

Physics

1. The half life of a radioactive substance is 15 minutes. In how much time, the activity of substance drops to $1/32$ th of its initial value?

A) 60 minutes
B) 75 minutes

C) 45 minutes
D) 90 minutes

2. Given below are two statements Statement I : The law of radioactive decay states that the number of nuclei undergoing decay per unit time is directly proportional to the total number of nuclei present in the sample at that instant. Statement II : The half life of a radionuclide is the sum of the life times of all nuclei, divided by the initial number of nuclei at time $t = 0$. In the light of the above statements, choose the most appropriate answer from the options given below.

A) Both statement I and statement II are correct
B) Statement I is correct but statement II is incorrect

C) Both statement I and statement II are incorrect
D) Statement I is incorrect but statement II is correct

3. At any instant, two elements X1 and X2 have same number of radioactive atoms. If the decay constant of X1 and X2 are 7λ and 3λ respectively, then the time when the ratio of their atoms becomes $1/e$ respectively will be :

A) $1/(10\lambda)$
B) $1/(4\lambda)$

C) $1/(3\lambda)$
D) $1/(7\lambda)$

4. The half life of a radioactive nuclide is 20 years. The fraction of original activity that will remain after 50 years would be :

A) $1/(2\sqrt{2})$
B) $1/4$

C) $1/8$
D) $1/(4\sqrt{2})$

5. If half life of an element is 34.65 h. then how much of its percent will decay in 20th to 21th h. Initial activity = $40 \mu\text{Ci}$.

A) 1%
B) 3%

C) 2%
D) 4%

6. A radioactive element X decays into a radioactive element Y. The half-life of X is very large compared to the half-life of Y ($T_X \gg T_Y$). After a long time, the ratio of their number of nuclei N_X/N_Y will be:

A) 1
B) T_Y/T_X

C) T_X/T_Y
D) 0

7. A radioactive nucleus ${}_{92}^{238}\text{U}$ decays into a stable nucleus ${}_{82}^{206}\text{Pb}$ by emitting α and β particles. The total number of α and β particles emitted are respectively:

A) 6, 8
B) 4, 6

C) 8, 6
D) 6, 4

8. How long will it take for a radioactive sample to decrease to 10% of its initial amount, if its half life is 30 years?

A) 90 years
B) 100 years

C) 110 years
D) 95 years

9. What is the decay constant of a radioactive substance whose half life is 8 hours?

- A) 2.41×10^{-5} per sec B) 3.85×10^{-5} per sec
C) 1.20×10^{-5} per sec D) 4.82×10^{-5} per sec

10. The amount of active substance reduces to 1/32 of its initial value in 20 hours. What is the half life?

- A) 5.0 hours B) 4.0 hours
C) 2.5 hours D) 3.5 hours

11. How many α and β particles are emitted when ${}_{92}^{235}\text{U}$ converts to ${}_{82}^{207}\text{Pb}$?

- A) 4α and $7\beta^-$ B) 6α and $4\beta^-$
C) 7α and $4\beta^-$ D) 7α and $2\beta^-$

12. A radioactive nucleus decays as $X \xrightarrow{\alpha} X_1 \xrightarrow{\beta^-} X_2 \xrightarrow{\alpha} X_3 \xrightarrow{\gamma} X_4$. If mass number and charge number of X are 190 and 75 then find these values of X_4 .

- A) Mass number 186, Charge number 74 B) Mass number 178, Charge number 70
C) Mass number 182, Charge number 72 D) Mass number 184, Charge number 73

13. The mean life of a radioactive material for α and β decay are 800 years and 1200 years. What is the half life of sample.

- A) 480 years B) 333 years
C) 400 years D) 240 years

14. Four statements are given (A is mass number, R is nuclear radius): A. The radius of a nucleus is proportional to $A^{1/3}$. B. The radius of a nucleus is proportional to A . C. The density of a nucleus is proportional to A . D. The density of a nucleus is nearly constant and independent of A . Choose the correct answer from the options given below:

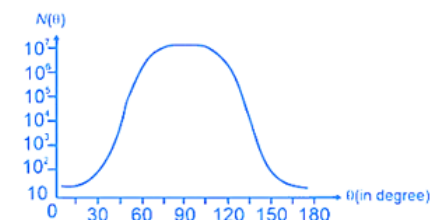
- A) A and C are true, but B and D are false B) B and C are true, but A and D are false
C) A and D are true, but B and C are false D) B and D are true, but A and C are false

15. Consider the following nuclear reaction: ${}^{226}\text{Ra} \rightarrow {}^{222}\text{Rn} + {}^4\text{He}$ Take masses of ${}^{226}\text{Ra}$, ${}^{222}\text{Rn}$ and ${}^4\text{He}$ as 226.025 u, 222.016 u and 4.003 u, respectively. The Q value for the reaction, in keV, is: [Given: $1 u = 931.5 \text{ MeVc}^{-2}$]

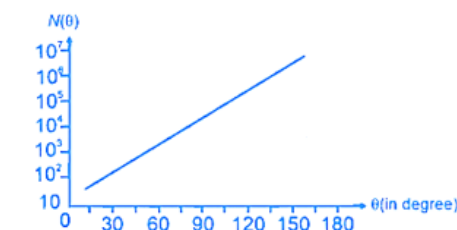
- A) 5526 B) 5598
C) 5589 D) 5604

16. In Geiger-Marsden experiment, the number of scattered α -particles $N(\theta)$ is plotted as a function of scattering angle θ . Which of the following options represents the correct plot?

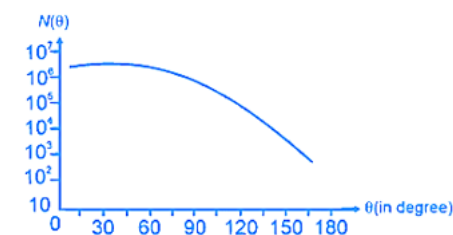
A)



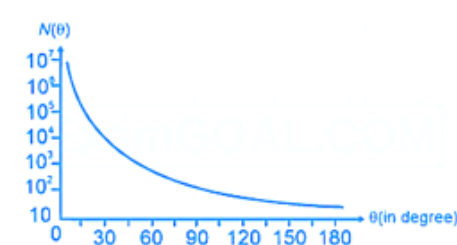
B)



C)



D)



17. Select the correct statements among the following: A. Cadmium rods are used to control the rate of fission in a nuclear reactor. B. In β^- decay, the mass number of the nucleus remains unchanged while the atomic number increases by one. C. The penetrating power of α particles is less than that of β particles of the same energy. D. The moderator in a nuclear reactor is used to speed up fast neutrons to higher velocities. Choose the most appropriate answer from the options given below:

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

18. ${}_{92}^{236}\text{X} \xrightarrow{\alpha} \text{Y} \xrightarrow{e^+} \text{Z} \xrightarrow{\beta^-} \text{P} \xrightarrow{e^-} \text{Q}$ In the nuclear emission stated above, the mass number and atomic number of the product Q respectively, are

- A) 236, 90 B) 232, 91
C) 232, 89 D) 228, 91

19. The half life of a radioactive substance is 30 minutes. In how much time, the activity of substance drops to $\left(\frac{1}{64}\right)^{th}$ of its initial value?

- A) 120 minutes B) 150 minutes
C) 210 minutes D) 180 minutes

20. In the given nuclear reaction, the element X is ${}_{90}^{234}\text{Th} \rightarrow \text{X} + e^- + \bar{\nu}$

- A) ${}_{91}^{234}\text{Pa}$ B) ${}_{88}^{230}\text{Ra}$
C) ${}_{89}^{234}\text{Ac}$ D) ${}_{92}^{238}\text{U}$

21. A nucleus of mass number 280 splits into two nuclei having mass number 216 and 64. The ratio of radius of two daughter nuclei respectively is

- A) 2 : 3 B) 9 : 4
C) 27 : 8 D) 3 : 2

22. The half life of a radioactive nuclide is 80 hours. The fraction of original activity that will remain after 200 hours would be :

- A) $\frac{1}{2\sqrt{2}}$ B) $\frac{1}{4\sqrt{2}}$
C) $\frac{1}{4}$ D) $\frac{1}{8}$

23. A radioactive nucleus ${}_Z^AX \rightarrow {}_{Z+1}B \rightarrow {}_{Z-1}C \rightarrow {}_{Z-2}D$. where Z is the atomic number of element X. The possible decay particles in the sequence are :

- A) β^- , α , β^+ B) α , β^- , β^+
C) β^+ , α , β^- D) β^- , β^+ , α

24. For a radioactive material, half-life is 25 minutes. If initially there are 1200 number of nuclei, the time taken (in minutes) for the disintegration of 1050 nuclei is

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

25. The half-life of a radioactive substance is 25 minutes. The time (in minutes) taken between 20% decay and 90% decay of the same radioactive substance is

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

26. If radius of the ${}_{30}^{64}\text{Zn}$ nucleus is taken to be R_{Zn} , then the radius of ${}_{13}^{27}\text{Al}$ nucleus is nearly

- A) $\frac{4}{3}R_{\text{Zn}}$ B) $\frac{3}{4}R_{\text{Zn}}$
C) $\left(\frac{30}{13}\right)^{1/3}R_{\text{Zn}}$ D) $\left(\frac{13}{30}\right)^{1/3}R_{\text{Zn}}$

27. The binding energy per nucleon of ${}_3^7\text{Li}$ and ${}_2^4\text{He}$ nuclei are 6.0 MeV and 7.5 MeV respectively. In the nuclear reaction ${}_3^7\text{Li} + {}_1^1\text{H} \rightarrow {}_2^4\text{He} + {}_2^4\text{He} + Q$ the value of energy Q released is

- A) 18 MeV B) 24 MeV
C) 12 MeV D) 21 MeV

28. A radioactive X with a half life 1.2×10^9 years decays to Y which is stable. A sample of the rock from a cave was found to contain X and Y in the ratio 1 : 15. The age of the rock is

- A) 3.60×10^9 years B) 2.40×10^9 years
C) 9.60×10^9 years D) 4.80×10^9 years

29. A radioactive P with a half life 2.5×10^9 years decays to Q which is stable. A sample of the rock from a cave was found to contain P and Q in the ratio 1 : 3. The age of the rock is

- A) 5.00×10^9 years B) 2.50×10^9 years
C) 7.50×10^9 years D) 10.00×10^9 years

30. A mixture consists of two radioactive materials A_1 and A_2 with half lives of 30 s and 15 s respectively. Initially the mixture has 30 g of A_1 and 240 g of A_2 . The amount of the two in the mixture will become equal after

- A) 60 s B) 90 s
C) 45 s D) 120 s

- A) 20 s**
- B) 60 s**
- C) 40 s**
- D) 80 s**

- A) 80 years**
- B) 160 years**
- C) 240 years**
- D) 120 years**

- A) 100 years** **B) 125 years**
C) 75 years **D) 150 years**

- A)** $\frac{m-8}{n-4}Y$ **B)** $\frac{m-8}{n-3}Y$
C) $\frac{m-4}{n-2}Y$ **D)** $\frac{m-8}{n-5}Y$

- A)** $\frac{m-8}{n-4}Y$
B) $\frac{m-4}{n-2}Y$
C) $\frac{m-8}{n}Y$
D) $\frac{m-8}{n-2}Y$

- A) $\frac{8}{\log_e 2}$ B) $8 \log_{10} 2$
C) $8 \log_e 2$ D) $\log_e \frac{2}{8}$

- A)** $3 \log_e 2$
- B)** $\frac{6}{\log_e 2}$
- C)** $6 \log_e 2$
- D)** $3 \log_{10} 2$

- A)** α, β, γ
B) β, α, γ
C) γ, β, α
D) α, γ, β

- A)** α, β, γ
B) γ, α, β
C) β, γ, α
D) α, γ, β

- A)** $N_1 = N_2$
- B)** $N_1 = N_2 e^{-\lambda(t_2 - t_1)}$
- C)** $N_1 = N_2 e^{\lambda(t_2 - t_1)}$
- D)** $N_1 = N_2(t_2/t_1)$

- A)** $R_1 e^{\lambda(t_2 - t_1)}$
B) $R_1 e^{-\lambda(t_2 + t_1)}$
C) $R_1(t_1/t_2)$
D) $R_1 e^{-\lambda(t_2 - t_1)}$

- A)** $a - 2c$
- B)** $2c - a$
- C)** $c - 2a$
- D)** $2c + a$

43. In the reaction ${}^2_1\text{H} + {}^2_1\text{H} \rightarrow {}^3_2\text{He} + {}^1_0\text{n}$, if the binding energies of ${}^2_1\text{H}$ and ${}^3_2\text{He}$ are respectively a and c (in MeV), then the energy (in MeV) released in this reaction is

- A) $2a - c$ B) $c - a$
C) $c - 2a$ D) $a + c$

44. Energy levels A, B and C of a certain atom corresponding to increasing values of energy i.e. $E_A < E_B < E_C$. If λ_1 , λ_2 and λ_3 are wavelengths of radiations corresponding to transitions C to A, B to A and C to B respectively, which of the following relations is correct?

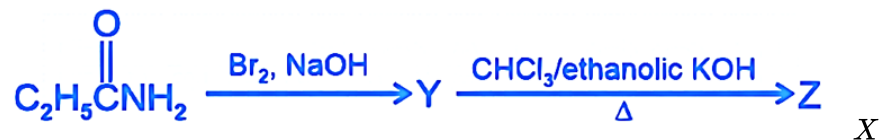
- A) $\lambda_3 = \lambda_1 + \lambda_2$ B) $\lambda_3 = \frac{\lambda_1\lambda_2}{\lambda_1 + \lambda_2}$
C) $\lambda_3 = \lambda_2 - \lambda_1$ D) $\lambda_3 = \frac{\lambda_1\lambda_2}{\lambda_2 - \lambda_1}$

45. Energy levels A, B and C of a certain atom corresponding to increasing values of energy i.e. $E_A < E_B < E_C$. If ν_1 , ν_2 and ν_3 are frequencies of radiations corresponding to transitions C to B, B to A and C to A respectively, which of the following relations is correct?

- A) $\nu_3 = \frac{\nu_1\nu_2}{\nu_1 + \nu_2}$ B) $\nu_3^2 = \nu_1^2 + \nu_2^2$
C) $\nu_3 = \nu_1 + \nu_2$ D) $\frac{1}{\nu_3} = \frac{1}{\nu_1} + \frac{1}{\nu_2}$

Chemistry

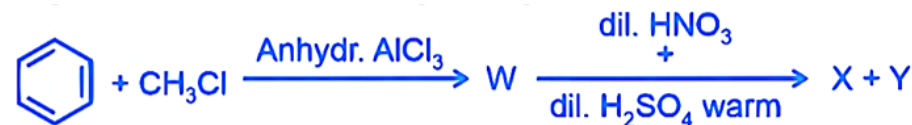
46. The following two reactions give the same foul smelling product Z.



and Z, respectively, are:

- A) $X = \text{AgCN}$; $Z = \text{C}_2\text{H}_5\text{NC}$ B) $X = \text{KCN}$; $Z = \text{C}_2\text{H}_5\text{CN}$
C) $X = \text{AgCN}$; $Z = \text{C}_2\text{H}_5\text{CN}$ D) $X = \text{KCN}$; $Z = \text{C}_2\text{H}_5\text{NC}$

47. Two products X and Y are formed in the following reaction sequence.



The suitable method that can be used for the separation of products X and Y is:

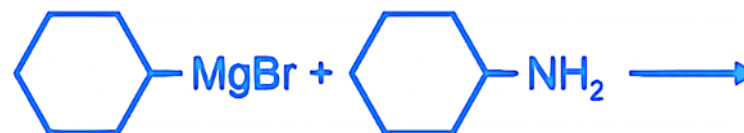
- A) Fractional distillation B) Sublimation
C) Differential extraction D) Continuous extraction

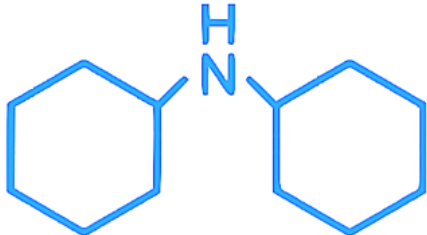
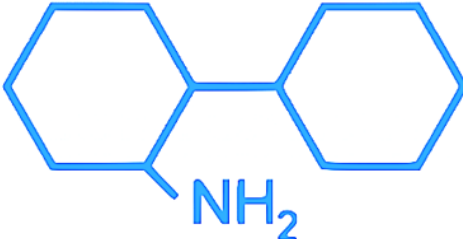
48. The major product Z formed in the following sequence of reactions is:



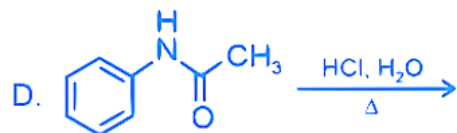
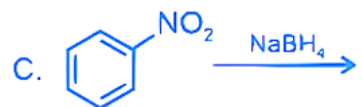
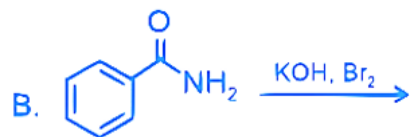
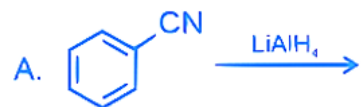
- A) $\text{C}_2\text{H}_5\text{NO}_2$ B) $\text{C}_2\text{H}_5 - \text{N} = \text{N} - \text{OH}$
C) $\text{C}_2\text{H}_5\text{OH}$ D) $\text{C}_2\text{H}_5\text{NH}_2$

49. One of the products formed in the following reaction is:



- A)  B) 
C)  D) 

50. Identify the reactions which give aniline as the major product.



Choose the correct answer from the options given below.

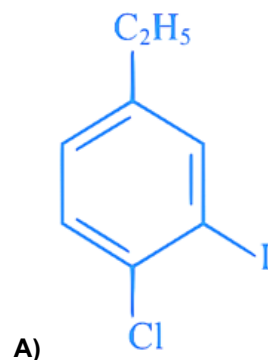
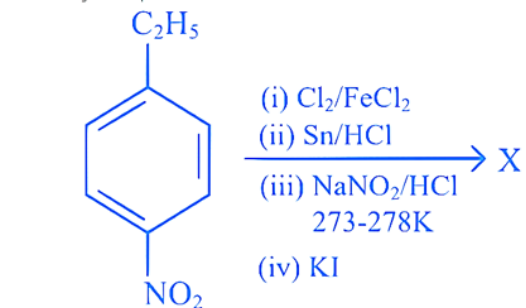
A) C and D only

C) B and D only

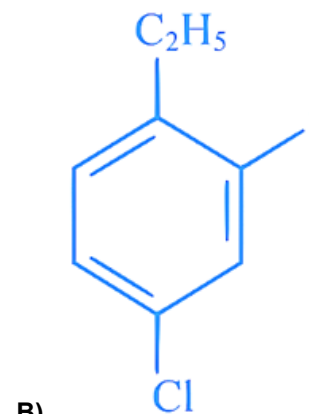
B) A and B only

D) A and C only

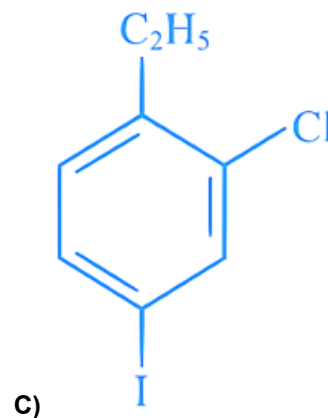
51. The major product X formed in the following reaction sequence is:



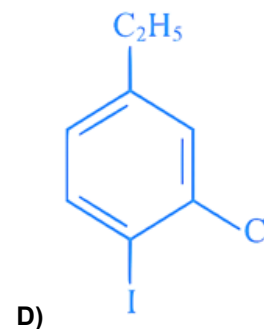
A)



B)

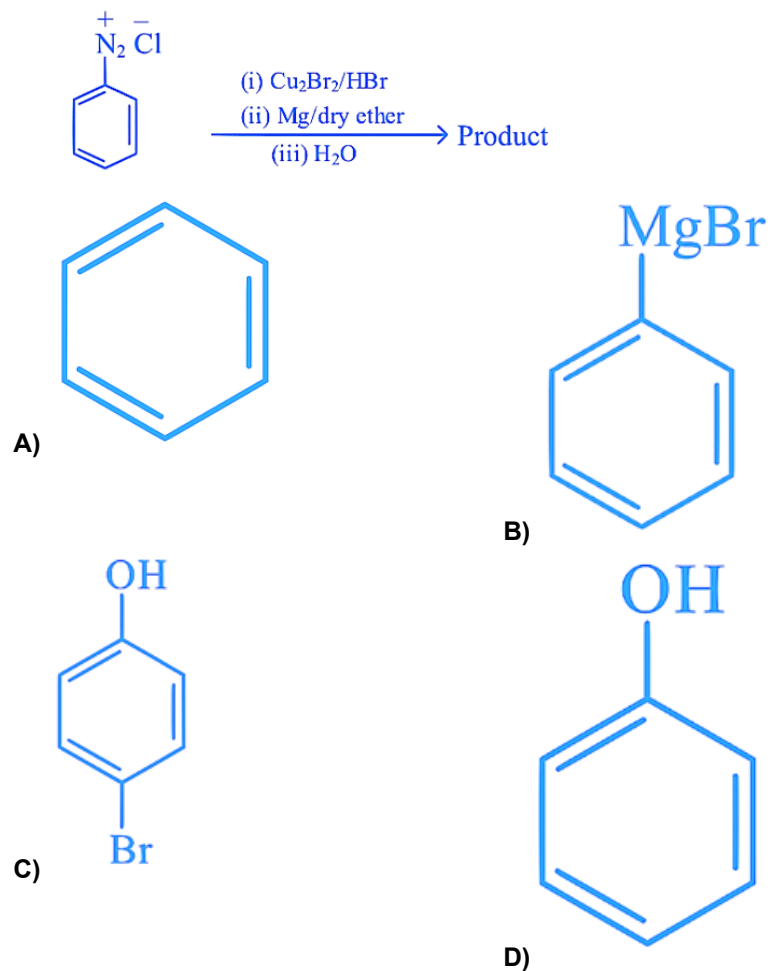


C)

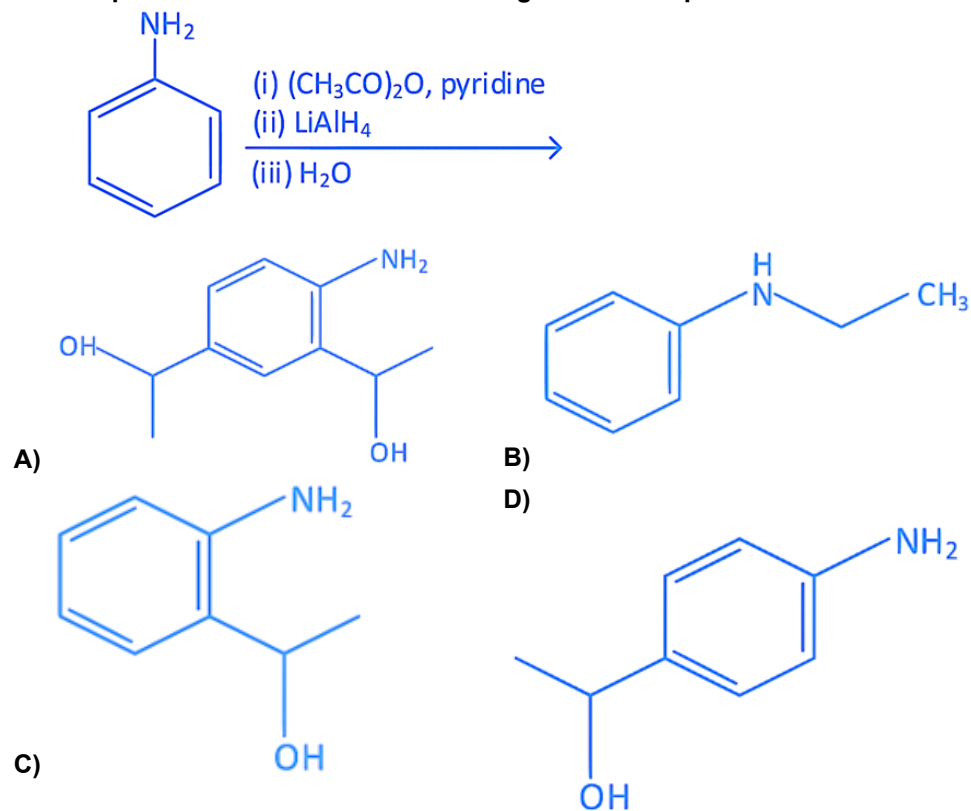


D)

52. Identify the product in the following reaction:



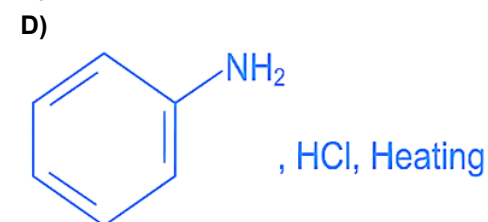
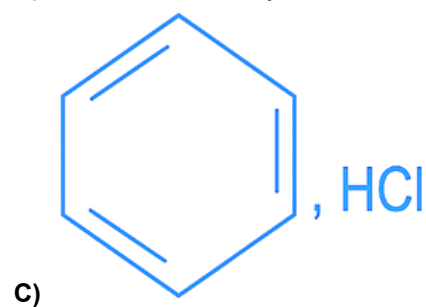
53. The product formed from the following reaction sequence is:



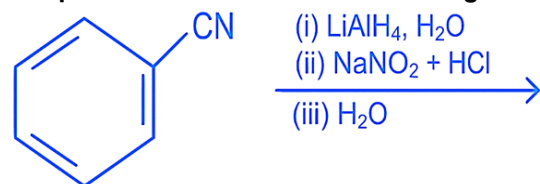
54. Which of the following sequence of reactions is suitable to synthesize chlorobenzene?

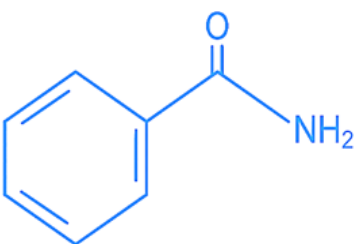
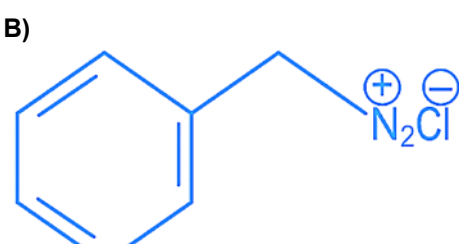
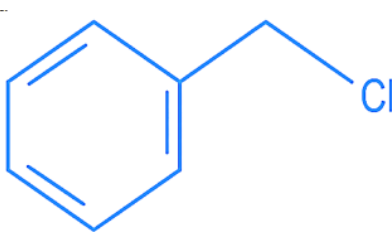
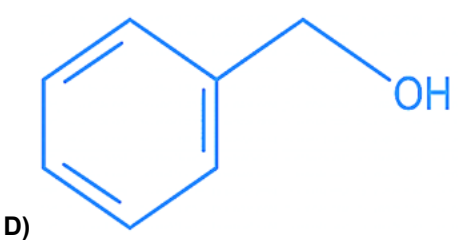
A) Benzene, Cl_2 , anhydrous $FeCl_3$

B) Phenol, $NaNO_2$, HCl , $CuCl$

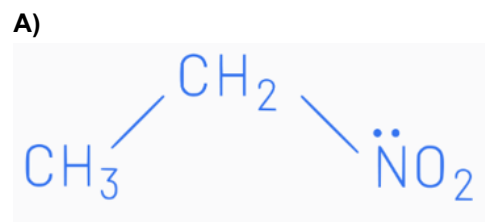
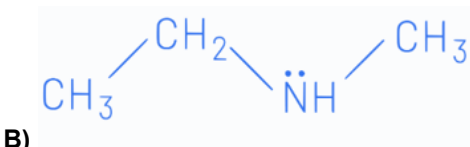
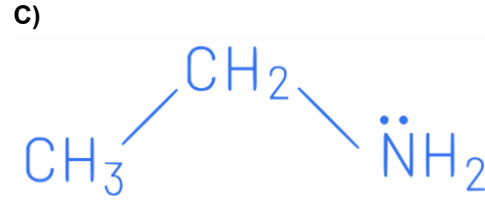
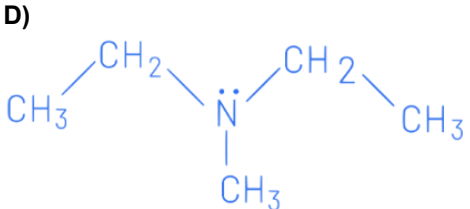


55. The product formed from the following reaction sequence is:

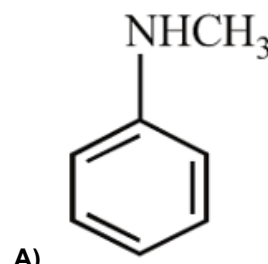
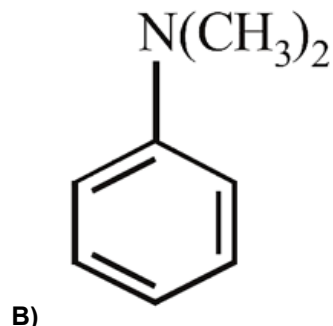
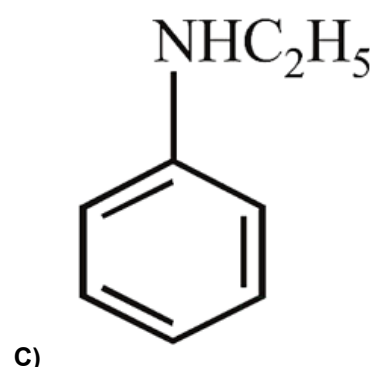
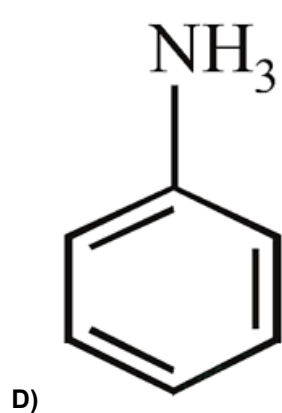


- A) 
- B) 
- C) 
- D) 

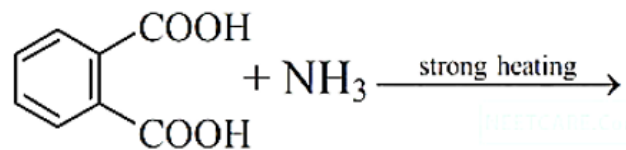
56. Identify the compound that will react with Hinsberg's reagent to give a solid which dissolves in alkali.

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

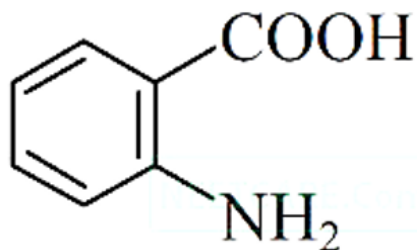
57. Which of the following amine will give the carbylamine test?

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

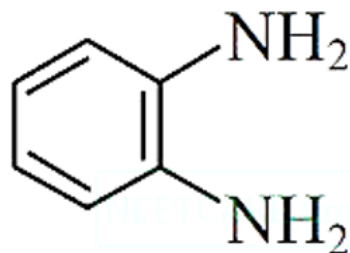
58. The major product of the following reaction is:



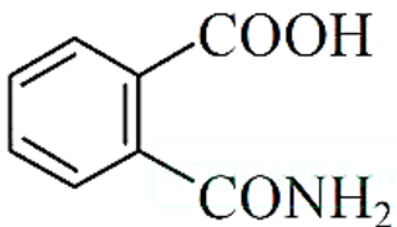
A)



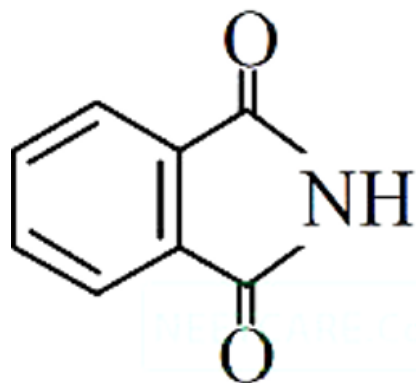
B)



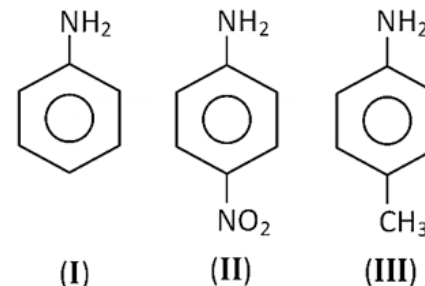
C)



D)



59. The correct increasing order of basic strength for the following



compounds is:

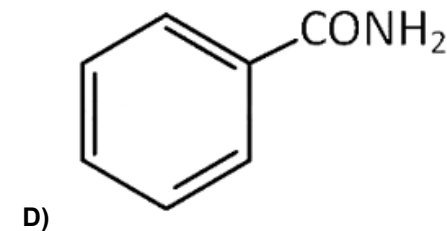
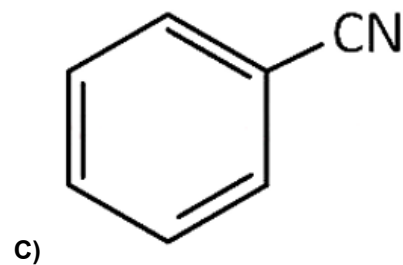
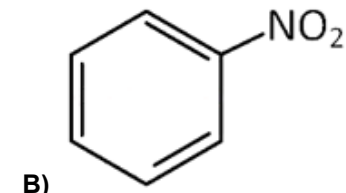
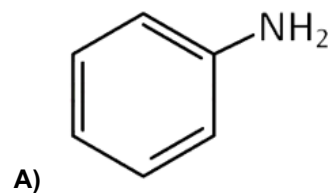
A) III < I < II

B) III < II < I

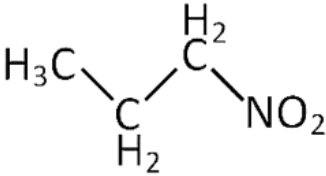
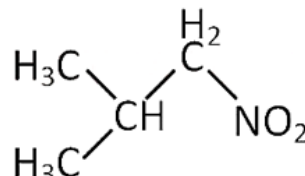
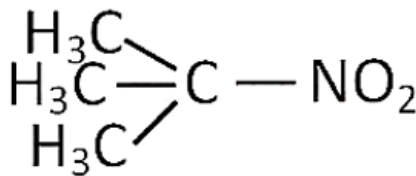
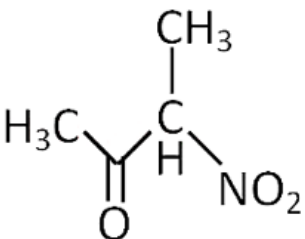
C) II < I < III

D) II < III < I

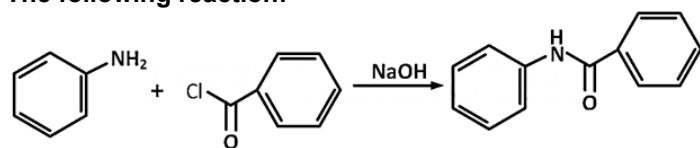
60. A given nitrogen-containing aromatic compound 'A' reacts with Sn/HCl , followed by HNO_2 to give unstable compound 'B'. 'B', on treatment with phenol, forms a beautiful coloured compound 'C' with the molecular formula $\text{C}_{12}\text{H}_{10}\text{N}_2\text{O}$. The structure of compound 'A' is



61. Which one of the following nitro-compounds does not react with nitrous acid (HNO_2)?

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

62. The following reaction:

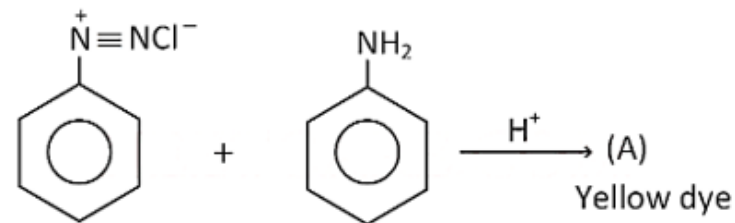


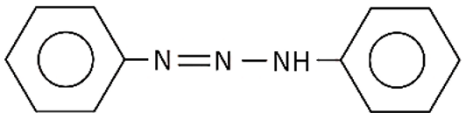
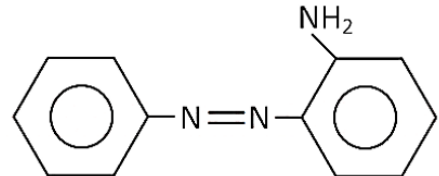
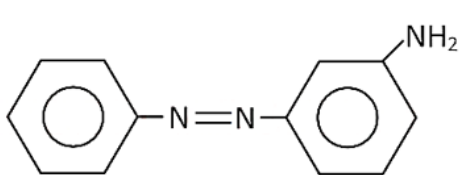
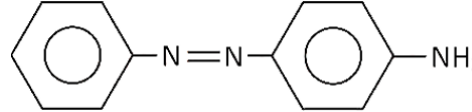
name

is known by the

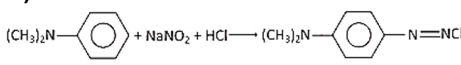
- A) Perkin's reaction
B) Acetylation reaction
C) Schotten-Baumann reaction
D) Friedel-Craft's reaction

63. In the following reaction, the product (A) is:



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

64. Some reactions of amines are given. Which one is not correct?

- A) 
- B) $\text{CH}_3\text{CH}_2\text{NH}_2 + \text{HNO}_2 \rightarrow \text{CH}_3\text{CH}_2\text{OH} + \text{N}_2$
- C) $\text{CH}_3\text{NH}_2 + \text{C}_6\text{H}_5\text{SO}_2\text{Cl} \rightarrow \text{CH}_3\text{NH}_2\text{SO}_2\text{C}_6\text{H}_5 + \text{HCl}$
- D) $\text{CH}_3\text{NH}_2 + \text{HNO}_2 \rightarrow \text{CH}_3\text{NH}_2\text{NO} + \text{H}_2\text{O}$

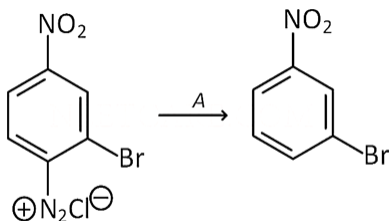
65. On hydrolysis of a "compound", two compounds are obtained. One of which on treatment with sodium nitrite and hydrochloric acid gives a product which does not respond to iodoform test. The second one reduces Tollens reagent and Fehling's solution. The "compound" is

- A) $\text{CH}_3\text{CH}_2\text{CH}_2\text{NC}$
B) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CN}$
C) $\text{CH}_3\text{CH}_2\text{CH}_2\text{ON} = \text{O}$
D) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CON}(\text{CH}_3)_2$

66. Nitrobenzene on reaction with conc. $\text{HNO}_3/\text{H}_2\text{SO}_4$ at $80 - 100^\circ\text{C}$ forms which one of the following products?

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

67.

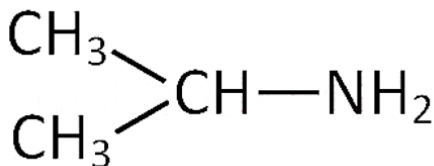


Identify reagent A:

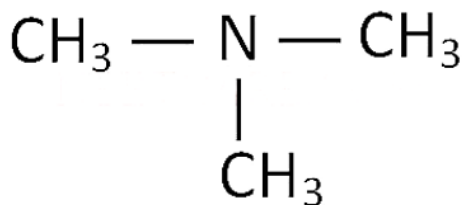
- A) H_3PO_2 and H_2O
 B) $\text{H}^+/\text{H}_2\text{O}$
 C) $\text{HgSO}_4/\text{H}_2\text{SO}_4$
 D) Cu_2Cl_2

68. An organic compound ($\text{C}_3\text{H}_9\text{N}$) (A), when treated with nitrous acid, gave an alcohol and N_2 gas was evolved. (A) on warming with CHCl_3 and caustic potash gave (C) which on reduction gave isopropylmethanamine. Predict the structure of (A).

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

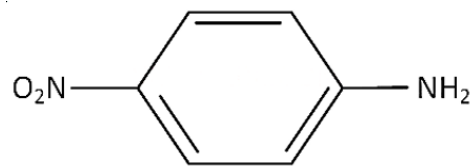


- C) D) $\text{CH}_3\text{CH}_2\text{CH}_2 - \text{NH}_2$

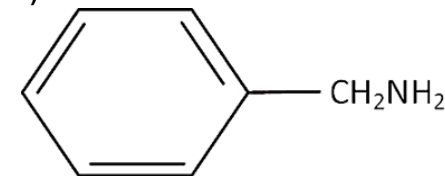


69. What of the following compounds is most basic?

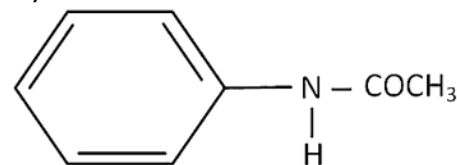
A)



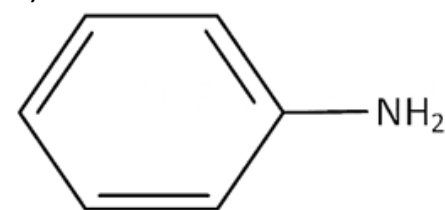
B)



C)



D)



70. Which of the following statements about primary amines is false?

- A) Alkyl amines are stronger bases than aryl amines.
 B) Alkyl amines react with nitrous acid to produce alcohols.
 C) Aryl amines react with nitrous acid to produce phenols.
 D) Alkyl amines are stronger bases than ammonia.

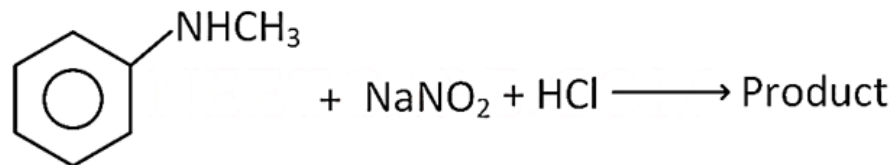
71. Acetamide is treated with the following reagents separately. Which one of these would yield methyl amine?

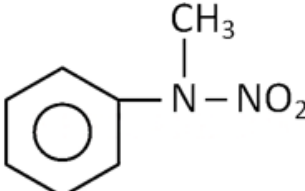
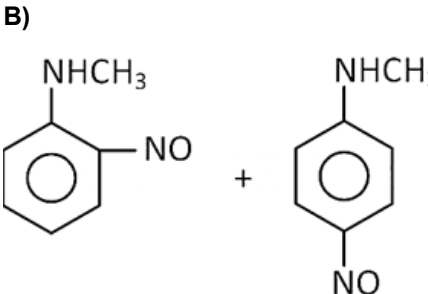
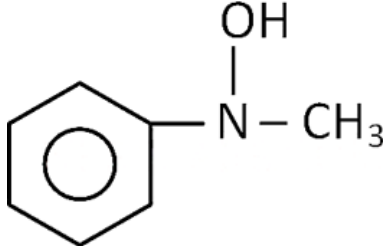
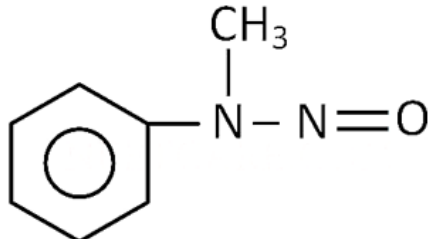
- A) NaOH/Br_2
 B) Sodalime
 C) Hot conc. H_2SO_4
 D) PCl_5

72. Nitrobenzene can be prepared from benzene by using a mixture of conc. HNO_3 and conc. H_2SO_4 . In the mixture, nitric acid acts as a/an:

- A) acid
 B) base
 C) catalyst
 D) reducing agent

73. Predict the product:

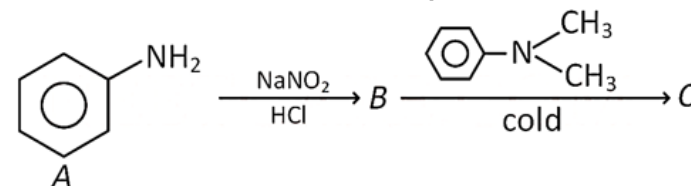


- A) 
- B) 
- C) 
- D) 

74. Which one of the following on reduction with lithium aluminium hydride yields a secondary amine?

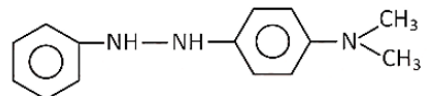
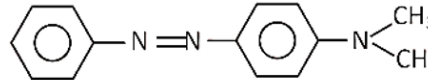
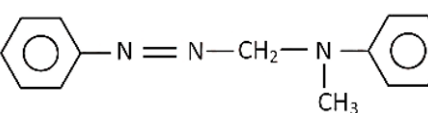
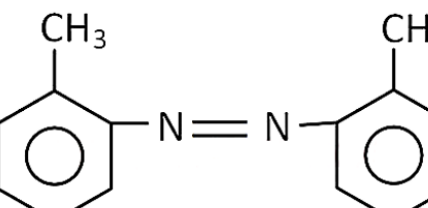
- A) Methyl isocyanide B) Acetamide
C) Methyl cyanide D) Nitroethane

75. In a reaction of aniline a coloured product C was obtained:



The structure of

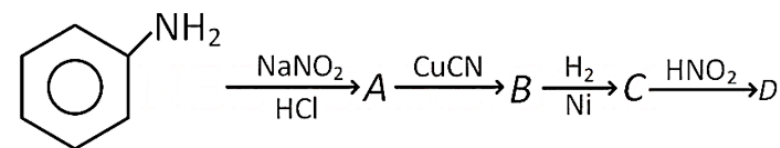
C would be:

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

76. Which of the following is more basic than aniline?

- A) Benzylamine B) Diphenylamine
C) Triphenylamine D) p-Nitroaniline

77. Aniline in a set of reactions yielded a product D.



The

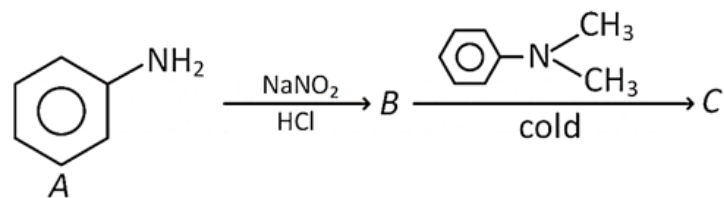
structure of the product D would be:

- A) $\text{C}_6\text{H}_5\text{NHOH}$ B) $\text{C}_6\text{H}_5\text{NHCH}_2\text{CH}_3$
C) $\text{C}_6\text{H}_5\text{CH}_2\text{NH}_2$ D) $\text{C}_6\text{H}_5\text{CH}_2\text{OH}$

78. Electrolytic reduction of nitrobenzene in weakly acidic medium gives:

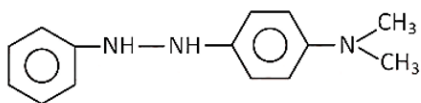
- A) N-phenylhydroxylamine B) nitrosobenzene
C) aniline D) p-hydroxyaniline

79. In a reaction of aniline a coloured product C was obtained.

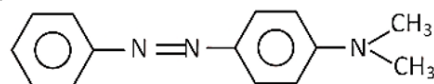


of C would be:

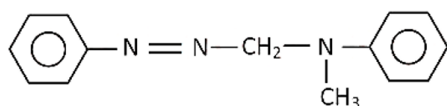
A)



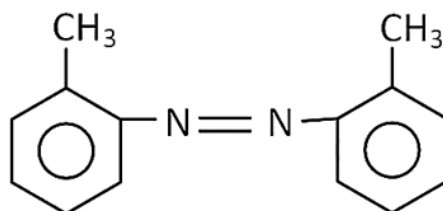
B)



C)

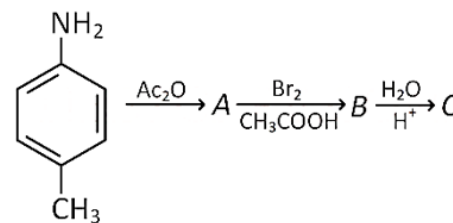


D)



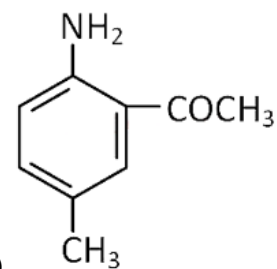
The structure

80. The final product C, obtained in this reaction:

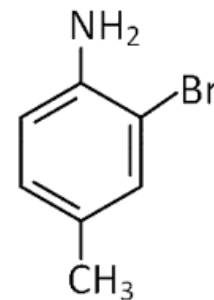


would be

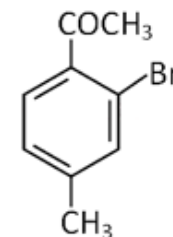
A)



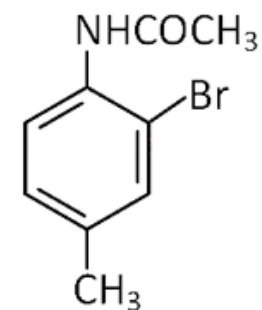
c)



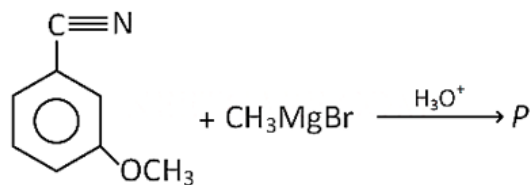
B)



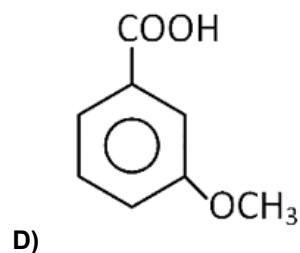
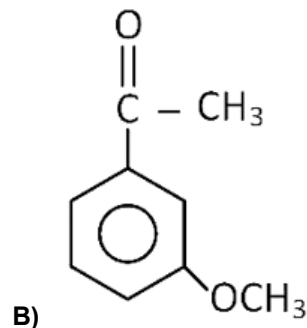
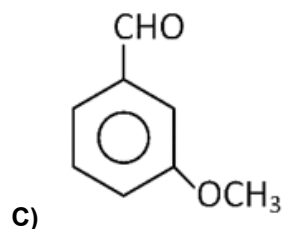
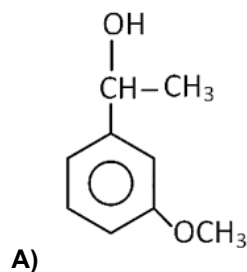
D)



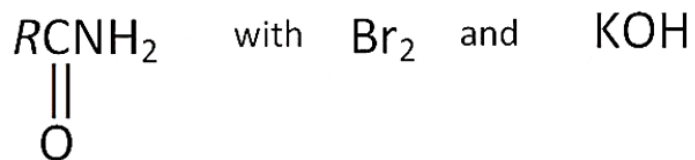
81.

Product *P* in the above

reaction is:



82. Intermediates formed during reaction of

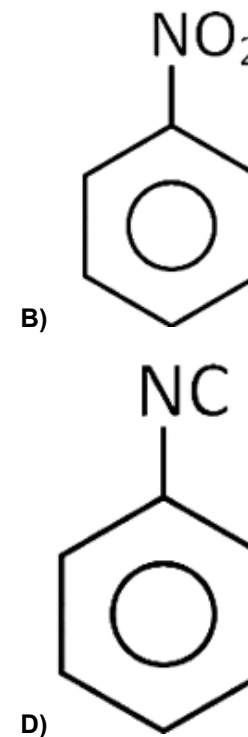
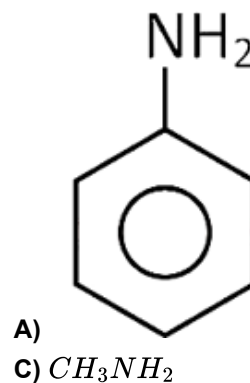


- A) RCONHBr and RNCO
 C) $\text{RNH}-\text{Br}$ and RCONHBr

- B) RNHCOBr and RNCO
 D) RCONBr_2

83.

$A \xrightarrow{\text{reduction}} B \xrightarrow{\text{CHCl}_3/\text{KOH}} C \xrightarrow{\text{reduction}} \text{N-methylaniline}$ then **A** is



84. Select the reagents that reduce nitriles to primary amines. **A.** (i) LiAlH_4 and (ii) H_2O **B.** $\text{Sn} + \text{HCl}$ **C.** H_2/Ni **D.** $\text{Na}(\text{Hg})/\text{C}_2\text{H}_5\text{OH}$ **E.** $\text{Br}_2/\text{aq. NaOH}$ Choose the correct answer from the options given below.

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

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

85. Given below are two statements: **Statement-I:** Oxidation of p-nitrotoluene with acidic KMnO_4 gives an acid that is stronger than benzoic acid. **Statement-II:** Reduction of p-nitrotoluene with Sn/HCl followed by neutralization gives an amine that is more basic than aniline. In light of the above statements, choose the most appropriate answer from the options given below.

- A) Statement-I is incorrect but Statement-II is correct

- B) Both Statement-I and Statement-II are correct

- C) Both Statement-I and Statement-II are incorrect

- D) Statement-I is correct but Statement-II is incorrect

86. The correct order of decreasing basic strength of the given amines is:

- A) N-ethylethanamine > ethanamine > N-methylaniline > benzenamine
B) benzenamine > ethanamine > N-methylaniline > N-ethylethanamine
C) N-methylaniline > benzenamine > ethanamine > N-ethylethanamine
D) N-ethylethanamine > ethanamine > benzenamine > N-methylaniline

87. Given below are two statements: Statement-I: Benzenediazonium salt is prepared by the reaction of aniline with nitrous acid at 273 – 278 K. It decomposes easily in the dry state. Statement-II: Insertion of iodine into the benzene ring is difficult and hence iodobenzene is prepared through the reaction of benzenediazonium salt with KI. In the light of the above statements, choose the most appropriate answer from the options given below:

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

88. The compound that does not undergo Friedel-Crafts alkylation reaction but gives a positive carbylamine test is :

- A) Aniline
B) Pyridine
C) N-methylaniline
D) Triethylamine

89. Given below are two statements: Statement I : Aniline does not undergo Friedel-Crafts alkylation reaction. Statement II : Aniline cannot be prepared through Gabriel synthesis.

- A) Both statement I and Statement II are true
B) Both Statement I and Statement II are false
C) Statement I is correct but Statement II is false
D) Statement I is incorrect but Statement II is true

90. Which of the following reactions will NOT give primary amine as the product?

- A) $CH_3CN \xrightarrow[(ii) H_3O^+]{(i) LiAlH_4}$ Product
B) $CH_3NC \xrightarrow[(ii) H_3O^+]{(i) LiAlH_4}$ Product
C) $CH_3CONH_2 \xrightarrow[(ii) H_3O^+]{(i) LiAlH_4}$ Product
D) $CH_3CONH_2 \xrightarrow{Br_2/KOH}$ Product

Botany

91. In a raceme inflorescence, the flowers are arranged:

- A) Acropetally
B) Basipetally
C) Centripetally
D) Centrifugally

92. Cymose inflorescence is present in:

- A) Solanum
B) Mustard
C) Radish
D) Lupin

93. The technical term used for the androecium in a flower of China rose (*Hibiscus rosa-sinensis*) is:

- A) Monadelphous
B) Diadelphous
C) Polyadelphous
D) Polyandrous

94. Bilateral symmetry (zygomorphic) is characteristic of:

- A) Mustard, Chilli, Datura
B) Pea, Gulmohur, Bean, Cassia
C) Datura, Tomato, Brinjal
D) Canna, Calotropis, Mustard

95. A flower which can be divided into two equal vertical halves only in one particular plane is called:

- A) Actinomorphic
B) Zygomorphic
C) Asymmetric
D) Cyclic

96. Ray florets of Sunflower have:

- A) Superior ovary
B) Hypogynous ovary
C) Half-inferior ovary
D) Inferior ovary

97. Perigynous flowers are found in:

- A) Rose, Plum, Peach
B) Cucumber, Guava
C) Mustard, Brinjal
D) China rose, Tulip

98. Hypogynous flowers are characterized by:

- A) Ovary occupying the highest position while the other parts are situated below it
B) Margin of receptacle growing upwards enclosing the ovary completely
C) Receptacle forming a cup shape around the half-inferior ovary
D) All floral parts positioned at the exact same level

99. The aesthetic whorl of a flower that is often brightly colored to attract insects for pollination is:

- | | |
|----------------------|---------------------|
| A) Calyx | B) Corolla |
| C) Androecium | D) Gynoecium |

100.

If one margin of the appendage overlaps that of the next one and so on, the aestivation is called:

- | | |
|---------------------|-------------------|
| A) Imbricate | B) Twisted |
| C) Vexillary | D) Valvate |

101.

Twisted aestivation is found in:

- | | |
|--|---|
| A) China rose, Salvia, Mustard | B) China rose, Lady's finger, Cotton |
| C) Calotropis, Cassia, Gulmohur | D) Pea, Bean, Indigofera |

102.

Vexillary aestivation is characteristic of the family:

- | | |
|---------------------|------------------------|
| A) Fabaceae | B) Solanaceae |
| C) Liliaceae | D) Brassicaceae |

103.

The smallest, anterior, fused pair of petals in a pea flower is called:

- | | |
|--------------------|------------------|
| A) Standard | B) Keel |
| C) Wings | D) Corona |

104.

When the stamens are attached to the petals, they are called:

- | | |
|-----------------------|------------------------|
| A) Epipetalous | B) Epiphyllous |
| C) Episealous | D) Syngenesious |

105.

Epipetalous stamens are found in:

- | | |
|----------------------------------|----------------------------|
| A) Brinjal / Solanaceae | B) Lily / Liliaceae |
| C) Mustard / Brassicaceae | D) Pea / Fabaceae |

106.

Diadelphous stamens (9+1 arrangement) are found in:

- | | |
|------------------|----------------------|
| A) Pea | B) China rose |
| C) Citrus | D) Sunflower |

107.

Polyadelphous stamens are characteristically found in:

- | | |
|------------------|----------------------|
| A) Citrus | B) Pea |
| C) Tomato | D) China rose |

108.

Apocarpous gynoecium (free carpels) is found in:

- | | |
|--------------------------------|------------------------------|
| A) Lotus and Rose | B) Mustard and Tomato |
| C) Papaver and Michelia | D) Brinjal and Onion |

109.

In marginal placentation, the placenta forms a ridge along the:

- | | |
|---------------------------------------|--------------------------------------|
| A) Ventral suture of the ovary | B) Dorsal suture of the ovary |
| C) Central axis of the ovary | D) Base of the ovary |

110.

Axile placentation is found in:

- | | |
|-------------------------------------|-------------------------------|
| A) China rose, Tomato, Lemon | B) Mustard, Argemone |
| C) Dianthus, Primrose | D) Sunflower, Marigold |

111.

In parietal placentation, the ovules develop on the:

- | | |
|--|--------------------------|
| A) Inner wall of the ovary or peripheral part | B) Central axis |
| C) Base of the ovary | D) Ventral suture |

112.

In a drupe fruit, like Mango and Coconut, the pericarp is well differentiated into:

- | | |
|---|------------------------------------|
| A) Epicarp, Mesocarp, Endocarp | B) Testa, Tegmen, Perisperm |
| C) Coleoptile, Scutellum, Coleorhiza | D) Hilum, Micropyle, Raphe |

113.

In mango, the edible portion is the:

- | | |
|-------------------|--------------------|
| A) Fleshy epicarp | B) Fleshy mesocarp |
| C) Stony endocarp | D) Entire pericarp |

114.

In coconut, the mesocarp is:

- | | |
|-----------|---------------|
| A) Fleshy | B) Fibrous |
| C) Stony | D) Membranous |

115.

The outer layer of the seed coat is called the _____, and the inner layer is called the _____.

- | | |
|--------------------------|-------------------------|
| A) Testa, Tegmen | B) Tegmen, Testa |
| C) Scutellum, Coleoptile | D) Perisperm, Endosperm |

116.

In monocotyledonous seeds (like Maize), the large shield-shaped cotyledon is known as:

- | | |
|---------------|-------------------|
| A) Coleoptile | B) Scutellum |
| C) Coleorhiza | D) Aleurone layer |

117.

Assertion: Pea and Pea-like flowers (Fabaceae) are zygomorphic. Reason: They show bilateral symmetry and can be cut into two equal halves in only one particular vertical plane.

- | | |
|---|---|
| A) Both Assertion and Reason are true and Reason is the 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. |

118.

Assertion: Mango and Coconut are called drupes. Reason: They develop from monocarpellary superior ovaries and are one-seeded.

- | | |
|---|---|
| A) Both Assertion and Reason are true and Reason is the 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. |

119.

Assertion: In Mango, the mesocarp is edible and fleshy. Reason: The endocarp in Mango is stony and hard, protecting the single seed.

- | | |
|---|---|
| A) Both Assertion and Reason are true and Reason is the 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. |

120.

Assertion: Coleoptile and coleorhiza are protective sheaths found in dicot embryos. Reason: The plumule is enclosed in coleoptile, and the radicle is enclosed in coleorhiza.

- | | |
|---|---|
| A) Both Assertion and Reason are true and Reason is the 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. |

121.

Assertion: Mustard, China rose, and Brinjal have hypogynous flowers. Reason: In hypogynous flowers, the gynoecium occupies the highest position while the other parts are situated below it, making the ovary superior.

- | | |
|---|---|
| A) Both Assertion and Reason are true and Reason is the 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. |

122.

Assertion: China rose shows twisted aestivation in its corolla. Reason: One margin of the appendage overlaps that of the next one and vice versa.

- | | |
|---|---|
| A) Both Assertion and Reason are true and Reason is the 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. |

123.

Assertion: Stamens in Pea are diadelphous. Reason: The filaments are united into two bundles, typically written as (9) + 1.

- A) Both Assertion and Reason are true and Reason is the 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.

124.

Consider the following statements regarding inflorescence: (I) In racemose type of inflorescence, the main axis continues to grow indefinitely. (II) In cymose inflorescence, the flowers are borne in a basipetal order. (III) In racemose inflorescence, the youngest flower is present at the apex. Which of the statements given above are correct?

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

125.

Read the following statements about flower symmetry and choose the correct option: (I) Mustard, Datura, and Chilli show actinomorphic symmetry. (II) Pea, Gulmohur, Bean, and Cassia show zygomorphic symmetry. (III) Canna is asymmetric and cannot be divided into two similar halves by any vertical plane passing through the centre.

- A) Statement I is correct, but II and III are incorrect. B) Statements I and II are correct, but III is incorrect.
C) Statements I and III are correct, but II is incorrect. D) All statements I, II and III are correct.

126.

Given below are statements regarding the position of floral organs on the thalamus: (I) In hypogynous flowers, the ovary occupies the highest position while the other parts are situated below it. (II) In perigynous flowers, the ovary is named half inferior. (III) In epigynous flowers, the thalamus grows upwards enclosing the ovary completely and getting fused with it. Identify the correct statements:

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

127.

Select the correct combination of statements concerning vexillary aestivation: (I) It is also known as papilionaceous aestivation and is characteristic of the family Fabaceae. (II) The largest petal is called the standard, which overlaps the two lateral petals called wings. (III) The wings overlap the two smallest anterior petals called the keel.

- A) I and II are correct B) II and III are correct
C) I and III are correct D) I, II and III are correct

128.

Consider the statements about the androecium conditions: (I) When stamens are united into one bunch or one bundle, the condition is monadelphous as in China rose. (II) Stamens united into two bundles are called diadelphous as in Pea. (III) When stamens are united into more than two bundles, it is polyadelphous as in Citrus. Which of the above statements are correct?

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

129.

Read the following statements describing the adhesion of stamens: (I) Epipetalous stamens are attached to the petals, as seen in Brinjal. (II) Epiphyllous stamens are attached to the perianth, as seen in Lily. (III) Polyandrous condition refers to the fusion of filaments while anthers remain free. Choose the correct option:

- A) I and II are correct, III is false B) I and III are correct, II is false
C) II and III are correct, I is false D) All statements are correct

130.

Read the statements regarding Parietal and Free-central placentation: (I) In parietal placentation, the ovules develop on the inner wall of the ovary or on peripheral parts. (II) Ovary is one-chambered in parietal placentation but it becomes two-chambered due to the formation of a false septum (replum) in Mustard and Argemone. (III) In free-central placentation, the ovules are borne on a central axis and septa are absent, as in Dianthus and Primrose. Which of the statements given above are correct?

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

131.

Statements regarding Basal Placentation: (I) The placenta develops at the base of the ovary. (II) A single ovule is attached to the basal placenta. (III) It is found commonly in Sunflower and Marigold. Choose the correct option:

- A) I and II are true B) II and III are true
C) I and III are true D) I, II and III are true

132.

Compare the pericarp of Mango and Coconut based on these statements: (I) In mango, the pericarp is well differentiated into an outer thin epicarp, a middle fleshy edible mesocarp and an inner stony hard endocarp. (II) In coconut, the mesocarp is fibrous. (III) The edible part of both mango and coconut is the mesocarp. Identify the correct statements:

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

133.

Study the statements about the embryo of a monocot seed (Maize): (I) The embryo is small and situated in a groove at one end of the endosperm. (II) It consists of one large and shield-shaped cotyledon known as scutellum. (III) The plumule and radicle are enclosed in sheaths which are called coleoptile and coleorhiza respectively.

- A) I and II are correct B) II and III are correct
C) I and III are correct D) I, II and III are correct

134.

Read the statements given below: (I) A true fruit develops only from the ovary after fertilization. (II) In apple, pear, and cashew, the thalamus also contributes to fruit formation; hence they are called false fruits. (III) Parthenocarpic fruits can be induced through the application of growth hormones and such fruits are seedless. Which of the above statements are correct?

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

135.

Match the seed component with its nutritional or protective property:

Column I	Column II
A. Endosperm-pericarp in maize	1. Fused thin protective barrier with seed
B. Seed coat	2. Food storing tissue formed due to double fertilization
C. Cotyledons – food materials in dicots	3. Often fleshy and full of reserve

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

Zoology

136.

Vasa efferentia in frogs enter into the kidneys and open into

- A) Ejaculatory duct B) Ureters
C) Bidder's canal D) Urethra

137.

In male frogs, a small, median chamber that is used to pass faecal matter, urine and sperms to the exterior is

- A) Fat body B) Cloaca
C) Urinary bladder D) Ureter

138.

Which of the following is not associated with forebrain of frog?

- A) Olfactory lobes B) Optic lobes
C) Cerebral hemispheres D) Diencephalon

139.

In the circulatory system of frog, ventricle opens into a sac-like conus arteriosus on the _____ side of the heart. Choose the option which fills the blank correctly.

- A) Dorsal B) Ventral
C) Lateral D) Dorso-lateral

140.

Read the given statements w.r.t. frogs and choose the correct Statement (A) : Mesorchium is a double fold of peritoneum that attaches ovaries in a frog to body wall. Statement (B) : The ovaries are situated near kidneys and there is no functional connection with kidneys.

- A) Statement (A) is correct and statement (B) is the correct explanation for (A)
B) Statement (A) is incorrect while statement (B) is correct
C) Both statements (A) and (B) are correct
D) Statement (A) is correct but statement (B) is not the correct explanation for (A)

141.

During aestivation and hibernation, frog respire through _____. Select the option which fills the blank correctly.

- A) Buccal cavity
B) Lungs
C) Gills
D) Skin

142.

A mature female frog can lay how many ova at a time?

- A) 250-300
B) 2500-3000
C) 1100-2000
D) 10-16

143.

A pair of elongated, pink coloured sac-like structures present in the upper part of trunk region/thorax of adult frogs is

- A) Liver
B) Lungs
C) Cloaca
D) Gills

144.

Homo sapiens and adult Rana tigrina have similar

- A) Mode of excretion
B) Number of chambers in heart
C) Number of webbed digits
D) Venous connection present between kidney and lower parts of the body

145.

Choose the correct statement w.r.t. frogs

- A) External ear is represented by the auricular muscles
B) A muscular, bilobed tongue is used to capture the prey
C) On land, cutaneous respiration is exclusively used to supply oxygen to the tissues
D) Unlike humans they lack the common bile duct.

146.

Read the following statements and choose the correct option. Statement A : In some countries, the muscular legs of frogs are used as food by man Statement B : The system for control and coordination is highly evolved in frogs

- A) Both statements A and B are correct
B) Both statements A and B are incorrect
C) Only statement A is correct
D) Only statement B is correct

147.

In frogs, the hind brain consists of

- A) Pons and cerebellum
B) Pons, cerebellum and medulla oblongata
C) Cerebellum and medulla oblongata
D) Pairs of optic lobes, cerebellum and medulla oblongata

148.

Male frogs can be distinguished from the female frogs by which of the following characters?

- A) Presence of vocal cords in males
B) Presence of copulatory pad on the first digit of hind limb of males
C) Presence of sound producing vocal sacs in males
D) Five webbed digits in the hind limbs of females

149.

Name the special venous connection which is present in both humans and frogs and carries deoxygenated blood from GIT to the liver. A) Hepatic portal system B) Renal portal system C) Coronary circulation D) Hypophyseal portal system

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

150.

Select the incorrect statement w.r.t. *Rana tigrina*

- A) Adult frog is a ureotelic animal B) Each kidney is composed of several structural and functional units called uriniferous tubules
- C) Thin walled urinary-bladder present dorsal to rectum receives opening of ureters D) Kidneys are red and bean like structures situated posteriorly on both sides of vertebral column

151.

Sexual dimorphism can be established in *Rana tigrina* based on the presence of all, except

- A) Webbed digits in males B) Vocal sacs in males
- C) Copulatory pad in forelimb of male D) Small size and darker coloration than females.

152.

Consider the following: (a) Presence of urinogenital duct. (b) Excretion by 100-150 yellow coloured thin filamentous structures present at the junction of foregut and midgut. (c) Blood from sinuses enter heart through ostia and is then pumped anteriorly to sinuses again. (d) Presence of ventrally located heart. (e) Exhibits development through nymphal stages. How many of the above is/are true for male *Rana tigrina* and *Periplaneta* respectively?

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

153.

Choose the option that represents correct set of structures present in fore brain of *Rana tigrina*.

- A) (1) Olfactory lobes, paired cerebral hemispheres, unpaired diencephalon B) Olfactory lobes, paired cerebral hemispheres, paired diencephalon
- C) Optic lobe, paired cerebral hemispheres, pons D) Optic lobe, unpaired cerebral hemisphere, medulla

154.

Choose the correct statement

- A) Arteries, veins and capillaries form series of vessels through which blood circulates in open circulatory system B) Coelenterates, ctenophores and adult echinoderms have same symmetry
- C) Platyhelminthes exhibit tissue level of organisation D) Sycon is a true diploblastic sponge

155.

Choose the incorrect statement w.r.t sponges

- A) Sponges reproduce asexually by gemmule formation B) Larval stages are morphologically distinct from adult stages
- C) Digestion occurs in spongocoel D) Water enters into the body through ostia and leaves through osculum

156.

Read the following statements (A) All members of kingdom Animalia exhibit the same pattern of organisation of cells (B) In most of Platyhelminthes, the digestive system has only a single opening to the outside of the body (C) In chordates, the blood is pumped out of the heart and the cells and tissue are directly bathed in it From above

- A) A and B are correct B) B and C are correct
- C) A and C are incorrect D) B and C are incorrect

157.

Which one of the following statements about certain given animals is correct?

- A) Circulatory system is of open type in hemichordates B) Body of *Limulus* is covered by a calcareous shell
- C) Body of Platyhelminth, *Ascaris* is circular in cross section D) Molluscs are mostly viviparous

158.

Which of the following statements is incorrect with respect to the Phylum Arthropoda?

- A) Malpighian tubules as excretory organs in most members B) Chitinous exoskeleton
- C) Mostly dioecious D) Contributes about one third of all named biological species on the earth

159.

Match the following genera in column I with their respective phylum in column II.

Column I	Column II
a. Cucumaria	<u>(i)</u> Platyhelminthes
b. Meandrina	<u>(ii)</u> Mollusca
c. Chaetopleura	<u>(iii)</u> Coelenterata
d. Taenia	<u>(iv)</u> Echinodermata

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

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

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

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

160.

Read the following statements and choose the correct option. Statement A : In annelids body surface is distinctly marked out into metamer. Statement B : Nereis possesses parapodia which help in neural regulation.

- A) Both statements A and B are correct B) only statements A is correct
C) Both statements A and B are incorrect D) Only statement A is incorrect

161.

Match column I with column II and select the correct option.

Column I	Column II
a. Dentalium	<u>(i)</u> High regeneration capacity
b. Pheretima	<u>(ii)</u> Radula
c. Nereis	<u>(iii)</u> Longitudinal and circular muscles
d. Planaria	<u>(iv)</u> Parapodia

A) A-Q, B-S, C-R, D-P

B) A-P, B-S, C-R, D-Q

C) A-S, B-Q, C-P, D-R

D) A-Q, B-R, C-S, D-P

162.

Match the column I with column II w.r.t. their respective characteristics.

Column I	Column II
a. Fasciola	<u>(i)</u> Metameres
b. Laccifer	<u>(ii)</u> Flame cells
c. Aplysia	<u>(iii)</u> Malpighian tubules
d. Nereis	<u>(iv)</u> Radula

A) A-Q, B-S, C-R, D-P

B) A-S, B-R, C-Q, D-P

C) A-Q, B-R, C-S, D-P

D) A-R, B-P, C-Q, D-S

163.

Read the given statements and select the correct option. Statement (P): In case of poriferans, the spongocoel and canals are lined with flagellated cells called choanocytes. Statement (Q): Sponges exhibit external fertilisation and indirect developemnt having a larval stage which is morphologically distinct from the adult.

- A) Both statement (P) and (Q) are correct B) Both statement (P) and (Q) are incorrect
C) Only statement (P) is correct D) Only statement (Q) is correct

164.

Which of the following statements is incorrect with respect to the Phylum Mollusca?

- A) Gills act as excretory organs in most members B) Chitinous exoskeleton
C) Mostly dioecious and oviparous D) The second largest phylum

165.

Match the following

Column-I

Column-II

(i) Gills

(a) Horse Shoe Crab

(ii) Book-gills

(b) Crabs

(iii) Book-lungs

(c) Butterfly

(iv) Tracheal system

(d) Scorpion

A) A-R, B-S, C-P, D-Q

B) A-S, B-R, C-Q, D-P

C) A-Q, B-P, C-S, D-R

D) A-Q, B-R, C-S, D-P

166.

Given below are four animals a, b, c and d. Select the correct answer w.r.t. a common characteristic of two of these animals. (a) Spongilla (b) Adamsia (c) Taenia (d) Ascaris

A) (a) and (c) are hermaphrodites

B) (b) and (d) show radial symmetry

C) (a) and (d) have a true coelom

D) (c) and (d) show sexual dimorphism

167.

Read the following statements (A – E) A - Most of the sponges are marine but a few live in freshwater also B - Segmentation is seen in annelids, arthropods and chordates C - Coelenterates are bilaterally symmetrical animals D - Digestion is intracellular in sponges E - Digestion is partly extracellular and partly intracellular in coelenterates How many of the above statements are true?

A) 2

B) 3

C) 4

D) 5

168.

Match column A with column B A) Cellular level B) Tissue level C) Organ level D) Organ system level P) Porifera Q) Annelida R) Cnidaria S) Platyhelminthes

A) A-Q, B-P, C-R, D-S

B) A-P, B-S, C-R, D-Q

C) A-P, B-Q, C-S, D-Q

D) A-P, B-Q, C-R, D-S

169.

Consider the given statements and select the incorrect one.

A) Planaria possesses high capacity of regeneration.

B) Metagenesis in cnidarians occurs between asexual and sexual phases of an organism.

C) Cnidocytes contain the stinging capsules or nematocysts, present on the tentacles and the body of cnidarians.

D) Poriferans have a central gastro-vascular cavity with a single opening, mouth.

170.

Identify the following statements as true (T) or false (F) I. Bioluminescence is well-marked in ctenophores II. Digestion is only extracellular in ctenophores III. Ctenophores are dioecious IV. Fertilization is external in ctenophores

A) I-T, II-F, III-F, IV-T

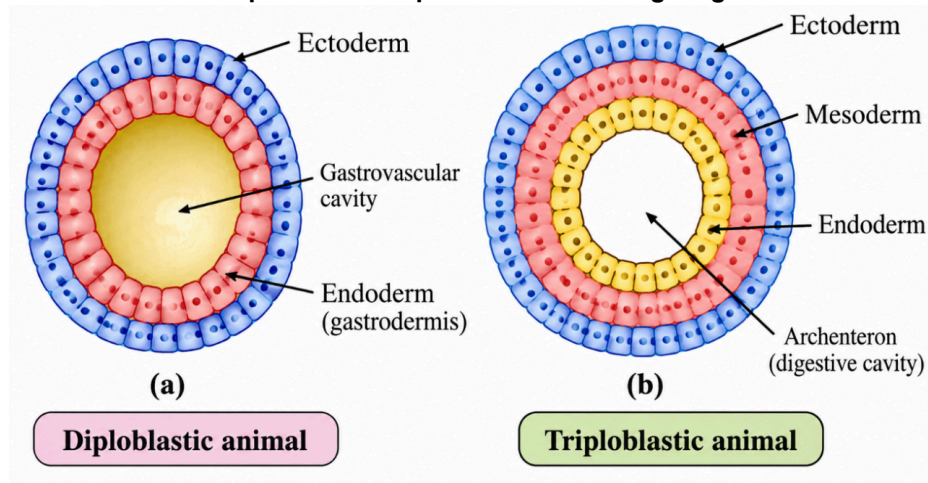
B) I-T, II-F, III-T, IV-F

C) I-T, II-F, III-F, IV-F

D) I-F, II-F, III-F, IV-T

171.

Select the correct option with respect to the following diagram



A) Figure (a) represents diploblastic and figure (b) represents triploblastic animals

B) Figure (a) is associated with Platyhelminthes whereas figure (b) is associated with Coelenterata.

C) Animals in which the developing embryo has mesoderm are triploblastic animals

D) More than one option is correct

172.

Choose the correct option: Statement A : Ctenophores are exclusively marine Statement B : Reproduction takes place only by sexual means in Ctenophora

A) Only statement A is correct

B) Only statement B is correct

C) Both statements A and B are correct

D) Both statements A and B are incorrect

173.

In which of the following, the genus name, its two characters and its phylum are not correctly matched? A) Sycon B) Taenia C) Pleurobrachia D) Ascaris P) Pore-bearing body; Canal system Q) Flame cells present; Monoecious R) Radially symmetrical; Bioluminescence S) Bilaterally symmetrical; Pseudocoelomate

A) A-P, B-Q, C-R, D-S

B) A-Q, B-P, C-S, D-R

C) A-P, B-R, C-Q, D-S

D) A-S, B-Q, C-R, D-P

174.

Match the Phylum in column A with examples in column B and choose the correct option. A. Cnidaria B. Platyhelminthes C. Porifera P. Physalia Q. Spongilla R. Taenia S. Aurelia T. Fasciola

A) A-P, S; B-Q, R; C-T

B) A-P, S; B-R, T; C-Q

C) A-P, Q; B-R, S; C-T

D) A-S, T; B-R; C-P, Q

175.

Canal system of Porifera is not involved in

A) Locomotion

B) Nutrition

C) Respiration

D) Excretion

176.

Read the following statements (A – E) A – In cnidarians, polyp is a cylindrical form B – Digestion is both intracellular and extracellular in ctenophores C – Suckers and hooks are found in Ascaris D – Ascaris is acoelomate E – Metamorphosis occurs in Cyclostomes How many of the above statements are true?

A) 2

B) 5

C) 3

D) 4

177.

Identify the following statements as true (T) or false (F) I. In ctenophores, fertilization is internal II. The suckers and hooks present in all Platyhelminthes help in the adhesion III. The transfer of sperms from one sponge to another occurs with the help of canal system and fertilization is internal IV. Fasciola is dorsoventrally flattened

A) I-T, II-F, III-F, IV-T

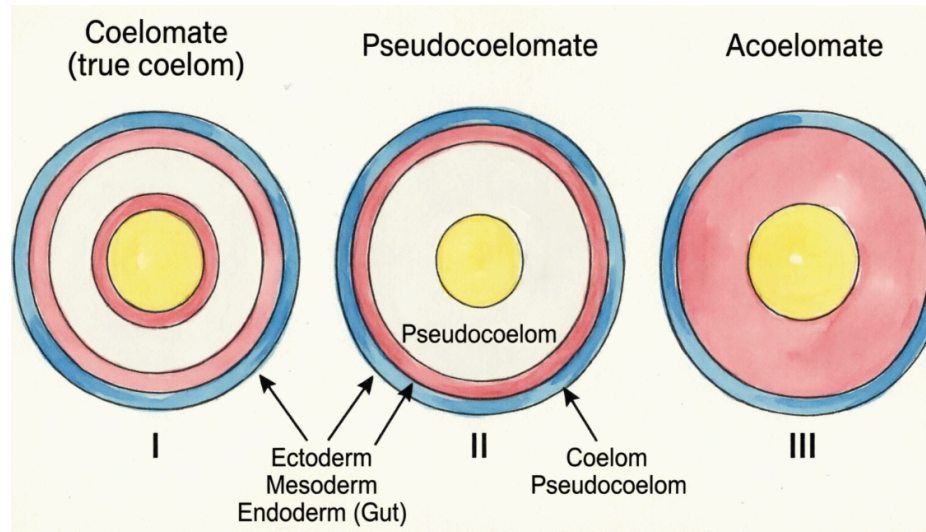
B) I-T, II-F, III-T, IV-F

C) I-F, II-T, III-T, IV-T

D) I-F, II-F, III-T, IV-T

178.

Select the correct match of coelom (shown in diagram below) with the animals listed in the table



- A) Ascaris-II, Liver Fluke-III, Fish-I, Frog-I
 B) Ascaris-II, Liver Fluke-III, Fish-I, Frog-III
 C) Ascaris-III, Liver Fluke-II, Fish-I, Frog-I
 D) Ascaris-III, Liver Fluke-I, Fish-II, Frog-I

179.

In which of the following, the genus name and its character is not correctly matched?

Genus Name	Character
(1) Sycon	: Canal system present
B) Hydra	: Metagenesis present in life cycle
C) <u>Pleurobrachia</u>	: Ciliated comb plates present
D) Planaria	: Triploblastic, acoelomate

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

180.

Sycon belongs to a group of animals, which are best described as

- A) Unicellular
 B) Multicellular without any tissue organization
 C) Multicellular with a gastrovascular system
 D) Multicellular having tissue organization, but no body cavity

ANSWER KEY

Physics

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

Chemistry

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

Botany

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

Zoology.

136.	2	148.	3	160.	2	172.	3
137.	2	149.	1	161.	1	173.	2
138.	2	150.	4	162.	2	174.	2
139.	2	151.	1	163.	4	175.	4
140.	2	152.	1	164.	2	176.	4
141.	4	153.	1	165.	1,2,3,4	177.	1
142.	2	154.	2	166.	1	178.	1
143.	2	155.	3	167.	2	179.	2
144.	1	156.	3	168.	1	180.	2
145.	2	157.	1	169.	4		
146.	3	158.	2	170.	4		
147.	3	159.	4	171.	3		

SOLUTIONS

Q1.

Answer: B

Explanation:

The activity after n half lives is $A = A_0(1/2)^n$. Since $1/32 = (1/2)^5$, the substance needs $n = 5$ half lives, so the required time is $t = 5 \times 15 = 75$ minutes.

Q2.

Answer: B

Explanation:

Statement I follows the decay law $\frac{dN}{dt} = -\lambda N$, where the decay rate is directly proportional to N , so it is correct. Statement II actually defines the mean life $\tau = \frac{1}{\lambda}$, not the half life, so it is incorrect.

Q3.

Answer: B

Explanation:

With equal initial atoms N_0 , the ratio is $\frac{N_1}{N_2} = e^{-(7\lambda-3\lambda)t} = e^{-4\lambda t}$. Setting this equal to $1/e$ gives $4\lambda t = 1$, so $t = 1/(4\lambda)$.

Q4.

Answer: D

Explanation:

The number of half lives elapsed is $n = 50/20 = 2.5$, so the remaining fraction of activity is $(1/2)^{2.5} = 1/(4\sqrt{2})$.

Q5.

Answer: C

Explanation:

The decay constant is $\lambda = 0.693/34.65 = 0.02$ per hour, so the fraction decaying in any one hour interval is $1 - e^{-\lambda} \approx 0.02$, i.e. 2 percent. The initial activity is extra information and is not needed.

Q6.

Answer: C

Explanation:

After a long time, secular equilibrium is reached so the activities become equal, $\lambda_X N_X = \lambda_Y N_Y$. Hence $N_X/N_Y = \lambda_Y/\lambda_X = T_X/T_Y$.

Q7.

Answer: C

Explanation:

Each α particle reduces the mass number by 4 and the atomic number by 2, while each β particle increases the atomic number by 1. Mass number balance gives $n_\alpha = (238 - 206)/4 = 8$, and charge balance gives $n_\beta = 2n_\alpha - (92 - 82) = 6$.

Q8.

Answer: B

Explanation:

Using $N = N_0(1/2)^{t/T}$ with $N/N_0 = 1/10$ and $T = 30$ years gives $t = T \times \frac{\ln 10}{\ln 2} = 30 \times 3.322 \approx 100$ years.

Q9.

Answer: A

Explanation:

The decay constant is $\lambda = \frac{0.693}{T_{1/2}}$. Converting 8 hours to seconds gives $T_{1/2} = 28800$ s, so $\lambda = \frac{0.693}{28800} \approx 2.41 \times 10^{-5}$ per sec.

Q10.

Answer: B

Explanation:

Since $\frac{1}{32} = \left(\frac{1}{2}\right)^5$, five half lives elapse in 20 hours, so the half life is $T = 20/5 = 4$ hours.

Q11.

Answer: C

Explanation:

Each α emission lowers the mass number by 4 and each β^- emission changes only the charge by +1. Mass balance gives $n_\alpha = (235 - 207)/4 = 7$, and charge balance gives $n_\beta = 2n_\alpha - (92 - 82) = 4$.

Q12.

Answer: C

Explanation:

Two α emissions reduce the mass number by 8 and the charge number by 4, one β^- emission increases the charge number by 1, and γ emission changes nothing. Hence X4 has mass number $190 - 8 = 182$ and charge number $75 - 4 + 1 = 72$.

Q13.

Answer: B

Explanation:

For simultaneous (parallel) decay the decay constants add:

$\lambda = \lambda_\alpha + \lambda_\beta = \frac{1}{800} + \frac{1}{1200} = \frac{1}{480}$ per year, so the effective mean life is 480 years and the half life is $0.693 \times 480 \approx 333$ years.

Q14.

Answer: C

Explanation:

The nuclear radius obeys $R = R_0 A^{1/3}$, so statement A is true and B is false. Since both the nuclear mass and the nuclear volume are proportional to A , the density $\rho = M/V$ is constant, making D true and C false. Hence A and D are true, while B and C are false.

Q15.

Answer: C

Explanation:

The Q value is the mass defect converted to energy:

$$\Delta m = 226.025 - (222.016 + 4.003) = 0.006 \text{ u, so}$$

$$Q = 0.006 \times 931.5 \text{ MeV} = 5.589 \text{ MeV} = 5589 \text{ keV}.$$

Q16.

Answer: D

Explanation:

According to Rutherford's scattering formula from the Geiger-Marsden experiment, the number of scattered α -particles $N(\theta)$ is inversely proportional to $\sin^4(\theta/2)$. As the scattering angle θ increases, $N(\theta)$ decreases very rapidly, which is correctly represented by graph D.

Q17.

Answer: C

Explanation:

Statements A, B and C are correct: cadmium absorbs neutrons and regulates the chain reaction, β^- decay converts a neutron into a proton so A stays constant while Z increases by one, and α particles ionise heavily and hence penetrate less. Statement D is wrong because a moderator slows fast neutrons down to thermal energies instead of speeding them up.

Q18.

Answer: B

Explanation:

An α particle reduces the mass number by 4 and the atomic number by 2, while e^+ emission reduces Z by 1 and each e^- (or β^-) emission increases Z by 1, with no change in A . Hence the final nucleus has $A = 236 - 4 = 232$ and $Z = 92 - 2 - 1 + 1 + 1 = 91$.

Q19.

Answer: D

Explanation:

The activity falls by a factor of 2 in every half life, so $\left(\frac{1}{2}\right)^n = \frac{1}{64}$ gives $n = 6$ half lives. Therefore the required time is $t = n \times T_{1/2} = 6 \times 30 = 180$ minutes.

Q20.

Answer: A

Explanation:

The emission of an electron e^- together with an antineutrino $\bar{\nu}$ is β^- decay, in which a neutron changes into a proton. Hence the mass number stays at 234 while the atomic number increases by one, from 90 to 91, giving $X = {}_{91}^{234}\text{Pa}$.

Q21.

Answer: D

Explanation:

The nuclear radius follows $R = R_0 A^{1/3}$, so the ratio of radii is $\left(\frac{216}{64}\right)^{1/3} = \frac{6}{4} = \frac{3}{2}$, i.e. 3 : 2.

Q22.

Answer: B

Explanation:

The number of half lives elapsed is $n = \frac{200}{80} = \frac{5}{2}$, so the remaining fraction is $\left(\frac{1}{2}\right)^{5/2} = \frac{1}{4\sqrt{2}}$.

Q23.

Answer: A

Explanation:

The first step increases the atomic number by 1 ($Z \rightarrow Z + 1$), which is β^- decay; the second step decreases it by 2 ($Z + 1 \rightarrow Z - 1$), which is α decay; the third step decreases it by 1 ($Z - 1 \rightarrow Z - 2$), which is β^+ decay. Hence the sequence is β^-, α, β^+ .

Q24.

Answer: D

Explanation:

The number of nuclei left is $1200 - 1050 = 150$, which is $\frac{1}{8} = \left(\frac{1}{2}\right)^3$ of the initial number, so 3 half lives pass and the time is $3 \times 25 = 75$ minutes.

Q25.

Answer: C

Explanation:

After 20% decay, 80% of the nuclei remain; after 90% decay, only 10% remain. The ratio

$\frac{10}{80} = \frac{1}{8} = \left(\frac{1}{2}\right)^3$ corresponds to 3 half lives, so the time between these stages is $3 \times 25 = 75$ minutes.

Q26.

Answer: B

Explanation:

Since $R = R_0 A^{1/3}$, the ratio of radii is $\left(\frac{27}{64}\right)^{1/3} = \frac{3}{4}$, so the radius of the aluminium nucleus is $\frac{3}{4} R_{Zn}$.

Q27.

Answer: A

Explanation:

The energy released equals the total binding energy of the products minus that of the reactants: $Q = 2 \times (4 \times 7.5) - (7 \times 6.0) = 60 - 42 = 18$ MeV.

Q28.

Answer: D

Explanation:

The fraction of X remaining is $\frac{1}{1+15} = \frac{1}{16} = \left(\frac{1}{2}\right)^4$, so 4 half lives have passed and the age is $4 \times 1.2 \times 10^9 = 4.80 \times 10^9$ years.

Q29.

Answer: A

Explanation:

The fraction of P remaining is $\frac{1}{1+3} = \frac{1}{4} = \left(\frac{1}{2}\right)^2$, so 2 half lives have passed and the age is $2 \times 2.5 \times 10^9 = 5.00 \times 10^9$ years.

Q30.

Answer: B

Explanation:

Setting the remaining masses equal, $30\left(\frac{1}{2}\right)^{t/30} = 240\left(\frac{1}{2}\right)^{t/15}$, gives $2^{t/30} = 8 = 2^3$, so $t = 90$ s.

Q31.

Answer: C

Explanation:

Setting the remaining masses equal, $15\left(\frac{1}{2}\right)^{t/40} = 120\left(\frac{1}{2}\right)^{t/10}$, gives $2^{3t/40} = 8 = 2^3$, so $t = 40$ s.

Q32.

Answer: D

Explanation:

The fraction of P remaining is $\frac{1}{1+7} = \frac{1}{8} = \left(\frac{1}{2}\right)^3$, so 3 half lives have elapsed and the age is $3 \times 40 = 120$ years.

Q33.

Answer: B

Explanation:

The fraction of A remaining is $\frac{1}{1+31} = \frac{1}{32} = \left(\frac{1}{2}\right)^5$, so 5 half lives have elapsed and the age is $5 \times 25 = 125$ years.

Q34.

Answer: B

Explanation:

Each α emission reduces the mass number by 4 and the atomic number by 2, while each β emission increases the atomic number by 1. Hence the mass number becomes $m - 8$ and the atomic number becomes $n - 4 + 1 = n - 3$, giving ${}_{n-3}^{m-8}Y$.

Q35.

Answer: D

Explanation:

Two α emissions reduce the mass number by 8 and the atomic number by 4, and two β emissions then raise the atomic number by 2. Hence the product is $m - 8$ and $n - 4 + 2 = n - 2$, i.e. ${}_{n-2}^{m-8}Y$.

Q36.

Answer: C

Explanation:

From $A = N_0 e^{-\lambda t}$, the condition $N_0/e = N_0 e^{-8\lambda}$ gives $8\lambda = 1$, so $\lambda = 1/8$ per minute.

The half life is $T_{1/2} = \frac{\log_e 2}{\lambda} = 8 \log_e 2$ minutes.

Q37.

Answer: A

Explanation:

From $A = N_0 e^{-\lambda t}$, the condition $N_0/e^2 = N_0 e^{-6\lambda}$ gives $6\lambda = 2$, so $\lambda = 1/3$ per minute.

The half life is $T_{1/2} = \frac{\log_e 2}{\lambda} = 3 \log_e 2$ minutes.

Q38.

Answer: A

Explanation:

The first step lowers A by 4 and Z by 2, which is α emission; the second step keeps A fixed and raises Z by 1, which is β emission; the third step changes neither A nor Z and only removes excitation, which is γ emission. Hence the sequence is α, β, γ .

Q39.

Answer: D

Explanation:

The first step lowers A by 4 and Z by 2, which is α emission; the second step changes neither A nor Z and only removes excitation, which is γ emission; the third step keeps A fixed and raises Z by 1, which is β emission. Hence the sequence is α, γ, β .

Q40.

Answer: C

Explanation:

Since $N(t) = N_0 e^{-\lambda t}$, the ratio $\frac{N_1}{N_2} = e^{-\lambda(t_1-t_2)} = e^{\lambda(t_2-t_1)}$, so $N_1 = N_2 e^{\lambda(t_2-t_1)}$.

Q41.

Answer: D

Explanation:

Activity also follows the exponential decay law, $R(t) = R_0 e^{-\lambda t}$, so between the two instants $R_2 = R_1 e^{-\lambda(t_2-t_1)}$.

Q42.

Answer: B

Explanation:

The energy released equals the total binding energy of the products minus that of the reactants: $Q = 2c - (a + 0) = 2c - a$, since the proton has zero binding energy.

Q43.

Answer: C

Explanation:

The energy released equals the total binding energy of the products minus that of the reactants: $Q = (c + 0) - (a + a) = c - 2a$, since the neutron has zero binding energy.

Q44.

Answer: D

Explanation:

Using $E = \frac{hc}{\lambda}$, the transition C to B satisfies

$\frac{hc}{\lambda_3} = (E_C - E_A) - (E_B - E_A) = \frac{hc}{\lambda_1} - \frac{hc}{\lambda_2}$, so $\frac{1}{\lambda_3} = \frac{1}{\lambda_1} - \frac{1}{\lambda_2}$, giving $\lambda_3 = \frac{\lambda_1 \lambda_2}{\lambda_2 - \lambda_1}$.

Q45.

Answer: C

Explanation:

Using $E = h\nu$, the transition C to A satisfies

$h\nu_3 = E_C - E_A = (E_C - E_B) + (E_B - E_A) = h\nu_1 + h\nu_2$, so $\nu_3 = \nu_1 + \nu_2$.

Q46.

Answer: A

Explanation:

The reaction of C_2H_5Cl with AgCN produces ethyl isocyanide (C_2H_5NC) as the major product because AgCN is predominantly covalent. The sequence starting from $C_2H_5CONH_2$ undergoes Hoffmann bromamide degradation with $Br_2/NaOH$ to yield ethylamine ($C_2H_5NH_2$ as Y). Ethylamine on carbylamine test (reaction with $CHCl_3$ and ethanolic KOH) gives a foul-smelling ethyl isocyanide (Z). Thus, both reaction routes yield ethyl isocyanide as Z , making $X = AgCN$ and $Z = C_2H_5NC$.

Q47.

Answer: A

Explanation:

Alkylation of benzene with CH_3Cl in the presence of anhydrous $AlCl_3$ gives toluene (W). Oxidation of toluene with dilute HNO_3 and H_2SO_4 yields a mixture of ortho-nitrobenzoic acid (X) and para-nitrobenzoic acid (Y). Since o-nitrobenzoic acid is steam-volatile (due to intramolecular hydrogen bonding) while p-nitrobenzoic acid is non-steam-volatile (due to intermolecular hydrogen bonding), or because they have distinct boiling points/volatility properties, fractional distillation is ideally used to separate them. (Alternatively, fractional crystallization is also used for isomers, but between the choices, fractional distillation/steam distillation principles apply to separate volatile ortho isomers from non-volatile para isomers).

Q48.

Answer: C

Explanation:

Ethane (C_2H_6) undergoes free-radical chlorination with Cl_2 under UV light to form chloroethane (X , C_2H_5Cl). Chloroethane reacts with ammonia (NH_3) through nucleophilic substitution to form ethylamine (Y , $C_2H_5NH_2$). Ethylamine reacts with nitrous acid ($NaNO_2 + HCl$) to form an unstable aliphatic diazonium salt, which immediately decomposes in the presence of water ((ii) H_2O) to yield ethanol (Z , C_2H_5OH).

Q49.

Answer: A

Explanation:

Grignard reagents ($RMgX$) are strong bases due to the highly nucleophilic/basic carbon-magnesium bond, which readily abstracts active/acidic hydrogen atoms from compounds containing $-OH$, $-NH$, or $-SH$ groups. Diphenylamine ($(C_6H_5)_2NH$) contains an acidic hydrogen attached to the nitrogen atom. When phenylmagnesium bromide (C_6H_5MgBr) reacts with diphenylamine, the Grignard reagent abstracts the acidic proton from the nitrogen, forming benzene (C_6H_6) as one of the products alongside a magnesium salt of the amine.

Q50.

Answer: C

Explanation:

Reaction A: Benzonitrile on reduction with $LiAlH_4$ gives benzylamine ($C_6H_5CH_2NH_2$), not aniline, because the carbon chain is extended by the $-CN$ carbon being reduced to $-CH_2NH_2$. Reaction B: Benzamide undergoes Hoffmann bromamide degradation with KOH/Br_2 to form aniline ($C_6H_5NH_2$) as the major product by losing the carbonyl carbon as K_2CO_3 . Reaction C: Nitrobenzene is not selectively or effectively reduced to aniline by $NaBH_4$; typically, reducing agents like Sn/HCl , Fe/HCl , or catalytic hydrogenation (H_2/Pd) are used. Reaction D: Acetanilide on acidic hydrolysis with HCl and water upon heating (Δ) yields aniline and acetic acid. Thus, reactions B and D correctly yield aniline.

Q51.

Answer: A

Explanation:

Step (i): Chlorination of 1-ethyl-4-nitrobenzene introduces a chlorine atom at the position ortho to the ethyl group (and meta to the nitro group) due to the dominant directing effect of the alkyl group, yielding 2-chloro-4-nitrotoluene/ethyl derivative. Step (ii): Reduction of the nitro ($-NO_2$) group with Sn/HCl converts it into an amino group ($-NH_2$). Step (iii): Diazotization of the resulting amine with $NaNO_2/HCl$ at $273 - 278$ K forms a diazonium salt. Step (iv): Treatment with potassium iodide (KI) replaces the diazonium group with an iodine atom (Sandmeyer/iodination reaction), yielding 2-chloro-4-ethyliodobenzene as the major product X.

Q52.

Answer: A

Explanation:

Benzenediazonium chloride reacts with Cu_2Br_2/HBr (Sandmeyer reaction) to form bromobenzene (C_6H_5Br). Bromobenzene reacts with magnesium in dry ether to form phenylmagnesium bromide (C_6H_5MgBr), which is a Grignard reagent. Subsequent hydrolysis with water ((iii) H_2O) protonates the Grignard reagent to yield benzene (C_6H_6) as the final product.

Q53.

Answer: B

Explanation:

Treating aniline with acetic anhydride in the presence of pyridine yields acetanilide ($C_6H_5NHCOCH_3$). Subsequent reduction with lithium aluminium hydride ($LiAlH_4$) reduces the amide carbonyl group ($-C=O$) to a methylene group ($-CH_2-$), converting the acetyl group into an ethyl group attached to the nitrogen atom, resulting in *N*-ethylaniline.

Q54.

Answer: A

Explanation:

Chlorobenzene is prepared via electrophilic aromatic substitution (halogenation) of benzene using chlorine gas (Cl_2) in the presence of a Lewis acid catalyst such as anhydrous ferric chloride (*anhydrous* $FeCl_3$).

Q55.

Answer: D

Explanation:

When benzonitrile (C_6H_5CN) is treated with $LiAlH_4$ followed by water, it undergoes complete reduction to form benzylamine ($C_6H_5CH_2NH_2$). Subsequent treatment of benzylamine with nitrous acid ($NaNO_2 + HCl$) forms an unstable aliphatic/benzylic primary amine diazonium salt, which immediately decomposes upon reaction with water to yield benzyl alcohol ($C_6H_5CH_2OH$).

Q56.

Answer: C

Explanation:

Hinsberg's reagent ($C_6H_5SO_2Cl$, benzenesulfonyl chloride) reacts with primary amines to form *N*-alkylbenzenesulfonamides, which contain an acidic hydrogen attached to the nitrogen atom. Because of this acidic hydrogen, the sulfonamide derivative is soluble in alkali (such as NaOH), yielding a clear solution.

Q57.

Answer: D

Explanation:

The carbylamine test (isocyanide test) is a specific chemical test used to identify primary amines (both aliphatic and aromatic). When a primary amine is heated with chloroform ($CHCl_3$) and alcoholic potassium hydroxide (KOH), it forms an offensive-smelling alkyl or aryl isocyanide (carbylamine). Secondary and tertiary amines do not respond to this test. Among the given choices, $C_6H_5NH_2$ is a primary amine, whereas options A, B, and C are secondary or tertiary amines.

Q58.

Answer: D

Explanation:

When phthalic acid (benzene-1,2-dicarboxylic acid) reacts with ammonia, it initially forms ammonium phthalate. Upon strong heating (dehydration and loss of ammonia), it undergoes intramolecular cyclization to yield phthalimide as the major product.

Q59.

Answer: C

Explanation:

The basic strength of aromatic amines depends on the availability of the lone pair of electrons on the nitrogen atom for protonation. Electron-withdrawing groups (like $-NO_2$) decrease basicity by stabilizing the lone pair via resonance and inductive effects ($-M$, $-I$), whereas electron-donating groups (like $-CH_3$) increase basicity via inductive and hyperconjugation effects ($+I$, $+H$). Therefore, *p*-nitroaniline is the least basic, followed by aniline, and *p*-toluidine is the most basic.

Q60.

Answer: B

Explanation:

Nitrobenzene ('A') on reduction with Sn/HCl gives aniline ($C_6H_5NH_2$). Aniline reacts with nitrous acid (HNO_2) at $0 - 5^\circ C$ to form benzene diazonium chloride ('B'), which is an unstable diazonium salt. When 'B' is treated with phenol in an alkaline medium, a coupling reaction occurs to form *p*-hydroxyazobenzene ('C') with the molecular formula $C_{12}H_{10}N_2O$, which is an orange-yellow coloured dye.

Q61.

Answer: C

Explanation:

Aliphatic nitro compounds react with nitrous acid (HNO_2) depending on the presence of α -hydrogen atoms. Primary nitro-compounds (having two α -hydrogens) form nitrolic acids which dissolve in NaOH to give red-coloured solutions. Secondary nitro-compounds (having one α -hydrogen) form pseudonitroles which dissolve in NaOH to give blue-coloured solutions. Tertiary nitro-compounds (having no α -hydrogen) do not react with nitrous acid.

Q62.

Answer: C

Explanation:

The reaction involves the benzylation of aniline (an amine) with benzoyl chloride ($\text{C}_6\text{H}_5\text{COCl}$) in the presence of an aqueous alkali (NaOH). The introduction of a benzoyl group into an organic compound containing an active hydrogen atom (H attached to N) in the presence of a base is known as the Schotten-Baumann reaction.

Q63.

Answer: D

Explanation:

The reaction represents a diazo coupling reaction between benzenediazonium chloride and aniline in a mildly acidic/acidic medium. The electrophilic diazonium ion attacks the activated aromatic ring of aniline predominantly at the para-position relative to the amino group, yielding *p*-aminoazobenzene, which is a yellow-colored dye.

Q64.

Answer: A

Explanation:

Tertiary aromatic amines like *N,N*-dimethylaniline react with nitrous acid via electrophilic aromatic substitution at the para-position to form *p*-nitroso derivatives ($[4 - (N, N\text{-dimethylamino})\textit{nitrosobenzene}]$), rather than forming a diazonium salt. Therefore, the reaction given in option A is incorrect.

Q65.

Answer: A

Explanation:

Hydrolysis of an alkyl isocyanide (RNC) yields a primary amine and formic acid (HCOOH). Formic acid acts as a reducing agent, reducing Tollens reagent and Fehling's solution. The primary amine formed ($\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$) reacts with NaNO_2 and HCl to give an alcohol ($\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$), which does not respond to the iodoform test.

Q66.

Answer: D

Explanation:

The nitro group ($-\text{NO}_2$) attached to the benzene ring in nitrobenzene is a strongly deactivating and meta-directing group. Therefore, further electrophilic nitration introduces the second nitro group at the meta-position relative to the first nitro group, yielding 1,3-dinitrobenzene (*m*-dinitrobenzene) as the major product.

Q67.

Answer: A

Explanation:

The conversion of an aromatic diazonium salt into a corresponding arene (replacement of the diazonium group by $-\text{H}$) is a reduction (deamination) reaction. This is typically achieved using mild reducing agents such as hypophosphorous acid (H_3PO_2) or ethanol.

Q68.

Answer: A

Explanation:

A primary aliphatic amine reacts with nitrous acid to yield an alcohol with the evolution of nitrogen gas. Furthermore, primary amines undergo the carbylamine test (warming with CHCl_3 and KOH) to form an isocyanide, which upon reduction gives a secondary amine with a specific alkyl branching matching the starting amine.

Q69.

Answer: B

Explanation:

The basicity of an amine depends on the availability of the lone pair of electrons on the nitrogen atom to accept a proton. In benzylamine, the lone pair is localized because it is separated from the aromatic ring by a $-\text{CH}_2-$ group, whereas in arylamines and amides, the lone pair is delocalized through resonance into the benzene ring or the carbonyl group, reducing basicity.

Q70.

Answer: C

Explanation:

Primary aromatic amines (aryl amines) react with nitrous acid (HNO_2) at low temperatures ($0 - 5^\circ\text{C}$ or $273 - 278\text{K}$) to form stable aromatic diazonium salts, not phenols. Phenols are typically produced when these diazonium salts are subsequently treated with warm water. Therefore, stating that aryl amines react directly with nitrous acid to produce phenols is false.

Q71.

Answer: A

Explanation:

The conversion of an amide into a primary amine with one carbon atom less is known as the Hofmann bromamide degradation reaction. When acetamide (CH_3CONH_2) is treated with a mixture of aqueous sodium hydroxide and bromine (NaOH/Br_2), the carbonyl carbon is removed as Na_2CO_3 , yielding methylamine (CH_3NH_2).

Q72.

Answer: B

Explanation:

In the nitration mixture of concentrated nitric acid and concentrated sulfuric acid, sulfuric acid is a stronger acid and donates a proton to nitric acid (HNO_3). Consequently, nitric acid accepts a proton, acting as a base to generate the nitronium ion (NO_2^+), which is the electrophile in the reaction.

Q73.

Answer: D

Explanation:

Secondary aromatic amines, such as *N*-methylaniline, react with nitrous acid (HNO_2 , generated in situ from $\text{NaNO}_2 + \text{HCl}$) at low temperatures to undergo *N*-nitrosation. The electrophilic nitrosonium ion ($-\text{NO}^+$) attacks the amino nitrogen rather than the aromatic ring, forming a yellow oily *N*-nitroso compound known as *N*-methyl-*N*-nitrosoaniline.

Q74.

Answer: A

Explanation:

Reduction of alkyl isocyanides (carbylamines) with lithium aluminium hydride (LiAlH_4) results in the addition of hydrogen across the carbon-nitrogen triple bond, yielding a secondary amine where one of the alkyl groups is a methyl group ($\text{R} - \text{NH} - \text{CH}_3$). In contrast, the reduction of amides or nitriles yields primary amines.

Q75.

Answer: B

Explanation:

Primary aromatic amines like aniline react with nitrous acid ($\text{NaNO}_2 + \text{HCl}$) at $0 - 5^\circ\text{C}$ ($273 - 278\text{K}$) to form a benzenediazonium salt (*B*). When this diazonium salt is treated with a reactive tertiary aromatic amine such as *N,N*-dimethylaniline in mildly acidic or cold conditions, it undergoes an electrophilic aromatic substitution (coupling reaction) at the para position to yield a brightly colored azo dye, *p*-(phenylazo)-*N,N*-dimethylaniline.

Q76.

Answer: A

Explanation:

Benzylamine is more basic than aniline because the lone pair of electrons on the nitrogen atom in aniline is delocalized into the benzene ring via resonance, making it less available for protonation. In contrast, the nitrogen atom in benzylamine is separated from the aromatic ring by a methylene ($-\text{CH}_2-$) group, preventing resonance stabilization of the lone pair and allowing it to remain more basic.

Q77.

Answer: D

Explanation:

The reaction sequence involves diazotization of aniline to form benzenediazonium chloride, followed by cyanation, catalytic reduction of the nitrile group to a primary amine, and finally diazotization of the aliphatic amine which yields benzyl alcohol.

Q78.

Answer: C

Explanation:

The electrolytic reduction of nitrobenzene in a weakly acidic medium yields aniline as the major product due to the stepwise transfer of electrons and protons forming intermediate species before complete reduction.

Q79.

Answer: B

Explanation:

Aniline undergoes diazotization with nitrous acid ($\text{NaNO}_2 + \text{HCl}$) at $0 - 5^\circ\text{C}$ to form benzenediazonium chloride (*B*). When compound *B* is treated with *N,N*-dimethylaniline, it undergoes an electrophilic aromatic substitution (coupling) reaction at the para-position to form a brightly coloured azo dye, *p*-(dimethylamino)azobenzene (*C*).

Q80.

Answer: C

Explanation:

Treatment of *p*-toluidine (4-methylaniline) with acetic anhydride (Ac_2O) in acetic acid acetylates the amino group to protect it, forming *N*-(4-methylphenyl)acetamide (*A*). Bromination of *A* directs the incoming bromine atom selectively to the ortho position relative to the amino group, yielding intermediate *B* (2-bromo-4-methylacetanilide). Subsequent acid-hydrolysis removes the acetyl protecting group to regenerate the free amino group, yielding 2-bromo-4-methylaniline as the final product *C*.

Q81.

Answer: B

Explanation:

The reaction involves the nucleophilic addition of a Grignard reagent (CH_3MgBr) to the carbon-nitrogen triple bond of *p*-methoxybenzonitrile. The methyl group from the Grignard reagent attacks the electrophilic nitrile carbon, forming an intermediate imine complex. Subsequent acid hydrolysis (H_3O^+) of this complex converts the imine into a carbonyl group, yielding 4-methoxyacetophenone as the final product *P*.

Q82.

Answer: A

Explanation:

The reaction of an amide with bromine and potassium hydroxide is known as the Hofmann bromamide degradation reaction. During this reaction, the amide is converted into a primary amine with one carbon atom less. The reaction proceeds through the formation of an N-bromoamide intermediate (RCONHBr), which then loses a proton in the presence of base to form an isocyanate intermediate (RNCO).

Q83.

Answer: B

Explanation:

Working backward from the final product *N*-methylaniline ($\text{C}_6\text{H}_5\text{NHCH}_3$), it is formed by the reduction of an intermediate *C*. Intermediate *C* is produced by the reaction of *B* with CHCl_3/KOH (carbylamine reaction), which converts a primary amine into an isocyanide ($-\text{NC}$). Therefore, Cis phenyl isocyanide ($\text{C}_6\text{H}_5\text{NC}$) and B must be aniline ($\text{C}_6\text{H}_5\text{NH}_2$). Aniline B is obtained by the reduction of compound *A*, which means compound *A* is nitrobenzene ($\text{C}_6\text{H}_5\text{NO}_2$).

Q84.

Answer: B

Explanation:

Nitriles ($\text{R}-\text{CN}$) can be reduced to primary amines ($\text{R}-\text{CH}_2-\text{NH}_2$) using strong reducing agents such as lithium aluminium hydride (LiAlH_4 followed by hydrolysis), catalytic hydrogenation (H_2/Ni or H_2/Pt), and sodium with ethanol ($\text{Na}(\text{Hg})/\text{C}_2\text{H}_5\text{OH}$ or Na/EtOH , known as Mendius reduction). On the other hand, $\text{Sn} + \text{HCl}$ (Stephen's reduction) reduces nitriles to intermediate imines which on hydrolysis yield aldehydes, while $\text{Br}_2/\text{aq. NaOH}$ is used for the Hoffmann bromamide degradation of amides. Therefore, reagents A, C, and D are the correct reducing agents for this conversion.

Q85.

Answer: B

Explanation:

Both statements are correct. The oxidation of *p*-nitrotoluene yields *p*-nitrobenzoic acid, where the electron-withdrawing $-\text{NO}_2$ group increases acidity compared to benzoic acid. The reduction of *p*-nitrotoluene followed by neutralization yields *p*-toluidine (*p*-methylaniline), where the electron-donating $-\text{CH}_3$ group increases basicity compared to aniline.

Q86.

Answer: A

Explanation:

Basic strength is inversely proportional to the pK_b value ($\text{basic strength} \propto \frac{1}{pK_b}$), meaning a lower pK_b value indicates a stronger base. Aliphatic amines are generally stronger bases than aromatic amines due to the electron-donating inductive effect of alkyl groups and the absence of delocalization of the lone pair into an aromatic ring. Secondary aliphatic amines (like *N*-ethylethanamine) are typically stronger bases than primary aliphatic amines (like ethanamine), which in turn are much stronger than aromatic amines (like *N*-methylaniline and benzenamine).

Q87.

Answer: C

Explanation:

Benzenediazonium chloride is synthesized by diazotization of aniline using nitrous acid (generated from NaNO_2 and HCl) at $273 - 278$ K. These diazonium salts are thermally unstable and decompose readily when dry. Additionally, direct iodination of an aromatic ring is a reversible and slow reaction, so iodobenzene is efficiently synthesized via the Sandmeyer or replacement reaction of benzenediazonium salt with potassium iodide (KI).

Q88.

Answer: A

Explanation:

Aniline contains a primary amine group ($-\text{NH}_2$), which reacts with chloroform and alcoholic potassium hydroxide to produce a foul-smelling carbylamine (isocyanide), giving a positive carbylamine test. However, due to the basic nature of the amino group, it coordinates with the Lewis acid catalyst (AlCl_3) used in Friedel-Crafts reactions to form a salt, preventing further electrophilic substitution and rendering it unreactive toward Friedel-Crafts alkylation.

Q89.

Answer: A

Explanation:

Aniline undergoes salt formation with aluminium chloride (a Lewis acid catalyst used in Friedel-Crafts reactions), rendering the ring unreactive. Furthermore, aryl halides do not undergo nucleophilic substitution with the phthalimide anion, meaning aromatic primary amines like aniline cannot be synthesized via Gabriel synthesis.

Q90.

Answer: B

Explanation:

Reduction of methyl isocyanide (CH_3NC) with LiAlH_4 followed by acid hydrolysis yields a secondary amine (CH_3NHCH_3), whereas nitriles (CH_3CN), amides (CH_3CONH_2 via reduction), and Hoffmann degradation of amides all yield primary amines.

Q91.

Answer: A

Q92.

Answer: A

Q93.

Answer: A

Q94.

Answer: B

Q95.

Answer: B

Q96.

Answer: D

Q97.

Answer: A

Q98.

Answer: A

Q99.

Answer: B

Q100.

Answer: B

Q101.

Answer: B

Q102.

Answer: A

Q103.

Answer: B

Q104.

Answer: A

Q105.

Answer: A

Q106.

Answer: A

Q107.

Answer: A

Q108.

Answer: A

Q109.

Answer: A

Q110.

Answer: A

Q111.

Answer: A

Q112.

Answer: A

Q113.

Answer: B

Q114.

Answer: B

Q115.

Answer: A

Q116.

Answer: B

Q117.

Answer: A

Q118.

Answer: A

Q119.

Answer: B

Q120.

Answer: D

Q121.

Answer: A

Q122.

Answer: A

Q123.

Answer: A

Q124.

Answer: D

Q125.

Answer: D

Q126.

Answer: D

Q127.

Answer: D

Q128.

Answer: D

Q129.

Answer: A

Q130.

Answer: D

Q131.

Answer: D

Q132.

Answer: A

Q133.

Answer: D

Q134.

Answer: D

Q135.

Answer: A

Q136.

Answer: B

Q137.

Answer: B

Q138.

Answer: B

Q139.

Answer: B

Q140.

Answer: B

Q141.

Answer: D

Q142.

Answer: B

Q143.

Answer: B

Q144.

Answer: A

Q145.

Answer: B

Q146.

Answer: C

Q147.

Answer: C

Q148.

Answer: C

Q149.

Answer: A

Q150.

Answer: D

Q151.

Answer: A

Q152.

Answer: A

Q153.

Answer: A

Q154.

Answer: B

Q155.

Answer: C

Q156.

Answer: C

Q157.

Answer: A

Q158.

Answer: B

Q159.

Answer: D

Q160.

Answer: B

Q161.

Answer: A

Q162.

Answer: B

Q163.

Answer: D

Q164.

Answer: B

Q165.

Answer: A,B,C,D

Q166.

Answer: A

Q167.

Answer: B

Q168.

Answer: A

Q169.

Answer: D

Q170.

Answer: D

Q171.

Answer: C

Q172.

Answer: C

Q173.

Answer: B

Q174.

Answer: B

Q175.

Answer: D

Q176.

Answer: D

Q177.

Answer: A

Q178.

Answer: A

Q179.

Answer: B

Q180.

Answer: B