

Section - H (Total questions - 15)

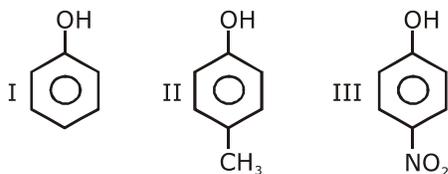
Chemistry (Compulsory)

Questions 01 to 05 carry one mark each.

- The ratio of the difference in energy between the first and the second Bohr orbit to that between the second and the third Bohr orbit is
  - 1/2
  - 1/3
  - 4/9
  - 27/5
- The correct order of decreasing polarity is
  - HF > SO<sub>2</sub> > H<sub>2</sub>O > NH<sub>3</sub>
  - HF > H<sub>2</sub>O > SO<sub>2</sub> > NH<sub>3</sub>
  - HF > NH<sub>3</sub> > SO<sub>2</sub> > H<sub>2</sub>O
  - H<sub>2</sub>O > NH<sub>3</sub> > SO<sub>2</sub> > HF
- If half cell reaction  $A + e^- \longrightarrow A^-$  has a large negative reduction potential, it follows that
  - A is readily reduced
  - A is readily oxidized
  - A<sup>-</sup> is readily reduced
  - A<sup>-</sup> is readily oxidized
- To prepare 3-ethylpentan-3-ol, the reagents needed are
  - CH<sub>3</sub>CH<sub>2</sub>MgBr + CH<sub>3</sub>COCH<sub>2</sub>CH<sub>3</sub>
  - CH<sub>3</sub>MgBr + CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>COCH<sub>2</sub>CH<sub>3</sub>
  - CH<sub>3</sub>CH<sub>2</sub>MgBr + CH<sub>3</sub>CH<sub>2</sub>COCH<sub>2</sub>CH<sub>3</sub>
  - CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>MgBr + CH<sub>3</sub>COCH<sub>2</sub>CH<sub>3</sub>
- Which of the following carbocations is least stable?
  - C<sub>6</sub>H<sub>5</sub>CH<sub>2</sub><sup>+</sup>
  - p-NO<sub>2</sub>-C<sub>6</sub>H<sub>4</sub>-CH<sub>2</sub><sup>+</sup>
  - p-CH<sub>3</sub>O-C<sub>6</sub>H<sub>4</sub>-CH<sub>2</sub><sup>+</sup>
  - p-Cl-C<sub>6</sub>H<sub>4</sub>-CH<sub>2</sub><sup>+</sup>

Questions 06 to 15 carry two marks each.

- What is the decreasing order of strength of the bases OH<sup>-</sup>, NH<sub>2</sub><sup>-</sup>, H-C≡C<sup>-</sup> and CH<sub>3</sub>-CH<sub>2</sub><sup>-</sup>?
  - CH<sub>3</sub>-CH<sub>2</sub><sup>-</sup> > NH<sub>2</sub><sup>-</sup> > H-C≡C<sup>-</sup> > OH<sup>-</sup>
  - H-C≡C<sup>-</sup> > CH<sub>3</sub>-CH<sub>2</sub><sup>-</sup> > NH<sub>2</sub><sup>-</sup> > OH<sup>-</sup>
  - OH<sup>-</sup> > NH<sub>2</sub><sup>-</sup> > H-C≡C<sup>-</sup> > CH<sub>3</sub>-CH<sub>2</sub><sup>-</sup>
  - NH<sub>2</sub><sup>-</sup> > H-C≡C<sup>-</sup> > OH<sup>-</sup> > CH<sub>3</sub>-CH<sub>2</sub><sup>-</sup>
- The correct acidic order of the following is



- I > II > III
- III > I > II
- II > III > I
- I > III > II





6. Which of the following statements about cyclic photophosphorylation is *incorrect*?
- It doesn't involve NADPH formation.
  - It is activated when  $\text{NADP}^+$  is limiting.
  - It does not generate  $\text{O}_2$ .
  - It involves a substrate-level phosphorylation.
7. *Group I* (Enzymes) *Group II* (Pathways)
- |                           |                        |
|---------------------------|------------------------|
| P. Glycogen phosphorylase | A. glycolytic pathways |
| Q. Hexokinase             | B. calvin cycle        |
| R. Pyruvate carboxylase   | C. C3 cycle            |
| S. RuBP carboxylase       | D. C4 cycle            |
|                           | E. glycogenolysis      |
|                           | F. C6 cycle            |
- P - E, Q - A, R - F, S - C
  - P - B, Q - A, R - C, S - D
  - P - D, Q - B, R - E, S - A
  - P - F, Q - E, R - B, S - A
8. Which of the following equation represents the reciprocal of Michaelis-Menten equation?
- $\frac{1}{V} = \frac{K_m + [S]}{V_{\max} [S]}$
  - $\frac{V}{[S]} = -\frac{V}{K_m} + \frac{V_{\max}}{K_m}$
  - $V = \frac{K_{\text{cat}}}{K_m} [E]_t [S]$
  - $V = \frac{V_{\max} [S]}{K_m + [S]}$
9. Mobile IS elements, in addition to the transposase gene, must also carry
- a drug resistance gene
  - inverted terminal repeat sequence
  - replication genes
  - host genes
10. Which of the following is *incorrect* statement?
- Actin filaments, microtubules, and intermediate filaments each have a different arrangement in a eucaryotic cell and, in combination with a variety of accessory proteins, provide a different function.
  - Microtubules are highly dynamic structures that can shorten as well as lengthen; in general, they grow by addition of subunits to the plus end and shrink by removal of subunits from their minus end.
  - In an isolated cell fragment, microtubules will reorganize themselves to form a star like array emanating from a new microtubule organizing centre at the centre of the cell fragment.
  - The normal locations of the ER and Golgi are thought to be determined by receptor proteins on their cytosolic surface that bind specific microtubule-dependent motors—a plus-end-directed kinesin for the ER and a minus-end-directed dynein for the Golgi apparatus.

**Questions 11 to 20 carry two marks each.**

11. Choose the statement that is *not* correct with respect to the protein kinase C(PKC)
- activated PKC can phosphorylate the specific tryptophan residue on the target protein.
  - PKC is a  $\text{Ca}^{2+}$  dependent kinase.
  - PKC can be activated by diacylglycerol.
  - activation of PKC can lead to the activation of MAP kinase.
12. Oncogenes incorporated into viral genomes can differ from their normal, cellular counterparts (proto-oncogenes) in all of the following ways *except*
- they can contain fusions to viral sequences that result in structural changes that deregulate the protein.
  - they can contain point mutations in regulatory domains that result in a loss of protein regulation.
  - they can be present in many tandem copies, as opposed to the single copy present in the cell.
  - they can be expressed from much stronger promoters than the normal, cellular promoter.

13. The directionality of nuclear protein import is determined by
- a Ran/GTP gradient
  - importin
  - an ion gradient
  - the nuclear lamina
14. The difference between the proton gradient across the inner mitochondrial membrane and across the thylakoid membrane of chloroplasts is that
- the first creates an electrochemical gradient, while the second is largely just a chemical gradient.
  - there is no proton gradient across the thylakoid membrane. Magnesium ions create the gradient instead.
  - it is generated by an electron transport system in the first case, but not in the second.
  - it drives the synthesis of ATP in the first case but not in the second.
15. Which of the following statements is *correct*?
- The alpha-helix can be composed of more than one polypeptide chain.
  - Beta-sheets exist only in the antiparallel form.
  - Beta-bends often contain proline.
  - Motif is a type of secondary structure.
16. Which of the following is *not* true about beta oxidation of fatty acid containing even number of carbons?
- End product — acetyl-CoA
  - Cofactor required —  $\text{NAD}^+$  and FAD
  - Decreases during starvation
  - Site — mitochondria
17. Gene regulation can only be fully understood in the context of cellular physiology and/or development. The fact that the lactose operon is off when repressor protein is bound to the operator DNA sequence only takes on significance when we understand the effect that the disaccharide lactose has on this operon. When lactose is taken up by bacterial cells, it is converted to allolactose. How does allolactose activate the lactose operon?
- Allolactose is converted to the very effective inducer IPTG which binds to repressor protein to inactivate it.
  - Allolactose is converted to the very effective inducer IPTG which binds to repressor protein to activate it.
  - Allolactose binds to repressor protein directly and inactivates the repressor.
  - Allolactose binds to repressor protein directly and activates the repressor.
18. Which of the following properties is *not* exhibited by  $T_H$  cells?
- Stimulate division of B cells.
  - Stimulate division of cytotoxic T cells (CTLs).
  - Are cytotoxic for other cells.
  - Stimulate migration of macrophages.
19. The predominant secondary structural motif in an antibody molecule is
- antiparallel beta-sheet
  - a 4-helix bundle
  - alpha-helical coiled coil
  - parallel beta-sheet
20. Choose the correct match.
- |                             |  |
|-----------------------------|--|
| <i>Group I</i>              | <i>Group II</i>                                    |
| P. Immunodeficiency disease | 1. Hexosaminidase-A                                |
| Q. Tay-Sach disease         | 2. Hypoxanthine-guanine phosphoribosyl-transferase |
| R. Lesch-Nyhan syndrome     | 3. Chloride channel                                |
| S. Cystic fibrosis          | 4. Adenosine deaminase                             |
| a. P-1, Q-3, R-4, S-2       | b. P-3, Q-2, R-4, S-1                              |
| c. P-4, Q-1, R-2, S-3       | d. P-2, Q-4, R-3, S-1                              |

## Microbiology

Questions 01 to 10 carry *one* mark each.

- When a population of bacteria capable of conjugation transfers a specific chromosomal gene (say a gene coding for galactose metabolism) but no other genes, regardless of how long the bacteria are allowed to mate, these bacteria are said to be
  - F<sup>+</sup>
  - F<sup>-</sup>
  - Hfr
  - F'
- Which of the following statement is *incorrect*?
  - Enzyme activity associated with reverse transcriptase that digests the RNA template after DNA has been synthesized is RNase-H.
  - Viral envelope attaches the HIV to host cell is gp120.
  - Genomes of retroviruses contain two copies of plus ssRNA.
  - HIV contains single copy of ssRNA.
- Erythromycin is the antibiotic of choice when treating respiratory tract infections in Legionnaires' disease, whooping cough, and *Mycoplasma*-based pneumonia because of its ability to inhibit synthesis in certain bacteria by
  - inhibiting translocation by binding to 50S ribosomal subunits.
  - acting as an analogue of mRNA.
  - causing premature chain termination.
  - inhibiting initiation.
- Two proteins have the same molecular mass and have identical net charge at pH 7. The best way to separate them would be to use
  - native gel electrophoresis.
  - SDS-polyacrylamide gel electrophoresis.
  - cation-exchange chromatography.
  - anion-exchange chromatography.
- Papain digestion of an IgG preparation of antibody specific for the antigen hen egg albumin (HEA) will
  - lose its antigen specificity
  - precipitate with HEA
  - lose all interchain disulfide bonds
  - produce two Fab molecules and one Fc molecule
- Match the column
  - P. psychrophile
  - Q. psychrotroph
  - R. mesophile
  - S. halophile
  1. can grow at 0–7°C, optimum growth temperature between 20°C and 30°C
  2. grow well at 0°C
  3. optimum growth around 20–45°C
  4. require right salt concentration
  - a. P-2, Q-1, R-3, S-4
  - b. P-1, Q-2, R-4, S-3
  - c. P-1, Q-2, R-3, S-4
  - d. P-2, Q-1, R-4, S-3
- All of the following components of a retrovirus are encoded by the viral genome *except*
  - viral RNA's
  - capsid proteins
  - envelope lipids
  - receptor-binding proteins

8. You are working with two strains of *E. coli*. One contains a wild-type beta-galactosidase gene and an  $I^-$  mutation; the other contains a temperature-sensitive beta-galactosidase gene and an  $O^c$  mutation. After mating these strains, you assay for the production of beta-galactosidase at both permissive and nonpermissive temperatures in the absence of lactose. Which of the following is *not* correct?
- The temperature-sensitive gene will be expressed constitutively.
  - $\beta$ -galactosidase will be produced at the permissive temperature.
  - Wild-type gene will be regulated.
  - $\beta$ -galactosidase will express in the nonpermissive temperature.
9. Enveloped animal viruses that lose their envelope as they penetrate the plasma membrane are entering the cell by
- endocytosis
  - membrane fusion
  - encapsidation
  - endosome fusion
10. Interleukin-2 is inactivated by an antibody. This inactivation would inhibit which immune system component?
- Complement activation
  - Antigen presentation
  - T-cell activation
  - Immunoglobulin E-activation

**Questions 11 to 20 carry two marks each.**

11. Bacterial cells that can be lysogenized by lambda possess in their genome
- 80S ribosome genes
  - attB* sites
  - attP* sites
  - attL* sites
12. Which of the following does *not* make direct use of a pH of proton gradient?
- mitochondria
  - chloroplast
  - protozoan cilium
  - bacterial flagellum
13. Which of the following statement about the enzyme complexes of the electron transport system is *correct*?
- They are located in the mitochondrial matrix.
  - They cannot be isolated from one another in functional form.
  - They have very similar visible spectra.
  - They are integral membrane proteins located in the inner mitochondrial membrane.
14. The presence of D-amino acids in the crosslinks of the peptidoglycan layer is most likely because
- most peptidases can only cleave L-amino acids.
  - D-amino acids fit the structural constraints of the cell wall better than L-amino acids.
  - most L-amino acids have already been used for protein synthesis.
  - D-amino acids are easier to crosslink in the absence of ribosomes.

15. Which of the following combinations represent the *correct* structure of maltose and sucrose?
- O-alpha-D-glucopyranosyl-(1 → 4)-beta-D-glucopyranose and O-beta-D-galactopyranosyl-(1 → 4)-beta-D-glucopyranose
  - O-beta-D-fructofuranosyl-(2 → 1)-alpha-D-glucopyranoside and O-beta-D-galactopyranosyl-(1 → 4)-beta-D-glucopyranose
  - O-alpha-D-glucopyranosyl-(1 → 4)-beta-D-glucopyranose and O-beta-D-fructofuranosyl-(2 → 1)-alpha-D-glucopyranoside
  - O-alpha-D-glucopyranosyl-(1 → 6)-beta-D-glucopyranose and O-beta-D-fructofuranosyl-(2 → 1)-alpha-D-glucopyranoside
16. Match the subunit of the RNA polymerase of *E. coli* in the left column with its putative function during catalysis from the right column.
- |                       |  |
|-----------------------|--|
| P. $\alpha$           | 1. binds the DNA template                          |
| Q. $\beta$            | 2. binds regulatory proteins and sequences         |
| R. $\beta'$           | 3. binds NTPs and catalyzes bond formation         |
| S. $\sigma^{70}$      | 4. recognizes the promoter and initiates synthesis |
| a. P-2, Q-3, R-1, S-4 | b. P-3, Q-2, R-4, S-1                              |
| c. P-3, Q-4, R-2, S-1 | d. P-1, Q-3, R-2, S-4                              |
17. During translation initiation in prokaryotes, GTP is required for
- formation of formyl-met-tRNA.
  - binding of 30S subunit of ribosome with mRNA.
  - association of 30S-mRNA with formyl-met-tRNA.
  - association of 50S subunit of ribosome with initiation complex.
18. The entire complement of mRNA produced under a given set of conditions is called a transcriptome. A powerful technique exists for transcriptome analysis is microarrays is needed to measure
- gene expression by making hybridization between specific mRNA and DNA on the chip.
  - translational ability of mRNA.
  - transcriptome
  - both a and c
19. Bacteria do not have organelles. How are they able to carry out photosynthesis?
- They use their cell membrane to carry out photosynthesis.
  - 70S ribosomes function as a photosystem.
  - They are parasites of plants that do have organelles.
  - They interact in a symbiotic relationship with eukaryotic plants.
20. Which of the following is *false* statements?
- Retroviruses convert their RNA genomes into DNA that is longer than the RNA genome.
  - Double-stranded RNA viruses carry RNA-dependent RNA polymerase known as a replicase.
  - Replication of DNA of poxvirus occurs in the nucleus.
  - Viroid contains non-coding RNA.

## General aptitude

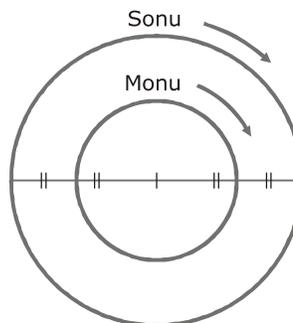
**Questions 01 to 05 carry one mark each.**

1. 10 years ago Ram was 5 times as old as Shyam, but 20 years later from now he will be twice as old as Shyam. How many years old is Shyam?
  - a. 20 years
  - b. 30 years
  - c. 40 years
  - d. 50 years
  
2. Pick out the most effective word from the given words to fill in the blanks to make the sentence meaningfully complete.  
 He spent whole of his life in \_\_\_\_\_ the miseries of the downtrodden people
  - a. destroying
  - b. advocating
  - c. avoiding
  - d. mitigating
  
3. Choose the word from the options given below that is most nearly opposite in meaning to the given word:  
**Concede**
  - a. object
  - b. refuse
  - c. grant
  - d. accede
  
4. Which of the following options is the closest in the meaning to the word below?  
**Uncouth**
  - a. ungraceful
  - b. rough
  - c. slovenly
  - d. dirty
  
5. Which of phrases given below each sentence should replace the phrase printed in bold type to make the grammatically *correct*?  
 The man **to who I sold** my house was a cheat.
  - a. to whom I sell
  - b. to who I sell
  - c. who was sold to
  - d. to whom I sold

**Questions 06 to 10 carry two marks each.**

6. Sonu and Monu went jogging round a circular track as shown in the diagram. The table below shows the number of rounds each of them ran round the track on different days. On which day did the two of them complete the same distance?

Day	Number of rounds completed by	
	Sonu	Monu
Monday	4	2
Wednesday	2	4
Friday	4	6
Sunday	3	5



- a. Monday
- b. Wednesday
- c. Friday
- d. Sunday

