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CSIR Life Science Sample Questions (Part 4 of 10)

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1. An isolated carotid sinus was prepared so that the pressure may be regulated by a pump and the resulting discharge in single carotid sinus nerve fibre could be recorded. The following are the possible observations.
 - a. No discharge when carotid sinus perfusion pressure was below 30 mm Hg.
 - b. Linear increase in discharge frequency when carotid sinus perfusion pressure was gradually increased from 70 to 110 mm Hg.
 - c. Increase in discharge frequency was more prominent in greater pulsatile changes of carotid sinus pressure keeping the mean pressure identical in all cases.
 - d. Increase in discharge was more prominent in the falling phase of pulsatile change of carotid sinus pressure than in the rising phase.
 - o Which one of the following is correct?
 - a. 1 2 3
 - b. 1 3
 - c. 2 4
 - d. 4 only
2. Synthesis of normal hemoglobin requires coordinated synthesis of α globin and β globin. Thalasseмии are genetic defects perturbed in this coordinated synthesis. Patients suffering from deficiency of β globin chains (β -thalassemia) could also be due to mutations affecting the biosynthesis of β globin mRNA. The following statements describe the genesis of non-functional β globin leading to β -thalassemia.
 - a. Mutation in the promoter region of the β globin gene.
 - b. Mutation in the splice junction of the β globin gene.
 - c. Mutation in the intron I of the β globin gene.
 - d. Mutations towards the 3' end of the β globin gene that codes for polyadenylation site.
 - o Which of the following combinations is correct?
 - a. 1 2 4
 - b. 1 2 3
 - c. 2 3 4

- d. 3 4 1
3. Equilibrium constant (K) of noncovalent interaction between two non-bonded atoms of two different groups was measured at 27°C. It was observed that $K = 100M - 1$. The strength of this noncovalent interaction in terms of Gibbs free energy change is:
- a. 2746 kcal/mole.
 - b. -2746 kcal/mole.
 - c. 247 kcal/mole.
 - d. -247 kcal/mole.
4. The erythrocyte membrane cytoskeleton consists of a meshwork of proteins underlying the membrane. The principal component spectrin has α , β subunits which assemble to form tetramers. The cytoskeleton is anchored to the membrane through linkages with the transmembrane proteins band 3 and glycophorin C. The cytosolic domain of band 3 also serves as the binding site of glycolytic enzymes such as glyceraldehyde 3-phosphate dehydrogenase. Analysis of the blood sample of a patient with haemolytic anemia shows spherical red blood cells. The patient carries
- a. a mutation in glycophorin C.
 - b. a mutant spectrin with increased tetramerization propensity.
 - c. mutant β spectrin defective in $\alpha\beta$ dimerization ability.
 - d. mutant glyceraldehyde 3-phosphate dehydrogenase.
5. Bacteriophage λ has two modes in its life cycle, lytic and lysogenic. In the lysogenic mode, the expression of all the phage genes are repressed while the expression of repressor gene switches between on and off position depending on the concentration of repressor. The following statements are made:
- a. Repressor may act both as a positive regulator and a negative regulator
 - b. Expression of repressor gene, cI is independent of the expression of cII and $cIII$ genes.
 - c. Mutation of cI gene will cause it to form clear plaques on both wild type E. Coli and E. Coli (λ^-).
 - d. Mutation at operators, O_L and O_R will allow the phage to act as a virulent phage.
- o The correct statements are
- a. 1 2
 - b. 2 3
 - c. 3 4
 - d. 4 1
6. In the following statement taken from a research paper, what does p in the parenthesis stand for? "The mean temperature of this region now is significantly higher than the one 50 years ago ($p < 0.05$, t-test) "
- a. Ratio of the mean temperatures of the two time periods tested.

- b.* Probability of the error of rejecting a true null hypothesis.
- c.* Probability of the error of accepting a false null hypothesis.
- d.* Probability of the t-test being effective in detecting significant differences in the mean annual temperatures of the two time periods.

7. Assuming a 1: 1 sex ratio, what is the probability that three children from the same parents will consist of two daughters and one son?

- a. 0.375
- b. 0.125
- c. 0.675
- d. 0.75

8. Maturation-promoting factor (MPF) controls the inhibition of mitosis in eukaryotic cells. MPF kinase activity requires cyclin B. Cyclin B is required for chromosome condensation and breakdown of the nuclear envelope into vesicles. Cyclin B degradation is followed by chromosome decondensation, nuclear envelope reformation and exit from mitosis. This requires ubiquitination of a cyclin destruction box motif in cyclin B. RNase-treated *Xenopus* egg extracts and sperm chromatin were mixed. MPF activity increased with chromosome condensation and nuclear envelope breakdown. However, this was not followed by chromosome decondensation and nuclear envelope reformation because:

- a. RNase contamination persisted in the system.
- b. cyclin B was missing from the system.
- c. ubiquitin ligase had been overexpressed.
- d. cyclin B lacking the cyclin destruction box had been overexpressed.

9. In an in vitro experiment using radiolabelled nucleotides, a researcher is trying to analyze the possible products of DNA replication by resolving the products using urea-polyacrylamide gel electrophoresis. In one experimental set up RNase H was added (Set 1), while in another set no RNase H was added (Set 2). The possible observations of this experiment could be

- a. There is no difference in the mobility of labelled DNA fragment between the Set 1 and Set 2
- b. There is distinct difference in the mobility of the newly synthesized labelled DNA fragments between Set 1 and Set 2
- c. The mobility of the newly synthesized labelled DNA fragments in case of Set 1 is faster as compare to the Set 2
- d. The mobility of the newly synthesized labelled DNA fragments in case of Set 1 is slower as compared to the Set 2

- Which of the following combinations represent correct observations?
a. 1 2

b. 2 3

c. 1 4

d. 2 4

10. The bacterial flagellar motor is a multi-protein complex. Rotation of the flagellum requires movement of protons across the membrane facilitated by a multi-protein complex. The flagellar motor proteins combine to create a proton channel that drives mechanical rotation. In a screen for mutants, some non-motile ones were selected. These could have

- a.* mutations in tubulin and actin proteins.
- b.* mutations in kinesin proteins.
- c.* mutated H^+ ATPase.
- d.* mutations in the charged residues lining the ridge of the FliG subunit.