

M. Sc. (BIOTECHNOLOGY) EXAMINATION, 2023

(1st Year, 1st Semester)

CELL BIOLOGY

PAPER – CORE/TH/131

Time : Two hours

Full Marks : 40

(Use a separate Answer script for each Group)

Group – A

Answer any **three** questions from A1 and **one** from A2.

Group – A1

1. i) What is a proton pump? How does the use of proton pump inhibitors help in the treatment of heartburn?
1+2=3
- ii) Why an aquaporin does not allow ions (like Na⁺) to pass through it? 2
2. “A nuclear localization sequence (NLS) is often a short stretch of basic amino acids”. You have identified a novel short basic amino acid sequence, which you think is a putative nuclear localization signal.
 - i) How will you experimentally prove that newly identified sequence is indeed a NLS? 3
 - ii) What would be the consequences, if basic amino acids are replaced with hydroxyl ion-containing amino acids? Experimentally demonstrate the fate of such incidence in an in vitro culture system? 2

[Turn over

[2]

3. i) "Mitochondrial fission and fusion network is tightly regulated for cell viability" – Justify the statement. 3
- ii) Phospholipid bilayer is only slightly permeable to small polar molecules like water and yet placing an animal cell in hypotonic solution leads to swelling of it. But surprisingly, frog oocytes and eggs are protected from osmotic lysis if placed in hypotonic solution. Explain this phenomenon with proper justification. 2
4. i) What are the factors that can alter lysosomal membrane permeabilization (LMP) in a cell? What would happen upon alteration of LMP in a cell? 2.5
- ii) Briefly describe the function of Na⁺K⁺-ATPase pump. How does cardiac glycoside like, Digoxin, help in the treatment of heart failure patient? 2.5
5. i) How does glutathione molecule is able to predict the oxidative status of a cell? 3
- ii) How would you experimentally prove that ATP hydrolysis is required to keep the protein in an unfolded state for the incorporation of the protein into mitochondria? 2

[5]

- of antagonism between oncogene and tumor suppressor gene products. Explain the phenomenon. 2+3=5
8. Can cancer be inherited from parents? Put up your views with scientific reasoning. p53 and RB are at the heart of the two main tumour-suppressor pathways that control cellular responses to potentially oncogenic stimuli. Justify the statement mentioning properly their molecular mode of action. 2+3=5

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3. State the functions of Profilin, Cofilin, Thymosin β 4? How Formin protein is associated with Rho-dependent pathway in actin polymerization? 3+2=5
4. How Troponin regulates muscle contraction? Briefly state the molecular signaling pathway in Ca^{++} -dependent smooth muscle contraction process. Why smooth muscle contraction is comparatively a slower process? 2+2+1=5
5. What are the two principal signal transduction pathways involving the G protein-coupled receptors? What is the role of β -arrestins and RGS proteins in GPCR signaling? Which downstream proteins of Dsh are responsible for the positive and negative regulations of non-canonical Wnt signaling pathway? 1+2+2=5
6. What is the role of DAAM1 protein in non-canonical PCP-mediated Wnt signaling pathway? What is the function of coSmad proteins? Which Smad proteins act as inhibitors of TGF- β /Smad signaling pathway and how these proteins inhibit the pathway? 1+1+1+2=5

Group – B2

7. How can you distinguish between a tumor suppressor gene and a proto-oncogene? The protein encoded by the PTEN tumor suppressor gene is an interesting example

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Group – A2

Answer any **one** of the following.

6. “Activated APC/C first target non cyclin protein”. Justify your answer. Give an brief account for the formation of replication complex. Define the role of Mad2 (mitotic arrest deficient 2) protein in spindle assembly check point. 2+2+1
7. How during apoptosis initiator caspase is activated. Why executioner caspase target PARP (Poly (ADP-ribose) polymerases) protein? How in extrinsic pathway of apoptosis mitochondria become leaky? 2+2+1

Group – B

Answer any **3** questions from B1 and **one** from B2. 3 \times 5=15

Group – B1

1. State the differences between Desmoglein and Desmoplakin in terms of position and function. Which proteins form occluding junctions? State two primary functions of occluding junctions. Name any approach with which we can identify new gap junction. 1+1+2+1=5
2. Elaborate the polymerization steps of actin. What is critical concentration (C_c) in the polymerization process? Why C_c is important in regulating polymerization process? 2+1+2=5

[Turn over