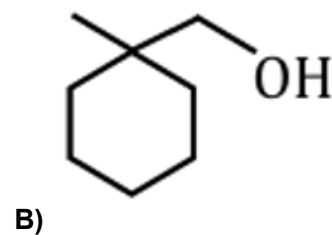
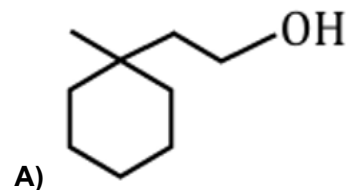
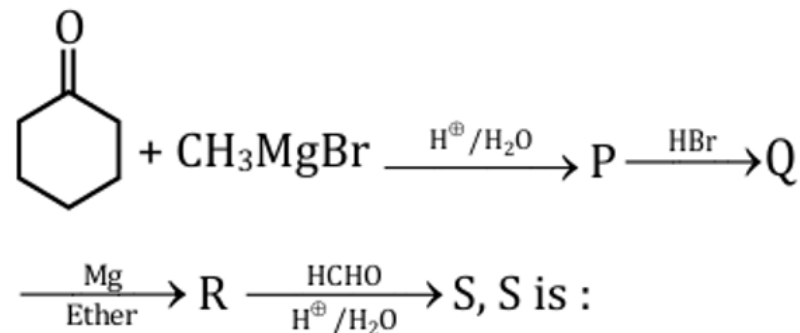
D)



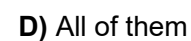
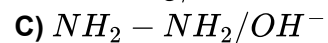
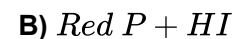
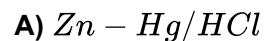
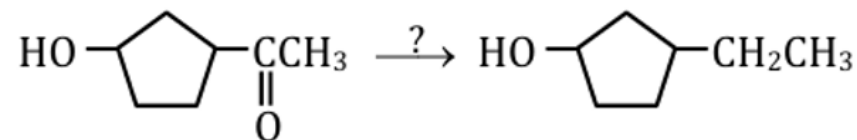
53. The major organic product formed from the following reaction is:



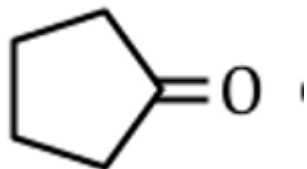
54.



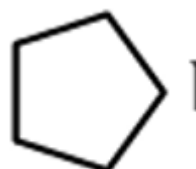
55. Which of the following reagents can be used for the conversion



56.



can be converted to



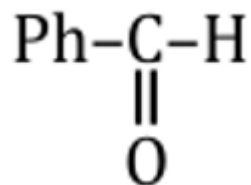
by:

A) Red P + HI

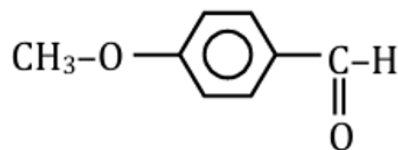
B) Wolff-Kishner reduction

C) Clemmensen reaction

D) All

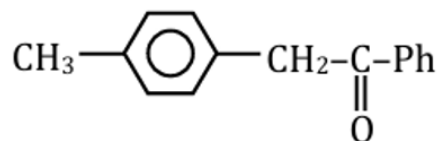
57. Which of the following does not react with $NaHSO_3$?

B)

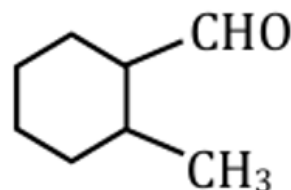


A)

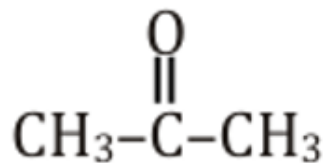
C)



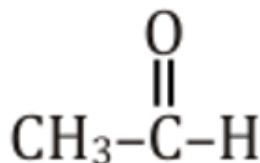
D)



58.



and



are readily distinguished by their reaction with:

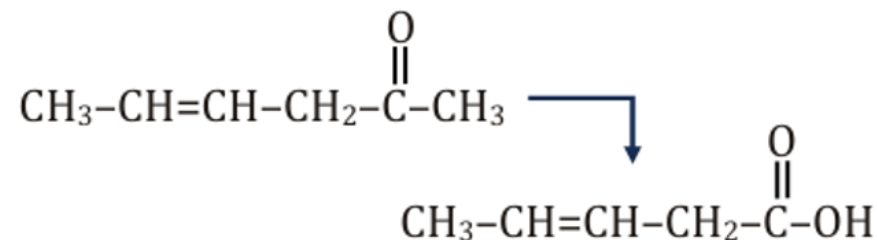
A) Iodine and alkali

B) 2,4-Dinitrophenylhydrazine

C) Tollen's reagent

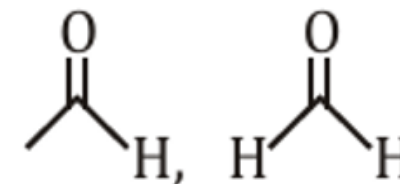
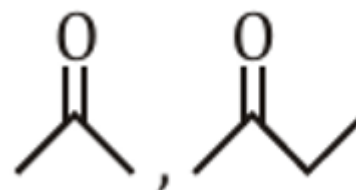
D) All the above

59. Which is the most suitable reagent for the conversion:

A) (i) Tollen's reagent (ii) H^+ B) (i) Benzoyl peroxide (ii) H^+ C) (i) I_2 and NaOH (ii) H^+ D) $KMnO_4/H^+, \Delta$

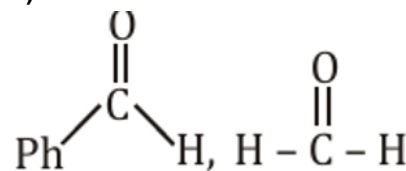
60. Which of the following pairs is differentiated by the iodoform test?

B)

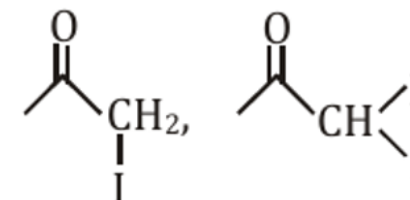


A)

C)

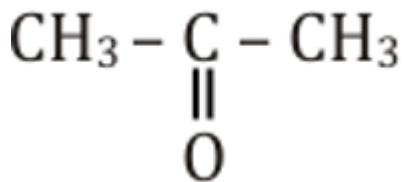


D)

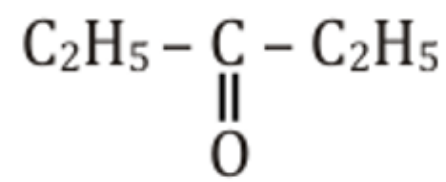


61. Which of the following will not give a positive iodoform test?

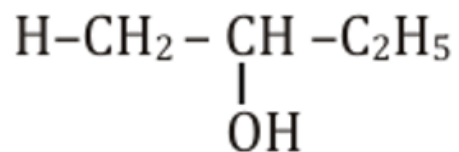
A)



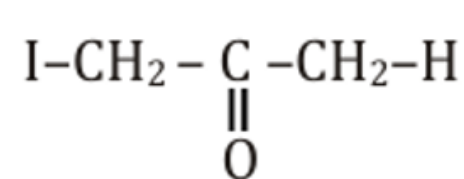
B)



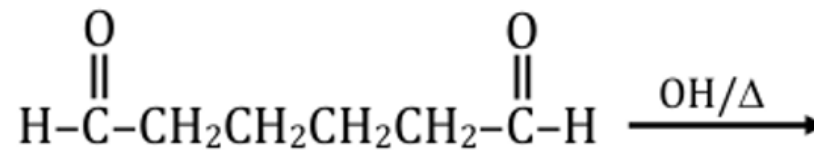
C)



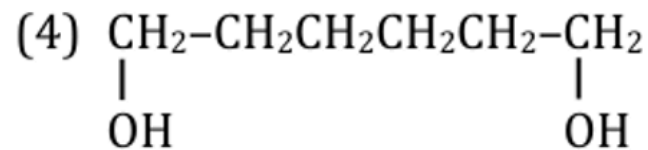
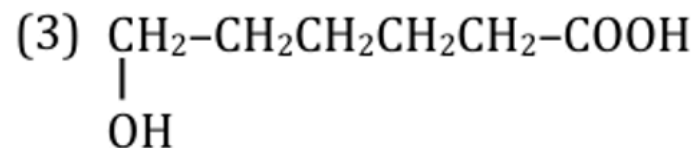
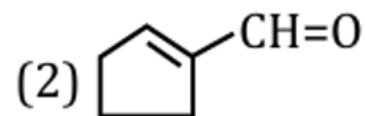
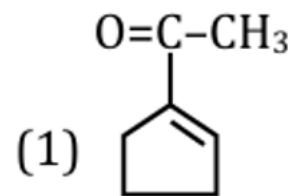
D)



62.



Reaction Product (A) is:



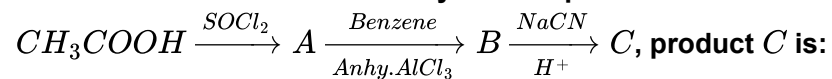
A) 1

B) 2

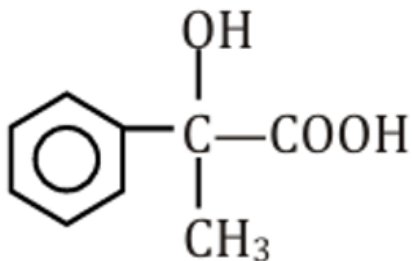
C) 3

D) 4

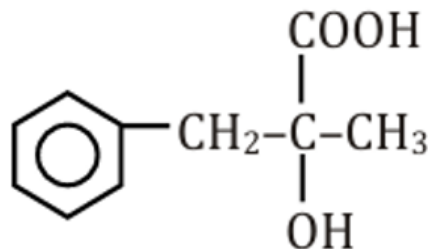
63. In a set of reactions acetic acid yielded a product C



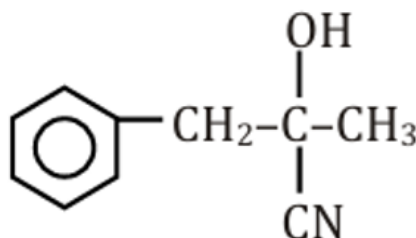
A)



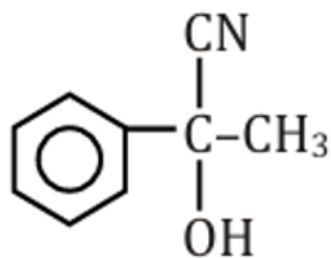
B)



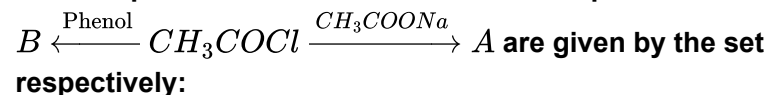
D)



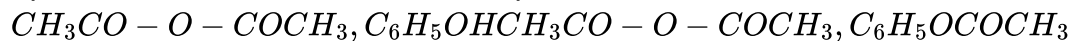
C)



64. The compounds A and B in the reaction sequence:



A)

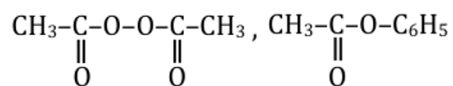


B)



C) $\text{CH}_3\text{COCH}_3, \text{C}_6\text{H}_5\text{OCOCH}_3$

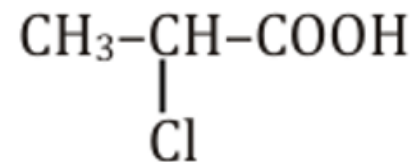
D)



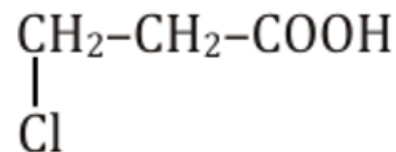
65. In the reaction: $\text{CH}_3-\text{CH}_2-\text{COOH} \xrightarrow{\text{Red P/Cl}_2} \text{A} \xrightarrow[\text{KOH}]{\text{alc.}} \text{B}$, the structure of B is:

A) $\text{CH}_2=\text{CH}-\text{COOH}$

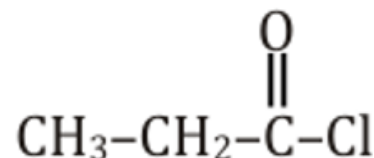
B)



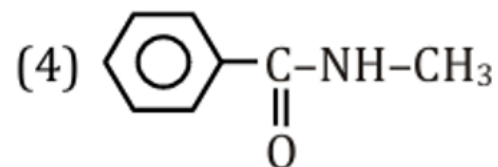
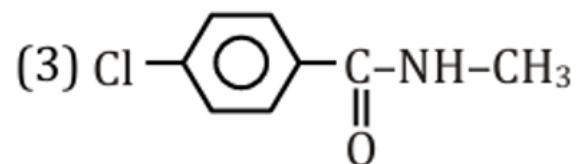
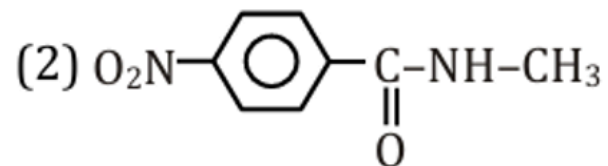
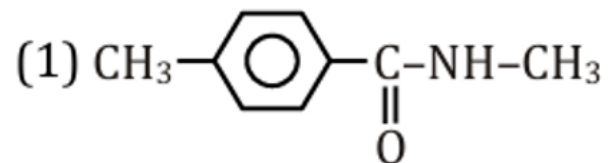
C)



D)



66. Which of the following substituted amides is most reactive towards



hydrolysis?

A) 1

B) 2

C) 3

D) 4

67. Which of the following reagents may be used to distinguish between phenol and benzoic acid?

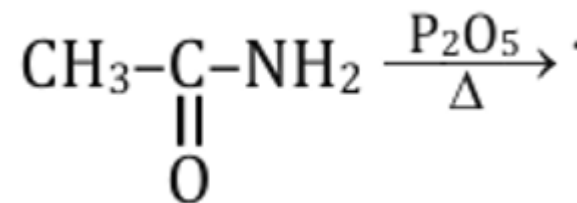
A) Victor-Meyer test

B) Neutral $FeCl_3$

C) Aqueous NaOH

D) Tollen's reagent

68.



In the reaction:

product is:

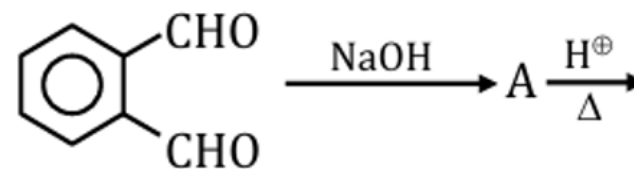
A) CH_3COOH

B) CH_3-CN

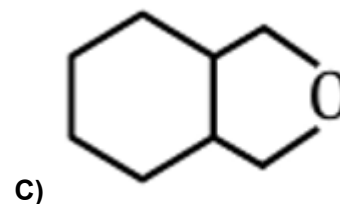
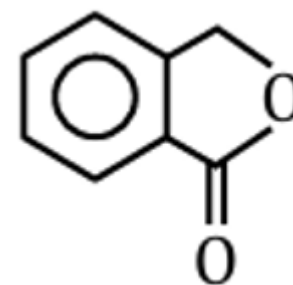
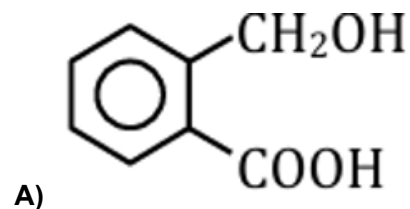
C) CH_3-CH_3

D) CH_3-CHO

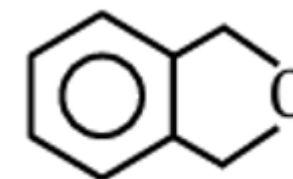
69.



In the reaction

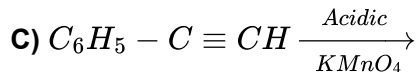
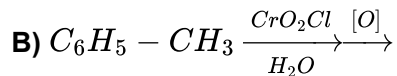
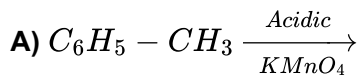


B)

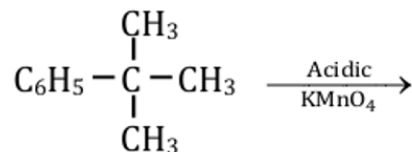


D)

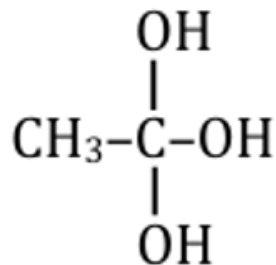
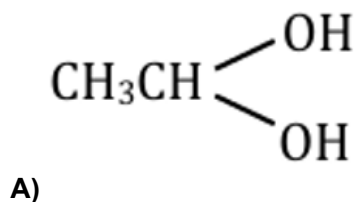
70. Which of the following reactions does not give benzoic acid?



D)

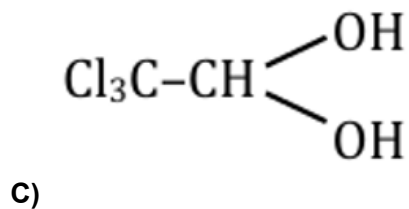


71. A compound containing two $-OH$ groups attached to one carbon atom is generally unstable, but which one of the following gem-diols is stable?



B)

D) All



72. Carbonyl compounds are best purified by:

A) Steam distillation

B) Hydrolysis of sodium bisulfite adducts

C) Fractional crystallization

D) Sublimation

73. Hydrazine on reaction with acetone gives:

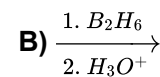
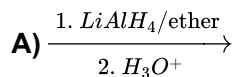
A) Acetylene

B) Acetone hydrazone

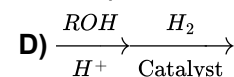
C) Nitrochloroform

D) Chloroacetone

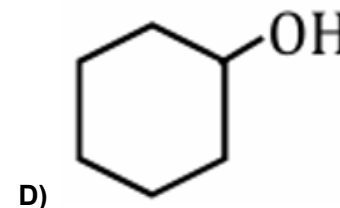
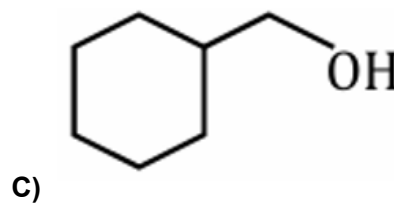
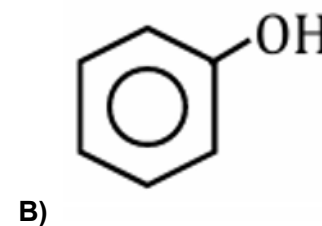
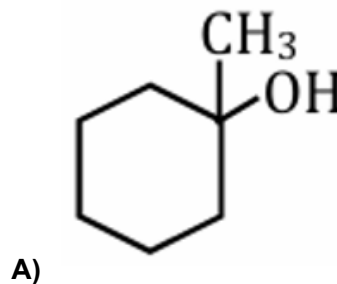
74. Which of the following reagents does not reduce carboxylic acids into primary alcohols?



C) $NaBH_4$

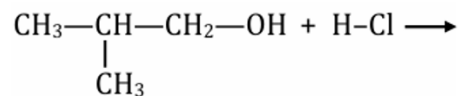


75. Which is most reactive with $H-X$?

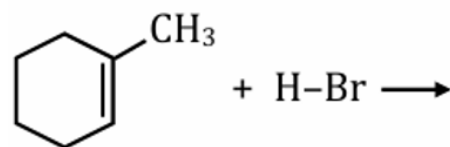


76. In which reaction 3° Halide is not obtained as a major product?

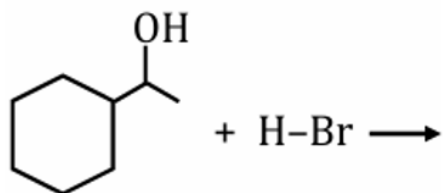
A)



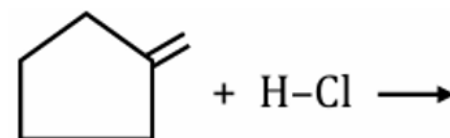
B)



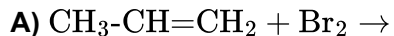
C)



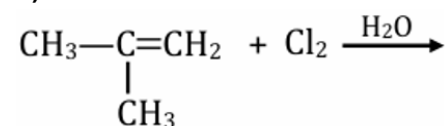
D)



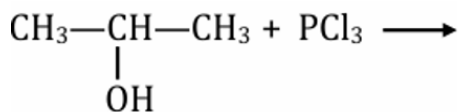
77. Which reaction gives only dihalide?



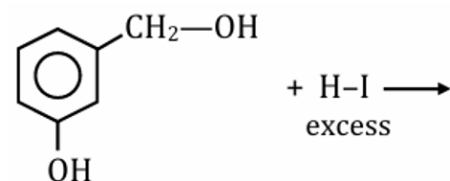
B)



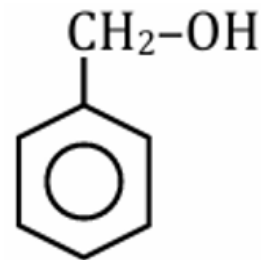
C)



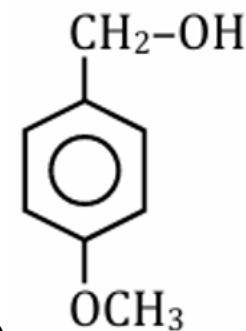
D)



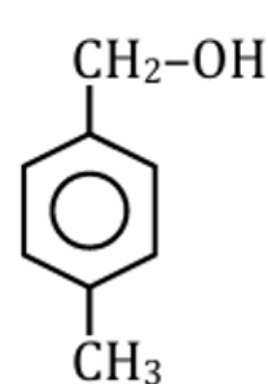
78. Which is maximum reactive towards H-X?



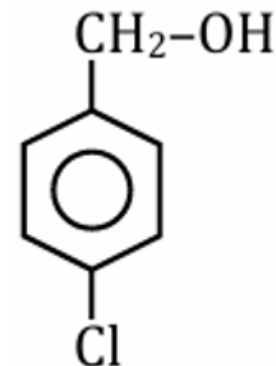
A)



B)



C)



D)

79. Phenol on treatment with methyl chloride in the presence of anhydrous AlCl_3 gives chiefly:

A) *o*-cresol

B) *m*-cresol

C) Anisole

D) *p*-cresol

80. The reduction of acetamide gives :-

A) $\text{CH}_3\text{CH}_2\text{NH}_2$

B) $(\text{CH}_3)_2\text{CHNH}_2$

C) $(\text{CH}_3)_3\text{CNH}_2$

D) $(\text{CH}_3\text{CH}_2)_2\text{NH}$

81. Phenol on heating with NaNO_2 and a few drops of conc. H_2SO_4 mainly gives:

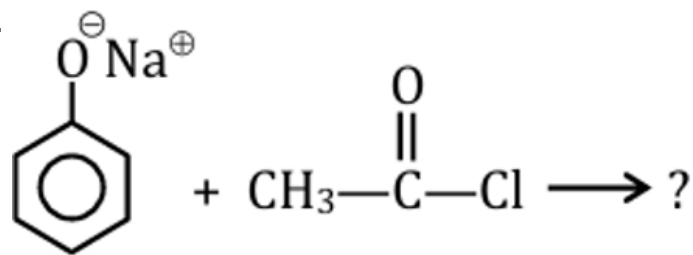
A) *p*-nitrophenol

B) *p*-nitrosophenol

C) *o*-nitrophenol

D) *m*-nitrosophenol

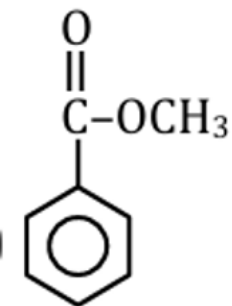
82.



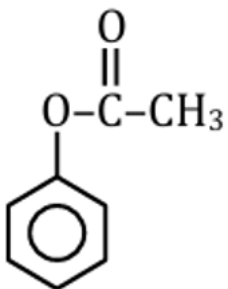
phenate

Sodium

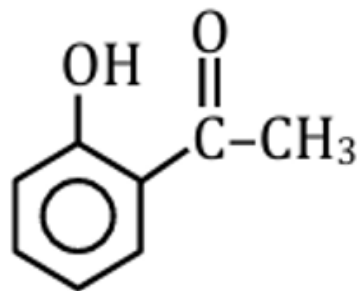
A)



C)



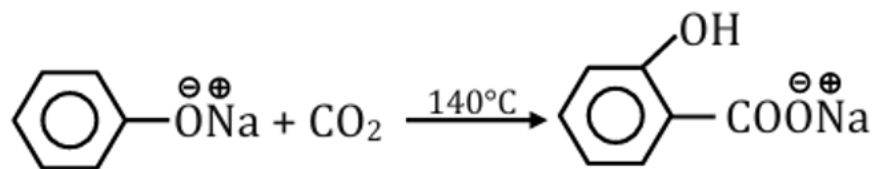
B)



D)



83. The reaction:



is called:

A) Schotten-Baumann reaction

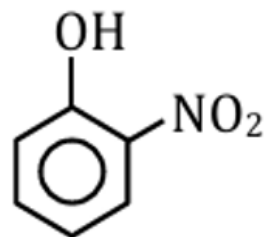
B) Kolbe-Schmidt reaction

C) Reimer-Tiemann reaction

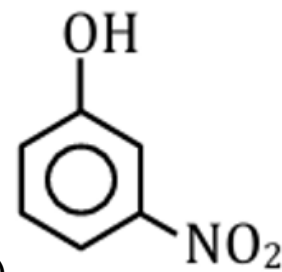
D) Lederer-Manasse reaction

84. Nitration of phenol with conc. H_2SO_4 followed by nitric acid gives:

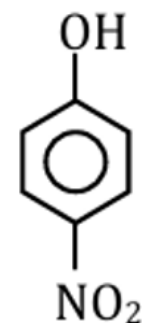
A)



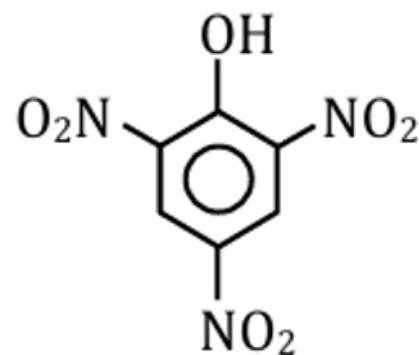
B)



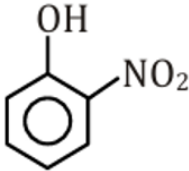
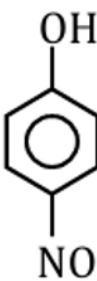
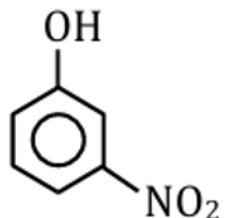
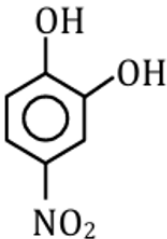
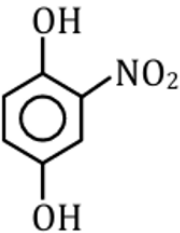
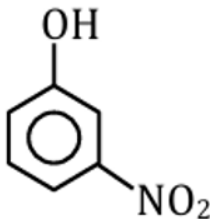
C)



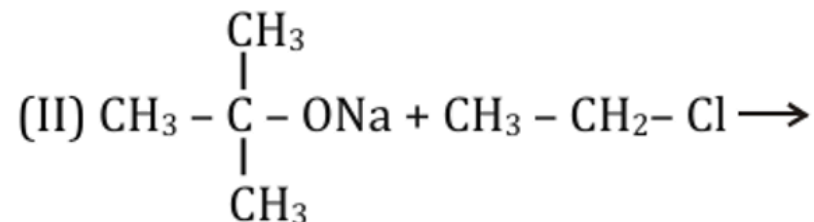
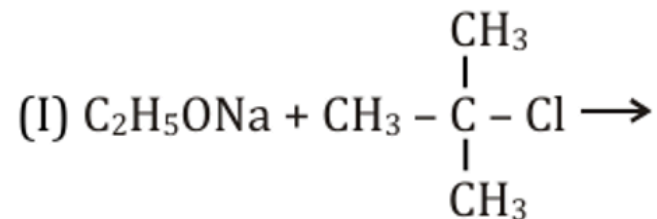
D)



85. Phenol on treatment with dil. HNO_3 at low temp (298 K) gives two products P and Q . P is steam volatile but Q is not. P and Q are respectively:

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

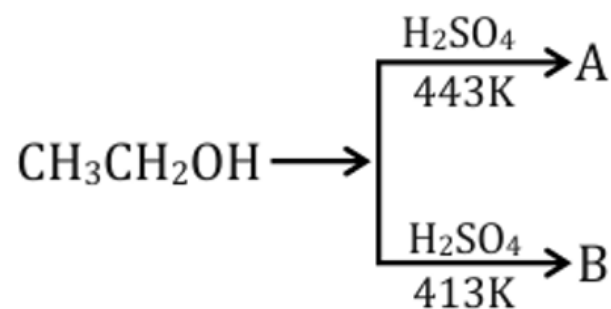
86. A student tried two reactions for preparing tert-butyl ethyl ether:



Which reaction will give a better yield of tert-butyl ethyl ether?

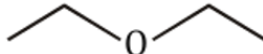
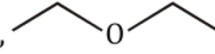
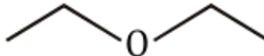
- A) Only I
B) Only II
C) Both I & II
D) Neither I nor II

87.

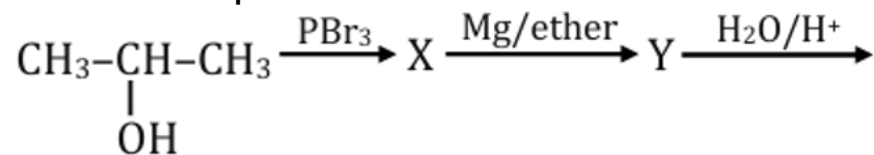


A and B are

respectively:

- A) , $\text{CH}_2 = \text{CH}_2$
- B) , 
- C) $\text{CH}_2 = \text{CH}_2$, $\text{CH}_2 = \text{CH}_2$
- D) $\text{CH}_2 = \text{CH}_2$, 

88. In the reaction sequence:



The final product is:

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

89. Oxonium ion of ether has the structure:

- A) $\text{C}_2\text{H}_5-\text{O}-\underset{\text{CH}_3}{\text{CH}}-\overset{\oplus}{\text{O}}-\text{H}$
 B) $\text{CH}_3-\text{CH}_2-\overset{\oplus}{\text{O}}-\underset{\text{H}}{\text{CH}}_2-\text{CH}_3$
 C) $(\text{C}_2\text{H}_5)_2\text{O}$
 D) $\text{CH}_3-\text{CH}_2-\text{O}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\overset{\oplus}{\text{O}}-\underset{\text{H}}{\text{CH}}_2-\text{O}-\text{H}$

90. Which of the following is insoluble in water?

- A) Ethanol
 B) Ethoxyethane
 C) Phenol
 D) Pentane

Botany

91. The main cause for the discovery of laws of heredity by Mendel.

- A) He analysed every trait independently
 B) He was lucky that he did not come across linkage
 C) His plants were true breeding
 D) All of the above

92. Mendel called the fundamental physical unit of heredity as

- A) Gene
 B) Unit factor
 C) Cistron
 D) Operon

93. Mendel's work was rediscovered by

- A) Charles Darwin
 B) T.H. Morgan
 C) K. Correns, Tschermak and H. de Vries
 D) W. Bateson and R.C. Punnett

94. During sexual reproduction, characters are transmitted through

- A) Any vegetative cell
 B) Gametes
 C) Propagules
 D) Clones

95. Number of pairs of characters used by Mendel during his experiments were

- A) Ten
 B) Six
 C) Seven
 D) Two

96. In *Pisum sativum*, experimental error is minimum because

- A) They are self-pollinated
 B) The hybrids produced are fertile
 C) Large number of offspring is obtained
 D) They are pure lines

97. Which one of the following cannot be explained on the basis of Mendel's Law of Dominance?

- A) Factors occur in pairs
 B) The discrete unit controlling a particular character is called a factor
 C) Out of one pair of factors one is dominant, and the other recessive
 D) Alleles do not show any blending and both characters recover as such in F_2 generation

98. The trait that is expressed in both homozygous and heterozygous conditions is

- A) Codominant trait
 B) Dominant trait
 C) Recessive trait
 D) Incomplete dominant trait

99. In dihybrid cross, the pattern of inheritance represented by the punnett square given below, where yellow(Y) is dominant over white (y) and round (R) is dominant over wrinkled (r) seeds

	YR	Yr	yR	yr
YR	F	J	N	R
Yr	G	K	O	S
yR	H	L	P	T
yr	I	M	Q	U

A plant Of type 'H'

will produce seeds with the genotype identical to seeds produced by the plants Of

- A) Type M
 B) Type J
 C) Type P
 D) Type N

100.

In a typical monohybrid cross, percentage of F_2 resembling the F_1 genotypically is

- A) 100%
 B) 75%
 C) 50%
 D) 25%

101.

The ratio of homozygous and heterozygous organisms in the F_2 of a monohybrid cross is

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

102.

How many different kinds of gametes are produced by the F_1 offspring from a cross between pure strain of plants with yellow peas and a pure strain of plants with green peas?

- A) 1
 B) 2
 C) 3
 D) 8

103.

Mendel's principle of segregation was based on the separation of alleles in the gamete during:

- A) Embryonic development
 B) Seed formation
 C) Gamete formation
 D) Pollination

104.

Find out the correct statements from the following: I. Test cross is performed to identify the genotype of the hybrid/dominant progeny II. The number of linkage groups in garden pea is 7 III. The number of linkage groups in male fruit fly is 5 IV. One centiMorgan is equal to recombination frequency of 0.01 or 1%

- A) I, II, III & IV
 B) I, II & III only
 C) I, II & IV only
 D) I and II only

105.

The postulate of Mendel that cannot be explained with a monohybrid cross is

- A) Unit factors in pairs
 B) Dominance/recessive
 C) Segregation of unit factors
 D) Independent assortment of unit factors

106.

The genotype of a dominant phenotype is

- | | |
|--------------------------------------|--|
| A) Only homozygous | B) Only heterozygous |
| C) Either homozygous or heterozygous | D) Neither homozygous nor heterozygous |

107.

A gamete normally contains

- | | |
|---------------------------|--------------------------|
| A) Many alleles of a gene | B) All alleles of a gene |
| C) Two alleles of a gene | D) One allele of a gene |

108.

Identify the correct statements from the following w.r.t. *Drosophila*:

I. They complete their life cycle in about two weeks II. Female flies are bigger than the male flies III. Genes for body colour and eye colour are present on the 'X' chromosomes IV. They could not be grown on simple synthetic medium in the laboratory

- | | |
|---------------------|--------------------|
| A) I & II only | B) I, II, III & IV |
| C) I, II & III only | D) IV only |

109.

A cross between F_1 plant with a plant which is phenotypically and genotypically similar to any parent is called

- | | |
|-----------------|-----------------|
| A) Test cross | B) Back cross |
| C) Hybrid cross | D) Inbred cross |

110.

More than two allelic forms existing for certain genes is termed as

- | | |
|---------------|---------------------|
| A) Pleiotropy | B) Polygenic traits |
| C) Epistasis | D) Multiple alleles |

111.

In a multiple allele system, a gamete has alleles:

- | | |
|----------|---------|
| A) One | B) Two |
| C) Three | D) Many |

112.

In Mendelism, linkage was not observed due to

- | | |
|-------------|---------------------------|
| A) Synapsis | B) Independent assortment |
| C) Mutation | D) Crossing over |

113.

Kinds of genotypes in F_2 generation of Mendel's dihybrid cross:

- | | |
|------|------|
| A) 4 | B) 9 |
| C) 2 | D) 1 |

114.

When true breeding pea plant with yellow cotyledons and round seeds is crossed to a plant with green cotyledons and wrinkled seeds, the genotype of progeny will be:

- | | |
|---------|---------|
| A) YYRR | B) YYrr |
| C) YyRr | D) yyRR |

115.

In a Mendelian dihybrid cross, kinds of recombinants formed in F_2 generation:

- | | |
|------|-------|
| A) 2 | B) 4 |
| C) 6 | D) 10 |

116.

In a cross between a pure tall pea plant with green pod and a pure short plant with yellow pod, how many short plant out of 16 are expected in F_2 generation?

- | | |
|---------|----------|
| A) One | B) Four |
| C) Nine | D) Three |

117.

If F_2 progeny of dihybrid cross, the expected genotypic proportions of individuals homozygous for both dominant character is:

- | | |
|----------|---------|
| A) 3/16 | B) 9/16 |
| C) 12/16 | D) 1/16 |

118.

The fraction of single homozygous individuals in the of a typical dihybrid cross is

- A) 8/16
- B) 10/16
- C) 4/16
- D) 12/16

119.

The fraction of single heterozygous recombinants in the F_2 of a Mendelian dihybrid cross is

- A) 6/16
- B) 2/16
- C) 4/16
- D) 3/16

120.

In a Mendelian dihybrid cross the number of phenotypic recombinants is 36 is F_2 generation. The number of organisms with the genotype that itself accounts for 1/4th of F_2 generation is

- A) 48
- B) 24
- C) 18
- D) 12

121.

This person united the knowledge of chromosomal segregation with Mendelian principles and called it the chromosomal theory of inheritance:

- A) Sutton
- B) Morgan
- C) Correns
- D) Bateson

122.

Select the odd one out with respect to the chromosomal theory of inheritance:

- A) It was proposed by Sutton and Boveri
- B) The behavior of chromosomes is parallel to the behavior of genes
- C) Chromosomes and genes occur in pairs in diploid and haploid cells, respectively
- D) The paired condition of both chromosomes as well as Mendelian factors is restored during fertilization

123.

The genes for the eye colour and size of the wing in *Drosophila* are located on the same chromosome. They can be separated by:

- A) Non-disjunction
- B) Crossing over
- C) Hybridization
- D) Not be separated at any stage

124.

A phenomenon which results in alteration of DNA sequences and consequently results in changes in the genotype and the phenotype of an organism is?

- A) Independent assortment
- B) Random gametic fusion
- C) Mutation
- D) Crossing

125.

The linked characters would always inherit together till they are:

- A) Delinked due to segregation
- B) Masked by dominance
- C) Mutated
- D) Separated due to crossing over

126.

Variation in DNA is due to:

- A) Mutation
- B) Recombination
- C) Both (A) and (B)
- D) Neither (A) nor (B)

127.

Arrange the following in the increasing order based on the combinations obtained in the F_2 progeny of dihybrid cross in a garden pea: I. Number of parental phenotype combinations II. Number of Mendelian recombinations in phenotype III. Types of phenotypes IV. Types of genotypes

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

128.

Morgan discovered sex linked inheritance first in

- A) Human beings B) Sweet pea
C) *Drosophila melanogaster* D) Guinea pigs

129.

The crossing over between homologous chromosomes never exceeds beyond

- A) 50% B) 75%
C) 100% D) 85%

130.

The percentage of recombination involving the seed shape and seed colour in a plant is 10%, what is the distance (cM) between the genes on a chromosome controlling these characters?

- A) 5 B) 10
C) 20 D) 15

131.

The map distance between genes A and B is 3 units, between B and C 10 units and between C and A 7 units. The order of the genes in a linkage map constructed on the above data would perhaps be:

- A) A, B, C B) A, C, B
C) B, C, A D) B, A, C

132.

(A): Mendel succeeded to know the process of inheritance. (R): He considered a single character at one time.

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

133.

(A): Generally the gametes are pure for the factors they possess.

(R): During the formation of gametes due to meiosis the paired unit factors segregate randomly with equal probability.

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

134.

(A): In mis-sense mutation, different amino acid is produced. (R): In sense mutation, the type of amino acid produced is same.

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

135.

(A): Unmodified Allele, which represents the original phenotype is the dominant allele. (R): A dominant allele modified into recessive allele by only crossing over.

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

Zoology.

136.

Match List I with List II and select the correct code.

List I:	List II:
(1) <i>Ascidia</i>	(a) Hag fish
(2) <i>Branchiostoma</i>	(b) Lamprey
(3) <i>Petromyzon</i>	(c) Sea squirt/tunicate
(4) <i>Myxine</i>	(d) <i>Amphioxus</i> /lancelet

- A) 1-c, 2-d, 3-b, 4-a B) 1-d, 2-c, 3-a, 4-b
C) 1-a, 2-b, 3-d, 4-c D) 1-b, 2-a, 3-c, 4-d

137.

Which combination correctly identifies the animal and its characteristic?

- A) Torpedo — poisonous sting
 B) Trygon — electric organs
 C) Hippocampus — male brood pouch
 D) Pristis — flying fish

138.

Consider the following statements: 1. Carcharodon is a great white shark. 2. Scoliodon is an Indian dog fish. 3. Pristis is a saw fish. 4. All three belong to Osteichthyes.

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

139.

A fish has a ventral mouth, placoid scales and pelvic fins bearing claspers. It is most appropriately identified as:

- A) Osteichthyes
 B) Chondrichthyes
 C) Cyclostomata
 D) Amphibia

140.

Match the following.

List-(I)	List-(II)
(1) Aptenodytes	(a) Vulture
(2) Struthio	(b) Parrot
(3) Psittacula	(c) Penguin
(4) Neophron	(d) African ostrich

- A) 1-c, 2-d, 3-b, 4-a
 B) 1-d, 2-c, 3-a, 4-b
 C) 1-b, 2-a, 3-d, 4-c
 D) 1-a, 2-b, 3-c, 4-d

141.

Which pair combines an animal with a feature characteristic of the same group?

- A) Ornithorhynchus — oviparous mammal with cloaca
 B) Pavo — mammary glands
 C) Rana — pneumatic bones
 D) Panthera leo — placoid scales

142.

Which statement is correct?

- A) All chordates are vertebrates without exception
 B) All vertebrates are chordates
 C) Protochordates are chordates that are not vertebrates
 D) Vertebrates and chordates are completely unrelated

143.

The central nervous system described as dorsal, hollow, single and non-ganglionated is characteristic of:

- A) Non-chordates
 B) Chordates
 C) Reptilia only
 D) Mammalia only

144.

Which pair is correctly matched with the circulatory system?

- A) Non-chordates — closed circulation
 B) Cephalochordata to Mammalia — closed circulation
 C) Only fishes — open circulation
 D) Aves — open circulation

145.

Petromyzon is associated with which combination?

- A) Anadromous migration + ectoparasitic habit on some fishes
 B) Electric organs + poisonous sting
 C) Male brood pouch + air bladder
 D) Operculum + placoid scales

146.

Which combination is correctly matched?

- A) Osteichthyes — air bladder present; Chondrichthyes — air bladder absent
 B) Osteichthyes — air bladder absent; Chondrichthyes — air bladder present
 C) Both — air bladder absent
 D) Both — air bladder present

147.

A fish has gill slits covered by an operculum and a terminal mouth. Which group does it represent?

- A) Chondrichthyes
 B) Osteichthyes
 C) Cyclostomata
 D) Amphibia

148.

Match the animals with their groups.

List-I	List-II
(1) Clarias	(a) Cyclostomata
(2) archarodon	(b) Chondrichthyes
(3) Myxine	(c) Osteichthyes
(4) Pristis	

- A) 1-c, 2-b, 3-a, 4-b
 B) 1-b, 2-c, 3-a, 4-c
 C) 1-c, 2-a, 3-b, 4-b
 D) 1-a, 2-b, 3-c, 4-a

149.

Which of the following correctly connects an example with a reproductive feature?

- A) Hippocampus — male brood pouch
 B) Osteichthyes — internal fertilization and viviparity
 C) Amphibia — internal fertilization and direct development
 D) Mammalia — external fertilization

150.

Which one is correctly matched?

- A) Bufo — toad — Amphibia, Anura
 B) Salamandra — frog — Amphibia, Anura
 C) Hyla — salamander — Urodele
 D) Ichthyophis — fish — Osteichthyes

151.

Consider the following statements about amphibians: 1. Amphibian respiration may be branchial, pulmonary and cutaneous. 2. Their skin is moist and useful for cutaneous respiration. 3. Amphibians have a three-chambered heart. 4. Their reproductive pattern listed here is external fertilization, oviparity and indirect development.

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

152.

A reptile has a cornified skin with epidermal scales/scutes and shows creeping or crawling locomotion. Which example fits this group?

- A) Calotes
 B) Columba
 C) Clarias
 D) Macaca

153.

Which set contains only reptilian examples?

- A) Alligator, Bungarus, Calotes, Testudo
 B) Bufo, Hyla, Rana, Salamandra
 C) Corvus, Pavo, Neophron, Struthio
 D) Camelus, Canis, Felis, Rattus

154.

Match the reptile with the common name.

List-I	List-II
(1) Bungarus	(a) Cobra
(2) Naja	(b) Tortoise
(3) Vipera	(c) Krait
(4) Testudo	(d) Russell's viper

A) 1-c, 2-a, 3-d, 4-b

B) 1-a, 2-c, 3-b, 4-d

C) 1-d, 2-b, 3-a, 4-c

D) 1-b, 2-d, 3-c, 4-a

155.

Which statement about Aves is correct?

A) Skin is moist for cutaneous respiration

B) Skin is dry and without glands except oil glands at the base of the tail

C) Skin bears hair

D) Skin bears placoid scales

156.

Which combination is characteristic of Aves?

A) Crop and gizzard + air sacs connected to lungs + pneumatic bones

B) Mammary glands + hair + pinna

C) Placoid scales + claspers + ventral mouth

D) Moist skin + cutaneous respiration + three-chambered heart

157.

Which animal-feature pair is correct?

A) Struthio — flightless bird

B) Pavo — flightless bird

C) Columba — flightless bird

D) Corvus — flightless bird

158.

Which of the following correctly links an example with an avian feature?

A) Pavo — uropygial gland

B) Pteropus — pneumatic bones

C) Aptenodytes — mammary glands

D) Neophron — placoid scales

159.

Statement I: Forelimbs of Aves are modified into wings. Statement II: Quill feathers are associated with flight in Aves.

A) Both statements are correct

B) I correct, II incorrect

C) I incorrect, II correct

D) Both incorrect

160.

Which group has a four-chambered heart according to the given material?

A) Amphibia only

B) Reptilia including all crocodiles and lizards

C) Crocodiles, Aves and Mammalia

D) Pisces only

161.

Match the mammal with the common name.

List-I	List-II
(1) Balaenoptera	(a) Kangaroo
(2) Delphinus	(b) Elephant
(3) Elephas	(c) Blue whale
(4) Macropus	(d) Common dolphin

A) 1-c, 2-d, 3-b, 4-a

B) 1-d, 2-c, 3-a, 4-b

C) 1-b, 2-a, 3-d, 4-c

D) 1-a, 2-b, 3-c, 4-d

162.

Which combination contains only mammalian features?

- A) Hair + mammary glands + external ear and pinna
 B) Feathers + pneumatic bones + uropygial glands
 C) Placoid scales + claspers + ventral mouth
 D) Moist skin + cutaneous respiration + external fertilization

163.

Ornithorhynchus is best identified by which combination?

- A) Prototherian mammal + cloaca + oviparous condition
 B) Bird + pneumatic bones + feathers
 C) Reptile + placoid scales
 D) Fish + external fertilization

164.

Which sequence correctly represents the heart chambers?

- A) Pisces—2; Amphibia and Reptilia except crocodiles—3; crocodiles, Aves and Mammalia—4
 B) Pisces—3; Amphibia—2; Mammalia—4
 C) Pisces—4; Reptilia—2; Aves—3
 D) All vertebrates—4

165.

Which option correctly matches an example with a special mammalian feature?

- A) Pteropus — flying fox; Mammalia
 B) Pteropus — flying fish; Osteichthyes
 C) Panthera leo — lion; Aves
 D) Macropus — monkey; Mammalia

166.

Assertion (A): Chondrichthyes have placoid scales. Reason (R): Their teeth are modified placoid scales and are backwardly directed.

- 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

167.

Assertion (A): Mammalia are homeothermic. Reason (R): Aves and Mammalia are listed as warm-blooded groups.

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

168.

Which statement is correct regarding notochord?

- A) Urochordata has notochord only in the larval tail
 B) Cephalochordata has notochord only in the larval tail
 C) Osteichthyes retains notochord throughout life without replacement
 D) Non-chordates have a persistent notochord

169.

Match the notochord condition with the group.

List-I	List-II
(1) Larval tail only	(a) Urochordata
(2) Head to tail	(b) Cephalochordata
(3) Cartilaginous vertebral column replaces it	(c) Chondrichthyes
(4) Bony vertebral column replaces it	(d) Osteichthyes

- A) 1-a, 2-b, 3-c, 4-d
 B) 1-b, 2-a, 3-d, 4-c
 C) 1-c, 2-d, 3-a, 4-b
 D) 1-d, 2-c, 3-b, 4-a

170.

Which combination correctly represents reproductive patterns?

- A) Osteichthyes — external fertilization, oviparous, direct development
 B) Amphibia — internal fertilization, viviparous, direct development
 C) Mammalia — external fertilization, oviparous, indirect development
 D) Reptilia — external fertilization, oviparous, indirect development

171.

A vertebrate is unisexual, internally fertilized, viviparous and directly developing. Which group best fits?

- A) Mammalia B) Amphibia
C) Osteichthyes D) Aves

172.

Which pair is correctly matched with a circulatory/respiratory feature?

- A) Aves — air sacs connected to lungs B) Chondrichthyes — operculum-covered gills
C) Amphibia — four-chambered heart D) Mammalia — external fertilization

173.

Which of the following is an example of Osteichthyes?

- A) Labeo B) Trygon
C) Scoliodon D) Myxine

174.

Which combination correctly identifies the animal, common name and group?

- A) Pterophyllum — angel fish — Osteichthyes B) Pristis — angel fish — Osteichthyes
C) Pterophyllum — saw fish — Chondrichthyes D) Catla — great white shark — Chondrichthyes

175.

Consider the following statements: 1. Trygon has a poisonous sting. 2. Torpedo has electric organs derived from modified dorsal muscles. 3. Both are listed under Chondrichthyes. Which option is correct?

- A) 1 only B) 2 only
C) 1 and 2 only D) 1, 2 and 3

176.

Which option contains only animals associated with Mammalia?

- A) Canis, Felis, Rattus, Panthera leo B) Canis, Corvus, Rattus, Pavo
C) Elephas, Labeo, Macaca, Felis D) Delphinus, Clarias, Camelus, Pteropus

177.

Which statement correctly links an animal with locomotion?

- A) Mammalian limbs may be adapted for walking, running, climbing, burrowing, swimming and flying B) Aves have limbs only for burrowing
C) Reptilia have limbs only for flying D) Cyclostomata have paired fins for walking

178.

Which of the following correctly combines example, group and reproductive feature?

- A) Ornithorhynchus — Mammalia — oviparous B) Rana — Mammalia — viviparous
C) Petromyzon — Osteichthyes — external fertilization D) Hippocampus — Chondrichthyes — placoid scales

179.

Which statement set is completely correct?

- A) Corvus—crow—Aves; Columba—pigeon—Aves; Pavo—peacock—Aves B) Corvus—crow—Mammalia; Columba—pigeon—Reptilia; Pavo—peacock—Amphibia
C) Corvus—crow—Reptilia; Columba—pigeon—Aves; Pavo—peacock—Mammalia D) All three are Osteichthyes

180.

A specimen has a sucking circular mouth without jaws, no paired fins or scales, and 6–15 pairs of gill slits. Which identification is most appropriate?

A) Cyclostomata — e.g.,
Petromyzon/Myxine

B) Chondrichthyes — e.g.,
Carcharodon

C) Osteichthyes — e.g., Catla

D) Amphibia — e.g., Rana

ANSWER KEY

Physics

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

Chemistry

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

90. 4

Botany

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

Zoology

136.	1	147.	2	158.	1	169.	1
137.	3	148.	1	159.	1	170.	1
138.	2	149.	1	160.	3	171.	1
139.	2	150.	1	161.	1	172.	1
140.	1	151.	4	162.	1	173.	1
141.	1	152.	1	163.	1	174.	1
142.	3	153.	1	164.	1	175.	4
143.	2	154.	1	165.	1	176.	1
144.	2	155.	2	166.	2	177.	1
145.	1	156.	1	167.	1	178.	1
146.	1	157.	1	168.	1	179.	1

SOLUTIONS

Q1.

Answer: C

Explanation:

Momentum of photon: $p_{Ph} = \frac{E}{c}$ Momentum of electron: $p_e = \sqrt{2mE}$ Ratio:

$$\frac{p_e}{p_{Ph}} = \frac{\sqrt{2mE}}{E/c} = c\sqrt{\frac{2m}{E}} \text{ Substituting values:}$$

$$\frac{p_e}{p_{Ph}} = 3 \times 10^8 \times \sqrt{\frac{2 \times 9 \times 10^{-31}}{45 \times 1.6 \times 10^{-19}}} = 150$$

Q2.

Answer: B

Explanation:

Photoelectric emission occurs only when the incident wavelength is less than or equal to the threshold wavelength: $\lambda_0 = \frac{hc}{\phi}$ Work function in joules:

$$\phi = 4.95 \times 1.6 \times 10^{-19} = 7.92 \times 10^{-19} \text{ J Threshold wavelength:}$$

$$\lambda_0 = \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{7.92 \times 10^{-19}} = 2.5 \times 10^{-7} \text{ m} = 250 \text{ nm}$$

Since $300 \text{ nm} > 250 \text{ nm}$, this wavelength does not cause photoelectric emission.

Q3.

Answer: A

Explanation:

Einstein's photoelectric equation is $K_{\max} = h\nu - \phi$ Since the work function is $\phi = h\nu_0$, $K_{\max} = h(\nu - \nu_0)$ Thus, $K_{\max}$ increases linearly with frequency and becomes zero at the threshold frequency ν_0 . Therefore, the graph is a straight line with positive slope and an intercept on the frequency axis at ν_0 .

Q4.

Answer: D

Explanation:

Radius of nth orbit: $r_n = n^2 a_0 = 9 \times 0.052 = 0.468 \text{ nm}$ Bohr quantization

condition: $2\pi r_n = n\lambda$, so $\lambda = \frac{2\pi r_n}{n}$ Substituting: $\lambda = \frac{2\pi \times 0.468}{3} = 0.98 \text{ nm} \approx 1 \text{ nm}$

Q5.

Answer: C

Explanation:

Photon wavelength: $\lambda_{\text{photon}} = \frac{hc}{E}$ (since $p = E/c$) Electron wavelength:

$$\lambda_{\text{electron}} = \frac{h}{\sqrt{2mE}} \text{ Ratio: } \frac{\lambda_{\text{electron}}}{\lambda_{\text{photon}}} = \frac{h}{\sqrt{2mE}} \times \frac{E}{hc} = \frac{E}{c\sqrt{2mE}} = \frac{1}{c} \sqrt{\frac{E}{2m}}$$

Q6.

Answer: C

Explanation:

Using de Broglie relation, $\lambda = \frac{h}{p}$ For a non-relativistic particle, $E = \frac{p^2}{2m}$

Therefore, $p = \sqrt{2mE}$ Hence, $\frac{1}{\lambda} = \frac{p}{h} = \frac{\sqrt{2mE}}{h}$ So, $\frac{1}{\lambda} \propto \sqrt{E}$ The graph of $\sqrt{E}$ versus E is an increasing curve with decreasing slope, i.e. concave downward.

Q7.

Answer: A

Explanation:

Statement A is correct: by Planck's quantum hypothesis, $E = h\nu$. Statement B is correct: being massless, a photon travels with speed c in free space. Statement C is correct: $p = \frac{E}{c} = \frac{h\nu}{c} = \frac{h}{\lambda}$. Statement D is correct: a photon is electrically neutral. Statement E is incorrect: in a photon-electron collision (Compton effect), both total energy and total momentum are conserved. Hence the correct statements are A, B, C and D only.

Q8.

Answer: B

Explanation:

Energy of incident photon: $E = \frac{hc}{\lambda} = \frac{1240}{248} = 5 \text{ eV}$ Photoelectric equation:

$$E = \phi + K_{\max} \text{ Work function: } \phi = E - K_{\max} = 5 - 2 = 3 \text{ eV}$$

Q9.

Answer: D

Explanation:

Photoelectric emission is possible only when incident photon energy exceeds the work function: $E \geq \phi$ For Cs: $\phi = 1.95 \text{ eV} < 2.50 \text{ eV}$, emission occurs. For K: $\phi = 2.29 \text{ eV} < 2.50 \text{ eV}$, emission occurs. For Na: $\phi = 2.75 \text{ eV} > 2.50 \text{ eV}$, no emission. Hence both Cs and K may emit photoelectrons.

Q10.

Answer: A

Explanation:

$p = \frac{h}{\lambda}$ represents the momentum associated with a photon, so A-IV. The photoelectric effect demonstrates the particle nature of light, so B-III. $E = h\nu$ gives the energy of a photon, so C-I. Electron diffraction demonstrates the wave nature of matter, so D-II. Therefore, the correct matching is A-IV, B-III, C-I, D-II.

Q11.

Answer: D

Explanation:

Einstein's photoelectric equation: $K_{max} = E - \phi = 5.5 - 2.5 = 3.0 \text{ eV}$ Stopping potential relation: $K_{max} = eV_s$ Therefore: $V_s = \frac{3.0 \text{ eV}}{e} = 3 \text{ V}$ (stopping potential is a potential, so its unit is volt)

Q12.

Answer: C

Explanation:

Since work function is negligible: $\frac{hc}{\lambda} = \frac{p^2}{2m} = \frac{h^2}{2m\lambda_d^2}$ Therefore: $\lambda_d^2 = \frac{h\lambda}{2mc}$, i.e.,

$\lambda_d \propto \sqrt{\lambda}$ When $\lambda \rightarrow 4\lambda$: $\lambda'_d = \sqrt{4}\lambda_d = 2\lambda_d$

Q13.

Answer: D

Explanation:

Initial de-Broglie wavelength: $\lambda_0 = \frac{h}{mv_0}$ Force on electron: $\vec{F} = -e\vec{E} = -eE_0\hat{i}$,

so velocity at time t: $v = v_0 - \frac{eE_0}{m}t = v_0 \left(1 - \frac{eE_0}{mv_0}t\right)$ Therefore:

$$\lambda = \frac{h}{mv} = \frac{h}{mv_0 \left(1 - \frac{eE_0}{mv_0}t\right)} = \frac{\lambda_0}{\left(1 - \frac{eE_0}{mv_0}t\right)}$$

Q14.

Answer: B

Explanation:

Einstein's photoelectric equation: $\frac{1}{2}mv_{max}^2 = h(\nu - \nu_0)$ Case 1:

$\frac{1}{2}mv_1^2 = h(2\nu_0 - \nu_0) = h\nu_0$ Case 2: $\frac{1}{2}mv_2^2 = h(10\nu_0 - \nu_0) = 9h\nu_0$ Dividing:

$$\frac{v_1^2}{v_2^2} = \frac{1}{9}, \text{ so } \frac{v_1}{v_2} = \frac{1}{3}, \text{ i.e., } 1 : 3$$

Q15.

Answer: C

Explanation:

Thermal kinetic energy of neutron: $E = \frac{3}{2}kT$ Momentum:

$p = \sqrt{2mE} = \sqrt{3mkT}$ De-Broglie wavelength: $\lambda = \frac{h}{p} = \frac{h}{\sqrt{3mkT}}$, so $\lambda \propto \frac{1}{\sqrt{T}}$

$$\text{Therefore: } \frac{\lambda_1}{\lambda_2} = \sqrt{\frac{4T}{T}} = 2$$

Q16.

Answer: D

Explanation:

Photon wavelength: $\lambda_{photon} = \frac{hc}{E}$ (since $p = E/c$) Electron wavelength:

$$\lambda_{electron} = \frac{h}{\sqrt{2mE}} \text{ Ratio: } \frac{\lambda_{photon}}{\lambda_{electron}} = \frac{hc}{E} \times \frac{\sqrt{2mE}}{h} = \frac{c\sqrt{2mE}}{E} = c\left(\frac{2m}{E}\right)^{\frac{1}{2}}$$

Q17.

Answer: A

Explanation:

Einstein's equation for first case: $eV = \frac{hc}{\lambda} - \frac{hc}{\lambda_0}$ Einstein's equation for second case: $\frac{eV}{5} = \frac{hc}{3\lambda} - \frac{hc}{\lambda_0}$ Multiplying the second equation by 5 and equating with the first: $\frac{1}{\lambda} - \frac{1}{\lambda_0} = \frac{5}{3\lambda} - \frac{5}{\lambda_0}$ Solving: $\frac{4}{\lambda_0} = \frac{2}{3\lambda}$, so $\lambda_0 = 6\lambda$

Q18.

Answer: B

Explanation:

First case: $K_1 = \frac{hc}{\lambda} - \phi$ Second case: $K_2 = \frac{3hc}{\lambda} - \phi$ Given condition: $K_2 = 4K_1$, so $\frac{3hc}{\lambda} - \phi = \frac{4hc}{\lambda} - 4\phi$ Solving: $3\phi = \frac{hc}{\lambda}$, hence $\phi = \frac{hc}{3\lambda}$

Q19.

Answer: C

Explanation:

First case: $4eV_0 = \frac{hc}{\lambda} - \frac{hc}{\lambda_0}$ Second case: $eV_0 = \frac{hc}{2\lambda} - \frac{hc}{\lambda_0}$ Multiplying the second equation by 4 and equating with the first: $\frac{hc}{\lambda} - \frac{hc}{\lambda_0} = \frac{2hc}{\lambda} - \frac{4hc}{\lambda_0}$ Solving: $\frac{3}{\lambda_0} = \frac{1}{\lambda}$, hence $\lambda_0 = 3\lambda$

Q20.

Answer: A

Explanation:

The stopping potential depends on the frequency of incident light: $eV_0 = K_{\max} = h\nu - \phi$ If both curves have the same stopping potential, then they have the same frequency. The saturation current depends on the intensity of incident light. Since the saturation currents are different, their intensities are different. Therefore, Option A is correct.

Q21.

Answer: D

Explanation:

Centripetal condition: $\frac{mv^2}{r} = kr$, so $v^2 = \frac{kr^2}{m}$ Bohr quantization: $mvr = n\hbar$, so $v = \frac{n\hbar}{mr}$ Substituting: $\frac{n^2\hbar^2}{m^2r^2} = \frac{kr^2}{m}$, giving $r^4 = \frac{n^2\hbar^2}{km}$, so $r \propto n^{1/2}$ Then: $v = \frac{n\hbar}{mr} \propto \frac{n}{n^{1/2}} = n^{1/2}$

Q22.

Answer: B

Explanation:

The energy of the emitted photon is $\Delta E = \frac{hc}{\lambda}$ Hence, $\lambda \propto \frac{1}{\Delta E}$ The transition energies are: $\Delta E_1 = |-4E - (-2E)| = 2E$ $\Delta E_2 = |-2E - (-E)| = E$ $\Delta E_3 = |-4E - (-E)| = 3E$ Therefore, $\lambda_1 : \lambda_2 : \lambda_3 = \frac{1}{2} : 1 : \frac{1}{3}$ Multiplying by 6: $\lambda_1 : \lambda_2 : \lambda_3 = 3 : 6 : 2$ Thus, $\lambda_2 = 2\lambda_1$ and $\lambda_1 = \frac{3}{2}\lambda_3$ So, Option B is correct.

Q23.

Answer: B

Explanation:

Rydberg formula: $\frac{1}{\lambda} = R \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$, with $R = 1.097 \times 10^7 \text{ m}^{-1}$ A (4 to 3):

$\frac{1}{\lambda} = R \left(\frac{1}{9} - \frac{1}{16} \right) = \frac{7R}{144}$, so $\lambda = 1875.2 \text{ nm}$ (II) B (5 to 3):

$\frac{1}{\lambda} = R \left(\frac{1}{9} - \frac{1}{25} \right) = \frac{16R}{225}$, so $\lambda = 1281.9 \text{ nm}$ (IV) C (6 to 3):

$\frac{1}{\lambda} = R \left(\frac{1}{9} - \frac{1}{36} \right) = \frac{R}{12}$, so $\lambda = 1093.9 \text{ nm}$ (I) D (7 to 3):

$\frac{1}{\lambda} = R \left(\frac{1}{9} - \frac{1}{49} \right) = \frac{40R}{441}$, so $\lambda = 1005.0 \text{ nm}$ (III) Hence the correct matching is A-II, B-IV, C-I, D-III.

Q24.

Answer: A

Explanation:

Energy of nth state: $E_n = \frac{-13.6}{n^2} \text{ eV}$ Ionization energy from state n:

$\Delta E = 0 - E_n = \frac{13.6}{n^2}$ Given condition: $\frac{13.6}{n^2} = 0.85$, so $n^2 = \frac{13.6}{0.85} = 16$

Therefore: $n = 4$

Q25.

Answer: D

Explanation:

Bohr's quantization of angular momentum: $L = \frac{n\hbar}{2\pi}$ Given: $L = 2\frac{\hbar}{\pi} = \frac{4\hbar}{2\pi}$, so

$n = 4$ Energy of nth orbit: $E_n = \frac{E_1}{n^2} = \frac{-144}{16} = -9 \text{ eV}$

Q26.

Answer: C

Explanation:

Radius of nth orbit: $r_n = n^2 r_1$ Therefore: $n^2 = \frac{r_n}{r_1} = \frac{8.48 \times 10^{-10}}{5.3 \times 10^{-11}} = 16$ Hence: $n = 4$

Q27.

Answer: D

Explanation:

Bohr model relation: $r_n \propto n^2$ Sixth orbit: $R_1 \propto 6^2 = 36$ Second orbit: $R_2 \propto 2^2 = 4$ Therefore: $\frac{R_1}{R_2} = \frac{36}{4} = 9$

Q28.

Answer: B

Explanation:

Using de Broglie relation, $\lambda = \frac{h}{p}$ and kinetic energy, $K = \frac{p^2}{2m}$ Since $p = \frac{h}{\lambda}$,
 $K = \frac{h^2}{2m\lambda^2}$ Therefore, $K \propto \frac{1}{\lambda^2}$ So, K decreases rapidly as λ increases, giving a decreasing inverse-square curve.

Q29.

Answer: C

Explanation:

Bohr energy relation: $E_n = \frac{-13.6}{n^2}$ eV, so $E_n \propto \frac{1}{n^2}$ Second excited state means $n = 3$: $T_1 = \frac{-13.6}{9}$ Third excited state means $n = 4$: $T_2 = \frac{-13.6}{16}$ Therefore: $\frac{T_1}{T_2} = \frac{1/9}{1/16} = \frac{16}{9}$, i.e., 16 : 9

Q30.

Answer: D

Explanation:

Bohr model is applicable only to hydrogen-like (single electron) species. He^+ has $2 - 1 = 1$ electron, so Bohr model is valid. Li^{2+} has $3 - 2 = 1$ electron, so Bohr model is valid. Deuterium atom has 1 electron, so Bohr model is valid. Li^+ has $3 - 1 = 2$ electrons, so it is a multi-electron system and Bohr model is not valid.

Q31.

Answer: B

Explanation:

Kinetic energy relation: $K = -E = -(-6) = 6$ eV Potential energy relation: $U = 2E = 2 \times (-6) = -12$ eV Hence kinetic energy = 6 eV and potential energy = -12 eV.

Q32.

Answer: A

Explanation:

For an electron in a Bohr orbit: $K = -E$ and $U = 2E$, where E is total energy
Therefore: $\frac{U}{E} = \frac{2E}{E} = 2$ Hence the ratio $U : E = 2 : 1$

Q33.

Answer: C

Explanation:

Rydberg formula: $\frac{1}{\lambda} = R \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$ Last line of Paschen series ($n_1 = 3, n_2 = \infty$): $\frac{1}{\lambda_P} = \frac{R}{9}$, so $\lambda_P = \frac{9}{R}$ Last line of Lyman series ($n_1 = 1, n_2 = \infty$): $\frac{1}{\lambda_L} = R$, so $\lambda_L = \frac{1}{R}$ Therefore: $\frac{\lambda_P}{\lambda_L} = 9$

Q34.

Answer: D

Explanation:

Rydberg formula for 4 to 2 transition: $\frac{1}{\lambda} = R \left(\frac{1}{4} - \frac{1}{16} \right) = \frac{3R}{16}$, so $\lambda = \frac{16}{3R}$
Rydberg formula for 2 to 1 transition: $\frac{1}{\lambda'} = R \left(1 - \frac{1}{4} \right) = \frac{3R}{4}$, so $\lambda' = \frac{4}{3R}$
Therefore: $\frac{\lambda'}{\lambda} = \frac{4/(3R)}{16/(3R)} = \frac{1}{4}$, i.e., $\lambda' = \frac{\lambda}{4}$

Q35.

Answer: B

Explanation:

Longest wavelength corresponds to the smallest energy transition of the series.
Balmer series (3 to 2): $\frac{1}{\lambda_B} = R \left(\frac{1}{4} - \frac{1}{9} \right) = \frac{5R}{36}$, so $\lambda_B = \frac{36}{5R}$ Paschen series (4 to 3): $\frac{1}{\lambda_P} = R \left(\frac{1}{9} - \frac{1}{16} \right) = \frac{7R}{144}$, so $\lambda_P = \frac{144}{7R}$ Therefore: $\frac{\lambda_B}{\lambda_P} = \frac{36}{5R} \times \frac{7R}{144} = \frac{7}{20}$

Q36.

Answer: C

Explanation:

Coulomb force provides centripetal force: $\frac{mv^2}{r} = \frac{KZe^2}{r^2}$ Bohr quantization:

$mvr = \frac{nh}{2\pi}$ Combining: $v = \frac{2\pi KZe^2}{nh}$ Substituting values:

$$v = \frac{2\pi \times 9 \times 10^9 \times 3 \times (1.6 \times 10^{-19})^2}{2 \times 6.6 \times 10^{-34}} = 3.29 \times 10^6 \text{ m/s}$$

Q37.

Answer: B

Explanation:

Photon energy: $E = \frac{hc}{\lambda} = \frac{1240 \text{ eV nm}}{95 \text{ nm}} = 13.05 \text{ eV}$ Energy of excited state:

$E_n = -13.6 + 13.05 = -0.55 \approx -0.544 \text{ eV}$ Since $E_n = \frac{-13.6}{n^2}$, we get

$$n^2 = \frac{13.6}{0.544} = 25, \text{ so } n = 5 \text{ Number of spectral lines: } \frac{n(n-1)}{2} = \frac{5 \times 4}{2} = 10$$

Q38.

Answer: A

Explanation:

Time period: $T = \frac{2\pi r}{v}$, with $r \propto n^2$ and $v \propto \frac{1}{n}$, so $T \propto n^3$ Given condition:

$$\frac{T_1}{T_2} = \left(\frac{n_1}{n_2}\right)^3 = 27 \text{ Therefore: } \frac{n_1}{n_2} = 3, \text{ which is satisfied by } n_1 = 6 \text{ and } n_2 = 2$$

Q39.

Answer: D

Explanation:

Longest wavelength arises from the smallest energy transition of the series.

Paschen series (4 to 3): $\frac{1}{\lambda_P} = R \left(\frac{1}{9} - \frac{1}{16}\right) = \frac{7R}{144}$, so $\lambda_P = \frac{144}{7R}$ Balmer series (3

to 2): $\frac{1}{\lambda_B} = R \left(\frac{1}{4} - \frac{1}{9}\right) = \frac{5R}{36}$, so $\lambda_B = \frac{36}{5R}$ Therefore: $\frac{\lambda_P}{\lambda_B} = \frac{144}{7R} \times \frac{5R}{36} = \frac{20}{7}$

Q40.

Answer: B

Explanation:

Infrared radiation corresponds to the smallest photon energy among the given

transitions. Energy of transition: $\Delta E = 13.6 \left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right) \text{ eV}$ For $2 \rightarrow 1$:

$\Delta E = 10.2 \text{ eV}$ (ultraviolet) For $3 \rightarrow 1$: $\Delta E = 12.1 \text{ eV}$ (ultraviolet) For $4 \rightarrow 2$:

$\Delta E = 2.55 \text{ eV}$ (visible) For $5 \rightarrow 4$: $\Delta E = 13.6 \left(\frac{1}{16} - \frac{1}{25}\right) = 0.31 \text{ eV}$ (infrared)

Hence infrared radiation is obtained in the transition $5 \rightarrow 4$.

Q41.

Answer: C

Explanation:

Second excited state means $n = 3$, first excited state means $n = 2$, ground state

means $n = 1$. First transition (3 to 2): $\frac{1}{\lambda_1} = R \left(\frac{1}{4} - \frac{1}{9}\right) = \frac{5R}{36}$, so $\lambda_1 = \frac{36}{5R}$

Second transition (2 to 1): $\frac{1}{\lambda_2} = R \left(1 - \frac{1}{4}\right) = \frac{3R}{4}$, so $\lambda_2 = \frac{4}{3R}$ Therefore:

$$\frac{\lambda_1}{\lambda_2} = \frac{36}{5R} \times \frac{3R}{4} = \frac{27}{5}$$

Q42.

Answer: A

Explanation:

First line of Lyman series (2 to 1) for hydrogen: $\frac{1}{\lambda} = R \left(1 - \frac{1}{4}\right) = \frac{3R}{4}$ Third line of

Paschen series (6 to 3) for ion: $\frac{1}{\lambda} = RZ^2 \left(\frac{1}{9} - \frac{1}{36}\right) = \frac{RZ^2}{12}$ Equating both:

$$\frac{3R}{4} = \frac{RZ^2}{12} \text{ Solving: } Z^2 = 9, \text{ so } Z = 3$$

Q43.

Answer: D

Explanation:

Hydrogen-like energy formula: $E_n = \frac{-13.6Z^2}{n^2} \text{ eV}$ He⁺ ground state ($Z = 2, n = 1$):

$$E = \frac{-13.6 \times 4}{1} = -54.4 \text{ eV} \text{ Hydrogen first excited state } (Z = 1, n = 2):$$

$$E = \frac{-13.6}{4} = -3.4 \text{ eV} \text{ Therefore: ratio} = \frac{-54.4}{-3.4} = 16$$

Q44.

Answer: C

Explanation:

Energy of n th state: $E_n = \frac{E_1}{n^2}$ First excited state ($n = 2$): $E_2 = \frac{-100}{4} = -25$ eV

Kinetic energy relation: $K = -E = -(-25) = 25$ eV

Q45.

Answer: D

Explanation:

Energy of excited state: $E_n = -13.6 + 12.75 = -0.85$ eV Since $E_n = \frac{-13.6}{n^2}$:

$n^2 = \frac{13.6}{0.85} = 16$, so $n = 4$ Number of spectral lines: $\frac{n(n-1)}{2} = \frac{4 \times 3}{2} = 6$

Q46.

Answer: A

Explanation:

Nucleophilic attack on a planar sp^2 carbonyl carbon occurs with equal probability from top and bottom faces, producing a racemic mixture containing 50% d- and 50% l-enantiomers.

Q47.

Answer: A

Explanation:

Benzaldehyde can be prepared by Rosenmund reduction of benzoyl chloride (I), oxidation of toluene with chromic anhydride (II), and Etard reaction of toluene using chromyl chloride (III).

Q48.

Answer: D

Explanation:

Oxidation of a primary alcohol ($R - CH_2OH$) using PCC (Pyridinium chlorochromate) selectively yields an aldehyde ($R - CHO$), not a ketone.

Q49.

Answer: D

Explanation:

Chlorination of ethane gives ethyl chloride (*A*), alkaline hydrolysis forms ethanol (*B*), PCC oxidation gives acetaldehyde (*C*), and self-aldol condensation followed by dehydration gives crotonaldehyde (*D*).

Q50.

Answer: D

Explanation:

Nucleophilic addition of a Grignard reagent ($RMgX$) to the carbonyl carbon of acetone (a ketone) forms a tertiary alkoxide, which upon hydrolysis yields a 3°-alcohol.

Q51.

Answer: B

Explanation:

The iodoform test requires a $CH_3C = O$ group. Propionaldehyde (CH_3CH_2CHO) contains a $CH_3CH_2C = O$ group and lacks the required terminal methyl aldehyde structure.

Q52.

Answer: C

Explanation:

Brady's reagent is an alcoholic solution of 2,4-dinitrophenylhydrazine (2,4-DNP), used as a qualitative test to detect carbonyl groups ($C = O$).

Q53.

Answer: B

Explanation:

In the Etard reaction, chromyl chloride (CrO_2Cl_2) oxidizes the methyl group of toluene in CS_2 solvent to form a brown chromium complex intermediate: $C_6H_5CH(OCrOHCl_2)_2$.

Q54.

Answer: B

Explanation:

Reaction of formaldehyde (HCHO) with a Grignard reagent (cyclohexylmagnesium bromide) followed by hydrolysis yields a primary alcohol: cyclohexylmethanol ($C_6H_{11}CH_2OH$).

Q55.

Answer: C

Explanation:

Wolff-Kishner reduction (NH_2NH_2/OH^-) operates in basic medium and selectively reduces the ketone carbonyl to a methylene group without affecting the acid-sensitive phenolic group.

Q56.

Answer: D

Explanation:

Red phosphorus with HI, Wolff-Kishner reduction (NH_2NH_2/OH^-), and Clemmensen reduction ($Zn - Hg/HCl$) are all capable of reducing simple ketone carbonyl groups to methylene units.

Q57.

Answer: C

Explanation:

Sodium bisulfite ($NaHSO_3$) forms addition compounds with aldehydes and methyl ketones. Bulky aromatic ketones (like benzyl phenyl ketone) suffer from extreme steric hindrance and fail to react.

Q58.

Answer: C

Explanation:

Tollen's reagent oxidizes aldehydes (propanal) to give a silver mirror test, but does not react with ketones (acetone).

Q59.

Answer: C

Explanation:

Haloform oxidation using $I_2/NaOH$ selectively converts the methyl ketone group ($-COCH_3$) into a carboxylic acid ($-COOH$) while preserving the $C = C$ double bond.

Q60.

Answer: B

Explanation:

Acetaldehyde (CH_3CHO) contains a $CH_3C = O$ group and gives a positive iodoform test, whereas formaldehyde (HCHO) lacks a methyl group and gives a negative test.

Q61.

Answer: B

Explanation:

Pentan-3-one ($C_2H_5COC_2H_5$) is a symmetrical ketone lacking a methyl group attached directly to the carbonyl carbon ($-COCH_3$), so it does not give the iodoform test.

Q62.

Answer: B

Explanation:

Nucleophilic addition of methylmagnesium bromide (CH_3MgBr) across the carbonyl group of 2-methylcyclohexanone followed by protonation gives 1,2-dimethylcyclohexanol.

Q63.

Answer: A

Explanation:

Acetic acid with PCl_5 yields acetyl chloride (A). Friedel-Crafts acylation with benzene forms acetophenone (B). Grignard addition of C_2H_5MgBr to acetophenone gives 2-phenylbutan-2-ol (C).

Q64.

Answer: B

Explanation:

Acetyl chloride reacts with sodium acetate to form acetic anhydride ($A = (CH_3CO)_2O$) and with phenol to form phenyl acetate ($B = C_6H_5OCOCH_3$).

Q65.

Answer: A

Explanation:

Hell-Volhard-Zelinsky (HVZ) reaction converts propionic acid to α -chloropropionic acid (A). Dehydrohalogenation using alcoholic KOH yields acrylic acid ($B = CH_2 = CH - COOH$).

Q66.

Answer: B

Explanation:

Strong electron-withdrawing groups ($-NO_2$) at the para position withdraw electron density from the carbonyl group via $-M$ and $-I$ effects, making the carbonyl carbon highly electrophilic and reactive towards nucleophilic attack during hydrolysis.

Q67.

Answer: B

Explanation:

Phenol reacts with neutral ferric chloride ($FeCl_3$) solution to form a characteristic violet-colored coordination complex, whereas benzoic acid forms a buff-colored precipitate of ferric benzoate.

Q68.

Answer: B

Explanation:

Dehydration of acetamide (CH_3CONH_2) using phosphorus pentoxide (P_2O_5) upon heating removes a molecule of water (H_2O) to form acetonitrile (CH_3CN).

Q69.

Answer: B

Explanation:

Intramolecular Cannizzaro reaction of phthalaldehyde gives o -hydroxymethylbenzoate anion, which upon acidification and heating undergoes intramolecular esterification (lactonization) to form phthalide.

Q70.

Answer: D

Explanation:

Alkylbenzenes require at least one benzylic hydrogen atom for oxidation by $KMnO_4$. *tert*-Butylbenzene ($C_6H_5 - C(CH_3)_3$) lacks benzylic hydrogens and resists oxidation.

Q71.

Answer: C

Explanation:

Chloral hydrate ($CCl_3 - CH(OH)_2$) is stabilized by strong intramolecular hydrogen bonding between the hydroxyl hydrogens and the three electronegative chlorine atoms.

Q72.

Answer: B

Explanation:

Aldehydes and unhindered ketones react with sodium bisulfite ($NaHSO_3$) to form water-insoluble crystalline addition compounds. Filtering and hydrolyzing the adduct with acid or alkali regenerates the pure carbonyl compound.

Q73.

Answer: B

Explanation:

Condensation of acetone ($(CH_3)_2C = O$) with hydrazine (NH_2NH_2) involves nucleophilic addition followed by elimination of H_2O to yield acetone hydrazone ($(CH_3)_2C = N - NH_2$).

Q74.

Answer: C

Explanation:

Sodium borohydride (NaBH_4) is a mild reducing agent that selectively reduces aldehydes, ketones, and acyl chlorides, but fails to reduce carboxylic acids.

Q75.

Answer: A

Explanation:

Reaction of alcohols with H-X proceeds via an S_N1 mechanism involving carbocation formation. 1-Methylcyclohexan-1-ol forms a highly stable 3° tertiary carbocation, making it the most reactive towards H-X .

Q76.

Answer: A

Explanation:

Primary alcohols like isobutyl alcohol react with Lucas reagent ($\text{HCl} + \text{ZnCl}_2$) primarily via an S_N2 path, yielding primary isobutyl chloride as the major product rather than a tertiary halide.

Q77.

Answer: A

Explanation:

Electrophilic addition of bromine (Br_2) across the double bond of propene yields 1,2-dibromopropane, which is exclusively a vicinal dihalide.

Q78.

Answer: B

Explanation:

Reactivity with H-X depends on the stability of the benzylic carbocation. The $p\text{-OCH}_3$ group donates electron density strongly through resonance ($+M$ effect), stabilizing the carbocation and maximizing reactivity.

Q79.

Answer: D

Explanation:

Friedel-Crafts alkylation of phenol introduces a methyl group at the o - and p -positions. p -Cresol is obtained as the chief product due to minimal steric hindrance at the para position.

Q80.

Answer: A

Q81.

Answer: B

Explanation:

Reaction of sodium nitrite (NaNO_2) with sulfuric acid generates the nitrosonium ion (NO^+), which attacks the highly activated phenol ring at the para position to form p -nitrosophenol.

Q82.

Answer: C

Explanation:

Kolbe-Schmitt reaction of sodium phenoxide with CO_2 gives salicylic acid (B). Acetylation of salicylic acid with acetic anhydride (Ac_2O) converts the phenolic $-\text{OH}$ group into an acetoxy group, yielding aspirin (C).

Q83.

Answer: B

Explanation:

Carboxylation of sodium phenoxide using carbon dioxide (CO_2) under pressure followed by acidification to produce salicylic acid is named the Kolbe-Schmidt reaction.

Q84.

Answer: D

Explanation:

Treating phenol with conc. H_2SO_4 first forms phenol-2,4-disulfonic acid, which upon reaction with conc. HNO_3 undergoes nitration and desulfonation to yield 2,4,6-trinitrophenol (picric acid).

Q85.

Answer: A

Explanation:

Dilute HNO_3 nitration of phenol yields *o*-nitrophenol (*P*) and *p*-nitrophenol (*Q*). Intramolecular hydrogen bonding in *o*-nitrophenol makes it steam volatile, whereas intermolecular hydrogen bonding in *p*-nitrophenol makes it non-volatile.

Q86.

Answer: B

Explanation:

Williamson ether synthesis requires a primary alkyl halide ($\text{CH}_3\text{CH}_2\text{Cl}$) and an alkoxide ion to proceed via $\text{S}_{\text{N}}2$. Reaction I uses a tertiary alkyl halide, which undergoes $\text{E}2$ elimination with a strong base to form 2-methylpropene instead of ether.

Q87.

Answer: D

Explanation:

Acid-catalyzed dehydration of ethanol at 443 K yields ethene (*A*) via intramolecular elimination. At 413 K, nucleophilic attack of ethanol on a protonated ethanol molecule yields diethyl ether (*B*) via bimolecular substitution.

Q88.

Answer: D

Explanation:

Propan-2-ol reacts with PBr_3 to form 2-bromopropane (*X*). Reaction with Mg /ether forms isopropylmagnesium bromide (*Y*). Hydrolysis of this Grignard reagent protonates the carbanion to yield propane.

Q89.

Answer: B

Explanation:

Ethers act as weak Lewis bases due to unshared electron pairs on oxygen. Reaction with strong mineral acids (HX) protonates the oxygen atom, forming a trivalent oxonium cation $[(\text{C}_2\text{H}_5)_2\overset{+}{\text{O}}\text{H}] \text{X}^-$.

Q90.

Answer: D

Explanation:

Pentane is a non-polar hydrocarbon that cannot form hydrogen bonds with water molecules, making it completely insoluble in water.

Q91.

Answer: D

Q92.

Answer: B

Q93.

Answer: C

Q94.

Answer: B

Q95.

Answer: C

Q96.

Answer: C

Q97.

Answer: D

Q98.

Answer: B

Q99.

Answer: D

Q100.

Answer: C

Q101.

Answer: A

Q102.

Answer: B

Q103.

Answer: C

Q104.

Answer: A

Q105.

Answer: D

Q106.

Answer: C

Q107.

Answer: D

Q108.

Answer: C

Q109.

Answer: B

Q110.

Answer: D

Q111.

Answer: A

Q112.

Answer: B

Q113.

Answer: B

Q114.

Answer: C

Q115.

Answer: A

Q116.

Answer: B

Q117.

Answer: D

Q118.

Answer: A

Q119.

Answer: C

Q120.

Answer: B

Q121.

Answer: A

Q122.

Answer: C

Q123.

Answer: B

Q124.

Answer: C

Q125.

Answer: D

Q126.

Answer: C

Q127.

Answer: B

Q128.

Answer: C

Q129.

Answer: A

Q130.

Answer: B

Q131.

Answer: D

Q132.

Answer: B

Q133.

Answer: A

Q134.

Answer: B

Q135.

Answer: C

Q136.

Answer: A

Q137.

Answer: C

Q138.

Answer: B

Q139.

Answer: B

Q140.

Answer: A

Q141.

Answer: A

Q142.

Answer: C

Q143.

Answer: B

Q144.

Answer: B

Q145.

Answer: A

Q146.

Answer: A

Q147.

Answer: B

Q148.

Answer: A

Q149.

Answer: A

Q150.

Answer: A

Q151.

Answer: D

Q152.

Answer: A

Q153.

Answer: A

Q154.

Answer: A

Q155.

Answer: B

Q156.

Answer: A

Q157.

Answer: A

Q158.

Answer: A

Q159.

Answer: A

Q160.

Answer: C

Q161.

Answer: A

Q162.

Answer: A

Q163.

Answer: A

Q164.

Answer: A

Q165.

Answer: A

Q166.

Answer: B

Q167.

Answer: A

Q168.

Answer: A

Q169.

Answer: A

Q170.

Answer: A

Q171.

Answer: A

Q172.

Answer: A

Q173.

Answer: A

Q174.

Answer: A

Q175.

Answer: D

Q176.

Answer: A

Q177.

Answer: A

Q178.

Answer: A

Q179.

Answer: A

Q180.

Answer: A