

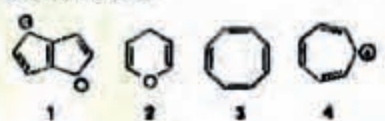
LIFE SCIENCES

J: CHEMISTRY (COMPULSORY)

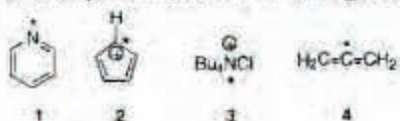
[Useful data: Gas constant, $R = 8.3143 \text{ JK}^{-1} \text{ mol}^{-1}$; Faraday, $F = 96500 \text{ Cmol}^{-1}$]

ONE MARKS QUESTIONS (1-10)

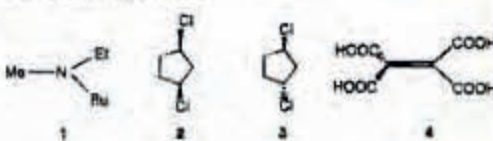
1. For a second order reaction, $2B \rightarrow$ Products, if the initial concentration of the species B is $[B]_0$ and the rate constant is k , then $t_{1/2}$ can be expressed as:
 - a. $1/[B]_0 k$
 - b. $1/k$
 - c. $[B]_0/k$
 - d. $1/2[B]_0 k$
2. If the heats of reaction of the following transformations $C + O_2(g) \rightarrow CO_2(g)$, $C + 1/2 O_2(g) \rightarrow CO(g)$ and $CO(g) + 1/2 O_2(g) \rightarrow CO_2(g)$ are Q , 11.5 and 10.5 joules respectively, then Q in joules is equal to:
 - a. 120.75
 - b. 1
 - c. -1
 - d. 22
3. The spontaneity of a reaction can be judged from the sign of the emf (E) and the free energy (G) of the cell. The criteria are:
 - a. $\Delta G = +ve$, $E = -ve$
 - b. $\Delta G = 0$, $E = 0$
 - c. $\Delta G = -ve$, $E = +ve$
 - d. $\Delta G = -ve$, $E = -ve$
4. the function $\cos(ax)$ is an eigen function of d^2/dx^2 with an eigenvalue of:
 - a. $-a$
 - b. $-a^2$
 - c. a
 - d. $-a^{-2}$
5. The heteronuclear diatomic molecule that is isoelectronic to HCN is:
 - a. NO
 - b. CO
 - c. BO
 - d. SO
6. The bond order in Be_2 molecule can be expected to be:
 - a. 0
 - b. 1
 - c. 2
 - d. 3
7. The intense color of $KMnO_4$ is due to:
 - a. electronic transition from one energy level to another in Mn
 - b. electronic transition from one energy level to another in O
 - c. charge transfer from Mn to O
 - d. charge transfer from O to Mn
8. Of the following, the compounds that are aromatic are:



 - a. 1, 4
 - b. 1, 2, 4
 - c. 2, 3, 4
 - d. 2, 4
9. The hybridization of the atoms indicated by an asterisk in the following compounds in a sequence (from 1 to 4) is given by:



 - a. sp^3, sp^2, sp^3, sp
 - b. sp^2, sp^2, sp^3, sp^2
 - c. sp^2, sp^2, sp^3, sp
 - d. sp^2, sp^3, sp^3, sp
10. Which of the following compounds can have enantiomers?



 - a. 2,3,4

- b. 1,3,4
c. 3,4
d. 1,3

TWO MARKS QUESTIONS (11-30)

11. The rate constant for a certain reaction is found to be doubled when the temperature is raised from 27 to 37°C. The activation energy for this reaction in kJ is:
a. 26.8
b. 107.2
c. 53.6
d. 50.0
12. The standard potential for the electrodes $\text{Hg}|\text{Hg}_2^{+2}$ and $\text{Hg}|\text{Hg}^{+2}$ are -0.799 and -0.855 volts at 25°C, respectively. The equilibrium constant for the reaction $\text{Hg} + \text{Hg}^{+2} \rightleftharpoons \text{Hg}_2^{+2}$ is:
a. 8512
b. 79.12
c. 70
d. 90.20
13. The freezing point of pure benzene is 5.44°C, and that of a solution containing 2.092 g of A in 100 g of benzene is 4.44°C. The molal depression constant (k) for benzene is 5.1. From his data, the molecular weight of A can be calculated to be:
a. 106.7
b. 206.6
c. 213.4
d. 53.2
14. The ion conductance of the alkali metal cations at a given concentration follow the following order:
a. $\text{Li}^+ > \text{Na}^+ > \text{K}^+ > \text{Rb}^+$
b. $\text{Li}^+ < \text{Na}^+ < \text{K}^+ > \text{Rb}^+$
c. $\text{Li}^+ < \text{Na}^+ < \text{K}^+ < \text{Rb}^+$
d. $\text{Li}^+ \cong \text{Na}^+ > \text{K}^+ > \text{Rb}^+$
15. A system undergoes a certain change in state by path I. The heat absorbed and the work done for this process are 10 kcal mol⁻¹ and 0 ergs mol⁻¹ respectively. The respective quantities for the same change in state by path II are 11 kcal mol⁻¹ and 0.5 w_{max} , where w_{max} is the work done if the change were reversibly carried out. The magnitude of w_{max} in kJ mol⁻¹ (1 cal = 4.2 J) is:
a. 4.2
b. 2
c. 1
d. 8.4
16. The total pressure for the reaction $\text{C(s)} + \text{CO}_2(\text{g}) \rightleftharpoons 2\text{CO(g)}$ under the equilibrium condition is 15 atm. The value of K_p is:
a. 16
b. 10
c. 20
d. 25
17. The order of increasing bond order for the diatomic species $\text{O}_2^+, \text{O}_2^-, \text{O}_2, \text{O}_2^{2-}$ is:
a. $\text{O}_2^{2-} < \text{O}_2^- < \text{O}_2 < \text{O}_2^+$
b. $\text{O}_2 < \text{O}_2^+ < \text{O}_2^- < \text{O}_2^{2-}$
c. $\text{O}_2^+ < \text{O}_2 < \text{O}_2^- < \text{O}_2^{2-}$
d. $\text{O}_2^- < \text{O}_2^{2-} < \text{O}_2^+ < \text{O}_2$
18. The bond angle in I_3^- is:
a. 90°
b. 104°
c. 120°
d. 180°
19. The number of ions present in the unit cell of cesium chloride (CsCl) is:
a. 6
b. 4
c. 2
d. 8
20. The crystal field stabilization energy and the spin-only magnetic of $[\text{CoF}_6]^{3-}$ are, respectively:
a. $0.4 \Delta_0$ and 4.9 B.M.
b. $0.8 \Delta_0$ and 3.8 B.M.
c. $1.8 \Delta_0$ and 1.7 B.M.
d. $2.4 \Delta_0$ and 0 B.M.
21. The reaction of H_3BO_3 with HF yields a product, which upon introduction into a flame gives a characteristic green coloration. The product is:
a. BH_3
b. B_2H_6
c. B_2O_3
d. BF_3

22. Graphite sublimes at a very high temperature (3700°C). This is due to:
- weak covalent interactions in the solid and stronger or more covalent interactions in the gas phase
 - strong covalent interactions in the solid and weaker or feaker covalent interactions in the gas phase
 - strong covalent interactions in the solid and strong covalent interactions in the gas phase
 - weak covalent interactions in the solid and stronger ionic interactions in the gas phase

23. The nickel(II) complex $[\text{NiCl}_2(\text{PPh}_3)_2]$ is paramagnetic. The analogous complex of palladium(II) is diamagnetic. The number of isomers that will exist for each of these formulations respectively are:

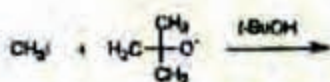
- 1,1
- 2,2
- 1,2
- 2,1

24. The order (from 1 to 3) in which the reactions below follow $\text{S}_{\text{N}}1$ and $\text{S}_{\text{N}}2$ mechanism is:

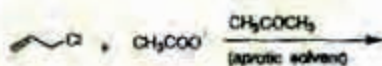
1.



2.

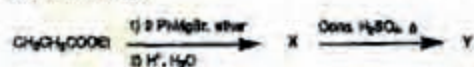


3.



- $\text{S}_{\text{N}}1, \text{S}_{\text{N}}2, \text{S}_{\text{N}}2$
- $\text{S}_{\text{N}}2, \text{S}_{\text{N}}1, \text{S}_{\text{N}}2$
- $\text{S}_{\text{N}}1, \text{S}_{\text{N}}2, \text{S}_{\text{N}}1$
- $\text{S}_{\text{N}}2, \text{S}_{\text{N}}2, \text{S}_{\text{N}}1$

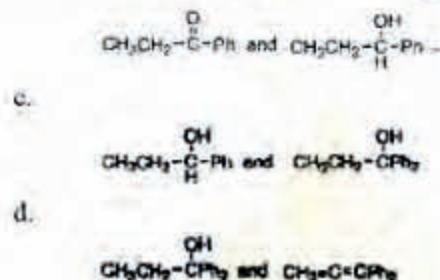
25. The products X' and Y' of the following reaction are:



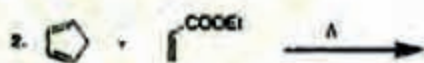
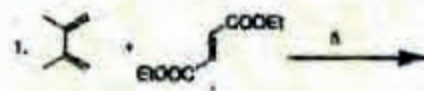
a.



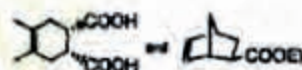
b.



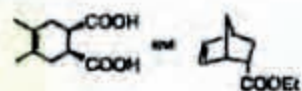
26. The major products of the following Diels-Alder cycloaddition reactions 1 and 2 with the correct stereochemistry are:



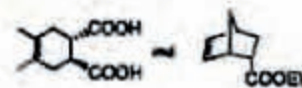
a.



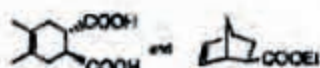
b.



c.

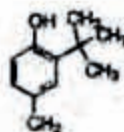


d.

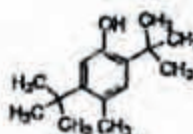


27. p-Cresol (4-methylphenol) reacts with two molar equivalents of isobutylene in the presence of HCl and AlCl_3 to give a product, which is an excellent antioxidant. The structure of the product is:

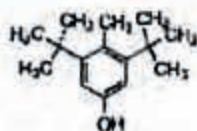
a.



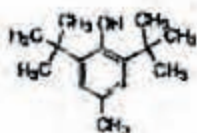
b.



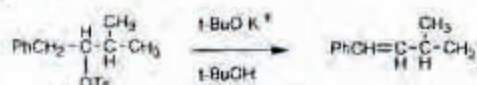
c.



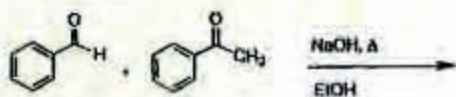
d.



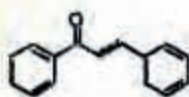
28. Which of the following statements is correct about the elimination reaction given below?



- a. the product shown will not be formed, because Saytzeff rule necessitates the formation of the alternative more substituted olefin
- b. the product shown will be formed predominantly, because the conjugation of the double bond with the phenyl ring leads to thermodynamic stability
- c. the product shown will be formed as a minor one. This follows from Saytzeff rule
- d. the product shown is correct and it follows from Saytzeff rule
29. The perhydroxylation of maleic and fumaric acids using KMnO_4 leads respectively to the following tartaric acids:
- a. meso and meso
- b. d, l racemate and meso
- c. meso and d, l racemate
- d. d, l racemate and d, l racemate
30. The product of the following reaction and the name reaction that leads to its formation are:

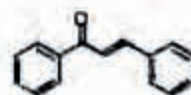


a.



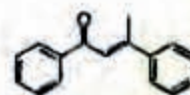
Mixed Aldol Condensation

b.



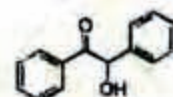
Perkin Condensation

c.



Claisen Condensation

d.



Benzoin Condensation

K: BIOCHEMISTRY

ONE MARKS QUESTIONS (1-10)

- The most abundant atom in a living organism is
 - Hydrogen
 - Oxygen
 - Nitrogen
 - Carbon
- The coenzyme involved in transfer of carboxyl group is
 - NADH
 - Coenzyme A
 - S-Adenosyl methionine
 - Biotin
- The unit of length Angstrom^o equals to
 - 10^{-6} m
 - 10^{-8} m
 - 10^{-10} m
 - 10^{-15} m
- Which of the following triplet does NOT code for any amino acid
 - UUA
 - UCA
 - UAA
 - UGU
- Erythrocytes resist shearing forces while travelling through narrow blood vessels because they contain the meshwork of
 - Glycophorin A

- b. Spectrin
c. Hemoglobin
d. Myoglobin
6. Tetrodotoxin, a highly poisonous toxin from Puffer fish acts on
a. Sodium channel
b. Potassium Channel
c. Chloride Channel
d. Calcium Channel
7. Electron flow in Cytochrome oxidase in the respiratory chain can be blocked by
a. Rotenone
b. Amytal
c. Cyanide
d. Cycloheximide
8. In case of humans, passive immunity observed in newborn child is due to the passage of the following immunoglobulin from the mother to the child through placenta
a. IgD
b. IgE
c. IgM
d. IgG
9. In eukaryotic cells, around 5% cytosine residues are methylated, the methylation most commonly occurs in the following sequence
a. CpA
b. CpT
c. CpG
d. CpC
10. The following reagent will NOT release the integral proteins from the plasma membrane
a. Sodium chloride
b. Triton X-100
c. Sodium dodecyl sulphate
d. NP-40
- a. 2
b. 1
c. 3
d. 4
12. Monoclonal antibodies were raised against three different proteins containing unique epitomes. All the monoclonal antibodies were mixed together and placed in one of the wells in an Ouchterlony Double Diffusion plate. Similarly all three proteins were mixed together and placed in the adjacent well. The number of precipitin bands observed after incubation are
a. 3
b. 2
c. 1
d. 0
13. L-19 RNA from the protozoan Tetrahymena was demonstrated to have two enzymatic activities and these activities are
a. RNA polymerase, DNA polymerase
b. Ribonuclease, RNA polymerase
c. Ribonuclease, Deoxyribonuclease
d. Ribonuclease, Protease
14. A single stranded DNA of unknown size can NOT be distinguished from a double stranded DNA by
a. Analysis of base composition
b. Thermal denaturation
c. Density gradient ultracentrifugation
d. Gel Electrophoresis
15. Telomerase is all enzyme whose macromolecular composition is
a. Lipoprotein only
b. Ribonucleoprotein only
c. Ribonucleic acid only
d. Protein only
16. The molecular weight of IgG-Antigen complex at antigen excess is 300 Kd. The molecular weight of antigen is
a. 75
b. 50
c. 100
d. 150
17. The net reaction of the Citric acid cycle is
a. $\text{Acetyl CoA} + 2\text{NAD}^+ + \text{FAD} + \text{GDP} + \text{P}_i + 2\text{H}_2\text{O} \rightarrow 2\text{CO}_2 + 2\text{NADH} + \text{FADH}_2 + \text{GTP} + 2\text{H}^+ + \text{CoA}$
b. $\text{Acetyl CoA} + 3\text{NAD}^+ + \text{FAD} + \text{GDP} + \text{P}_i + 2\text{H}_2\text{O} \rightarrow 2\text{CO}_2 + 3\text{NADH} + \text{FADH}_2 + \text{GTP} + 2\text{H}^+ + \text{CoA}$

TWO MARKS QUESTIONS (11-30)

11. The biochemical reactions leading from glucose to the generation of glyceraldehyde-3-phosphate consume ATP. The number of ATP molecules consumed for the conversion of one molecule of glucose to glyceraldehyde-3-phosphate is

- c. $\text{Acetyl CoA} + 2\text{NAD}^+ + 2\text{FAD} + 2\text{GDP} + 2\text{P}_i + 2\text{H}_2\text{O} \rightarrow 2\text{CO}_2 + 2\text{NADH} + 2\text{FADH}_2 + 2\text{GTP} + \text{CoA}$
 d. $\text{Acetyl CoA} + \text{NAD}^+ + \text{FAD} + \text{GDP} + \text{P}_i + \text{H}_2\text{O} \rightarrow 2\text{CO}_2 + \text{NADH} + \text{FADH}_2 + \text{GTP} + \text{CoA}$

18. Genetic variation between individuals within a species involving different alleles at a locus is called

- Isotypic variation
- Idiotypic variation
- Allotypic variation
- Haplotypic variation

19. A pentameric IgM molecule was electrophoresed on a reducing SDS-Polyacrylamide gel. How many bands one can expect

- 1
- 2
- 3
- 4

20. Viral encoded Ras oncogene transforms normal mammalian cells into cancer cells. Viral Ras protein differs from its normal counterpart by

- Diminished GTPase activity
- Increased GTPase activity
- Diminished ATPase activity
- Increased ATPase activity

21. Choose the correct match

Group I

P Immunodeficiency disease

Q Tay-Sach disease

R Lesch-Nyhan syndrome

S Cystic fibrosis

Group II

1. Hexosaminidase-A

2. Hypoxanthine-guanine phosphoribosyl-transferase

3. Chloride channel

4. Adenosine deaminase

Codes:

- | | P | Q | R | S |
|----|---|---|---|---|
| a. | 1 | 3 | 4 | 2 |
| b. | 3 | 2 | 4 | 1 |
| c. | 4 | 1 | 2 | 3 |
| d. | 2 | 4 | 3 | 1 |

22. Choose the correct match

Group I

P β -ketoacyl-ACP synthase

Q β -ketoacyl-ACP reductase

R Enoyl-ACP-reductase

S Acyl carrier protein (ACP)

Group II

- Reduces double bond forming saturated acyl-ACP
- Reduces β -keto group to 3-hydroxy group
- Condenses acyl and malonyl groups
- Carries acyl group in thioester linkages

Codes:

- | | P | Q | R | S |
|----|---|---|---|---|
| a. | 2 | 1 | 3 | 4 |
| b. | 3 | 2 | 1 | 4 |
| c. | 4 | 1 | 2 | 3 |
| d. | 3 | 1 | 2 | 4 |

23. A DNA was labeled at its 5' end using γ ^{32}P -ATP. Choose the correct combination from the following options to separate the free γ ^{32}P -ATP from γ ^{32}P labeled DNA

P. γ ^{32}P -ATP can be removed by treating the sample with phosphatases

Q. The labeled samples can be electrophoresed and blotted onto nitrocellulose membrane and then labeled DNA can be recovered from nitrocellulose membrane

R. Sample can be passed through a gel filtration column to separate free γ ^{32}P -ATP

S. DNA can be precipitated using ethanol to separate it from contamination γ ^{32}P -ATP

a. P, Q

b. P, S

c. R, S

d. R, Q

24. A team of researchers had used the following eluting buffers to prepare an anti albumin IgG from an anti IgG affinity column,

Buffer A: 0.1M Glycine-HCl, pH 3.0

Buffer B: 0.1M Sodium acetate, pH 6.0

Buffer C: 0.1M Sodium phosphate, pH 7.0

Buffer D: 0.1M Tris-HCl, pH 8.0

Which of the above buffers can be used for anti albumin IgG elution?

a. Buffer A

b. Buffer B

- c. Buffer C
d. Buffer D
25. Oligosaccharide chain is added to the Asparagine residue of a newly synthesized protein on the luminal side of the endoplasmic reticulum membrane. The Asparagine of the newly synthesized protein that is linked to oligosaccharide chain is a part of the sequence (x, can be any amino acid other than Proline)
- Asn-x-Asp
 - Asn-x-Thr
 - Asn-x-Ile
 - Asn-x-Gly
26. The Signal recognition particle binds to the signal peptide of the protein undergoing synthesis resulting into a pause in the translational process. The pause in the translational phenomenon is due to
- inactivation of aminoacyl-tRNA synthetases
 - inhibits the activity of elongation factor Tu
 - induced conformational change in the smaller ribosomal subunit
 - blockade of the entry of the next aminoacyl-tRNA for the reaction
27. Which of the following Statement is NOT true with respect to the Photo system II found in the chloroplasts? (Photo system I = PS I, Photosystem II = PS II)
- PS II is located in the grana
 - Chlorophyll molecule in the reaction center for the PS II is bound to a 110Kd integral membrane protein
 - A complex of Cytochromes b and f transports electrons from PS II to PS I
 - PS II reaction center is bound to two Mn^{2+} ions
28. 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 Ca^{2+} dependant kinase
 - PKC can be activated by diacylglycerol
 - Activation of PKC can lead to the activation of MAP kinase
29. 'Enhancer' elements are known to increase the rate of transcription when present at the upstream side of the promoter sequences. If the same enhancer element is placed in reverse orientation,
- the rate of transcription increases
 - the rate of transcription decreases
 - the rate of transcription remains same
 - no transcription is observed
30. Choose the group containing only the peptide hormones
- Vasopressin, Oxytocin, Epinephrine
 - Vasopressin, Testosterone, Glucagon
 - Oxytocin, Vasopressin, Thyroxine
 - Oxytocin, Vasopressin, Somatostatin

J : BIOTECHNOLOGY

ONE MARKS QUESTIONS (1-10)

- Expression of hundreds of different genes in DNA micro array technology is monitored by using
 - Radioactive probe
 - Visible chromogenic probe
 - UV absorbing probe
 - Fluorescent probe
- Transfer of T-DNA from Ti plasmid into plant cell is mediated by
 - mob gene
 - vir gene
 - nif gene
 - octopine gene
- For the growth of T-cell, the growth factor needed would be
 - Epidermal growth factor
 - Interleukin-2
 - Fibroblast growth factor
 - TNF- α
- Nick translation of DNA is a method for making DNA probes. Identify from below what is NOT required for nick translation method
 - DNA polymerase
 - DNAase
 - Primers
 - Deoxyribonucleotides
- During the functioning of biosensor which of the following sequences of event occurs

- a. Enzymatic/cellular reaction \rightarrow detector \rightarrow transducer
 b. Enzymatic/cellular \rightarrow reaction \rightarrow transducer \rightarrow detector
 c. Enzymatic/cellular reaction \rightarrow pressure gauge \rightarrow time
 d. Enzymatic/cellular reaction \rightarrow vibrator \rightarrow mechanical signal
6. During the media preparation for cultivation of cells, insoluble precipitates of calcium phosphates are often formed. identify which method can be adopted to avoid this problem
- a. Hold the pH at 5.6
 b. Hold the pH at 7.5
 c. Add calcium salt first and then phosphate source
 d. None of the above
7. Somatic embryogenesis is a procedure in plant tissue culture methodology described best as
- a. Formation of both shoot and root meristem
 b. Formation of stable embryos
 c. Formation of axillary buds
 d. None of the above
8. An immobilized enzyme being used in a continuous plug flow reactor exhibits an effectiveness factor (η) of 1.2. The value of η being greater than one could be apparently due to one of the following reasons. Identify the correct reason.
- a. The enzyme follows substrate inhibited kinetics with internal pore diffusion limitation
 b. The enzyme experiences external film diffusion limitation
 c. The enzyme follows sigmoidal kinetics
 d. The immobilized enzyme is operationally unstable
9. The degree of inhibition for non-competitive inhibition of an enzyme catalyzed reaction
- a. Increases with increase in substrate concentration
 b. Reaches a maxima with increase in substrate concentration and then decreases
 c. Is independent of substrate concentration

d. Decreases with increase in substrate concentration

10. The two columns given below indicate some of the fermentation products and the microbial cultures used for their production. Identify the correct set of groups from the four options.

Fermentation products

- A. Ethanol
 B. Streptomycin
 C. Citric acid
 D. Cellulase

Microbial cultures

1. *Aspergillus niger*
 2. *Zymomonas mobilis*
 3. *Streptomyces griseus*
 4. *Trichoderma reesei*

Codes;

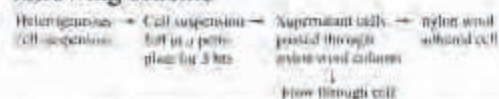
	A	B	C	D
a.	1	2	3	4
b.	2	3	1	4
c.	2	3	4	1
d.	4	3	2	1

TWO MARKS QUESTIONS (11-30)

11. The culture fluids of 1000 to 5000 colonies of hybridoma are screened for monoclonal antibody by
- P western blot analysis
 Q antigen capture analysis
 R northern blot analysis
 S antibody capture analysis
- Choose the correct pair from the following
- a. P, Q
 b. Q, R
 c. R, S
 d. Q, S
12. Tobacco leaf discs are transfected with *Agrobacterium tumefaciens* strain containing binary vector (GUS as reporter gene) with selectable marker neo (kanamycin resistant gene) and then regenerated to plants. The plants are kanamycin resistant but leaf tissues are negative to GUS assay. The explanations are
- a. The plants are transformed for both genes but GUS gene is turned off

- b. The plants are transformed for only neo gene not the GUS gene
 c. The plants are not transformed at all, but the development of kanamycin resistance is due to somaclonal variation
 d. All the above
13. The restriction endonuclease HaeIII recognizes the sequence GG↓CC and the point of cleavage is given by the arrow. If you want to clone a piece of DNA in a plasmid digested by HaeIII, what will be restriction enzyme of choice
 a. SmaI(CC↓GGG)
 b. NotI(GC↓GGCCGC)
 c. SmaIII(GG↓CC)
 d. PstI(CTGCA↓G)
14. For the sequence of ds DNA given below, identify the set of primers required to amplify this DNA by PCR
 3' GACTCCA.....TACAACC 5'
 5' CTGAGGT.....ATGTTGG 3'
 a. 5' GGTTGTA and 5' GACTCCA
 b. 5' CTGAGGT and 5' CCAACAT
 c. 5' ACTCAGT and 5' ATGTTGG
 d. None of the above
15. Expression of antisense RNA of ACC synthase in transgenic tomato plants inhibited the synthesis of ethylene resulting in
 a. Change in color from green to red
 b. Change in aroma
 c. Change in color from red to green
 d. None of the above
16. Some of the genes from viruses introduced into plants in fully functional form often exhibit Mendelian inheritance because
 a. the genes are stably integrated in chromosomes
 b. the genes are stably maintained in vectors
 c. the genes are co-expressed with chromosomal genes
 d. the genes are not interrupted by introns
17. Agrobacterium based transformation of protoplasts obtained from dicots is based on the fact that
 a. These exhibit strong chromosomal structures
 b. These have two cotyledons
 c. These exhibit strong wound response
 d. These have long tap root system
18. What would be the effect of addition of 2,4-D on the production of berberine by cell culture of *Thalictrum minus*
 a. To stimulate growth and thereby urease secondary metabolite production
 b. Stimulate dedifferentiation and thereby decrease secondary metabolite production
 c. Stimulate proliferation and reduce secondary metabolite production
 d. None of the above
19. Reverse vaccinology indicates
 a. From antigenic protein to vaccine development
 b. From antigenic polysaccharide to vaccine development
 c. From antibody to vaccine development
 d. From genome sequence to vaccine development
20. An enzyme following Michaelis - Menten kinetics with $V_m = 2.5 \text{ mmol m}^{-3} \text{ s}^{-1}$ and $K_m = 5.0 \text{ mM}$ was used to carry out the reaction in a batch stirred reactor. Starting with an initial substrate concentration of 0.1 M, the time required for 50% conversion of the substrate will be about: (In 2 = 0.69)
 a. 01 hr
 b. 06 hr
 c. 02 hr
 d. 12 hr
21. The maximum reaction velocity (V_m) for an enzyme catalyzed reaction was experimentally measured at two different temperatures and following results were obtained:
- | | | |
|---|------|------|
| Temperature, °C | 27 | 37 |
| V_m , $\text{mmol m}^{-3} \text{ s}^{-1}$ | 2.25 | 4.50 |
- The energy of activation for the reaction is:
 a. 12834 cal mol⁻¹
 b. 25668 cal mol⁻¹
 c. 6417 cal mol⁻¹
 d. 19251 cal mol⁻¹
22. In a heterogeneous population of cells containing T-cells, B-cells and

macrophages, the cells are separated in the following scheme



Identify the major population of cells present in petri-plate, nylon wool adhered and nylon wool column flow through respectively

- a. Macrophage, B-cell, T-cell
 b. F-cell, B-cell, macrophage
 c. Macrophage, T-cell, B-cell
 d. B-cell T-cell, macrophage
23. Match the following genetic elements with their functions.

Genetic elements

- A. neo^R
 B. SV40
 C. LTR
 D. dhfr

Functions

1. Facilitates inducible expression of genes in eukaryotes
 2. Facilitates constitutive expression of genes in eukaryotes
 3. Allows amplification of gene
 4. Provides way of selecting eukaryotic cells, which have received foreign DNA

Codes;

	A	B	C	D
a.	4	2	1	3
b.	2	4	1	3
c.	1	4	2	3
d.	4	2	3	1

24. In the cell cycle of a typical eukaryote, the sequence of events operating at the time of cell division is

- a. S phase → G2 phase → G1 phase → M phase
 b. S phase → M phase → G1 phase → G2 phase
 c. S phase → G2 phase → M phase → G1 phase
 d. S phase → G1 phase → M phase → G2 phase

25. Batch fermentation of glucose to ethanol yields a productivity of $4.5 \text{ g}^{-1} \text{ hr}^{-1}$. If the yeast cell concentration in the fermentation broth is 5% (v/v) and the intracellular

NAD^+/NADH concentration in the yeast cells is $10 \mu\text{M}$, the cycling rate of $\text{NAD}^+ \rightleftharpoons \text{NADH}$ will be:

- a. $50,000 \text{ cycles hr}^{-1}$
 b. $20,000 \text{ cycles hr}^{-1}$
 c. $100 \text{ cycles hr}^{-1}$
 d. None of the above

26. The kinetics of the disintegration of baker's yeast cells in a bead mill is described as $dP/dt = K(P_m - P)$, where P is the concentration of protein released and m is the maximum protein concentration achievable; K is the first order rate constant and is 0.5 hr^{-1} for the system studied. The time required for the release of 90% of the intracellular proteins will be:

- a. 10 hr
 b. 0.7 hr
 c. 4.6 hr
 d. None of the above

27. Inversion of sucrose by immobilized invertase follows a substrate inhibited kinetics. The reaction rate (v) in $\text{mol m}^{-3} \text{ hr}^{-1}$ can be expressed as:

$v = 800 [S] / \{400 + 50 [S] + [S]^2\}$, where [S] is the sucrose concentration.

The immobilized invertase preparation is used in a CSTR with 100 mol m^{-3} sucrose concentration in the feed stream. If the reaction velocity passes through a maxima at $[S] = 20 \text{ mol m}^{-3}$ the feed flow rate for a reactor volume of 1 m^3 to get the maximum productivity from the reactor should be:

- a. $0.11 \text{ mol m}^{-3} \text{ hr}^{-1}$
 b. $1.10 \text{ m}^3 \text{ hr}^{-1}$
 c. $5.05 \text{ m}^3 \text{ hr}^{-1}$
 d. None of the above

28. Phytase, an enzyme produced by *Aspergillus niger* can be adsorbed on microcrystalline cellulose powder (MCCP). The adsorption follows a Langmuir isotherm and the maximum concentration of the protein that can be obtained on the adsorbent is 70 mg cm^{-3} . At a concentration of 50 mg l^{-1} of protein in the solution, the concentration of protein on the adsorbent reaches 35 mg cm^{-3} . It is desired to recover 90% of the protein from 1.5 litre of the cell free culture filtrate containing 220 mg l^{-1} protein by addition of MCCP to the solution. The

concentration of the protein adsorbed on the solid at equilibrium will be:

- 21.4 mg cm⁻³
 - 214 mg cm⁻³
 - 2.14 mg cm⁻³
 - None of the above
29. Measurement of $k_L a$ in a bioreactor can be carried out by sodium sulfite oxidation method, that is based on the oxidation of sodium sulfite to sodium sulfate in the presence of a catalyst (Cu^{++} or Co^{++}). In a typical experiment, a laboratory fermenter was filled with 5 litre of 0.5 M sodium sulfite solution containing 0.003 M Cu ions and the air was sparged in. After 10 minutes, the air flow was stopped and a 10 ml sample was taken and titrated. The concentration of sodium sulfite in the sample was found to be 0.20 M. The oxygen uptake rate for this aerated system will work out to be
- 0.08 g l⁻¹ s⁻¹
 - 0.008 l⁻¹ s⁻¹
 - 0.8 l⁻¹ s⁻¹
 - None of the above
30. Examine the data given below in the table on purification of a protein X
- | Step | volume (ml) | protein concentration (mg/ml) | Enzyme activity (units/ml) |
|--------------------------------|-------------|-------------------------------|----------------------------|
| Crude cell-free extract | 500 | 12.0 | 5.0 |
| Ammonium sulfate precipitation | 125 | 3.0 | 11.0 |
| Ion-exchange chromatography | 10 | 0.0 | 75.0 |
- The yield percent and purification factor respectively at the end of the experiment will be approximately
- 25 and 3
 - 30 and 20
 - 20 and 30
 - 75 and 30

M: BOTANY

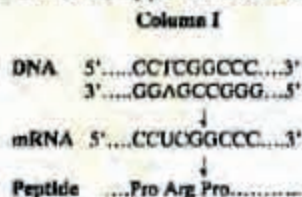
ONE MARKS QUESTIONS (1-10)

- During seed development, the organelle oleosome functions for storage of
 - Oil only
 - Oil and starch
 - Oil, starch and protein
 - Oil and protein
- From the single parent cell how many times the process of mitosis/cell division occur to produce 512 cells
 - 28
 - 10
 - 9
 - 128
- Two criteria of most cork cells are
 - Suberin and permeable
 - Suberin and impervious
 - Cutin and permeable
 - Cutin and impervious
- In gynostegium
 - Stamens adnate to corolla
 - Stamens adnate to perianth
 - Stamens adhere to carpets
 - Stamens are united by their filaments
- Which of the staining procedure is NOT followed to determine the viability of cells?
 - FDA staining
 - TTC staining
 - Evan's blue staining
 - Methyl blue staining
- In angiosperms adventives embryony develops from
 - Diploid nucellar cells asexually
 - Diploid nucellar cell sexually
 - Megaspore mother cell sexually
 - Any cell of the embryosac asexually
- Phytoremediation is
 - Remedial measure in deforestation
 - Removal of pollutants by plants
 - Remedial measure in soil erosion using plants
 - Curing of disease by photochemical
- Given below are the enzymatic reactions of Krebs cycle. In which of the following steps GTP is generated?
 - Citrate to isocitrate
 - α -ketoglutarate of succinyl-CoA
 - Fumarate to malate
 - Succinyl-CoA to succinate
- The metal ion required for the enzymatic activity of nitrogenase is
 - Zinc

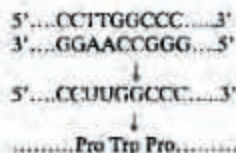
- b. Cobalt
 c. Copper
 d. Molybdenum
10. The *tol* gene is present in
 a. R_i plasmid
 b. Both R_i and T_i plasmid
 c. T_i plasmid
 d. pUC

TWO MARKS QUESTIONS (11-30)

11. If A = 1 micrometer, B = 1 nanometer and C = 5 Angstrom, find the product if A/B and B/C
 a. (-) 2000
 b. 2000
 c. 5000
 d. (-) 5000
12. Identify the correct set of three statements for cytoskeletal protein filaments from the following list
 1. Actin filament is about 8 nm wide
 2. Actin filament is 25 nm wide
 3. Intermediate filaments have size intermediate between actin filaments and microtubules
 4. Protofilaments of microtubules are composed of α/β tubulin heterodimer
 5. Colchicine binds to the tubulin subunits in spindle microtubule causing disassembly to free units.
 a. 3, 4, 5
 b. 2, 3, 4
 c. 1, 3, 4
 d. 1, 2, 3
13. The nucleotide and peptide sequences mentioned in column I were changed after mutation, and are shown in column II. Name the type of mutation.



Column II



- a. Frameshift mutation
 b. Non-sense substitution
 c. Same-sense substitution
 d. Mis-sense substitution
14. A mutant strain (*thi*⁻) of *Neurospora* was crossed with the wild type (*thi*⁺). A total of 132 asci were analyzed.
 First division segregation : 104
 Second division segregation : 28
 Find out the map distance (cM) of *thi* gene from the centromere.
 a. 10.6
 b. 21.2
 c. 5.3
 d. 8.3
15. In pea plants the following cross was made
GRRR x ggrr
(Yellow, round) (Green, wrinkled)
- ↓
- F₁ selfed**
- Mention the proportion of homozygous heterozygous yellow, round seeds in F₂
 a. 1:3
 b. 1:16
 c. 1:8
 d. 9:16

Q. 16-25 are matching exercises. Choose the correct one from among the alternatives a, b, c and d.

16. Group 1 (Pathogen)
 P *Puccinia graminis*
 Q *Ustilago hordei*
 R *Trichothecium reseau*
 S *Ustilago nuda*
- Group 2 (Infection site)
 1. Blossom infection
 2. Seedling infection
 3. Fruit infection
 4. Root infection
 5. Leaf infection
 6. Grain infection

Codes;

	P	Q	R	S
a.	5	2	4	6
b.	5	2	3	1
c.	6	5	3	1
d.	1	2	3	4

17. Group 1 (Plant)

P Mustard

Q Pea

R Cucumber

S Orchid

Group 2 (Floral Formula)

- Zygomorphic, bisexual, $P_{(3+3)}$, A_1 or \geq $G_{(3)}$
- Actinomorphic, σ , $K_{(5)}$, $C_{(5)}$, $A_{(5)}$
- Actinomorphic, bisexual, $P_{(3+3)}$, A_{3+3} , $G_{(3)}$
- Zygomorphic, bisexual, $K_{(5)}$, C_5 , $A_{(9)+1}$, G_1
- Actinomorphic, bisexual, K_{2+2} , C_4 , A_{2+4} , $G_{(2)}$
- Actinomorphic, bisexual, $K_{(5)}$, C_5 , $A_{(\infty)}$, G_1

Codes;

	P	Q	R	S
a.	5	4	2	1
b.	2	4	6	3
c.	5	6	3	2
d.	5	3	4	1

18. Group 1 (Enzyme)

P Phosphoglucomutase

Q Hexokinase

R Fructokinase

S Sucrose Phosphatase

Group 2 (Product)

- Fructose-6- PO_4
- Glucose-1- PO_4
- Glucose-6- PO_4
- UDP-glu + PP_i
- Sucrose + P_i
- Sucrose 6- PO_4

Codes;

	P	Q	R	S
a.	3	1	4	6
b.	6	4	2	5
c.	4	6	5	3
d.	2	3	1	5

19. Group 1 (Characteristics)

P Edible fungi

Q Deadly poisonous fungi

R Alkaloid producing fungi

S Fungi pathogenic to human

Group 2 (Species)

- Mucor mucedo
- Candida albicans
- Candida albicans
- Amanita verna
- Morchella conica
- Aspergillus flavus

Codes;

	P	Q	R	S
a.	5	3	4	1
b.	5	4	1	2
c.	5	4	3	2
d.	4	1	3	6

20. Group 1 (Property)

P Cointegrate

Q LTRs

R Hybrid dysgenesis

S Controlling elements

Group 2 (Transposon)

- Tn5
- P elements
- Tn3
- Ty1
- IS elements
- Ac/Ds

Codes;

	P	Q	R	S
a.	3	4	2	6
b.	6	5	2	1
c.	4	5	2	3
d.	1	3	2	5

21. Group 1

P Photochemical smog

Q Ozone hole

R Global warming

S Metal pollution

Group 2

- Carbon dioxide
- Ozone
- Formaldehyde
- Chlorofluorocarbons
- Phytochelatin
- Radon

Codes;

	P	Q	R	S
a.	6	4	1	3
b.	2	4	1	5
c.	3	4	1	5
d.	2	4	1	6

22. Group 1 (Pigment)

P Chlorophyll a

Q C-phycoerythrin

R C-phycoerythrin

S Bacteriochlorophyll b

Group 2 (Absorption maxima)

1. 1020 nm

2. 350 nm

3. 615 nm

4. 750 nm

5. 680 nm

6. 550 nm

Codes;

	P	Q	R	S
a.	5	6	3	1
b.	1	2	3	4
c.	1	3	6	5
d.	5	6	1	2

23. Group 1 (Metabolite)

P Menthol

Q Ajmalicine

R Caffeine

S Carotene

Group 2 (Chemical nature)

1. Diterpene

2. Tetraterpene

3. Purine alkaloid

4. Phenyl propanoid

5. Indole alkaloid

6. Monoterpene

Codes;

	P	Q	R	S
a.	6	5	2	3
b.	5	6	3	2
c.	6	5	3	2
d.	1	2	3	4

24. Group 1 (Plant/Organ)

P Dicot stem

Q Monocot stem

R Dicot root

S Monocot root

Group 2 (Vascular bundles)

1. Numerous, scattered in ground (issue,

2. Polyarch, xylem exarch

3. Open, arranged in a ring, xylem endarch.

4. Diarch to hexarch, xylem exarch

Codes;

	P	Q	R	S
a.	3	2	1	4
b.	3	1	4	2
c.	2	4	3	1
d.	2	3	1	4

25. Group 1 (Transgenic plant)

P. Glyphosate resistance

Q. Insect resistance (Bollgard)

R. Delayed ripening

S. Insect resistance (Yieldgard)

Group 2 (Relevant gene)

Group 2 (Relevant gene)

1. psbA

2. tfdA

3. cryI Ac

4. pg (Antisense)

5. crvI Ab

6. aro A

Codes;

	P	Q	R	S
a.	6	3	4	5
b.	1	2	3	4
c.	6	5	1	3
d.	2	3	4	5

26. With the objective of raising somatic embryos via friable cal using choose the best combination of growth regulators for medium I and II.

Medium I (Callusing)

P 2,4-D

Q IAA

Medium II (Embryogenesis)

1. IAA and TIBA

2. 2,4-D and RAP

3. IAA and BAP

4. 2,4-D and ABA

a. Q-2

b. P-1

c. Q-4

d. P-3

L MICROBIOLOGY

ONE MARKS QUESTIONS (1-10)

27. For cryopreservation of plant cells / tissues, maintaining viability over longest period of time, select the best possible combination of cryoprotectants (I) and temperature (II).

List I

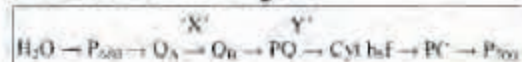
P Glycerol, DMSO and proline

Q Glycerol, acetic acid and ethanol

List II

1. (-)80°C
 2. (-)4°C
 3. (-)196°C
 4. 0°C
- a. Q-3
 - b. P-1
 - c. P-2
 - d. Q-4

28. Identify the inhibitors for the steps 'X' and 'Y' from the following list



P DCMU

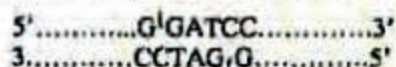
Q CO

R Paraquat

S DBMIB

- a. P-R
- b. Q-R
- c. P-Q
- d. P-S

29. Identify the restriction enzyme suitable for the following restriction digestion



- a. BamHI
- b. EcoRI
- c. AluI
- d. HaeIII

30. The two scientists who were awarded the Nobel Prize for transposable genetic elements and polymerase chain reaction

- a. Barbara McClintock and Susumu Tonegawa
- b. Barbara McClintock and Kary Mullis
- c. Barbara McClintock and Paul Berg
- d. Kary Mullis and Paul Berg

1. The Scientist who developed aseptic methods using phenol to prevent infections was
 - a. Robert Koch
 - b. John Tyndall
 - c. Paul Ehrlich
 - d. Joseph Lister
2. The organism Robert Koch used first to propose Koch's postulates was
 - a. Mycobacterium tuberculosis
 - b. Salmonella typhimurium
 - c. Bacillus anthracis
 - d. Klebsiella pneumoniae
3. The primary strain used for staining endospore is
 - a. Crystal violet
 - b. Malachite green
 - c. Safranin
 - d. Carbol fuchsin
4. The engulfment of disease causing bacteria by macrophages was discovered by
 - a. Emil von Behring
 - b. Ilya Metchnikoff
 - c. Shibasaburo Kitasato
 - d. J. Bordet
5. The two key enzymes of glyoxylate cycle are
 - a. Isocitrate dehydrogenase, α -Ketoglutarate dehydrogenase
 - b. Isocitrate lyase, α -Ketoglutarate dehydrogenase
 - c. Isocitrate lyase, Malate synthase
 - d. Malate synthase, Isocitrate dehydrogenase
6. Nitrosomonas europaea is a chemolithotroph in which electron donor and electron acceptor, respectively are
 - a. NH_4^+ , O_2
 - b. H_2 , O_2
 - c. NO_2^- , O_2
 - d. H_2S , NO_2^-
7. In Gram negative bacteria, the flagellum is attached to the cytoplasmic membrane by the rings

- a. S ring only
 b. S and M rings
 c. P ring
 d. P and L rings
8. In Rhizobium-legume symbiotic nitrogen fixation, oxygen-sensitive nitrogenase is protected by leghemoglobin. The ratio of leghemoglobin-bound O_2 to free O_2 is
 a. 0:1
 b. 100:1
 c. 1,000:1
 d. 10,000:1
9. Nonphosphorylated Entner Doudoroff pathway (EDP) is operative in species of
 a. Pyrococcus
 b. Streptococcus
 c. Micrococcus
 d. Staphylococcus
10. A 'regulon' is defined as
 a. A set of operons that are functionally co-ordinated
 b. A master gene regulating the function of a set of genes
 c. All the regulatory genes of the genome
 d. The genes present in the control region of an operon
14. Pseudomonas species metabolize a wide range of organic compounds through β -keto adipate whose structure is
 a. $CH_3CH_2COCH_2COOH$
 b. $HOOCCH_2CH_2COCOOH$
 c. $HOOCCH_2CH_2CH_2COCOOH$
 d. $HOOCCH_2CH_2COCH_2COOH$
15. In a different planet codons have four bases instead of three and there are four termination codons as against three found in our planet. Which of the following statements will NOT hold true in 4 base codon planet assuming there is no evolutionary selection?
 a. The number of codons will be too few to code for all twenty amino acids
 b. There will be greater codon degeneracy than in earth
 c. The number of t-RNA genes will be more compared to earth
 d. The sizes of proteins will be generally longer

TWO MARKS QUESTIONS (11-30)

11. In TCA cycle, both carbons of acetyl CoA are oxidized to CO_2 at two steps which are
 a. Cis-aconitate \rightarrow Isocitrate \rightarrow α -Ketoglutarate
 b. α -Ketoglutarate \rightarrow Succinate \rightarrow Fumarate
 c. Isocitrate \rightarrow α -Ketoglutarate \rightarrow Succinate
 d. Citrate \rightarrow Cis-aconitate \rightarrow Isocitrate
12. Cells of Escherichia coli grown on mineral salts medium with glycerol as carbon source are harvested and exposed to three different inducers of the operon. Their inducing efficiencies are
 a. TMG < IPTG < Lactose
 b. Lactose < TMG < IPTG
 c. IPTG < Lactose < TMG
 d. TMG < Lactose < IPTG
13. A bacterial suspension when counted in Petroff-Hausser bacteria counting chamber showed on average 20 bacteria in one large square (each large square = $1/25 \text{ mm}^2$). The number of bacteria/mi of the suspension is
 a. 25×10^6
 b. 50×10^6
 c. 10×10^7
 d. 25×10^7
16. In most phototrophic and autotrophic organisms, CO_2 is fixed by RuBisCo via Calvin cycle. The sugar into which CO_2 gets fixed is
 a. Ribulose-5-phosphate
 b. Glyceraldehyde-3-phosphate
 c. 1, 3-Bisphosphoglycerate
 d. Ribulose-1, 5-bisphosphate
17. The genome size of the following organisms are in the order
 a. Haemophilus influenzae \approx Saccharomyces cerevisiae \approx Escherichia coli $> \phi$ x 174
 b. Escherichia coli $>$ Saccharomyces cerevisiae $>$ Haemophilus influenzae $>$ ϕ x 174
 c. Saccharomyces cerevisiae \approx Escherichia coli $>$ Haemophilus influenzae $>$ ϕ x 174

d. *Saccharomyces cerevisiae* > *Haemophilus influenzae* > *Escherichia coli* > ϕ x 174

18. The following are the number of germ line genes for heavy and light chains in an individual. Calculate the approximate number of diverse IgG (Kappa) molecules that the individual can generate not taking into account somatic mutation

Germ line genes	Heavy chain	K chain
V	50	40
D	30	0
J	6	5

- a. 131
 b. 9,200
 c. 18,00,000
 d. 36,00,000
19. A strain of *Mycobacterium tuberculosis* was found to be resistant to INH, streptomycin and rifamycin at 10^{-5} , 10^{-6} , 10^{-7} frequencies, respectively. The frequency of appearance of a strain resistance to all three compounds is
 a. 10^{-3}
 b. 10^{-6}
 c. 10^{-11}
 d. 10^{-18}
20. In *Escherichia coli* the number of molecules per cell occur in the following order
 a. tRNA < mRNA < rRNA < DNA
 b. DNA < mRNA < rRNA < tRNA
 c. rRNA < mRNA < tRNA < DNA
 d. DNA < tRNA < mRNA < rRNA
21. Switch recombination does not take place among the immunoglobulin genes
 a. IgM \rightarrow IgD
 b. IgM \rightarrow IgG1
 c. IgM \rightarrow IgE
 d. IgM \rightarrow IgA
22. EMB (eosin-methylene blue) agar is used to differentiate *Escherichia* from *Enterobacter aerogenes*. The green metallic sheen of the colonies is due to
 a. Eosin and methylene blue combine to produce a precipitate under neutral conditions (*E. aerogenes*)
 b. Eosin and methylene blue combine to produce a precipitate under acidic conditions (*E. coli*)

- c. Methylene blue gets precipitated under acid conditions (*E. coli*)
 d. Eosin gets precipitated under neutral conditions (*E. aerogenes*)
23. UV spectroscopy is not used to quantitate the compounds based on absorbance
 a. Nucleic acids have absorbance peak at 260 nm
 b. NAD(P)H have absorbance peak at 340 nm
 c. Aromatic amino acids have absorption maxima about 280 nm
 d. Sulfur containing amino acids absorbance at 270 nm
24. Luminous bacterium (*Vibrio fischeri*) and flashlight fish (*Photoblepheron palpebratus*) provide an interesting symbiotic association. In the luciferase reaction the products are
 a. FMN + RCOOH + H₂O
 b. RCOOH + H₂O + light
 c. FMN + RCOOH + H₂O + light
 d. FMNH₂ + RCOOH + H₂O + light
25. The flagellate *Monas stigmatica* (6 μ m long) swims at the speed of 50 cell lengths per second. The distance it covers in 1 hour is
 a. 1.08 cm
 b. 10.80 cm
 c. 0.8 m
 d. 1.08 m
26. The serotypes of *Salmonella* sp. are due to
 a. Lipid A structure
 b. Core polysaccharide containing KDO and heptose
 c. Unusual sugars in O-side chain
 d. Both Lipid A structure and core polysaccharide
27. The property not possessed by *Archaeobacteria* is
 a. They have pseudomurein in their cell walls
 b. Their lipids have ether linkage
 c. They have N-acetylglucosamine and N-acetylglucosaminuronic acid as repeating alternating units in the backbone
 d. They have D and L amino acids in their short peptide chain

28. Which of the following properties of diphtheria toxin is not true
- The nicked toxin is biologically and immunologically identical to unnicked toxin
 - On reduction with GSH, chains A and B are separable
 - Diphtheria toxin inhibits protein synthesis by ADP-ribosylating EF2
 - Chain A alone is toxic to animals and whole cells
29. The following statements are made regarding incorporation of 5-bromodeoxyuridine into DNA
- 5-bromodeoxyuridine substitutes thymidine in DNA
 - The minimum number of DNA replication cycles required to observe mutation is two
 - 5-bromodeoxyuridine produces GC \rightarrow AT transition
 - 5-bromodeoxyuridine generates deletion mutants
- Which of the above statements are true
- (A) and (C)
 - (A) and (B)
 - (C) and (D)
 - (B) and (C)
30. In a bacterial cell culture the initial cell population (N_0) was 10^3 cells/ml. In 6 hours and 40 minutes, it has gone through 20 generations. The final cell population (N_t) and growth rate constant (K), respectively are
- | N_t | and | K |
|--------------------|-----|---|
| a. 10^9 cells/ml | and | 3 |
| b. 10^8 cells/ml | and | 4 |
| c. 10^7 cells/ml | and | 5 |
| d. 10^6 cells/ml | and | 6 |
2. Which one of the following would you qualify as a holometabolous insect?
- Cockroach
 - Grasshopper
 - Mosquito
 - Human body louse
3. All of the following statements about heterochromatin are true except one. Which one?
- Heterochromatin stains more darkly with DNA dyes than euchromatin
 - Heterochromatin contains more highly condensed DNA than euchromatin
 - Heterochromatin is associated with inactive genes
 - Heterochromatin is more susceptible to DNaseI than euchromatin
4. In human, the cardiac sphincter surrounds the cardiac orifice in the digestive tract. The failure of this sphincter's normal function will result in the
- regurgitation of food into the esophagus
 - loss of control of defecation
 - movement of the bolus into the trachea rather than the esophagus
 - rapid emptying from the stomach to the small intestine
5. Stroke occurs when
- the pacemaker becomes defective, producing an irregular heartbeat
 - a blood clot enters and blocks one of the coronary arteries
 - a blood clot dislodges from a vein and moves into the lung where it blocks a pulmonary artery
 - a blood clot enters the cerebral circulation blocking an artery and causing the death of brain tissue
6. Which one of the following statements is true with regard to tissue macrophages?
- have short life spans because they self-destruct after engulfing foreign invaders
 - originate from monocytes that leave the circulation and enter the tissues
 - are most effective against parasites
 - phylogenetically conserved structures

M: ZOOLOGY (optional)

ONE MARKS QUESTIONS (1-10)

1. Both birds and bats fly and have wings. Wings of birds and bats represent
- Analogous structures
 - Homologous structures
 - Vestigial structures

- d. do not attack microorganisms directly; instead, they destroy virus-infected body cells
7. Which of the following cell types does HIV preferentially infect?
- cytotoxic T cells
 - natural killer cells
 - helper T cells
 - memory cells
8. *Trichinella spiralis* infection is most commonly contracted from
- Beef products
 - Eating infested, undercooked pork
 - Undercooked vegetables
 - Non-pasteurized milk
9. In three of the four types of animals listed below colonies can be initiated by a single individual. However, the fourth one would need at least a pair (a male and a female) to set up a colony. Identify which one
- Sea anemones
 - Frogs
 - Tapeworms
 - Whiptail lizards
10. The synthesis of ATP by chemiosmosis
- is endergonic and is coupled to exergonic electron transport
 - is exergonic and is coupled to endergonic electron transport
 - is due to electrons shuttled down the electron transport chain to the final electron acceptor, which is NAD^+
 - produces less ATP than the Krebs's cycle and glycolysis combined
13. Consider an island population where a majority of the individuals display hexadactyly of their hands. Evolutionary biologists would readily explain this phenomenon based on
- Dominance of the hexadactyl condition
 - Small size of the founder population
 - Novel mutations
 - Improved fitness and adaptation of the hexadactyl individuals
14. Marsupials are naturally found in Australia. The hallmark of the marsupials is:
- Ovo-viviparity
 - Prolonged placental development
 - Parturition before completion of embryonic development
 - Incomplete adaptive radiation
15. Imagine that you are examining eosin-haematoxylin stained cross section of a mammalian stomach. Beginning from the outermost to the inner most layers, which of the following description accurately describes the different cell layers of the stomach?
- Mucosa-submucosa-serosa-muscularis
 - Serosa-mucosa-submucosa-muscularis
 - Serosa-muscularis-submucosa-mucosa
 - Muscularis-submucosa-mucosa-serosa
16. Animals belonging to the Phylum chordata are unambiguously classified based on only one of the four sets of characteristics described below. Which one?
- Notochord, Central nervous system, circulatory system and Segmented muscle
 - Notochord, dorsal hollow nerve cord, pharyngeal slits and postnatal tail
 - Notochord, dorsal hollow nerve chord, gills and segmented muscles

TWO MARKS QUESTIONS (11-30)

11. Presume that you can measure DNA content in a single cell throughout its cell cycle. After measuring the DNA content during G1 phase, at what other points during the remainder of the cell cycle would you find changes in DNA per cell?
- Prophase and metaphase
 - S phase and prophase
 - S phase and G2
 - Interphase
12. Frequency of individuals with darkly colored wings in the moth species *Biston*

d. Notochord, peripheral nervous system, pharyngeal slits and segmented muscles

17. A female fruit fly, *Drosophila* of the genotype $RrSs$ was mated to males with the genotype $rsss$. The progeny obtained in four different situations are displayed on the left column while their probable explanations are displayed on the right. Match the genotypic frequency with the most appropriate explanations.

Frequency of Progeny

- A. 50% RS and the rest rs
 B. 50% RS & rs ; the rest Rr & rS
 C. 90% RS & rs the rest Rr & rS
 D. All the progeny are RS

Explanation

- the two loci are not linked
- the r and s gametes in the female were not formed
- the two loci are 10 mu. apart
- the two loci are tightly linked

Answers:

- a. A-4; B-1; C-3; D-2
 b. A-1; B-4; C-2; D-3
 c. A-2; B-4; C-3; D-1
 d. A-4; B-1; C-2; D-3

18. Diploid chromosome number in human is 46. However, if you count chlorinated which are visible during mitotic or meiotic cell divisions, you would be able to count different sets of chromatid numbers pending on the stage and the type of the cell division in question. Match the chromatid numbers given on the left with cell division stage shown on the right.

- A. 46
 B. 23
 C. 92
 D. 24
- Mitotic metaphase
 - Aneuploid meiotic telophase II
 - Meiotic telophase I
 - Meiotic anaphase II

Answers:

	A	B	C	D
a.	3	4	1	2
b.	2	4	1	3
c.	1	4	2	3
d.	1	2	3	4

19. The transport of molecules of a particular solute from inside an animal cell across the cell membrane to the extra cellular fluid always requires energy when

- the concentration of the solute is higher inside the cell than outside it
- the concentration of the solute is lower inside the cell than outside it
- a transport protein is involved in the movement of the molecules
- the cytoskeleton blocks all available channels

20. Different cell types respond to the same signaling molecule (for example, a hormone like glucagons) in different ways because

- different cells possess different receptors, which produce signals unique to each cell type
- different cells possess identical receptors, however, ultimately different sets of targets are activated
- different cells have membrane receptors that bind to different sides of the signal molecule
- the signal transduction pathway in cells has a variable length

21. Indicate the order in which the following steps occur in the production of a mature mRNA.

- initiation of transcription, splicing, addition of 5' cap, addition of poly A tail, transport to cytoplasm
- initiation of transcription, addition of 5' cap, splicing, addition of poly A tail, transport to cytoplasm
- Initiation of transcription, addition of poly A tail, addition of 5' cap, splicing, transport to cytoplasm
- Initiation of transcription, addition of 5' cap, addition of poly A tail, splicing, transport to cytoplasm

22. All your cells contain proto-oncogene, which can change into cancer-causing genes. Why do cells possess such potential time bombs?

- Proto-oncogene protect cells from infection by cancer-causing viruses
- Proto-oncogene is genetic junk that has not yet been eliminated by natural selection.

- c. Proto-oncogene are unavoidable environmental carcinogens
 d. Proto-oncogene are necessary for normal control of cell division
23. Researchers have found homeotic genes in humans, but they are not yet certain how these genes shape the human phenotype. Considering the functions of homeotic genes are comparable in *Drosophila* and humans, which one of the following statements is most likely to be their function in humans?
- Determining skin and hair color
 - Regulating the cellular metabolic rate and growth
 - Determining that arms come off the upper portion of the torso and legs from the lower half of the body
 - Regulating the rate and timing of cell division
24. Which one of the pairs of answers provided below will correctly fill the blanks in the statement, "In lakes and ponds, eutrophication occurs when (i) _____ leading to (ii) _____?"
- (i) levels of dissolved CO_2 rise; (ii) bicarbonate levels too high to support life
 - (i) too much nutrients flow into the water body; (ii) anaerobic conditions in deeper waters
 - (i) pesticides are washed off agricultural land; (ii) decreased aquatic biodiversity
 - (i) primary producers are killed by pollution; (ii) starvation of organisms at higher trophic levels
25. In ecological parlance which of the following can be defined as a population?
- All the insects that are trapped in a spider web
 - All the plants in a forest
 - All the earthworms that live in a grassland plus those in the forest
 - All the sandalwood trees in a given forest
26. Which one of the following activities does NOT increase the concentration of greenhouse gases in the atmosphere?
- Increasing the number of cows and sheep to help feed a growing human population
 - Burning tropical rain forests to clear land for grazing
 - Leaving leaks in natural gas pipelines unchecked
 - Spreading salt on roads to prevent ice formation
27. Organism X can see colors we cannot and sense traces of chemicals we cannot. However, if organism X cannot hear very well, then which one of the following statements would be the ultimate explanation for their poor hearing?
- Organism X is too small to have functional auditory organs
 - Hearing may not contribute much to the reproductive success of organism X
 - If organism X could hear well, its brain would be swamped with unnecessary information
 - This is an example of altruism
28. Every morning a research student turns on the light in a laboratory aquarium to feed the fish. After a couple of weeks of this routine, the student noticed that the fish come to the surface to feed as soon as the lights are turned on. The behavior of the fish is a result of
- Habituation
 - Positive phototaxis
 - Imprinting
 - Classical conditioning
29. If an individual were to raise a set of relatives, which one of the following sets would result in a maximal continuation of his own gene pool through successive generations?
- Eight first cousins
 - One offspring and two nieces
 - One sibling, one grandchild, and two first cousins
 - One offspring, one nephew, and two grandchildren
30. You label a few cells at the tip of the animal pole of a gastrulating frog embryo with a fluorescent dye. At the end of embryogenesis, where would you find the fluorescing cells?
- The cardiac cells
 - The pancreatic cells
 - The neural cells
 - The intestinal cells