66

QUESTION PAPER SERIES CODE

A

Registration No. :

Centre of Exam. : _____

Name of Candidate : _____

Signature of Invigilator

COMBINED ENTRANCE EXAMINATION, 2015

M.Sc. BIOTECHNOLOGY

[**Field of Study Code : BIT**]

Time Allowed : 3 hours

Maximum Marks : 240

INSTRUCTIONS FOR CANDIDATES

Candidates must read carefully the following instructions before attempting the Question Paper :

(i) Write your Name and Registration Number in the space provided for the purpose on the top of this Question Paper and in the Answer Sheet.

(ii) **Please darken the appropriate Circle of Question Paper Series Code on the Answer Sheet.**

(iii) The Question Paper is divided into two Parts : Part—A and Part—B. Both Parts have multiple-choice questions. All answers are to be entered in the Answer Sheet provided with the Question Paper for the purpose by darkening the correct choice, i.e., (a) or (b) or (c) or (d) with BALLPOINT PEN only against each question in the corresponding circle.

(iv) Part—A consists of 60 questions and all are compulsory. Answer all the questions in the Answer Sheet provided for the purpose. Each correct answer carries *1* mark. **There will be negative marking and ⅓ mark will be deducted for each wrong answer.**

(v) Part—B consists of 100 questions consisting Biological and Physical Sciences. **Answer any 60 questions.** Each correct answer carries *3* marks. **There will be negative marking and 1 mark will be deducted for each wrong answer.**

In case any candidate answers more than the required 60 questions, the first 60 questions attempted will be evaluated.

(vi) Answer written by the candidates inside the Question Paper will not be evaluated.

(vii) Calculators and Log Tables may be used.

(viii) Pages at the end have been provided for Rough Work.

(ix) Return the Question Paper and Answer Sheet to the Invigilator at the end of the Entrance Examination. **DO NOT FOLD THE ANSWER SHEET.**

INSTRUCTIONS FOR MARKING ANSWERS

1. Use only Blue/Black Ballpoint Pen (do not use pencil) to darken the appropriate Circle.
2. Please darken the whole Circle.
3. Darken <u>ONLY ONE CIRCLE</u> for each question as shown in example below :

Wrong	Wrong	Wrong	Wrong	Correct
○ ⓑ ⓒ ○	ⓐ̸ ⓑ ⓒ ⓓ	ⓐ̸ ⓑ ⓒ ⓓ̸	◉ ⓑ ⓒ ○	ⓐ ⓑ ⓒ ○

4. Once marked, no change in the answer is allowed.
5. Please do not make any stray marks on the Answer Sheet.
6. Please do not do any rough work on the Answer Sheet.
7. Mark your answer only in the appropriate space against the number corresponding to the question.
8. **Ensure that you have darkened the appropriate Circle of Question Paper Series Code on the Answer Sheet.**

PART—A

Answer **all** questions

1. Sucrose on hydrolysis yields a mixture which is

   (a) optically inactive

   (b) dextrorotatory

   (c) laevorotatory

   (d) racemic

2. Which of the following amino acids contains sulphur?

   (a) Methionine

   (b) Cysteine

   (c) Serine

   (d) Both (a) and (b)

3. Nucleosomes are **not** found in

   (a) *Escherichia coli*

   (b) *Saccharomyces cerevisiae*

   (c) *Entamoeba histolytica*

   (d) *Trypanosoma brucei*

4. In genetics, amber refers to a

   (a) substance in which many fossils have been preserved

   (b) kind of mutation which changes one amino acid in a protein

   (c) stop codon

   (d) dye used for staining DNA

5. Hybridization of DNA and RNA

   (a) is referred to as Southern hybridization

   (b) is referred to as Northern hybridization

   (c) is referred to as Western hybridization

   (d) cannot occur because DNA can form double strands only with DNA

6. Blood is

   (a) acidic

   (b) alkaline

   (c) variable

   (d) neutral

7. Horns of most mammals are composed of

   (a) bone

   (b) cartilage

   (c) keratin

   (d) chitin

8. The lumen of the nuclear membrane will be continuous with the lumen of which of the following organelles?

   (a) Golgi body

   (b) Lysosome

   (c) Endoplasmic reticulum

   (d) Plasma membrane

9. A bacterium divides every 35 minutes. If a culture containing 10^5 cells per mL is grown for 175 minutes, what will be the cell concentration per mL after 175 minutes?

   (a) 175×10^5 cells

   (b) 32×10^5 cells

   (c) 5×10^5 cells

   (d) 35×10^5 cells

10. Swine flu is caused by which of the following influenza virus subtypes?

    (a) H5N1

    (b) H1N1

    (c) H1N2

    (d) H2N1

11. Which of the following is a symbiont nitrogen fixing bacterium?

    (a) *Rhizobium*

    (b) *Azotobacter*

    (c) *Klebsiella*

    (d) *Clostridium*

12. The only genetically modified crop/food plant approved in India is

    (a) Golden rice

    (b) Bt brinjal

    (c) Bt cotton

    (d) Bt tomato

13. The signum function $f : R \to R$ given by

$$f(x) = \begin{cases} 1 & , \text{ if } x > 0 \\ 0 & , \text{ if } x = 0 \\ -1 & , \text{ if } x < 0 \end{cases}$$

is

(a) one-one (injective) and onto (surjective)

(b) one-one but not onto

(c) onto but not one-one

(d) neither one-one nor onto

14. The function f is defined as $f(x) = ax + b$. The function g such that $g(f(x)) = f(g(x))$ is given by

(a) $g(x) = \dfrac{(x - b)}{a}$

(b) $g(x) = \dfrac{(x - a)}{b}$

(c) $g(x) = \dfrac{x + b}{a}$

(d) $g(x) = \dfrac{x + a}{b}$

15. $\tan^{-1}\left(\dfrac{1}{2}\right) + \tan^{-1}\left(\dfrac{2}{11}\right) =$

(a) $\tan^{-1}\left(\dfrac{5}{6}\right)$

(b) $\tan^{-1}\left(\dfrac{4}{5}\right)$

(c) $\tan^{-1}\left(\dfrac{3}{4}\right)$

(d) $\tan^{-1}\left(\dfrac{15}{22}\right)$

16. Given a matrix $A = \begin{bmatrix} a & b \\ c & -a \end{bmatrix}$, such that $A^2 = I$, then

(a) $1 + a^2 + bc = 0$

(b) $1 - a^2 + bc = 0$

(c) $1 - a^2 - bc = 0$

(d) $1 + a^2 - bc = 0$

17. The values of a and b such that the function

$$f(x) = \begin{cases} 5 & \text{if} & x \le 2 \\ ax+b & \text{if} & 2 < x < 10 \\ 21 & \text{if} & x \ge 10 \end{cases}$$

is a continuous function are given by

(a) $a = 1, b = 1$

(b) $a = 2, b = 1$

(c) $a = 1, b = 2$

(d) $a = 2, b = 2$

18. In how many ways can 10 things be put in 2 boxes so that no box remains empty?

(a) 1024

(b) 1022

(c) 512

(d) 256

19. How many 4-digit numbers greater than 5000 can be formed which are divisible by 5 using the digits 1, 3, 5, 7, 9, if no repetition of digits is allowed?

(a) 375

(b) 72

(c) 24

(d) 12

20. In a class of 50 students, 18 study Biology, 30 Chemistry and 25 Physics. 11 students study both Physics and Chemistry, 9 students study Biology and Chemistry and 7 students study Biology and Physics. The number of students who study all 3 subjects is

(a) 1

(b) 2

(c) 3

(d) 4

21. Differentiate $\ln x$ with respect to $\dfrac{1}{x}$.

(a) $-\dfrac{1}{x}$

(b) $\dfrac{1}{x}$

(c) x

(d) $-x$

22. A bag contains 3 red, 4 blue and 5 green balls. 2 balls are drawn with replacement. The probability that both are of the same color is

(a) $\dfrac{6}{17}$

(b) $\dfrac{25}{72}$

(c) $\dfrac{21}{90}$

(d) $\dfrac{27}{144}$

23. Identify the quotients for the following balanced chemical equation :

$$XFe + YO_2 \rightarrow ZFe_2O_3$$

(a) $X = 4$, $Y = 3$, $Z = 2$

(b) $X = 6$, $Y = 4$, $Z = 3$

(c) $X = 2$, $Y = 3$, $Z = 1$

(d) $X = 4$, $Y = 6$, $Z = 4$

24. Molality is

(a) $\dfrac{\text{number of moles of the solute}}{\text{volume of the solution in L}}$

(b) $\dfrac{\text{number of moles of the solute}}{\text{weight of the solution in kg}}$

(c) $\dfrac{\text{mass of the solute}}{\text{mass of the solvent}}$

(d) $\dfrac{\text{volume of the solute}}{\text{weight of the solution}}$

25. For photoelectric effect to occur, the incident light should

(a) have high intensity

(b) have minimum threshold frequency

(c) satisfy both (a) and (b)

(d) fall on the object for longer time

26. For the compound SiO_2, the oxidation number and valency of Si and O are respectively

    (a) +4, 4; –2, 2

    (b) +2, 2; –1, 1

    (c) –4, 4; +2, 2

    (d) Cannot predict

27. Al_2O_3 is

    (a) an acidic oxide

    (b) a basic oxide

    (c) an amphoteric oxide

    (d) a neutral oxide

28. Chalcogens belong to

    (a) s-block element

    (b) p-block element

    (c) d-block element

    (d) f-block element

29. Ionization enthalpy is the energy required to remove an electron from

    (a) an isolated gaseous atom in its ground state

    (b) an isolated gaseous atom in its excited state

    (c) its liquid state

    (d) its solid state

30. Which of the following statements is TRUE regarding the relationship of dipole moment of NH_3 and NF_3?

    (a) Their dipole moments are same

    (b) $NH_3 > NF_3$

    (c) $NF_3 > NH_3$

    (d) No relationship

31. Hydrogen bonding will be the maximum in

    (a) ice

    (b) NaCl

    (c) liquid water

    (d) steam

32. The heat capacity of a substance can be found using

(a) calorimeter

(b) colorimeter

(c) pH meter

(d) thermometer

33. If a Brønsted acid is a strong acid

(a) its conjugate base is a weak base

(b) its conjugate base is a strong base

(c) it can accept OH^- ions

(d) it is unstable and decomposes

34. Temporary hardness of water can be removed by which of the following methods?

(a) Boiling

(b) Treatment with washing soda

(c) Ion-exchange method

(d) Zeolite method

35. Buckminsterfullerene has

(a) 20 six-member rings and 12 five-member rings

(b) 12 six-member rings and 20 five-member rings

(c) 14 six-member rings and 18 five-member rings

(d) 20 six-member rings and 16 five-member rings

36. A traditional wall clock with hour and minute hands and without any digits is observed for the first time mistakenly in a mirror and the time is noted. After 2 hours 40 minutes it is observed directly and the same time is again noted. The original time was

(a) 4:15

(b) 3:20

(c) 5:10

(d) 2:05

37. Two hospitals A and B with maternity wards are checked for the percentage of boys and girls born in the last one year and A reports 52% boys and B reports 58% boys. A simple explanation for the above is

    (a) a large number of children were born in hospital A

    (b) a large number of children were born in hospital B

    (c) This is a part of random variation and conclusion cannot be drawn about hospital size

    (d) the number of children born in both hospitals is exactly equal

38. A trader buys goods and increases its selling price by 50%. He then offers a 20% discount and makes a profit of ₹ 500. The initial cost of the goods was

    (a) ₹ 2,000

    (b) ₹ 2,500

    (c) ₹ 1,666

    (d) ₹ 3,000

39. 1 ml STE (Sucrose-Tris–EDTA) buffer is to be made from stock solutions of 40% Sucrose, 1 M Tris and 0·5 M EDTA. If the STE buffer composition is 10% Sucrose, 50 mM Tris and 10 mM EDTA, then the water required to be added after mixing these stock solutions is

    (a) 620 µL

    (b) 680 µL

    (c) 720 µL

    (d) 740 µL

40. A mass m_1 is suspended from a light spring. An additional mass of m_2 is added to m_1 whereupon the spring is stretched by an additional length of x_1. The time period of the oscillation of the spring will be given by

    (a) $T = \dfrac{\pi}{2}((m_1 + m_2)/m_2 g x_1)^{1/2}$

    (b) $T = 2\pi(m_2 g / x_1(m_1 + m_2))^{1/2}$

    (c) $T = 2\pi(x_1(m_1 + m_2)/m_2 g)^{1/2}$

    (d) $T = 2\pi(m_1 g / x_1(m_1 + m_2))^{1/2}$

/66-A

the circular ring is made of uniform wire of negligible resistance as shown in the figure below, find the resistance between the two points A and C.

(a)   14 Ω

(b)   4·33 Ω

(c)   3·33 Ω
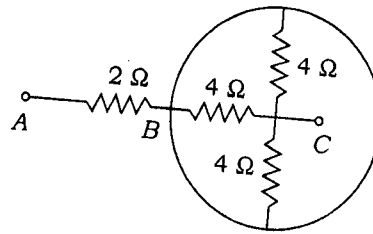
(d)   12·33 Ω

42. A potential barrier of 0·3 V exists across a p-n junction. If the depletion region is 1 μm wide, what will be the value of the electric field in this region?

(a) $0·3 \times 10^6$ V/m

(b) $0·1 \times 10^5$ V/m

(c) $3·0 \times 10^4$ V/m

(d) $0·3 \times 10^5$ V/m

43. A glass concave lens is placed in a liquid in which it behaves like a convergent lens. If the refractive indices of glass and liquid with respect to air are $_a\mu_g$ and $_a\mu_l$ respectively, then

(a) $_a\mu_g = 5\,_a\mu_l$

(b) $_a\mu_g < _a\mu_l$

(c) $_a\mu_g = 2\,_a\mu_l$

(d) $_a\mu_g = _a\mu_l$

44. Calculate the height above the earth's surface at which the value of acceleration due to gravity reduces to half of its value of the earth's surface. (Assume the earth to be a sphere of radius 6400 km)

(a)   3200 km

(b)   3000·6 km

(c)   2569·6 km

(d)   2649·6 km

45. Two lenses of power –10 D and +5 D are in contact with each other. The focal length of the combination is

(a) –5 cm

(b) –10 cm

(c) –15 cm

(d) –20 cm

46. A 600 pF capacitor is charged by 100 V battery. How much electrostatic energy is stored in the capacitor?

(a) 3×10^{-8} J

(b) 3×10^{-12} J

(c) 3×10^{-6} J

(d) 3×10^{-9} J

47. In a meter bridge, the neutral point was found at a distance of 60 cm from end A when the resistor $R = 30$ ohm. Find the resistance S.

(a) 40 ohm

(b) 60 ohm

(c) 20 ohm

(d) 50 ohm

48. If a wire is stretched 0·1% longer, its resistance will

(a) increase by 0·1%

(b) decrease by 0·2%

(c) increase by 0·2%

(d) decrease by 0·1%

49. A converging lens ($f = 12·0$ cm) is held 8 cm in front of a newspaper. If the size of the printed letters are 2 mm, find the size of its magnified image.

(a) 4 mm

(b) 6 mm

(c) 2 mm

(d) 8 mm

50. When n numbers of alpha particles are emitted from N atom of the radioactive element, the half-life is defined as

(a) n/N s

(b) 0·693 n/N s

(c) 0·693 N/n s

(d) N/n s

51. $_{92}U^{238}$ after the emission of an alpha particle is converted to

   (a) $_{92}U^{238}$

   (b) $_{92}U^{235}$

   (c) $_{90}Th^{234}$

   (d) $_{92}Np^{237}$

52. The period of a geostationary satellite at a height of $4R$ from the earth's surface is given by

   (a) 3600 s

   (b) 21600 s

   (c) 86400 s

   (d) 144000 s

53. How many electrons have to be removed from electrically neutral silver plate to give it a charge of +3·2 C? (Charge of single electron = $1·6 \times 10^{-19}$ C)

   (a) $1·5 \times 10^{19}$

   (b) $2·0 \times 10^{19}$

   (c) $2·0 \times 10^{-19}$

   (d) $3·0 \times 10^{19}$

54. If $n = 14 \times 22 \times 39$, which of the following is **not** an integer?

   (a) $n/21$

   (b) $n/24$

   (c) $n/26$

   (d) $n/42$

55. If A equals 16 percent of 30 and B equals 15 percent of 31, then which of the following statements is TRUE?

   (a) A is greater than B

   (b) B is greater than A

   (c) Both of them are equal

   (d) The relationship between A and B cannot be determined from the information given

56. In one class in a school, 30 percent of the students are boys. In a second class that is half the size of the first, 40 percent of the students are boys. What percent of both classes are boys?

    (a)   33·3% approximately

    (b)   66·6% approximately

    (c)   50%

    (d)   25%

57. How many odd integers are there between 10/3 and 62/3?

    (a)   8

    (b)   9

    (c)   10

    (d)   12

58. If $d = (c - b)/(a - b)$, then $b =$

    (a) $(c - ad)/(1 - d)$

    (b) $(c + ad)/(1 - d)$

    (c) $(c - ad)/(1 + d)$

    (d) $(c + ad)/(1 + d)$

59. If $x > 0$, then $(4^x)(8^x) =$

    (a) 2^{5x}

    (b) 2^{8x}

    (c) 2^{6x}

    (d) 2^{4x}

60. Which of the following measurements has the fewest significant figures?

    (a)   0·00001 cm

    (b)   12·6 m

    (c)   101 kg

    (d)   11·534 s

PART—B

Answer *any* **sixty** questions

61. What is the value of the determinant if *a*, *b*, *c* are in arithmetic progression (AP)?

$$\begin{vmatrix} x+2 & x+3 & x+2a \\ x+3 & x+4 & x+2b \\ x+4 & x+5 & x+2c \end{vmatrix}$$

(a) 0 (b) 1

(c) *x* (d) $(a+b+c)$

62. The derivative of $\cos^{-1}(\sin x)$ with respect to *x* is

(a) 0 (b) $\cot x$

(c) -1 (d) $\sin x \cos x$

63. The function $f(x) = \dfrac{\ln x}{x}$ has a maximum at

(a) $x = 1$ (b) $x = \ln 2$

(c) $x = e$ (d) infinity

64. The function

$$f(x) = \begin{cases} ax^2 + b & \text{if} \quad x \le 2 \\ x^3 & \text{if} \quad x > 2 \end{cases}$$

is both continuous and differentiable

(a) when $a = 1$ and $b = 2$

(b) when $a = 3$ and $b = 1$

(c) for all values of *a* and *b* satisfying the equation $4a + b = 8$

(d) when $a = 3$ and $b = -4$

65. $(n^2 + 3n + 2)(n^2 - n)(n - 2)!$ is equal to

(a) $n!$

(b) $(n+1)!$

(c) $(n+2)!$

(d) $(n+3)!$

66. There are 10 points in a plane of which four points are collinear. The number of straight lines (with different slopes) that can be obtained from the pairs of these points is

(a) 2^{10}

(b) 100

(c) 40

(d) 10

67. Given $f(x) = x^2 - 1$, then $f^{-1}(x)$ has a domain given by

(a) $(-1, \infty)$ (b) $[0, \infty)$

(c) $(-\infty, \infty)$ (d) $[-1, \infty)$

68. If $\sqrt{a+ib} = x+iy$, then $\sqrt{a-ib} =$
   (a) $x - iy$
   (b) $x + iy$
   (c) $x^2 + y^2 - 2ixy$
   (d) $x^2 + y^2 + 2ixy$

69. In the binominal expansion of $(a+b)^n$, the coefficients of the 5th and the 13th terms are equal. The value of n is
   (a) 16
   (b) 17
   (c) 18
   (d) 19

70. If the coefficients of the 2nd, 3rd and 4th terms in the expansion of $(1+x)^n$ are in arithmetic progression (AP), then $n =$
   (a) 5
   (b) 6
   (c) 7
   (d) 8

71. The sum of the series
   $$1 - \left(\frac{1}{2}\right) + \left(\frac{1}{4}\right) - \left(\frac{1}{8}\right) + \left(\frac{1}{16}\right) - \ldots \to \infty$$
   is
   (a) 2
   (b) $\frac{3}{4}$
   (c) $\frac{2}{3}$
   (d) indeterminate

72. A coin is tossed 5 times. A person gets ₹ 2 every time tail shows and he has to pay ₹ 1 if head appears. The probability that he will gain ₹ 4 at the end of 5 tosses is
   (a) 1/32
   (b) 5/32
   (c) 5/16
   (d) 1/2

73. The probability of a student passing both Maths and Physics exams is 0·48 and the probability of failing in both is 0·08. If the student has a better probability of passing Maths than Physics, then the probability of passing Maths is
   (a) 0·4
   (b) 0·5
   (c) 0·6
   (d) 0·8

/66-A

74. A random selection of 100 bacteria shows that the mean length with 95·5% confidence is $1 \pm 0 \cdot 1 \, \mu m$. If we wish to reduce the confidence interval $1 \pm 0 \cdot 01 \, \mu m$, then the sample size will need to be approximately

   (a) 100

   (b) 1000

   (c) 10000

   (d) 141

75. A 2 m tall man is moving away at 1 m/s from a streetlight mounted on a 6 m tall pole. The rate at which his shadow is lengthening when he is 3 m away from the pole is

   (a) 1 m/s

   (b) 0·75 m/s

   (c) $\frac{2}{3}$ m/s

   (d) 0·5 m/s

76. A 2 m long pole weighing 15 kg hangs horizontally with one end touching a vertical wall as shown below. A support wire is attached at a 60° angle (to the pole) at a point 0·5 m from the wall ($g = 10$ m/s^2). The tension in the support wire is approximately

   (a) 173·2 N   (b) 346·4 N
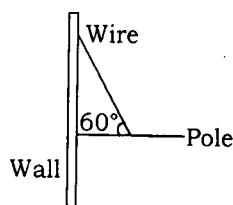
   (c) 519·6 N   (d) 692·8 N

77. Under what circumstances Raoult's law becomes Henry's law?

   (a) When $K_H = p_1^0$

   (b) When $K_H \gg p_1^0$

   (c) When $K_H \ll p_1^0$

   (d) None of the above

78. ΔH for a reaction does not depend on

   (a) state of the reactant and product

   (b) various intermediate reactions

   (c) nature of the reactant and product

   (d) specific heat capacity of the reactants

79. When the anion acts like a nucleophile, what type of reaction occurs?

   (a) Addition

   (b) Substitution

   (c) Elimination

   (d) Cannot predict

80. Predict the product of the following reaction :

$$(CH_3)_3-C-Cl \xrightarrow{\text{aq. NaN}_3}$$
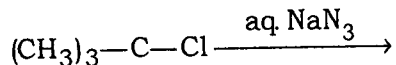
    (a) $(CH_3)_3-C-N_3$

    (b) $(CH_3)_3-C-OH$

    (c) Both (a) and (b)

    (d) None of the above

81. Arrange the following compounds in the increasing order of S_N2 reactivity :

    (a) (i) > (ii) > (iii) > (iv)   (b) (ii) > (i) > (iii) > (iv)

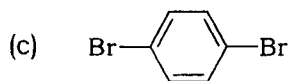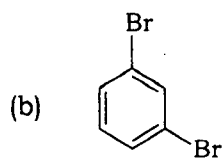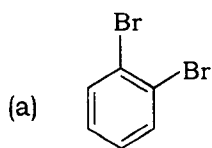   (c) (ii) > (i) ≈ (iii) > (iv)   (d) (i) ≈ (ii) > (iii) > (iv)

82. Which one of the following is non-radiative transition?

    (a) Internal conversion

    (b) Phosphorescence

    (c) Intersystem crossing

    (d) All of the above
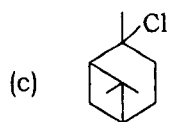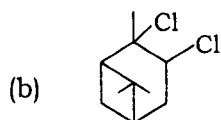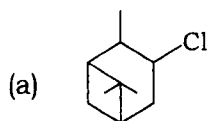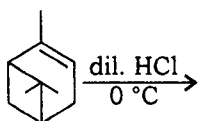
83. In azulene, the seven-member ring is

    (a) electrophilic

    (b) nucleophilic

    (c) aromatic

    (d) None of the above

84. On analysis it was found that compound $A(C_6H_4Br_2)$ shows two peaks in ^{1}H-NMR (100 MHz) in the ratio 1 : 1. Identify the product.

(a)

(b)

(c) Br—⟨⟩—Br

(d) None of the above

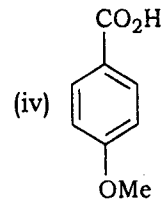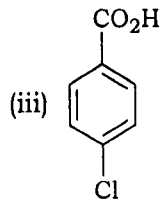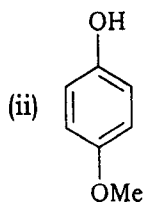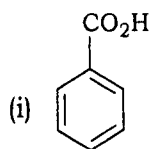**85.** Identify the product.

(a)

(b)

(c)

(d) None of the above

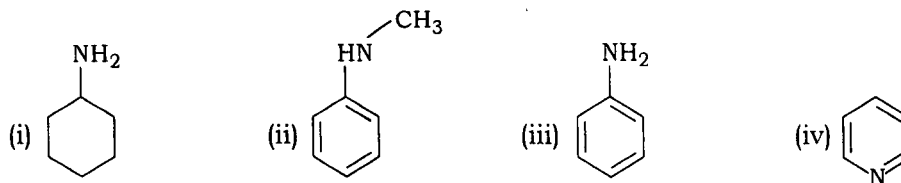**86.** The acidic functional group present in picric acid is

(a) —SO_3H

(b) —COOH

(c) —OH

(d) None of the above

87. Arrange the following compounds in the increasing order of acidity :

(i)   (ii)   (iii)   (iv)

(a) (ii), (iv), (i), (iii)

(b) (ii), (i), (iii), (iv)

(c) (ii), (iii), (i), (iv)

(d) (ii), (i), (iv), (iii)

88. Arrange the following compounds in the increasing order of basicity :

(i) cyclohexyl-NH_2 (ii) phenyl-$HN-CH_3$ (iii) phenyl-NH_2 (iv) pyridine

(a) (iii), (iv), (ii), (i)

(b) (iv), (iii), (ii), (i)

(c) (iv), (iii), (i), (ii)

(d) (iii), (iv), (i), (ii)

89. When ^{1}H-NMR is analyzed at 300 MHz, what will be the frequency at which ^{13}C-NMR will be recorded?

(a) 100 MHz

(b) 75 MHz

(c) 300 MHz

(d) 150 MHz

90. Which of the following is **not** an assumption of kinetic theory of gases?

(a) Gases consist of particles that are in constant motion with varying velocity

(b) Particles move in all directions in straight line

(c) Collisions of gas molecules are inelastic

(d) Particles may have different kinetic energies

91. The critical temperature of a gas is the

(a) lowest temperature at which liquefaction of the gas first occurs

(b) highest temperature at which liquefaction of the gas first occurs

(c) highest temperature at which the liquid boils

(d) temperature at which superheated steam is formed

92. A body starts from rest at the point $x = 0$ and $t = 0$. It accelerates by $t - t^2$. The maximum distance that is covered by the body in the +ve x-direction before moving backwards in the −ve direction is given by

(a) 8/192

(b) 1/8

(c) 8/27

(d) 27/192

93. A bar magnet is passed through an air-cored coil C from a far distance as shown in figure below. Which of the following graphs describes the induced e.m.f. (E) generated with time in the coil C?

(a)

(b)

(c)

(d)
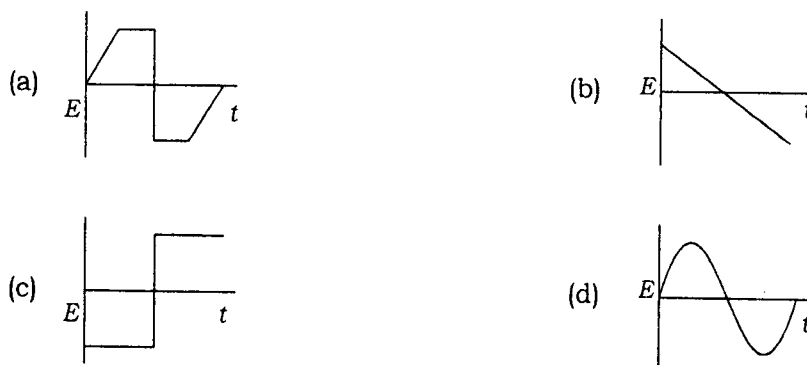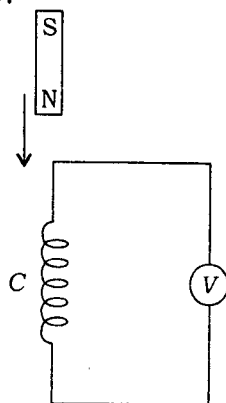
94. A body of mass 1 kg is attached to one end of a wire and rotated in horizontal circle of diameter 40 mm with constant speed of 2 m/s. What is the area of cross-section, if the stress developed in the wire is 5×10^6 N/m^2?

(a) 2 mm^2

(b) 3 mm^2

(c) 4 mm^2

(d) 5 mm^2

95. A mass m_2 is connected to a mass m_1 with a light weighed string passing over a frictionless pulley as shown in figure below. The m_1 slides on a horizontal table with a coefficient of friction μ. The acceleration of mass m_2 is given by
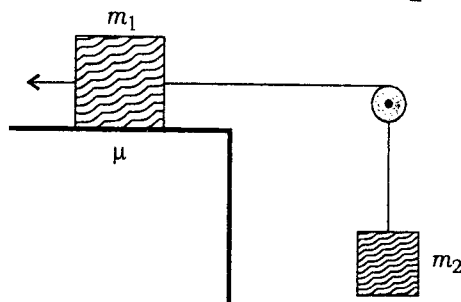
(a) $m_2 g / (m_1 + m_2)$

(b) $\mu * m_2 g / (m_1 + m_2)$

(c) $g * (m_2 - \mu m_1) / (m_1 + m_2)$

(d) $(m_2 + \mu m_1) / (m_1 + m_2) * g$

96. The light of wavelength 5000 Å falls on a sensitive plate of work function 1·9 eV. The kinetic energy of emitted photoelectrons is given by

(a) $0·938 \times 10^{-16}$ J

(b) $0·938 \times 10^{-19}$ J

(c) $0·938 \times 10^{-22}$ J

(d) $2·002 \times 10^{-16}$ J

97. A fighter jet having an initial mass of 800 kg consumes fuel at the rate of $R = 3$ kg/s during takeoff. The speed V_{rel} of the exhaust gases relative to the jet engine is 2400 m/s. What is the initial acceleration of the fighter jet?

(a) $7·8$ m/s^2

(b) 9 m/s^2

(c) $10·2$ m/s^2

(d) $11·5$ m/s^2

98. A parallel beam of light having a wavelength of 600 nm falls on a single narrow slit. In the resulting diffraction pattern when viewed on a screen at 1 m away, the first minima was formed at 3 mm from the centre of the screen. What was the width of the slit?

(a) $0·18$ mm

(b) $0·30$ mm

(c) $0·33$ mm

(d) $0·20$ mm

99. Two point white dots are 2·44 mm apart on a black paper. They are viewed by naked eye of pupil diameter 3 mm. What is the maximum distance from which the two dots can be separated? (Wavelength of light = 600 nm)

(a) 6 m

(b) 5 m

(c) 10 m

(d) 12 m

100. 300 J heat is required to raise the temperature of one mole of ideal gas by 10 K when heated at constant pressure. If the same gas is heated at constant volume to raise the temperature by the same 10 K, the heat required is ($R = 8·3$ J/mole K)

(a) 217 J

(b) 383 J

(c) 215·3 J

(d) 124 J

101. An electron is moving towards north with a velocity $4 \cdot 0 \times 10^7$ m/s in a uniform magnetic field of 10 T directed towards east. Find the magnitude and the direction of the magnetic force on the electron.

(a) $6 \cdot 4 \times 10^{-11}$ N, downwards

(b) $6 \cdot 4 \times 10^{-11}$ N, upwards

(c) $3 \cdot 2 \times 10^{-11}$ N, downwards

(d) $3 \cdot 2 \times 10^{-11}$ N, upwards

102. A prism has each angle 60°. At what angle the light should fall on the refracting surface so that it just suffers the total internal reflection at the other surface? (RI of the material of the prism = 1·524)

(a) 32·40°   (b) 29·75°

(c) 39·75°   (d) 42·40°

103. A radium 226 source was found in the laboratory with an activity of $5\,\mu\text{Ci}$ ($1\text{Ci} = 3 \cdot 7 \times 10^{10}$ Bq). What will be the mass of the source? (Avogadro constant, $L = 6 \cdot 02 \times 10^{23}$ and the disintegration constant for radium 226 is $1 \cdot 35 \times 10^{-11}\,\text{s}^{-1}$)

(a) 6·52 µg   (b) 5·14 µg

(c) 3·14 µg   (d) 7·14 µg

104. In a total of 100 white cells 63 are found to be polymorphonuclear cells. We can say with 95% confidence (1·95 times standard deviation from the mean) that the fraction of polymorphonuclear cells in the population is between

(a) 0·51 to 0·753   (b) 0·49 to 0·76

(c) 0·61 to 0·66   (d) 0·536 to 0·724

105. Eight patients are given two painkillers A and B respectively. The relative advantage of B (in terms of hours of extra relief) is calculated and the mean is found to be 1·050 hours and the variance (s^2) is 1·489. The appropriate statistical value we need to look at for testing the null hypothesis is

(a) $t = 0 \cdot 86$ with 7 degrees of freedom

(b) $t = 2 \cdot 434$ with 7 degrees of freedom

(c) $t = 2 \cdot 127$ with 8 degrees of freedom

(d) F-test with 2 and 7 degrees of freedom

106. In the secondary structure of a protein, which of the following is the main force required for alpha helix formation?

(a) Disulphide bond

(b) Ionic interaction

(c) Hydrogen bond

(d) Hydrophobic interaction

107. The three-dimensional conformation of a protein may be strongly influenced by amino acid residues that are very far apart in sequence. This relationship is in contrast to secondary structure, where the amino acid residues are

(a) always side by side

(b) generally near each other in sequence

(c) invariably restricted to about 7 of the 20 standard amino acids

(d) usually near the polypeptide chain's amino terminus or carboxyl terminus

108. How many millilitres of 0·8 M KOH should be added to 3·38 g of oxalic acid to give a pH of 4·0 when diluted to 500 ml? (Oxalic acid MW = 90·035; pK_1 = 1·252, pK_2 = 4·266)

(a) 73·97

(b) 63·23

(c) 122·34

(d) 36·65

109. The reversible reaction in which dihydroxyacetone phosphate and glyceraldehyde 3-phosphate combine to form fructose 1,6-bisphosphate is best characterized as

(a) an aldol condensation

(b) a Grignard reaction

(c) a free-radical reaction

(d) a hydrolytic reaction

110. If sucrose and monosodium glutamate (MSG) are added to a vinegar and oil salad dressing and shaken, the mixture will eventually separate into two phases of different density and polarity. Where will most of the sucrose and the MSG be located following phase separation?

(a) Both will concentrate in the vinegar

(b) Both will concentrate in the oil

(c) Both will concentrate at the interface

(d) Sucrose will concentrate in the oil and MSG will concentrate in the vinegar

111. The difference between the molecular weight of sucrose and that of the sum of the molecular weights of its components (glucose and fructose) is

(a) 0

(b) 1

(c) 16

(d) 18

112. Thyroxine labelled with ^{131}I is administered to a patient for the purpose of imaging the thyroid gland. The radioactive half-life of the isotope is 8 days. The biological half-life (the time required for half of the compound to be eliminated from the body) is 2 days. The time at which 3/4 of the original radioactivity will no longer be detectable in the body is closest to

(a) 2 days

(b) 3·2 days

(c) 4 days

(d) 4·8 days

113. The glyoxylate cycle is found in plants and bacteria but not in animals. The lack of this cycle in animals results in the inability to

(a) synthesize oxaloacetate from isocitrate

(b) synthesize glutamate from malate

(c) perform gluconeogenesis from amino acids

(d) perform gluconeogenesis from fatty acids

114. The equilibrium constant for the reaction catalyzed by malate dehydrogenase (malate to oxaloacetate) is about $5 \cdot 9 \times 10^{-6}$. Which of the following best describes the situation in which malate is converted to oxaloacetate during the citric acid (Krebs) cycle?

(a) The reaction is exergonic under standard conditions in the direction of the citric acid cycle and this drives the reaction

(b) The next reaction of the cycle, catalyzed by citrate synthase, is highly exergonic and it drives the malate dehydrogenase reaction forward by removing oxaloacetate

(c) Malate dehydrogenase changes the equilibrium constant for the reaction, allowing it to proceed rapidly

(d) Malate accumulates in the cell to such a high concentration that it pushes the reaction forward

115. Which of the following reactions is anaplerotic (replenishes intermediate pools) for the citric acid cycle?

(a) Oxaloacetate + GTP $\rightarrow$ Phosphoenolpyruvate + CO_2 + GDP

(b) Citrate + ATP + CoA $\rightarrow$ Oxaloacetate + ADP + Acetyl-CoA + P_i

(c) Oxaloacetate + Acetyl-CoA $\rightarrow$ Citrate + CoA

(d) Pyruvate + HCO_3^- + ATP $\rightarrow$ Oxaloacetate + ADP + P_i + H^+

116. A patient was admitted to a hospital. Her physical examination showed that she was lethargic and her liver was enlarged. Biopsy of liver showed large amount of excess glycogen. Her blood glucose level was also low. Which of the liver enzymes is responsible for her condition?

(a) Phosphomannose isomerase

(b) Glycogen phosphorylase

(c) Glycogen synthase

(d) Glycogen hydrolase

117. In crosses involving different pairs of genes A & B, C & D and E & F, the following proportions of recombinants were obtained :

A & B = 52%, C & D = 13·8% and E & F = 26·4%

The pair of genes which are not linked is

(a) A & B

(b) C & D

(c) E & F

(d) All of the above

118. Meselson and Stahl used ^{15}N rather than ^{3}H to label DNA, because

    (a) ^{3}H would not have got incorporated into DNA

    (b) ^{3}H is not suitable for autoradiography

    (c) ^{15}N has much stronger radioactivity than ^{3}H

    (d) incorporation of ^{15}N results in DNA with higher density

119. a, b and c are recessive to their respective wild type alleles. If individuals heterozygous at all 3 loci are crossed among themselves, the proportion of progeny showing all three wild type characters will be

    (a) 1/16

    (b) 9/16

    (c) 27/64

    (d) 1/3

120. A double-stranded DNA sample is heated to complete denaturation, followed by rapid cooling. The result will be predominantly

    (a) rapid reannealing of the two strands (minutes)

    (b) slow reannealing of the two strands (hours)

    (c) folding and intrastrand pairing of the single strands

    (d) precipitation of denatured DNA

121. All the following components are synthesized by retroviruses, *except*

    (a) envelope lipids   (b) viral mRNAs

    (c) capsid proteins   (d) receptor-binding proteins

122. When a protein binds to a specific sequence of bases in DNA, the specificity mostly reflects interactions with

    (a) groups found in the B form major groove

    (b) groups found in the A form major groove

    (c) groups found in the B form minor groove

    (d) phosphodiester backbone

123. Two *E. coli* strains *A* and *B* with the genotypes shown below were mixed and allowed to mate for several hours. The cells were then plated to observe recombinants. The results are shown in the table below :

$$Strain\ A\ :\ F^-\ \ lac^-\ \ arg^-\ \ his^-\ \ pyr^-\ \ lys^-\ \ Ton^R$$

$$Strain\ B\ :\ Hfr\ \ lac^+\ \ arg^+\ \ his^+\ \ pyr^+\ \ lys^+\ \ Ton^S$$

Wherein lac^- = inability to ferment the sugar lactose; arg^-, his^-, pyr^-, lys^- = inability to synthesize arginine, histidine, pyrimidines, or lysine respectively; Ton^S and Ton^R = sensitivity and resistance to the virulent phase T1.

Selected marker	Number of recombinants per 1000 Hfr cells
arg^+	350
pyr^+	100
lac^+	25
lys^+	350
his^+	500

The order of transfer of markers from Hfr to F^- is

(a) lys, arg, his, lac, pyr

(b) lac, pyr, arg, lys, his

(c) his, lys or arg, pyr, lac

(d) pyr, lac, his, lys, arg

124. When pure DNA was digested with nuclease, DNA fragments of all sizes were obtained. But when chromatin was digested with same enzymes, DNA fragments of size which were multiples of a smallest unit size were obtained. This suggests that in the chromatin, histone proteins are associated with DNA all along its length

(a) in a random manner

(b) in the form of tetramers

(c) in the form of octamers

(d) in the form of core particles distributed with a regular periodicity

125. Puromycin inhibits protein synthesis by inhibiting

(a) activation of amino acids

(b) aminoacyl transferase

(c) addition of amino acids to the peptide chain

(d) loading of mRNA onto the ribosome

126. Grafting is not possible in monocots, because they

    (a) have scattered vascular bundles

    (b) have parallel venation

    (c) are herbaceous

    (d) lack cambium

127. The sporophyte of *Funaria* is the

    (a) sexually reproducing generation

    (b) asexually reproducing generation

    (c) male plant

    (d) female plant

128. Accumulation of food in assimilatory cells results in

    (a) increase in the rate of photosynthesis

    (b) decrease in the rate of photosynthesis

    (c) No effect

    (d) May increase or decrease

129. Moll's leaf experiment demonstrated that

    (a) carbon dioxide is essential for photosynthesis

    (b) chlorophyll and water are necessary for photosynthesis

    (c) light and water are essential for photosynthesis

    (d) All of the above

130. In plants, during ionization of H_2O, H^+ is captured by

    (a) chlorophyll

    (b) NADP

    (c) O_2

    (d) cytochrome

131. Archaeopteryx was an evolutionary link between

    (a) fishes and amphibians

    (b) amphibians and reptiles

    (c) reptiles and birds

    (d) reptiles and mammals

132. Which one of the following blood pigments contains copper?

    (a) Haemoerythrin

    (b) Haemocyanin

    (c) Leghaemoglobin

    (d) Haemoglobin

133. In which of the following groups of animals does the heart pump only deoxygenated blood?

(a) Fishes   (b) Reptiles

(c) Birds   (d) Amphibians

134. Antidiuretic hormone is released into the blood by the

(a) hypothalamus

(b) pituitary gland

(c) liver

(d) small intestine

135. _____ of chick embryo is equivalent to dorsal lip of blastopore of frog embryo.

(a) Area opaca

(b) Area pellucida

(c) Koller's sickle

(d) Hensen's node

136. To control angina pain, nitroglycerine is usually given. It relieves angina pain by causing a dilation of the blood vessels. This effect of nitroglycerine is because

(a) nitroglycerine breaks down to nitric oxide that enters the blood vessels by diffusion resulting in dilation

(b) nitroglycerine enters the blood vessels by diffusion and dilates them

(c) nitroglycerine binds to a receptor on the plasma membrane of blood vessels that causes dilation

(d) nitroglycerine breaks down to nitric oxide that binds to its receptor on the plasma membrane of blood vessels and causes dilation

137. All of the following organelles can be isolated in their intact form from the cell, *except*

(a) lysosomes

(b) endoplasmic reticulum

(c) peroxisomes

(d) nuclei

138. The success of the famous experiment by Hershey and Chase that demonstrated the DNA to be the genetic material used radioactivity to label proteins and DNA. For this, growth of bacteriophage in media containing radioactive phosphorus or radioactive sulphur was carried out. It is expected that

(a) radioactive sulphur will label DNA and radioactive phosphorus will label proteins

(b) radioactive sulphur will label proteins and radioactive phosphorus will label DNA

(c) both labels will be found in DNA and proteins to the same extent

(d) radioactive sulphur will label both DNA and proteins

139. Biological membranes are made of lipids and proteins. Lipids were extracted from human red blood cells. The calculated total surface area of these red blood cells was found to be $36\,\mu^2$. How much surface area would these lipids cover once they were spread across the surface of water? (Ignore the area occupied by proteins in the RBC membrane)

   (a) $72\,\mu^2$

   (b) $36\,\mu^2$

   (c) $18\,\mu^2$

   (d) $144\,\mu^2$

140. Chloroplasts contain thylakoid membranes in which the apparatus for photosynthesis is embedded. The lumen of thylakoids also contains proteins. If a protein is translated in the cytosol and its final destination is thylakoid lumen, it has to be transferred across

   (a) a single membrane

   (b) two membranes

   (c) three membranes

   (d) four membranes

141. Diffusion across biological membranes depends on the nature of the substance being transported. Arrange the following substances in increasing order of their rates of passive diffusion across a biological membrane :

   Cl⁻ ions, Water, Glucose, Urea

   (a) Cl⁻ ions, Water, Glucose, Urea

   (b) Water, Cl⁻ ions, Glucose, Urea

   (c) Urea, Cl⁻ ions, Water, Glucose

   (d) Cl⁻ ions, Glucose, Urea, Water

142. Antigen recognition in the absence of costimulatory signal leads to

   (a) upregulation of B7

   (b) expression of high affinity IL-2 receptor

   (c) T cell anergy

   (d) T cell apoptosis

143. Athymic mice will show

   (a) lack of lymphocytes

   (b) lack of mature B lymphocytes

   (c) lack of mature T lymphocytes

   (d) an intact immune system

144. An Indian person goes for a job in the USA. During annual TB screening, his tuberculin test was positive. The doctor advised him to go for a chest X-ray to rule out any active TB. However, the X-ray result was normal and the other quantiferon assay for tuberculosis was also negative. What could be the most likely reason for the positive tuberculin test?

(a) The patient had tuberculosis but X-ray and quantiferon assay failed to detect it

(b) The patient had false positive result

(c) The patient might have had BCG vaccination

(d) The patient was only a *Mycobacterium* carrier

145. Toll-like receptors are

(a) pathogen recognition receptors (PRR) that recognize pathogen associated molecular pattern (PAMP)

(b) receptors that modulate immune exhaustion

(c) death receptors responsible for the apoptosis of the cells

(d) costimulatory receptors

146. The proton NMR-spectrum of $C_2H_2Cl_2Br_2$ will give

(a) 1 resonance peak

(b) 2 resonance peaks

(c) 3 resonance peaks

(d) 4 resonance peaks

147. Sodium dodecyl sulphate (SDS) is commonly used in polyacrylamide gel electrophoresis to separate a mixture of proteins in the gel by giving them a uniform negative charge. SDS works by binding to

(a) positively charged side chains

(b) negatively charged side chains

(c) hydrophobic side chains

(d) hydrophilic side chains

148. pH 2 is more acidic than pH 4 by

(a) 1-fold   (b) 10-fold

(c) 20-fold   (d) 100-fold

149. Indian biophysicist Prof. G. N. Ramachandran pioneered the use of a plot named after him as 'Ramachandran Plot' to define the conformational properties of polypeptide based on dihedral (torsion) angles ϕ, ψ and ω. The dihedral angle ϕ is defined by rotation around

(a) C—N bond

(b) C^α—C' bond

(c) N—C^α bond

(d) C—C bond of side chain

150. Two proteins of similar molecular weights (within 100 Da) and the same net charge in solution but differing in their amino acid composition can best be separated by

(a) cation exchange chromatography

(b) anion exchange chromatography

(c) reverse phase chromatography

(d) gel filtration chromatography

151. A concentrated protein solution was diluted 100 times with a buffer at pH 7·0 and the resulting solution gave an absorbance of 0·362 in a UV spectrophotometer at 280 nm using a 1 cm path length quartz cuvette. Given the extinction coefficient of the protein, $5189\ M^{-1}\,cm^{-1}$, the concentration of the undiluted protein solution in millimolar units would be

(a) 0·69

(b) 0·0069

(c) 1·0

(d) 6·9

152. Peptidoglycan is a polymer containing all of the following, *except*

(a) N-acetyl glucosamine

(b) N-acetyl muramic acid

(c) N-acetyl neuraminic acid

(d) sialic acid

153. In microbial fermentation, the electron acceptor is

(a) O_2

(b) CO_2

(c) pyruvate

(d) NADH

154. Organisms that ferment glucose may produce any of the following end products, *except*

(a) lactic acid

(b) propionic acid

(c) alcohol

(d) oxygen

155. Some organisms and their properties are randomly listed below :

(Organisms)	(Properties)
A. *Pseudomonas*	I. Obligate anaerobe
B. *Bacteriodes*	II. Aerotolerant anaerobe
C. *Escherichia*	III. Obligate aerobe
D. *Lactobacillus*	IV. Facultative anaerobe

Correct listing of organisms against their true properties will be

(a)
A	B	C	D
III	I	IV	II

(b)
A	B	C	D
II	III	I	IV

(c)
A	B	C	D
I	IV	II	III

(d)
A	B	C	D
IV	II	III	I

156. Some characteristics of *E. coli* cells are

    (a) gram-negative rods, peritrichously flagellated and endospore forming

    (b) gram-negative rods, lophotrichously flagellated and non-endospore forming

    (c) gram-negative rods, peritrichously flagellated and non-endospore forming

    (d) gram-negative rods, amphitrichously flagellated and non-endospore forming

157. Some viruses cause various types of red blood cells to clump or agglutinate. This is due to the presence of one of which of the following on their surface?

    (a) Glycoproteins

    (b) Nucleic acids

    (c) Capsomeres

    (d) Lipid molecules

158. *Thiobacillus ferrooxidans* is used in mining operations, because it oxidizes

    (a) sulphur

    (b) copper

    (c) iron

    (d) phosphate

159. What happens if a culture of a bacterium whose genotype is $F'lac^+/lac^-$ is grown in medium containing acridine orange?

    (a) Cells continue to grow and divide

    (b) After one generation the number of lac^+ cells remains constant while the number of lac^- cells increases

    (c) Cell growth and division is inhibited due to presence of acridine orange

    (d) Only lac^+ cells will grow and divide

160. 0·1 mL of a bacterial culture is diluted into 9·9 mL of buffer; 0·1 mL of this dilution is again diluted in 9·9 mL of fresh buffer. Plating 0·1 mL from the second dilution tube yields 72 colonies on a petri plate. What is the cell density of the original culture?

    (a) $7·2 \times 10^6$ cells per mL

    (b) $7·2 \times 10^5$ cells per mL

    (c) $7·2 \times 10^8$ cells per mL

    (d) $7·2 \times 10^7$ cells per mL

★★★

SPACE FOR ROUGH WORK

SPACE FOR ROUGH WORK

SPACE FOR ROUGH WORK