

IIT JAM

BIOTECHNOLOGY

SOLVED SAMPLE PAPER



- * DETAILED SOLUTIONS
- * PROJECTED IIT JAM RANK



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IIT JAM-BT

BIO-TECHNOLOGY

(FMTP)

Attempt ALL the 60 questions.

There are a total of 60 questions carrying 100 marks.

Section-A contains a total of 30 **Multiple Choice Questions (MCQ)**.

Q.1 - Q.10 carry 1 mark each and Questions Q.11 - Q.30 carry 2 marks each.

Section-B contains a total of 10 **Multiple Select Questions (MSQ)**. Questions Q.31 - Q.40 belong to this section and carry 2 marks each with a total of 20 marks.

Section-C contains a total of 20 **Numerical Answer Type (NAT)** questions.

Questions Q.41 - Q.60 belong to this section and carry a total of 30 marks.

Q.41 - Q.50 carry 1 mark each and Questions Q.51 - Q.60 carry 2 marks each.

In **Section-A** for all 1 mark questions, 1/3 marks will be deducted for each wrong answer. For all 2 marks questions, 2/3 marks will be deducted for each wrong answer. In **Section-B (MSQ)**, there is **NO NEGATIVE** and **NO PARTIAL** marking provisions. There is **NO NEGATIVE** marking in **Section-C (NAT)** as well.

Time : 3 Hours

MAX.MARKS : 100

MARKS SCORED :

SECTION-A (Q. 1-30): MULTIPLE CHOICE QUESTIONS (MCQs)

- Red Drop and Emerson effect have proved the existence of:
(A) light and dark reactions in photosynthesis.
(B) two distinct photosystems in photosynthesis.
(C) the supply of electrons from oxygen evolving complex.
(D) electron transport from water to NADP^+ across thylakoids.
- Calcium Dependent kinases can control:
(A) Cell cycle activities
(B) DNA replication
(C) Cell surface receptors
(D) Membrane structure
- RNA polymerase II which synthesizes mRNA in eukaryotes is generally :
(A) resistant to alpha-amanitin
(B) sensitive to alpha-amanitin

- (C) resistant to actinomycin-D
(D) sensitive to rifampicin
4. Crossing over occurs between
(A) homologous chromosomes
(B) sister chromatids
(C) chromatids of homologous chromosomes
(D) any two chromosomes
5. Genes that exhibit criss-cross inheritance are:
(A) Dominant genes (B) codominant genes
(C) Sex linked genes (D) Sex limited genes
6. Structure that prevents the entry of food into respiratory tract is:
(A) Larynx (B) pharynx (C) epiglottis (D) Glottis
7. If a man Rh⁺ marries a lady Rh⁻, then-
(A) first child will die (B) first child will survive.
(C) No child will be born (D) None of the above.
8. In the study of enzymes, a sigmoidal plot of substrate concentration [S] versus reaction velocity (V) may indicate:
(A) Michaelis - Menten kinetics (B) co-operative binding
(C) competitive inhibition (D) noncompetitive inhibition.
9. Which one of following is the competitive inhibitor of succinic dehydrogenase which participates in kreb's cycle?
(A) Malonate (B) Succinate (C) citrate (D) Fumarate
10. The taxonomic category class is between:
(A) Order and Family (B) Order and genus
(C) kingdom and phylum (D) Division and order.
11. Alec Jeffery's name is associated with
(A) DNA Sequencing
(B) DNA fingerprinting
(C) RNA Sequencing
(D) Site directed mutagenesis
12. Chemical transmission of nerve impulses from one neuron to another at a synapse, or from a neurons to a muscle is by.

- (A) Cholesterol (B) Acetylcholine
(C) ATP (D) None
13. Which one of the following is known to act as biological Mutagen ?
(A) Acridine orange (B) Nitrosoguanidine
(C) Transposon (D) streptomycin
14. RFLP [Restriction Fragment Length Polymorphism] study is a technique for:
(A) transferring genes from unrelated species
(B) Isolating single genes
(C) Isolating single gene products
(D) Identifying genetic [DNA] homologies.
15. Expression of a recessive phenotype in a deletion hetrozygote is due to:
(A) pseudo-dominance (B) partial-dominance
(C) super-dominance (D) co-dominance
16. When H_2S is passed through Hg_2^{2+} , we get :
(A) $2HgS + 2H^+$ (B) $HgS + Hg_2S$
(C) $HgS + Hg$ (D) Hg_2S
17. Among KO_2 , AlO_2^- , BaO_2 and NO_2^+ , unpaired electron is present in –
(A) NO_2^+ and BaO_2 (B) KO_2 and AlO_2^-
(C) $K^+O_2^-$ only (D) BaO_2 only
18. Which of the following will exhibit optical isomerism ?
(A) $[Cr(en)(H_2O)_4]^{3+}$
(B) $[Cr(en)_3]^{3+}$
(C) $trans-[Cr(en)(Cl_2)(NH_3)_2]^+$
(D) $[Cr(NH_3)_6]^{3+}$
19. A light green coloured salt soluble in water gives black precipitate on passing H_2S . The precipitate dissolves readily in HCl . Which of the following metal ion constitutes the salt ?
(A) Co^{2+} (B) Ni^{2+} (C) Fe^{2+} (D) Mn^{2+}
20. Which of the following is strongest base?
(A) $Be(OH)_2$ (B) $Mg(OH)_2$ (C) $Al(OH)_3$ (D) $Si(OH)_4$

21. In PMR, vinyl chloride gives
 (A) one signal
 (B) two singlets
 (C) three signals
 (D) one doublet and one triplet

22. Least contributing structure in nitroethene is :

- (A) $\text{CH}_2=\text{CH}-\overset{\ominus}{\text{N}}\begin{matrix} \text{O} \\ \parallel \\ \text{O} \end{matrix}$ (B) $\overset{\oplus}{\text{C}}\text{H}_2-\overset{\ominus}{\text{C}}\text{H}-\overset{\oplus}{\text{N}}\begin{matrix} \text{O} \\ \parallel \\ \text{O} \end{matrix}$
 (C) $\overset{\ominus}{\text{C}}\text{H}_2-\overset{\oplus}{\text{C}}\text{H}-\overset{\oplus}{\text{N}}\begin{matrix} \text{O} \\ \parallel \\ \text{O} \end{matrix}$ (D) $\overset{\oplus}{\text{C}}\text{H}_2-\text{CH}=\overset{\oplus}{\text{N}}\begin{matrix} \text{O} \\ \parallel \\ \text{O} \end{matrix}$

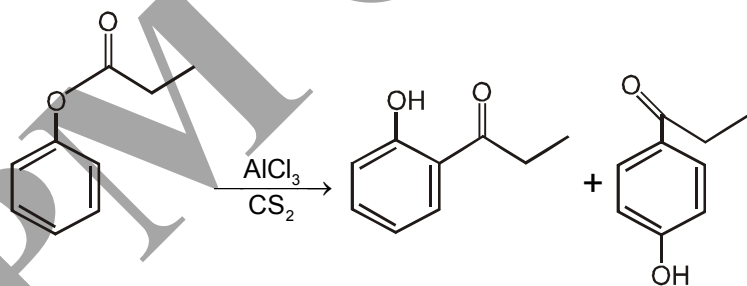
23. The compound which reacts with HBr obeying Markownikoff's rule is—

- (A) $\text{CH}_2 = \text{CH}_2$ (B) $\begin{matrix} \text{H}_3\text{C} & & \text{CH}_3 \\ & \diagdown & / \\ & \text{C} = \text{C} \\ & / & \diagdown \\ \text{H} & & \text{H} \end{matrix}$
 (C) $\begin{matrix} \text{H}_3\text{C} & & \text{H} \\ & \diagdown & / \\ & \text{C} = \text{C} \\ & / & \diagdown \\ \text{H} & & \text{CH}_3 \end{matrix}$ (D) $\begin{matrix} \text{H}_3\text{C} & & \text{H} \\ & \diagdown & / \\ & \text{C} = \text{C} \\ & / & \diagdown \\ \text{H}_3\text{C} & & \text{H} \end{matrix}$

24. How many isomeric aromatic $\text{C}_6\text{H}_2\text{Br}_4$ are possible which on bromination $\text{Br}_2/\text{FeBr}_3$ gives only 1 type of product.

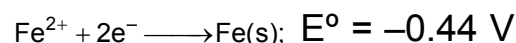
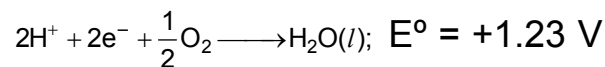
- (A) 1 (B) 2 (C) 3 (D) 4

25. The conversion shown below is an example of



- (A) Fries rearrangement (B) Claisen rearrangement
 (C) Friedel-Crafts acylation (D) Reimer-Tiemann reaction

26. The rusting of iron takes place as follows:-



Calculate ΔG° for the net process.

- (A) -322 kJ mol^{-1} (B) -161 kJ mol^{-1}
(C) -152 kJ mol^{-1} (D) -76 kJ mol^{-1}

27. Which gas when passed through dilute blood will impart a cherry red colour to the solution?

- (A) CO_2 (B) COCl_2 (C) NH_3 (D) CO

28. The rates of diffusion of SO_2 , CO_2 , PCl_3 and SO_3 are in the following order:-

- (A) $\text{PCl}_3 > \text{SO}_3 > \text{SO}_2 > \text{CO}_2$ (B) $\text{CO}_2 > \text{SO}_2 > \text{PCl}_3 > \text{SO}_3$
(C) $\text{SO}_3 > \text{SO}_2 > \text{PCl}_3 > \text{CO}_2$ (D) $\text{CO}_2 > \text{SO}_2 > \text{SO}_3 > \text{PCl}_3$

29. $\text{Z} - \text{CH} = \text{CH}_2 \xrightarrow{\text{HBr}} \text{Z} - \text{CH}_2 - \text{CH}_2 - \text{Br}$

Which of the following substituent might be best suited for Z ?

- (1) $-\text{Cl}$ (2) $-\text{SO}_3\text{H}$ (3) $-\text{OCH}_3$ (4) $-\text{CF}_3$
(A) 1, 3 (B) 2, 4 (C) 2, 3 (D) 3, 4

30. Hund's rule of maximum multiplicity suggests filling of electron in degenerate orbitals as

- (A) screening values increases
(B) nuclear charge increases
(C) effective nuclear charge increases
(D) effective nuclear charge decreases

SECTION-B (Q. 31-40): MULTIPLE SELECT QUESTIONS (MSQs)

31. Consider the following statements: Which of these statements are correct?

- (A) The genetic material of virus consists of DNA or RNA, but never both.
(B) Viruses can be cultured on any synthetic medium.
(C) Viruses lack enzymes necessary for generation of energy.
(D) Viruses are transmitted from one organism to another by biological vectors only.

32. Consider the following:

Which of the above is/are generated from genetically engineered microbes?

- (A) Insulin (B) Human Growth hormone
(C) Interferons (D) Hepatitis B surface Antigen

33. Cowper's glands secrete a viscid alkaline fluid -

- (A) Which neutralizes any acidity in urethra after the passage of urine.

- (B) Which Neutralizes any acidity in the vagina of the female which it passes out with semen.
- (C) In which the sperms flot
- (D) None
34. Which of the following is/are true when pepstain inhibits renin activity:
- (A) Km remains constant
- (B) Vmax decrease
- (C) km decrease
- (D) Vmax increase
35. Which of the following statements are correct:
- (A) ecosystem is an open system
- (B) Sun is the ultimate source of energy for any ecosystem
- (C) A single organism can feed at several trophic levels.
- (D) In an artificial ecosystem, flow of energy is not unidirectional.
- rophic levels which make food web. In an artificial ecosystem, flow of energy is unidirectional.
36. ELISA, used to detect Antigens or antibodies utilizes those enzymes that:
- (A) yield a stable coloured product.
- (B) have a high turnover rate
- (C) Are stable on conjugate to proteins
- (D) ELISA tests using chemiluminescence are the most sensitive immunoassay available.
37. Polymerase chain reaction is considered as a revolutionary technology because all of the following:
- (A) It enables an unlimited production of a DNA fragment in vitro.
- (B) It is a highly sensitive technology.
- (C) Its experimental protocol is simple.
- (D) It enables the direct production of a synthetic gene that did not exist before.
38. DNA dependent RNA polymerase of E. Coli is characterized by which of the following properties?
- (A) It requires a DNA template, Mg^{+2} , and all four ribonucleoside triphosphates

and forms a phosphodiesterase bond and pyrophosphate.

(B) It is a polymeric protein

(C) It requires a protein factor [σ factor] for initiation of transcription.

(D) It synthesizes nascent chain in 5' to 3' direction.

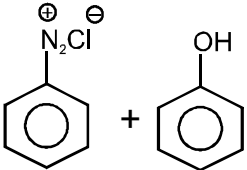
39. For chemi-osmotic hypothesis, which of the following statements are true :

(A) Transport of electrons takes place from low redox potential carriers

(B) Transport of protons to cytoplasmic side of membrane causes positive charge on inner mitochondrial membrane

(C) Hydrogen ion reactions take place on both sides of membrane

(D) Six protons are generated per electron pair transported.

40.  product. Which of the following statements are **correct** about the above reaction ?

(A) Product shows geometrical isomerism

(B) Product shows colour due to extended conjugation

(C) Electrophile attack at para position due to large size.

(D) Electron withdrawing group in phenol increases rate of reaction.

SECTION-C (Q. 41-60): NUMERICAL ANSWER TYPE (NATs)

41. In the Human ABO blood system, the alleles A and B are dominant to O. What will be the number of different possible genotypes?

42. If protons are to be transported from outside of the inner mitochondrial membrane to the inside i.e., the matrix, in the presence of (i) a proton gradient whose outside concentration is 10^2 fold high compared to the inside concentration and (ii) an electrical gradient whose value is 0.2 volt. Calculate the value of free energy change that is associated with this electrochemical gradient at 27°C . [$R=8.3$ Joules/mole, $F = 96.500$ Joules/(volt-mole)?

43. Black wool is dependent upon a dominant allele B and white wool upon its recessive allele b. Suppose that a sample of 1000 sheep gave following data : 990 white and 10 black. Estimate the allelic frequency of B?

44. Pyruvate dehydrogenase is a complex of how many enzymes?
45. With reference to relative proportion of parental & recombinant phenotypes in test cross progeny involve two recessive genes 'r' [around] & 'y' [yellow] contain the seed shape & seed colour respectively the observed percent recombinants is 20, then find the map distance between 'r' & 'y' ?
46. A diploid plant species of $2n=16$ chromosomes was hybridized with one having $2n=12$ chromosomes. Surprisingly the breeder found the hybrid to be an allotetraploid [amphidiploid]. How many chromosomes can he expect in it ?
47. How many pairs of peripheral microtubules present around single central microtubule in the axial filament of mammalian sperm?
48. What is the approximate molecular weight [kDa] of product after translation of a 390 bases mRNA?
49. A bacterial Culture was diluted 1000 fold & 0.1 ml of this diluted sample was spread per plate on nutrient agar. In a tetraplicate run, the number of colonies formed is 125, 97, 92, 86. Find the number of colony forming units/ml in original bacterial culture?
50. How many Kilograms of ethanol is produced from 1 kilogram of glucose in ethanol fermentation ?
51. How many number of nuclei participating in double fertilization?
52. The cross section of a trunk of a tree showed 50 annual rings. What is the age of the tree? [in years]
53. How many words/parts contain by a binomial nomenclature?
54. How many pairs of peripheral microtubule present in axial filament of mammalian sperm ?
55. In how many types, are enzymes classified?
56. How many free Energy liberated during oxidation per mole of Palmitic acid ? (ΔG [cal/mole] [in negative])
57. How many pyruvic acids are formed at completion of glycolytic process?
58. A couple with normal vision had colourblind father each. what is the percentage of probability that the daughter of the couple is colourblind?

59. 'a' is an autosomal gene and is responsible for albino Character. A male rat, heterozygous for 'a' is crossed with a female rat of same genotype. How many of F_1 offsprings will express 'a' phenotype [i.e., albino] ?
60. Minimum how many base pair deletion or insertion into the genetic code cause a frame shift mutation?

VPM CLASSES

QUESTION	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
ANSWER	B	A	B	C	C	C	B	B	A	D	B	B	C	D	A
QUESTION	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
ANSWER	A	C	B	C	B	D	B	D	C	A	A	D	C	B	C
QUESTION	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
ANSWER	A,C	A,B,C,D	A,B	A,B	A,B,C	A,B,C,D	A,B,C	A,B,C,D	A,C,D	A,B,C	6	-30,769	0.9	3	20
QUESTION	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
ANSWER	28	9	14300	1000000	511	5	50	2	9	6	-2338000	2	0	25	1

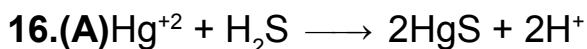
Hints And Solution

- 1.(B)** The experimental results on photosynthesis by Emerson in late 1950s revealed red drop effect and enhancement effect. These observations eventually explained by experiments performed in the 1960s that led to discovery that two photocomplexes, now know as photosystem I and PS II operate in series to carry out the early energy storage reactions of photosyntheses.
- 2.(A)** Calcium dependent kinases [CDKS] have the ability to control cell cycle activities during cell division. The key enzymes that control the entry of non dividing cells into the cell cycle are cyclin dependent kinases [CDKs] protein kinases are enzymes that phosphorylate proteins using ATP. The regulated activity of CDKs is essential for transition from $G_1 \rightarrow S$ & from $G_2 \rightarrow M$ and for entry of non dividing cells into cell cycle
- 3.(B)** RNA polymerase II which synthesizes m-RNA in eukaryotes is generally sensitive to α - amanitin and RNA polymerase I is completely resistant to α - amanitin.
- | | |
|------------------------|----------------------------------|
| Type of RNA polymerase | effect of α -amanitin |
| I | resistant |
| II | strongly inhibited |
| III | Inhibited by high concentrations |
- 4.(C)** The crossing over is a process that produces recombinations of genes by interchanging of corresponding segments between nonsister chromatids of homologous chromosomes. The term crossing over was coined by Morgan.

- 5.(C)** The sex linked recessive genes exhibit “criss-cross’ pattern of inheritance. In criss-cross inheritance, a x linked recessive gene is transmitted from P_1 male parent [father] to F_2 male progeny [Grandsons] through F_1 heterozygous females [daughters] which are called carriers.
- 6.(C)** Laryngopharynx is the lower part of pharynx. It has two apertures - anterior slit like glottis and posterior gullet. Glottis leads into trachea or wind pipe & can be closed by a bilobed leaf like cartilage, the epiglottis during the swallowing of food-bolus.
- 7.(B)** If a man Rh^+ marries a lady Rh^- become sensitized by carrying a Rh^+ child within her body. Some of cells from embryo may mix into her own blood stream during development. The first child of parents with this genetic background is nearly always normal. but in 2nd pregnancy it cause damage to RBC of foetus. This causes disease erythroblastosis fetalis
- 8.(B)** In the study of enzymes [an allosteric enzyme] a sigmoidal plot of substrate concentration [S] versus the reaction velocity (V) indicate co-operative binding. The curve has a steep section in middle of substrate concentration range, reflecting the rapid increase in enzyme velocity which occurs over a narrow range of substrate concentration.
- 9.(A)** A good example of competitive inhibition is provided by succinate dehydrogenase. This enzyme uses succinate as its substrate and is competitively inhibited by malonate which differs from succinate in having one rather than two methyl groups. Normally, succinate dehydrogenase catalysis the conversion of succinate to fumarate in TCA or kreb’s cycle
- 10.(D)**The taxonomic category lies in the sequence :
Kingdom > Division > class > order > Family > Genus > species.
Thus, category “class” is between division and order.
- 11.(B)** DNA fingerprinting was invented in 1984 by professor Sir Alec Jeffrey .DNA fingerprinting is a technique that simultaneously detects lots of minisatellites in the genome to produce a pattern unique to an individual.
- 12.(B)** Acetylcholine transmits nerve impulses from one neuron to another at synapse or from one neuron to muscle.
- 13.(C)** Transposons [Jumping gene] are known to act as a biological mutagen. Acridine orange etc cause chemically induced mutations.

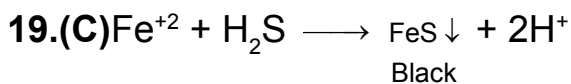
14.(D) RFLP is a technique for identifying genetic DNA homologies. In RFLP only a small segment of DNA is analyzed out of all the DNA from the cells of an individual. This segment is used as a probe and is analyzed from the DNA of desired individual. RFLP has significant role in DNA finger printing.

15.(A) Expression of a recessive phenotype in a deletion heterozygote is due to pseudo-dominance. Pseudo dominance is an autosomal recessive condition present in individual in two or more generations of a family, thereby appearing to follow a dominant inherent pattern.

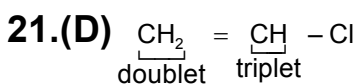


17.(C) K^+O_2^- ; O_2^- has one unpaired electron.

18.(B) When an octahedral complex contains all the three bidentate ligands, it shows optical isomerism.

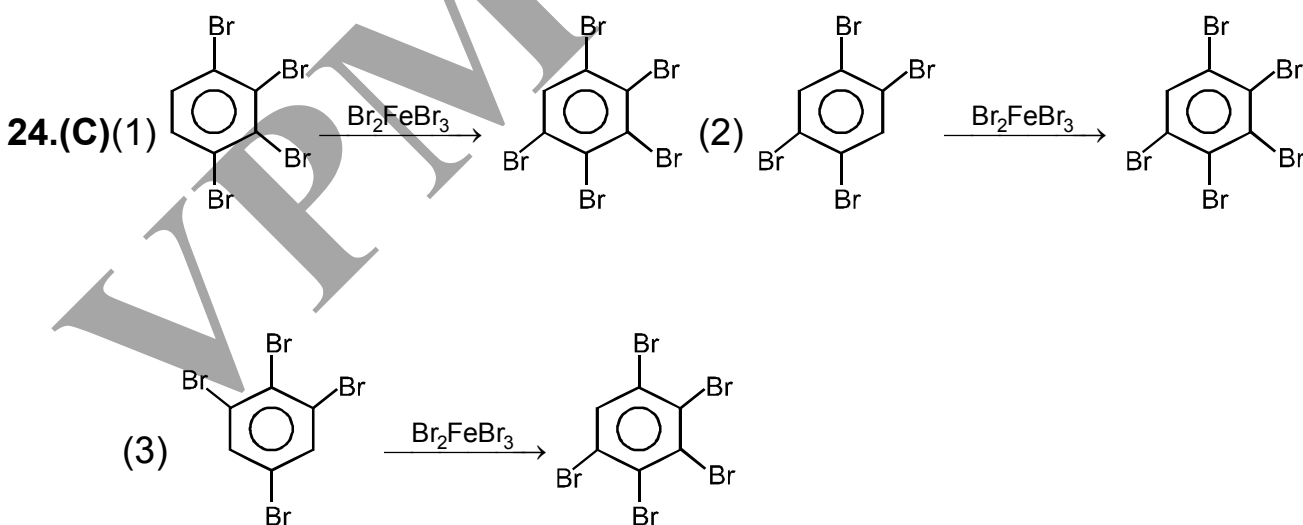


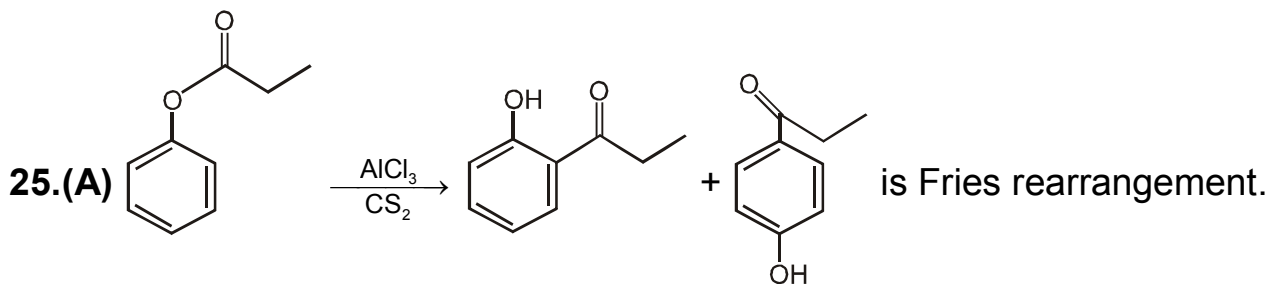
20.(B) Hydroxides of Alkaline earth metals are strongly basic.



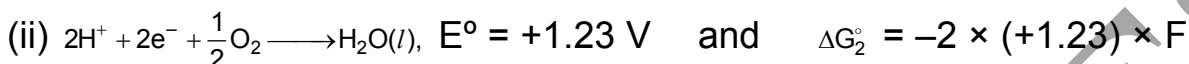
22.(B) $\overset{+}{\text{C}}\text{H}_2 - \overset{-}{\text{C}}\text{H} - \overset{+}{\text{N}} \overset{\text{O}}{\parallel} \text{O}^-$ -ve charge at adjacent atoms repel each other.

23.(D) Except (D), all are symmetrical alkenes, hence Markownikoff's addition occurs only in (D).

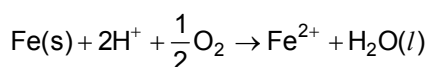




26.(A) Reactions:-



Net reaction



$$\begin{aligned} \Delta G_3^{\circ} &= \Delta G_1^{\circ} + G_2^{\circ} = -2 \times (+0.44) \times F + (-2 \times 1.23 \times F) = -0.88 F - 2.46 F = -3.34 F \\ &= -3.34 \times 96500 \text{ J} \\ &= -322.31 \text{ kJ} \approx \mathbf{-322 \text{ kJ}} \end{aligned}$$

27.(D) CO reacts with red colouring haemoglobin molecules in blood to form a complex of cherry red colour.

28.(C) Rate of diffusion $\propto \sqrt{\frac{1}{M}}$

29.(B) $\text{HO}_3\text{S} - \text{CH} = \text{CH}_2$, $\text{F}_3\text{C} - \text{CH} = \text{CH}_2$ both are strong electron withdrawing group

30.(C) Additional electron in a new orbital prevents shielding for degenerate orbitals, thus effective nuclear charge increases, stability increases.

31. (A,C) viruses differ from cellular organisms in that they contain only one type of nucleic acid which may be either DNA or RNA but never both.

Viruses lack metabolic machinery of their own to generate energy or to synthesize proteins. They depend on host cells to carry out these vital functions. Viruses are capable of independent growth in artificial media & they can transit from one host cell to another.

32.(A,B,C,D) Human insulin was the first commercial success of new recombinant DNA technologies. Human growth hormone is expressed in E.colli. Genetic engineering also provides an alternate strategy to production for immunization against viral disease.

33.(A,B) Cowper's / Bulbourethral glands:

A pair of small glands, 4–5 cm below prostate and opening into membranous urethra by separate duct. The secretion has abundant mucus for lubrication of reproductive tract.

34.(A,B) An noncompetitive inhibitor binds reversibly at a site other than the active site, & causes a change in overall 3-D shape of enzyme that leads to a decrease in catalytic activity. Example of Noncompetitive inhibition is action of palpitating on enzyme Renin. Due to this V_{max} is decreased while k_m remains constant.

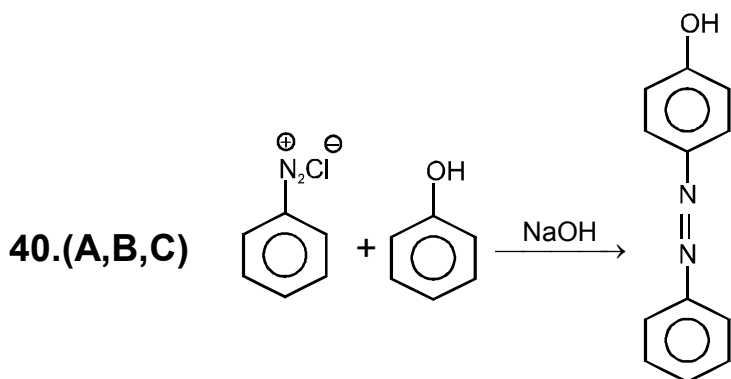
35. (A,B,C) Ecosystem is an open system . An ecosystem can be visualized as functional unit of nature representing complex interactions between living and nonliving components & Sun is the ultimate source of energy for any ecosystem because producers as well as consumers depend on Sun for energy. A single organism can feed at several trophic levels.

36.(A,B,C,D) Enzyme linked immunosorbent assay, depends on enzyme. An enzyme conjugated with an antibody reacts with a colorless substrate to generate a colored reaction product. This enzyme have a high turnover rate. They are stable on conjugation to proteins, Light produced by chemiluminescence during certain chemical reactions provides a convenient and during certain chemical reactions provides a convenient and highly sensitive alternative to absorbance measurements in ELISA.

37.(A,B,C) PCR is an extremely simple yet powerful technique. It allow enormous amplification of any specific sequence of DNA provided that short sequences either side of it are known. It is a highly sensitive technology.

38.(A,B,C,D) DNA dependent RNA polymerase of E. coli is a polymeric protein, it synthesize new chain in $5' \rightarrow 3'$ direction for transcription, it requires a DNA template, Mg^{+2} & all four ribonucleosides triphosphates and forms a phosphodiesterase bond and during this reaction pyrophosphate removed. It requires a protein [σ factor] for initiation of transcription. Which recognize promoter region.

39.(A,C,D) In chemiosmotic hypothesis protons (H^+) are ejected toward the cytoplasmic side (C – side) while OH^- remain on matrix side. This vectorial movement of protons creates a difference in p^H (i.e. lower p^H on C-side and higher on M-side), which results in an electrical potential.



Product shows geometrical isomerism

Product shows colour due to extended conjugation

41. (6)

ABO Blood Group or Human Blood Group are controlled by three alleles I^A , I^B , I^O . This phenomenon in which one gene has more than two alleles is known as multiple allelism. In this six genotypes are responsible for four phenotypes of blood group. Genotypes responsible for blood groups and phenotype for A is $I^A I^A$, $I^A I^O$. Genotypes responsible for blood groups and phenotype for B is $I^B I^B$, $I^B I^O$. Genotypes responsible for blood groups and phenotype for AB is $I^A I^B$. Genotypes responsible for blood groups and phenotype for O is $I^O I^O$.

42. (-30,769)

$$\Delta G = 2.303 RT \log_{10} \frac{[C_2]}{[C_1]} + ZF \Delta a$$

$$\therefore \frac{[C_2]}{[C_1]} = \frac{C_{\text{inside}}}{C_{\text{outside}}} = \frac{1}{10^2} = 10^{-2}$$

$$T = 273 + 27 = 300 \text{ K}$$

$$\Delta G = 2.303 \times 8.3 \times 300 \times \log_{10} \left(\frac{1}{10^2} \right) + 1 \times 96,500 \times (-0.2)$$

$$= -11,469 - 19300$$

$$= -30,769 \text{ Joules/Mole}$$

43. (0.9)

$$q = \sqrt{q^2} = \sqrt{\frac{10}{1000}} = 0.1$$

q = frequency of allele b.

Since $p+q = 1$

So the frequency of allele B is 0.9

44. (3)

The pyruvate dehydrogenase is a large, highly integrated complex of 3 different enzymes. Pyruvate dehydrogenase links glycolysis to the citric acid cycle.

Pyruvate dehydrogenase contains 3 enzymes :

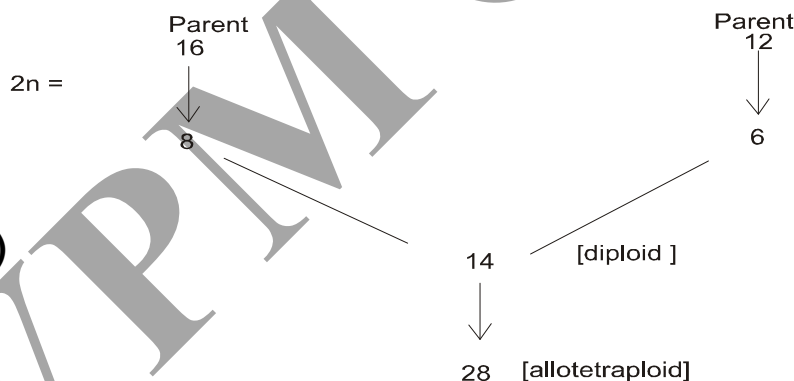
- (A) Pyruvate dehydrogenase
- (B) Dihydrolipoyl
- (C) Dihydrolipoyl dehydrogenase

45 (20)

In given problem the map distance between 'r' & 'y' is 20 map units.

& A map unit is equal to 1 percent of crossover [recombinants] , i.e. it represents the linear distance along chromosome for which a recombination frequency of 1 percent is observed.

46. (28)



A diploid plant species of $2n=16$ chromosomes was hybridized with one having $2n=12$ chromosomes. Surprisingly, the breeder found the hybrid

to be an allotetraploid [amphidiploid] , 28 chromosomes he expect in it.

47. (9)

In transverse section the axial filament of tail shows the characteristic arrangement of nine pairs of peripheral microtubules surrounding a central pair of microtubules.

48. (14300)

Da Number of codons in mRNA =130

Number of amino acids mRNA will encode=130 Average molecular mass of amino acid residue =110Da Approx , molecular mass of protein =130x110 =14300 Da

49.(1000000)

Average number of colonies formed :

$$= \frac{125 + 97 + 92 + 86}{4}$$

$$=100$$

$$\text{Dilution Factor} = \frac{1000}{0.1} = 10^4$$

CFU/ml in original bacterial Culture =
Average number of colonies x Dilution factor

$$= 100 \times 10^4$$

$$= 10^6$$

$$= 1000000$$

50. 511

One mole glucose produces 2 mole of ethanol.

$$\text{Number of moles of glucose} = \frac{1000}{180} = 5.56 \text{ mole}$$

So 5.56 mole of glucose produce = 11.11 mole of ethanol

$$\begin{aligned} \text{Total weight of ethanol} &= 11.11 \times 46 \\ &= 511 \text{ gram} \end{aligned}$$

51. (5)

In the double fertilization, fertilization occurs twice in same embryo sac, one is

called synergid & second as triple fusion. In it total 5 nuclei are involved [2 male gametes + one egg cell + 2 polar nuclei]. Double fertilization ensures that endosperm is formed.

52. (50)

Spring wood and autumn wood of a year constitute annual ring. The Age of tree can be determined by counting annual rings, in basal portion of tree trunk. This is called dendrochronology. So Age of tree is 50 years. which has 50 annual rings.

53. (2)

Binomial Nomenclature has two part one is generic name & other is species name like *Mangifera indica* [Mango]

54. (9)

In transverse section, the axial filament of tail shows the characteristic arrangement of nine pairs of peripheral microtubules surrounding a central pair of microtubule.

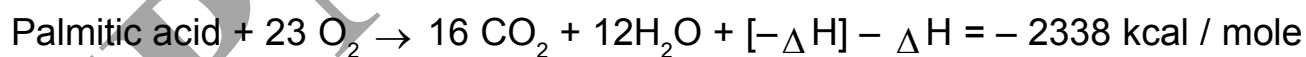
55. (6)

Enzymes are classified into 6 types :

- (1) Oxidoreductase
- (2) Transferases
- (3) Hydrolases
- (4) Lyases
- (5) isomerases
- (6) Ligase or synthetases.

56. (-2338000)

Palmitic acid has 16 carbon atoms when it undergoes β oxidation :



57. (2)

At the completion of glycolytic process, the products formed are two pyruvic acid molecules.

→ under aerobic conditions pyruvates can be converted to pyruvate dehydrogenase to acetyl - COA, which can then enter the citric Acid cycle.

→ Under Anaerobic conditions, pyruvate is converted to lactate by lactate dehy-

drogenase.

58. (0)

→ In human beings, colourblindness is caused due to recessive X linked gene.

Parent	$X^+ X^+$	X	$X^c Y$
	[Normal Female]		[Colourblind Male]
Gametes	$[X^+]$ $[X^+]$		$[X^c]$ $[Y]$
F_1	$\frac{1}{2} X^+ X^c$		$\frac{1}{2} X^+ Y$
	Normal but carrier Female		Normal but Hemizygous Male

Marriage between a carrier female and a normal male produces the progeny as follows:

$$F_2: \frac{1}{4} x^+ x^+ = \text{Normal Female}$$

$$\frac{1}{4} x^+ x^c = \text{Normal but carrier female}$$

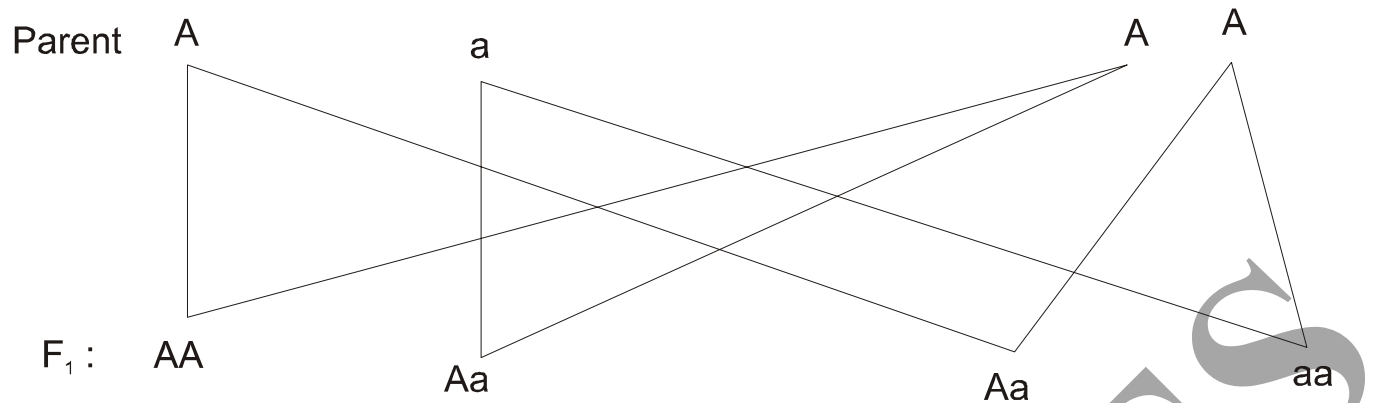
$$\frac{1}{4} x^+ y = \text{Normal male}$$

3 Normal:

1 colourblind

59. (25)

Recessive gene aa do not produce tyrosinase enzyme which is needed by melanocytes for synthesis of [black] pigment.



Therefore in F₁ progeny 25% offsprings will express 'a' phenotype.

60. (1)

Frame point mutation is a point mutation. The mutation which arise from the insertion or deletion of single base pair and cause the rest of the message downstream of the mutation to be read out of phase, are called frame shift mutation. They result in the production of an incorrect, hence, inactive protein, due to which the death of the cell may occur.