Entrance Examinations – 2020

Ph.D. Biochemistry

Hall Ticket No. [ ]

Time : 2 hours **Max. Marks : 70**

Please read the following instructions carefully before answering:

1. Enter Hall Ticket number in the space provided above and also on OMR sheet.
2. Paper contains two sections: Part A and Part B together with 60 questions for 70 marks. **Part A contains 25 questions. Questions 1 to 15 carries one mark each. Questions 16 to 25 carries 2 mark each. Part B contains 35 questions; each question carries one mark.**
3. **In Part A, there is no negative marking. In Part B, there is negative marking. 0.33 marks will be deducted for each wrong answer.**
4. Answers have to be marked on the OMR sheet as per the instructions provided.
5. Apart from OMR sheet, the question paper contains 13 (Thirteen) pages including the instructions.
6. **Please return the OMR answer sheet at the end of examination.**
7. No additional sheet will be provided.
8. Rough work can be carried out in the question paper itself in the space provided at the end of the booklet.
9. Non programmable calculators are allowed.

Part A

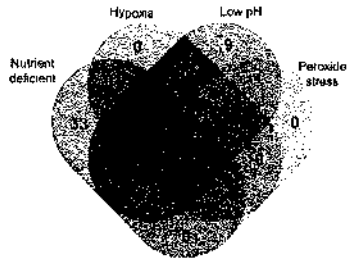
1. One young lady saw 7 young men while going towards the temple. Every young man saw 2 old women going towards the temple. Every old woman was holding one boy by hand. How many persons were going towards the temple?

   A. 7 B.14 C. 3 D.5

2. Which is the missing number in the following set?
   4, 16, 36, ---, 100, 144
   A. 72 B. 81 C. 64 D. 68

3. Three athletes from University of Hyderabad are competing in a chess competition for medals. Their chances of winning are 1/2, 1/3 and 1/4 respectively. What is the probability that the University will receive a medal?
   A. 1/4 B. 2/5 C. 1/2 D. 3/4

4. A bacterial culture was grown in four different conditions, that is, low pH, hypoxia, nutrient deficient and peroxide stress. The culture supernatant from each condition was subjected to proteomics analysis and the Venn diagram given below was generated comparing the proteins found in each culture supernatant.



The following inferences were drawn

(i) Peroxide stress shares maximum common protein in culture supernatant with Nutrient deficient condition, all of which overlaps with Hypoxia

(ii) Peroxide stress shares 10 protein in culture supernatant with hypoxia and Low pH

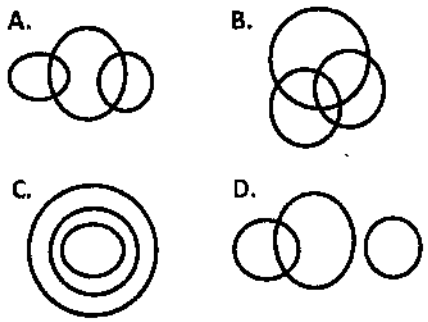
(iii) Hypoxia, Low pH and Peroxide stress shares one common protein in their culture supernatant, which is similar to that shared by Hypoxia, Nutrient deficient and Peroxide stress

(iv) Total number of proteins identified in the culture supernatant of Low pH is 26

Select the option that has all the correct inferences.

A. (ii) and (iii) only
B. (i) and (iv) only
C. (i), (ii) and (iii) only
D. (ii), (iii) and (iv) only

5. Which one of the following Venn diagrams best represents the relationship between eukaryotes, fungi, mushroom?



6. To determine the importance of mRNA levels during stress induced changes in gene expression in eukaryotes, which one of the following inhibitors would be useful?

A. Antimycin B. Alpha-amanitin C. Cycloheximide D. Rifampicin

7. What would be the linking number (L), twist (T) and writhe (Wr) of a covalently closed circular DNA with 105 base pairs with right-handed structure that is underwound by one turn

A. L= 10, T= 9, Wr = -1
B. L= 9, T=10, Wr = +1
C. L= 0; T= 9, Wr = +1
D. L=9, T=10 and Wr = -1

8. Which amino acid of a protein is involved in the attachment of myristic acid during myristoylation?

A. Free amino group of the N-terminal glycine
B. Free thiol of a cysteine side chain at or near the C-terminus of a protein
C. Amide nitrogen of asparagine in the C-terminus of the protein

D. C-terminal Glycine

9. Hyperphosphorylation of which one of the following eukaryotic initiation factor (eIF) stimulates general protein synthesis?
   A. eIF-4EBP B. eIF2 beta C. eIF2alpha D. eIF2B alpha subunit

10. Mean deviation from median is:
   A. Equal to that measured from another value
   B. Maximum if all observations are positive
   C. Greater than that measured from any other values
   D. Lesser than that measured from any other values

11. Circulating Very Low Density Lipoproteins (VLDL) gets into tissues by
   A. Simple diffusion as it is highly hydrophobic
   B. Receptor mediated endocytosis involving LDL receptor
   C. Insulin Receptor
   D. After degradation of the protein part in VLDL can enter by diffusion.

12. The biochemical basis for hemolytic anemia is attributed to
   A. Absence of glucose 6-phosphate dehydrogenase enzyme
   B. Increased production of NADPH
   C. Low activity of glutathione synthetase
   D. Ready availability of glutathione reductase

13. The composition of the core oligosaccharide that is anchored to Dolichol pyrophosphate is
   A. 2-GlCNAc-9-Man-3-GlC
   B. 2-GlCNAc-7-Man-3-GlC
   C. 2-GlCNAc-5-Man-3-GlC
   D. 2-GlCNAc-7-Man-2-GlC

14. If the telomere repeat sequence of *Tetrahymena* is 5' TTGGGG 3', what would be the telomerase RNA template sequence?
   A. 5' CCCCAA 3' B. 5' UUGGGG 3'
   C. 5' CAACCCCAA 3' D. 5' AACCCCAAC 3'

15. During mismatch repair in *E. coli* which of the following series of events take place?
   A. MutS recognize the mismatch; MutH binds at the methylated GATC and cuts DNA; exonuclease along with helicase removes part of the daughter DNA; DNA Pol III re-synthesizes the daughter DNA and ligase seals the nick.
   B. MutH recognize the mismatch; MutS binds at the un-methylated GATC and cuts DNA; exonuclease along with helicase removes part of the daughter DNA; DNA Pol II re-synthesizes the daughter DNA and ligase seals the nick.
   C. MutS recognizes the mismatch; MutH binds at the un-methylated GATC and cuts DNA; exonuclease along with helicase removes part of the daughter DNA; DNA Pol III re-synthesizes the daughter DNA and ligase seals the nick.

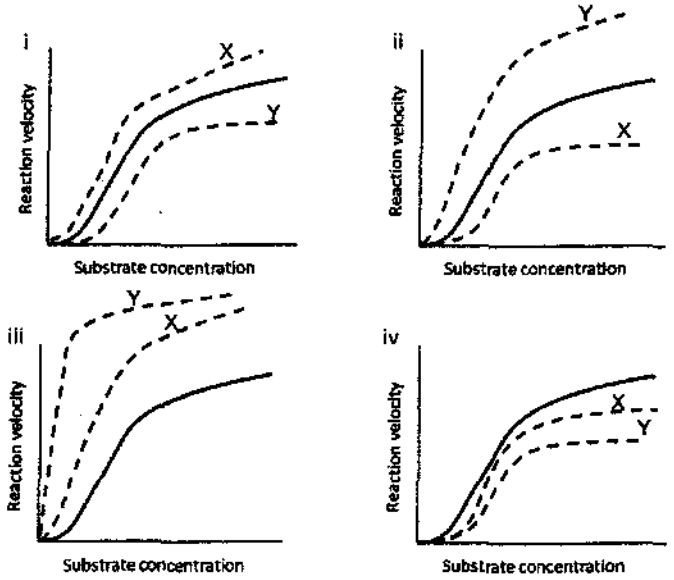
D. MutS recognize the mismatch; MutH binds at the un-methylated GATC and cuts DNA; exonuclease along with helicase removes part of the daughter DNA; DNA Pol II re-synthesizes the daughter DNA and ligase seals the nick.

16. You want to clone a 1 kb fragment of DNA into the EcoRI site of a plasmid containing two selectable markers: Amp^r and Kan^r. The size of the plasmid is 3 kb. There is a single EcoRI site in the plasmid and is present within the Amp^r gene. The single BamHI site of the plasmid is within the Kan^r gene. The distance between the BamHI and EcoRI sites of the plasmid is 0.7 kb. If the insert alone digested by BamHI enzyme, a single band of size 0.5 kb visualized on the gel. If you could successfully clone the insert into the plasmid, what would be your expected outcome? Choose the option that has the correct combination of statements given below:
    a. The transformants will be Ampicillin resistant but Kanamycin sensitive.
    b. The transformants will be Ampicillin sensitive but Kanamycin resistant.
    c. The transformants will be resistant to both Ampicillin and Kanamycin.
    d. If you digest the recombinant plasmid with BamHI enzyme, you will get two bands of sizes 1.2 kb and 2.8 kb.
    e. If you digest the recombinant plasmid with EcoRI enzyme, you will get two bands of sizes 1 kb and 3 kb.

        A. Only statements a and d are correct
        B. Only statements b, d and e are correct
        C. Only statements b and e are correct
        D. Only statements c and e are correct

17. Given below are statements on types of antigens that can stimulate B cells for antibody production. Select the INCORRECT statement.
    A. Antigens which bind to membrane-associated immunoglobulins (mIg) on B-cells are internalized and presented via MHC molecules require CD4+T cells for stimulating B cell
    B. LPS from Gram negative organisms can function as Type1 T-independent antigen to stimulate B cells without any help from CD4+T cells
    C. B cells can be stimulated by Cd3 bound antigens that can crosslink both Cd3 receptors and membrane-associated immunoglobulin (mIg), without any help from CD4+T cells
    D. LPS from Gram negative organisms cannot function as Type1 T-independent antigen to stimulate B cells as it always requires CD4+Tcells

18. The allosteric constant L for an allosterically regulated enzyme in the absence of any effector molecule is 1000. When effector X was added, the L increased to 5000, while when an effector Y was added it decreased to 100. Select the plot that correctly represent the regulatory effect of X and Y on the enzyme. The solid line represents the plot for the enzyme in the absence of any effector molecule.



A. i B. ii C. iii D. iv

19. A GFP transgene in *Drosophila* expressed in varying degrees in multiple cell types. FISH analysis showed that the transgene was located close to the centromere. A screen for loss of function mutations that increase the expression of the transgene was carried out. Which one of the following mutations is most likely to have been isolated in this screen?

A. Histone acetyl transferase
B. Histone K9 methyl transferase
C. Histone H2B SUMOylation
D. Histone H4 ubiqutination

20. Choose the option that correctly matches contents of column A to column B

	Column A		Column B
1	Plasma membrane	i	Cholesterol
2	Mitochondrial membrane	ii	GPI anchor
3	Lipid rafts	iii	Phosphatidyl ethanolamine
4	Membrane curvature	iv	Cardiolipin

A. 1:iv; 2: iii; 3: ii; 4:i
B. 1:iii; 2: iv; 3: ii; 4:i
C. 1:i; 2: ii; 3: iv; 4:iii
D. 1:ii; 2: iv; 3: i; 4:iii

21. The following steps are required for the purification of mitochondrial cytochrome C oxidase from muscle tissue. However, the steps are arranged in a random order below. Choose the correct series of steps from the statements given below

Step 1. 35-45% ammonium sulfate precipitation
Step 2. Dialysis
Step 3. Filter through cheese cloth
Step 4. Suspension and grinding in a cholate buffer
Step 5. Centrifugation of sample
Step 6. Ion-exchange chromatography
Step 7. Minced muscle

A. 1, 3, 2, 6, 5, 4, 7
B. 7, 4, 3, 1, 5, 2, 6
C. 4, 7, 5, 3, 1, 2, 6
D. 7, 4, 5, 3, 1, 2, 6

22. The following events occur during GPCR signal transduction

a) CREB phosphorylation
b) gene transcription
c) adenylate cyclase (AC)–mediated GTP hydrolysis
d) cAMP production
e) G protein translocation and binding to AC
f) PKA activation
g) Ligand binding to GPCR

The correct sequence of events

A. g-d-c-e-f-b-a
B. g-e-d-c-a-b-f
C. g-e-c-d-f-a-b
D. g-c-d-e-f-a-b

23. Damaged receptor proteins on the plasma membrane are transferred to the lysosomal lumen for degradation. All of the following statements about this process is true EXCEPT:

A. Cargo proteins are monoubiquitinated
B. Inward budding of the membrane with the damaged protein
C. Multivesicular bodies are present in the endosome
D. This process is independent of the ESCRT proteins

24. A researcher wants to identify the DNA sequence bound by a transcription factor Z. Which one of the sequence of methods given in the options below would allow the researcher to successfully identify the sequence?

A. Nuclei isolation, run on transcription, electrophoretic mobility shift assay with Z, DNA sequencing, sequencing
B. Nuclei isolation, DNase digestion, DNA sequencing
C. Electrophoretic mobility shift assay with Z; DNase foot printing
D. DNase digestion, run-on transcription, PFGE

25. The mechanisms regulating the decision between lysis and lysogeny for bacteriophage has been described as a genetic switch. The following five statements are made of this system:

a. The cI and cro are transcribed in opposite directions.
b. The mRNA encoding cI and Cro protein are synthesized using the same strand of DNA as template.

c. Of the three O_R sites in genome, Cro has greatest affinity for O_R3.
d. Of the three O_R sites in genome, cI has greatest affinity for O_R1.
e. Synthesis of cI is stimulated by its binding to O_R1 and O_R2.

Which of the above statements are correct?
A. Only a and e are correct
B. Only a, b and e are correct
C. Only a, c and d are correct
D. Only a, c, d and e are correct

Part B

26. If the adaptor protein MyD88 is defective in a cell, the signaling from which of the following receptors may get affected, assuming that the cell has all these receptors on its surface?

A. G protein-coupled receptors (GPCRs)
B. IL-1 receptor and Toll-like receptor 2
C. IL-12 and IL-4 receptors
D. Toll-like receptor 2 only

27. Which one of the following statements is correct in the context of multi-plex and single-plex capture ELISA?

A. Capture antibody is bound to the solid surface and is against a different epitope than detection antibody in both the kinds of ELISA
B. Multi-plex ELISA does not require treatment of surface with blocking buffer after the adsorption of capture antibody on the solid surface
C. Diluted test samples (such as diluted serum) cannot be used in a single-plex capture ELISA
D. Both multi-plex and single-plex capture ELISA depend solely on fluorescence-tagged secondary antibody for detection

28. Defect in which one of the following innate mechanisms may lead to reduced production of 2'-5'-oligoadenylate synthetase, an IFN-inducible gene, that counteracts viral attack by degrading viral RNA?

A. Defect in TAP1 and TAP2
B. Defect in complement protein 3 (C3)
C. Defect in TLRs 3, 7 and 9
D. Defect in RAG1 and RAG2

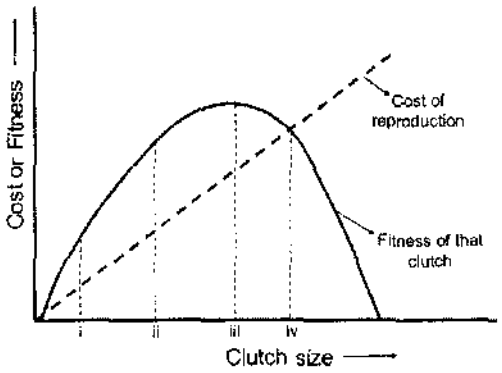
29. Hanes–Woolf equation is a linearization of Michaelis-Menten equation and is plotted with X-axis as [S] and Y-axis as $[S]/v_o$. Which of the following statement is correct about Hanes-Woolf plot?

A. The slope is positive and indicates K_m/V_{max}
B. The X intercept is $-K_m$
C. The X intercept is $-1/K_m$
D. The Y intercept is $1/V_{max}$

30. For a competitive inhibitor of an enzyme that follows Michaelis-Menten kinetics, what equation will you use to calculate the inhibitor constant (Ki), where Km is the Michaelis-Menten constant and Vmax is the maximum velocity of the uninhibited enzyme and Km (app) and Vmax (app) are that for the enzyme in the presence of a specific concentration of the inhibitor [I]?

A. Km (app) = Km (1+[I]/Ki)
B. Vmax (app) = Vmax/(1+[I]/Ki)
C. Vmax (app) = Vmax(1+[I]/Ki)
D. Km (app) = Km / 1+[I]/Ki

31. Given below is a plot depicting the clutch size and fitness of a clutch. The cost of reproduction is shown by dashed line in the plot.



Then as per Lack's theory on the trade-off between offspring number and fitness of clutch, and considering the cost of reproduction, which of the four points, i, ii, iii or iv, will depict the 'optimum' clutch size that will give maximum net benefit (where the net fitness is greatest)?

A. i B. ii C. iii D. iv

32. Proteins are fluid entities, and can theoretically exist in an astronomical number of conformations due to the rotation of bonds in the peptide backbone. Which Greek names are given to the two types of bond in the peptide backbone that are freely rotatable?

A. Chi and Theta
B. Phi and Psi
C. Alpha and Beta
D. Omega and Epsilon

33. For a nucleus with nuclear spin quantum number I = ½, what are the values of m_I

A. +1/2, 0 B. +1/2, 1 C. 0, +1/2 D. +1/2, -1/2

34. If a protein unfolds at 80°C with a standard enthalpy of transition of 500 kJ mol^{-1}, what is the associated entropic change?

A. 1.42 kJ/mol K
B. 6.25 kJ/mol K
C. 6.25 J/mol
C. 14.2 J/mol K

35. Given below are statements with respect to the role of polar bodies during oogenesis.

i. They ensure ovum has only one set of chromosomes
ii. They ensure isolation of defective set of chromosomes so that it does not go to the ovum

iii. They ensure that the ovum will have most of the cytoplasm.
iv. They are the by-products of meiosis and serve no function

Select the option that has all the correct statements

A. (i), (ii) and (iii) only
B. (iv) only
C. (i) and (iii) only
D. (ii), (iii) and (iv) only

36. Eukaryotes have evolved from primitive prokaryotes. Based on molecular phylogeny studies, which one of the following statements correctly represents our current understanding?
    A. Membranes of eukaryotes are similar to archaeal membranes
    B. Genes encoding for proteins of metabolic processes are derived from archeae
    C. Both metabolic and information processing genes are of bacterial origin
    D. Genes encoding information processing are derived from archeae

37. Sex is determined in *Drosophila* by
    A. The presence of the Y chromosome
    B. Number of X chromosomes
    C. The ratio of number of X chromosomes to sets of autosomes
    D. Multiple genes on X, Y chromosomes and autosomes

38. To introduce a mutation in replicating DNA, which one of the following methods would be most suitable?
    A. Ethidium bromide
    B. Ethane methane sulfonic acid
    C. 5-bromo uracil
    D. UV light

39. A couple with no manifestation of disease produce 5 children (3 sons and 2 daughters). Two males show the disease and other three are disease free. Which one of the following statements is the most likely reason for this observation?
    A. The trait is autosomal recessive
    B. The trait is Y-linked recessive
    C. It is a sex-limited trait
    D. It is an X-linked recessive trait

40. The positive (+) charge in NAD^+ is found in which part of the molecule?
    A. Nicotinamide
    B. Adenine
    C. Both adenine and nicotinamide
    D. Ribose

41. How many moles of equivalent ATP/UTP are required for the synthesis of 1 mole of sucrose during photosynthesis?
    A. 96 ATP and 1 UTP
    B. 48 ATP and 1 UTP
    C. 36 ATP and 1 UTP
    D. 48 ATP and 2 UTP

42. Bacteriorhodopsin and halorhodopsin are active transport proteins present in some bacteria required for the movement of protons and chloride ions respectively using light as energy source. In which direction protons and chloride ions move in a bacterial cell?

A. Protons from cytoplasmic side to extracellular side and chloride ions from extracellular to cytoplasmic side
B. Protons from extracellular side to cytoplasmic side and chloride ions from cytoplasmic side to extracellular side
C. Both proton and chloride ions from cytoplasmic side to extracellular side
D. Both protons and chloride ions from extracellular side to cytoplasmic side

43. The energy difference for protons across the inner mitochondrial membrane is given by $\Delta G = 2.303\ RT \log H^+$ out/log H^+ in + nFy. How would this equation be modified if protons were uncharged species?
A. 2.303 RT log H^+ out/log H^+ in + nFΔy
B. nFΔ y
C. -2.303 RT log H^+ out/log H^+ in + nFΔ y
D. 2.303 RT log H^+ out/log H^+ in

44. Which one of the following compounds has the highest free energy change upon hydrolysis?
A. Phosphoenolpyruvate B. ATP
C. Creatine phosphate D. Pyrophosphate

45. Four batches of alkaline phosphatase were purified from *E.coli*. The table below shows the total protein and alkaline phosphatase activity of each batch. Which one of the batches shown below has the most purified and least purified alkaline phosphatase?

Batch No.	Total protein (in mg)	Activity of alkaline phosphatase (units)
Batch 1	22,000	4,400,000
Batch 2	7,000	7,35,000
Batch 3	150	90,000
Batch 4	12,000	7,800,000

A. Batch1 and Batch 2 respectively
B. Batch3 and Batch 4 respectively
C. Batch4 and Batch 2 respectively
D. Batch4 and Batch 3 respectively

46. Which one of the following is NOT a function of mitochondria-associated membranes?
A. Calcium signaling B. Electron transport
C. Phospholipid exchange D. Mitochondrial fission

47. Which of the following is a prosthetic group of acyl carrier protein and the enzyme that condenses acyl and malonyl groups:
A. 4'-phosphopantetheine & β-ketoacyl ACP synthase
B. 1'-phosphopantetheine & Enoyl-ACP reductase
C. 4'-phosphopantetheine & Enoyl-ACP reductase
D. 1'-phosphopantetheine & β-ketoacyl ACP synthase

48. Aminolevulinic acid, a non-proteinogenic amino acid and first product of porphyrin synthesis is synthesized from

A. Valine and Succinyl-CoA
B. Glycine and Acetyl-CoA
C. Valine and Acetyl-CoA
D. Glycine and Succinyl-CoA

49. Statins regulate the cholesterol biosynthesis by which of the following means
A. Competitive inhibition HMG-CoA synthase.
B. Competitive inhibition HMG-CoA lyase.
C. Competitive inhibition HMG-CoA reductase.
D. Non-Competitive inhibition HMG-CoA synthase.

50. For which of the following distribution, mean and variance are equal?

A. Normal distribution
B. Poisson distribution
B. Binomial distribution
D. Negative binomial distribution

51. During cell cycle which of the following statements are TRUE
a. Restriction point is located in G1 phase
b. Thymidine treatment blocks the cells at G1/S boundary
c. Centrosome duplication occurs during M phase
d. APC/C complex utilizes Cdc20 and Cdh1 as coactivators during mitotic entry and exit respectively

A. c & d B. a & c C. b only D. a, b & d

52. Statement (S): Missense mutations in p53 gene are common in cancer cells.
Reason (R): Often loss of heterozygosity at p53 gene locus causes cancer.
The correct answer is
A. S is correct and R is the correct explanation for S
B. S is correct and R is not the correct explanation for S
C. S is correct but R is wrong
D. Both S and R are wrong

53. Red blood cells are a-nucleated because
A. presence of nucleus leads to heavier cells that cannot flow in blood stream
B. they are short lived
C. presence of nucleus leads to increased proliferation of RBCs which harms the body
D. absence of nucleus leads to increased space for Hb that carries molecular oxygen

54. All of the following statements about nuclear transport are true EXCEPT
a) alpha-importin is involved in nuclear localization sequence (NLS) interaction
b) Ran protein shuttles between the nucleus and cytoplasm
c) The nuclear import of proteins requires the hydrolysis of one GTP while nuclear export of proteins involves the hydrolysis of two GTP

A. a and b B. c only C. b only D. b and c

55. Antibodies against group A streptococcus infection sometime attack tissues of heart, brain, and joints affecting these structures, and are collectively referred to as acute rheumatic fever. This is an example of _____.
A. antibody cross-reactivity and molecular mimicry
B. immunodeficiency disease

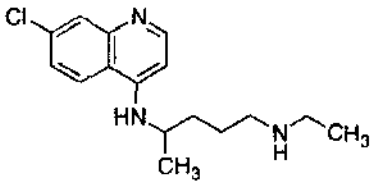
C. cross presentation of streptococcal antigens
D. type-III antibody-antigen complexes mediated hypersensitive reaction

56. Which one of the following inhibitors inhibits EF-G involved in bacterial protein synthesis?
A. Kirromycin B. Fusidic Acid C. Puromycin D. Chloramphenicol

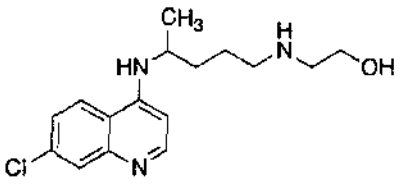
57. Which of the following pairs represents molecules with a non-zero dipole moment only?

A. CH_4, CCl_4 B. NMe_3, CH_3Cl C. CH_3Cl, CH_4 D. CCl_4, NMe_3

58. In the body, Chloroquine and Hydroxychloroquine are first acted upon by cytochrome 450 enzymes and dealkylated (first step: single dealkylation) to give metabolites of the type M1 and M2.



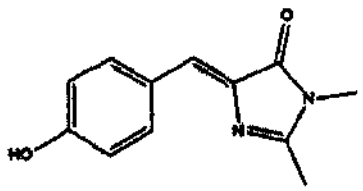
M1



M2

Patient A was administered Chloroquine while patient B was administered Hydroxychloroquine. Patient C was given a combination of both Chloroquine and Hydroxychloroquine.
Which of the following metabolite(s) combinations be detected in the respective patients?
A. Patient A: M1; Patient B: M1 &M2; Patient C: M1 & M2
B. Patient A: M1 and M2; Patient B: M2; Patient C: M1 & M2
C. Patient A: M1; Patient B: M1, Patient C: M1 & M2
D. Patient C: M2; Patient B: M2; Patient C: M1 & M2

59. Green fluorescent protein is a barrel shaped protein that is fluorescent due to a chromophore formed through an autocatalytic reaction. A small molecule comprising of the main chromophore (1) in green fluorescent protein has been identified and synthesized separately.



(1)

Which one of the following would be INCORRECT about this chromophore?
A. Normalized absorption spectra of (1) resembles normalized GFP absorption spectra in the visible region
B. Emission quantum yield of (1) in water (pH 7) and GFP would be similar

C. Emission quantum yield of (1) in water (pH7) would be considerably lower than emission quantum yield of GFP
D. Absorption spectra of both (1) and GFP would be pH sensitive

60. According to Randle's theory, which of the following explains how free fatty acids (FFA) compete with glucose metabolism in a cell?
A. FFA prevent insulin secretion and glucose intake by a cell
B. FFA prevent insulin induced GLUT4 translocation
C. FFA give more ATP than glucose, so cell prefers FFA as a fuel
D. FFA increases the rate of glycogenesis over glycogenolysis

University of Hyderabad
Entrance Examinations - 2020

School/Department/Centre : Life Sciences/ Biochemistry
Course/Subject : PhD (code No. Y-68)

Q.No.	Answer	Q.No.	Answer	Q.No.	Answer	Q.No.	Answer
1	D	26	B	51	D	76	
2	C	27	A	52	B	77	
3	D	28	C	53	D	78	
4	B	29	B	54	B	79	
5	C	30	A	55	A	80	
6	B	31	B	56	B	81	
7	D	32	B	57	B	82	
8	A	33	D	58	A	83	
9	A	34	A	59	B	84	
10	D	35	C	60	B	85	
11	B	36	D	61		86	
12	A	37	C	62		87	
13	A	38	C	63		88	
14	C	39	D	64		89	
15	C	40	A	65		90	
16	B	41	A	66		91	
17	D	42	A	67		92	
18	B	43	D	68		93	
19	B	44	A	69		94	
20	D	45	C	70		95	
21	B	46	B	71		96	
22	C	47	D	72		97	
23	D	48	D	73		98	
24	C	49	C	74		99	
25	D	50	B	75		100	

Note/Remarks :

Signature
School/Department/Centre