Indraprastha Institute of Information Technology (Delhi)
Foundations of Biology - BIO101.
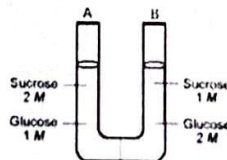### End Semester, Time – 2 hr, Total marks - 35

PART-A (15 x 1 = 15 M)

(Choose one best answer)

1. During oxidative phosphorylation, the proton motive force that is generated by electron transport is used to:
   A) induce a conformational change in the ATP synthase
   B. generate the substrates (ADP and Pi) for the ATP synthase.
   C) oxidize NADH to NAD+.
   D) reduce O2 to H2O.
   E) None of the above

   A

2. When your body temperature rises on a hot day, the neural and hormonal mechanisms activate sweating. Evaporation of sweat leads to cooling of the body surface. This is an example of
   A) Positive feedback regulation
   B) Negative feedback regulation.
   C) Complex system.
   D) Chemiosmosis.
   E) None of the above

   B

3. Which of the following metabolic processes take place in the cytosol of a eukaryotic cell?
   A) citric acid cycle
   B) fermentation and chemiosmosis
   C) oxidation of pyruvate to acetyl CoA
   D) glycolysis and fermentation
   E) None of the above

   D

4. The solutions in the two arms of this U-tube are separated by a membrane that is permeable to water and glucose but not to sucrose. Side A is half-filled with a solution of 2 M sucrose and 1 M glucose. Side B is half-filled with 1 M sucrose and 2 M glucose. Initially, the liquid levels on both sides are equal.

Sucrose 2 M — Sucrose 1 M
Glucose 1 M — Glucose 2 M

In the U-tube illustrated above, _____.
   A) side A is isotonic to side B
   B) side A is hypotonic to side B
   C) side A is hypertonic to side B
   D) side A is more turgid than side B
   E) None of the above

   A

5. For a protein to be an integral membrane protein, it would have to be
   _____.
   A) hydrophilic
   B) Hydrophobic
   C) amphipathic, with at least one hydrophobic region
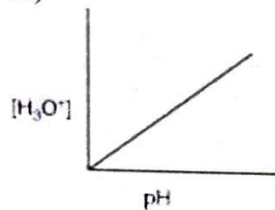   D) exposed on only one surface of the membrane
   E) None of the above

   C

6. According to the fluid mosaic model, a membrane _____.
   A) is composed of a fluid bilayer of phospholipids between two layers of hydrophilic proteins
   B) is composed of a single layer of fluid phospholipids between two layers of hydrophilic proteins
   C) is composed of a mosaic of fluid polysaccharides and amphipathic proteins
   D) is composed of a fluid bilayer of phospholipids with embedded amphipathic proteins

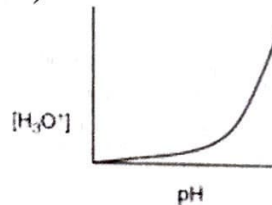   D

7. Which of the following graphs describes the relationship between $[H^3O^+]$ and pH?
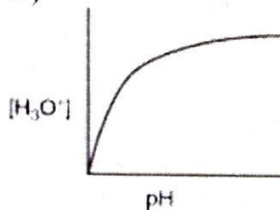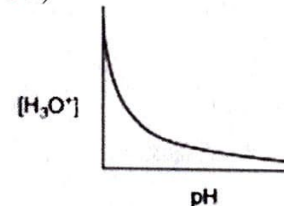
   A)   B)

   $[H_3O^+]$ $[H_3O^+]$

          pH   pH

   C)   D)

   $[H_3O^+]$ $[H_3O^+]$

          pH   pH

   E) None of the above

   D

8. F1 is a tetrahybrid cross of Aa Bb Cc Dd, and it is self-fertilised.
   What proportion of Aa Bb Cc Dd is got in F2?
   A) 1/64   B) 1/256   C) 1/16   D) 1/128
   E) None of the above

   C

9. During which of the following processes do sister chromatids separate from each other?
   A) During mitosis only
   B) During meiosis only
   C) During both mitosis and meiosis-II
   D) During both mitosis and meiosis-I
   E) None of the above

   C

10. Which of the following statements correctly describes *osmosis*?
  A) Osmosis only takes place in red blood cells.
  B) Osmosis is an energy-demanding or "active" process.
  C) In osmosis, water moves across a membrane from areas of lower solute concentration to areas of higher solute concentration.
  D) In osmosis, solutes move across a membrane from areas of lower water concentration to areas of higher water concentration.
  E) None of the above

`C`

11. Phenylketonuria is an inherited disease caused by a recessive autosomal allele. If a woman and her husband are both carriers, what is the probability that their first child will be a phenotypically normal girl?
  A) 3/4   B) 3/8   C) 1/4   D) 1/16   E) None of the above

`B`

12. The molecular weight of a protein is 44 kDa. The number of amino acid residue is
  A) 4   B) 40   C) 400   D) 4000   E) None of the above

`C.`

13. Which of the following are qualities of any good scientific hypothesis?
  I.   It is testable.
  II.   It is falsifiable.
  III. It produces quantitative data.
  IV.   It produces results that can be replicated.
  A) I only   B) III only   C) I and II   D) III and IV   E) None of the above

`C`

14. A glass of grapefruit juice, at pH 3, contains __ H as a glass of tomato juice, at pH 4.
  A) one-tenth as much   B) half as much   C) twice as much
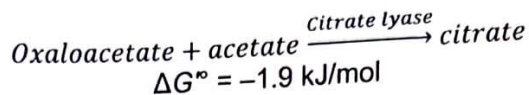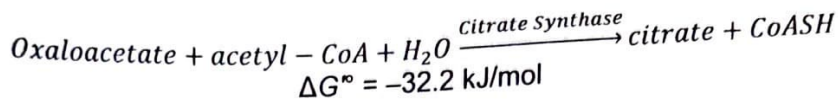 D) ten times as much   E) None of the above

`D`

15. How many heme groups are present in three haemoglobin protein molecules?
  A) 3   B) 4   C) 5   D) 9   E) None of the above
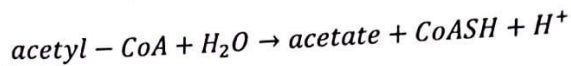
`E`

PART-B (3 x 2 = 6 M)

1. The $\Delta G°$ values for the two reactions shown below are given.

$$Oxaloacetate + acetyl - CoA + H_2O \xrightarrow{Citrate\ Synthase} citrate + CoASH$$
$$\Delta G° = -32.2\ kJ/mol$$

$$Oxaloacetate + acetate \xrightarrow{Citrate\ lyase} citrate$$
$$\Delta G° = -1.9\ kJ/mol$$

What is the $\Delta G°$ for the hydrolysis of acetyl-CoA?

$$acetyl - CoA + H_2O \rightarrow acetate + CoASH + H^+$$

A) −30.3 kJ/mol
B) −32.2 kJ/mol
C) −34.1 kJ/mol
D) +61.9 kJ/mol
E) +34.1 kJ/mol

A

2. Given the following genotypes for two parents, AABBCc × AabbCc, assume that all traits exhibit simple dominance and independent assortment. What proportion of the progeny of this cross will be expected to phenotypically resemble the first parent with the genotype AABBCc?
   A) 1/4   B) 3/8   C) 3/4   D) 0   E) None of the above

C

3. If Vmax = 100 µ mol/mL.sec-1 and Km = 80 mM, what is the velocity of the reaction when [S] = 20 mM ?
   A) v = 20 µmol/mL sec-1.
   B) v = 50 µmol/mL sec-1.
   C) v = 80 µmol/mL sec-1.
   D) v = 10 µmol/mL sec-1.
   E) None of the above

A

Part-C (3 x 3 = 9 M)

1. Calculate the pH of $[OH^-] = 1 \times 10^{-2}$ M at 25 °C and indicate whether the solution is acidic or basic. Show all the steps in your calculation.
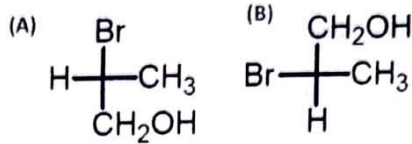
$$OH^- = 1 \times 10^{-2} M$$
$$[H^+][OH^-] = 1 \times 10^{-14}$$
$$[H^+] = \frac{1 \times 10^{-14}}{1 \times 10^{-2}} = 10^{-12}$$
$$pH = -\log_{10}(10^{-12}) = 12.$$

pH = 12, basic.

2. What is the relationship between the molecules shown below? Is it chiral? If so, what is the specification?

(A)
$$Br$$
$$H-\!\!-CH_3$$
$$CH_2OH$$

(B)
$$CH_2OH$$
$$Br-\!\!-CH_3$$
$$H$$

→ identical stereoisomers.   ①

→ Yes, chiral   ①

→ A) R   ⓪⑤

   B) R   ⓪⑤
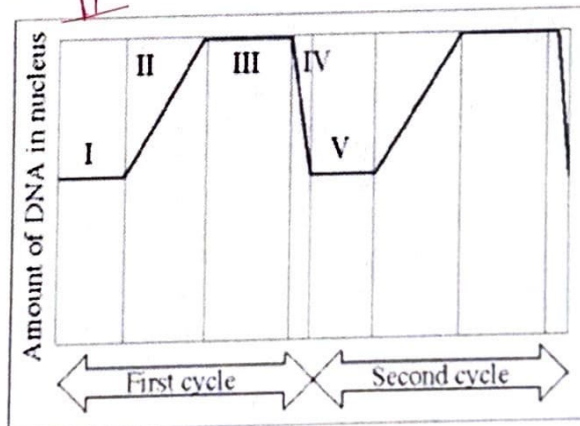
3. In the figure given below Regions I-V are provided for cell division cycle.   ①
   (A) Identify the region where number of DNA molecules/cell and chromosomes are same.   I, V
   (B) Identify the regions where chromosome is half of DNA molecules/cell   IV   ①
   (C) Identifythe region(s) where DNA molecules/cell is twice the number of DNA molecules/cell.   II   ①
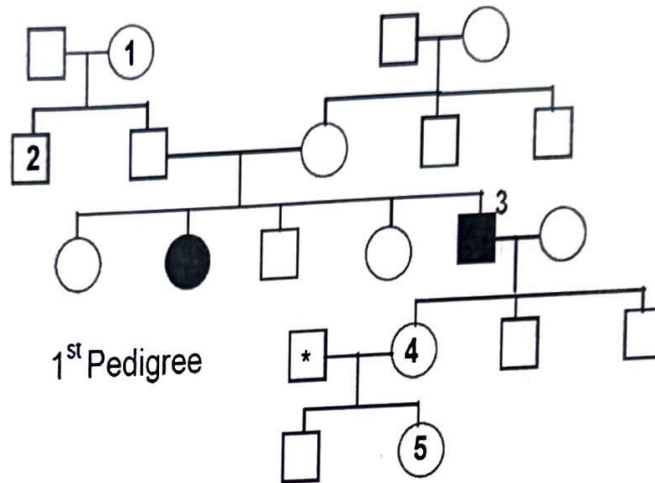

First cycle   Second cycle

Amount of DNA in nucleus

Part-D (1 x 5 = 5 M)

1. In the following human pedigrees, the filled symbols represent the affected individuals. You may assume that the disease allele is rare and therefore individuals marrying into the family are unlikely to have defective allele?

1ˢᵗ Pedigree

I.   What is the most likely mode of inheritance for this pedigree?   ①

Autosomal Recessive.

II. State all possible exhaustive genotype(s) of individuals # 1, 3, and 4 in the following table using the letter "A". Use the uppercase letter to represent the dominant allele and lowercase letter to represent the recessive allele.

Individual	Genotypes
#1	AA or Aa
#3	aa
#4	Aa

③

III. What is the probability that Individual 5 will be a carrier?

50 %.

①