
1.

Distinguish between a covalent bond and a non-covalent interaction.

Sample - In a covalent bond, a pair of electrons is shared between two atoms. - Non-
Correct covalent interactions do not involve the sharing of electrons. These are weaker
Answer interactions than covalent bonds. They are based on the attraction of an
electronegative atom for a hydrogen atom (hydrogen bond), transient attraction of
dipoles of opposite charge (van der Waals interaction), the attraction of ions of
opposite charge (ionic bond) or the tendency of hydrophobic molecules to be
excluded by water (hydrophobic interaction).

2.

Distinguish between G-actin and a G protein.

Sample - G-actin is a globular monomeric protein that, when ATP is bound to it,
Correct polymerizes to form F-actin (filamentous actin) and microfilaments. - A G
Answer protein is a heterotrimeric protein that is activated when the G protein-coupled
receptor that links to it is activated by its ligand. When activated, the G protein
binds GTP and splits into two units (an alpha unit and a beta-gamma unit),
each of which can activate cellular signalling pathways

3.

What is a ligand-binding domain and why is it significant?

Sample - A ligand-binding domain is the part of a receptor to which its particular
Correct signalling molecule (the ligand) binds to activate the receptor; there is a
Answer specific fit between the receptor and its ligand. - It is significant as the
mechanism through which a receptor is activated by a signalling molecule in a
very specific fashion.

4.

What is homeoviscous adaptation and why is it significant?

Sample - Homeoviscous adaptation refers to the adjustment of membrane phospholipid
Correct composition by an organism so as to maintain constant membrane fluidity in
Answer the face of changes in environmental temperature. - It is significant in
accounting for how organisms maintain membrane fluidity as temperature
changes, and in accounting for the changes in membrane phospholipid
composition that occur with changes in temperature.

5.

Contrast and compare the basic structure of prokaryotic and eukaryotic cells, using your analysis to explain why prokaryotic cells are typically 10 times smaller than eukaryotic cells in their largest linear dimension.

Sample 6 marks - Prokaryotic cells lack membrane-bound organelles, whereas
Correct eukaryotic cells may include a number of different membrane-bound organelles

Answer such as mitochondria, chloroplasts, Golgi complex, ER, vesicles or vacuoles. (1) - The presence of membrane-bound organelles in eukaryotic cells compartmentalizes the cytoplasm. This reduces the number of molecules that are required to achieve the adequate concentration for biochemical reactions to occur. (1) - The cell may not be able to synthesize sufficient molecules to achieve the adequate concentration for biochemical reactions to occur as cell size increases. The presence of membrane-bound organelles in eukaryotic cells allows them to overcome this limitation, which exists in prokaryotic cells. (1) - Prokaryotic cells lack a cytoskeleton, whereas eukaryotic cells may include microfilaments, microtubules and intermediate filaments. (1) - The presence of microtubules and microfilaments in eukaryotic cells, together with the existence of motor proteins, allows molecules, vesicles and organelles to be moved around the cell rather than relying on diffusion. (1) - Diffusion over long distances may not be sufficiently rapid to keep up with the requirements of the cell. The presence of cytoskeletal transport systems in eukaryotic cells allows them to overcome this limitation, which exists in prokaryotic cells. (1) - Eukaryotic cells possess a membrane-bound nucleus in which the genetic material (DNA) is organized into discrete chromosomes together with protein. By contrast, although prokaryotic cells also possess genetic material that is DNA, it is organized into a single, circular chromosome that lacks protein and constitutes the nucleoid, a region of the cell that is not bounded by a membrane. (1) - Both prokaryotic and eukaryotic cells possess ribosomes for protein synthesis; those of prokaryotic cells are smaller and simpler than those of eukaryotic cells. OR Both prokaryotic and eukaryotic cells may possess a cell wall; the composition of the cell wall differs. (1) (Note - total marks to a maximum of 6)

6.

Contrast and compare the structure and function of keratin and collagen.

Sample Correct Answer 4 marks - Both keratin and collagen are fibrous proteins (although keratin does have globular domains at each end of the fibrous alpha-helix region) that are synthesized by animal cells and play structural roles. (1) - Whereas keratin is found in intermediate filaments (and so is an intracellular protein), collagen forms into collagen microfibrils in the extracellular matrix. (1) - The building block of intermediate filaments is a protofilament consisting of two keratin coiled-coil dimers (i.e. a tetramer) (1). By contrast, the building block of collagen microfibrils is a triple helix of collagen proteins (a trimer). (1)

7.

You hypothesize that the growth of the axon of a neuron during development relies on the cytoskeleton. Design an experiment to test this hypothesis, briefly describing the experimental approach that would be taken, the rationale for this experimental approach, and the expected results.

Sample Correct Answer 3 marks - To determine whether the growth of the axon of a neuron during development relies on the cytoskeleton, one could inhibit microfilament polymerization using cytochalasin OR one could stabilize microfilaments using phalloidin. (1) - The rationale for this approach is that growth of the axon would rely on microfilament polymerization to create a cytoplasmic extension (a lamellipodium or filopodium) in the direction the axon is to grow. In this

mechanism, addition of ATP-G-actin monomers to the plus end of a microfilament lengthens the microfilament, creating a cytoplasmic extension. At the same time, ADP-G-actin monomers dissociate from the minus end of the microfilament and can be recycled to the plus end to maintain the growth/extension of the cytoplasm. (1) - Thus, we would predict that if axon growth relies on microfilament polymerization, axon growth would be inhibited by inhibiting the dynamic activity of microfilaments. This could be done by inhibiting microfilament polymerization with cytochalasin. (1) OR This could be done by stabilizing microfilament arrays with phalloidin. (1)

8.

For a bonus mark that, in the spirit of socialism will be applied to the entire class if even one person is successful, identify the fish species of the roadside attractions of the following locations (all of which have been featured on the "Announcements" slides!).

- a. Gananoque, Ontario - 1.-----
- b. Selkirk, Manitoba - 2.-----
- c. Sault Ste Marie, Ontario - 3.-----
- d. Campbellton, New Brunswick - 4.-----
- e. Dominion City, Manitoba - 5.-----
- f. Upsala, Ontario - 6.-----
- g. Westport, Ontario - 7.-----
- h. Kenora, Ontario - 8.-----

Correct Answer
1. Equals muskie (5%)
2. Equals catfish (20%)
3. Equals trout (10%)
4. Equals salmon (10%)
5. Equals sturgeon (20%)
6. Equals walleye (20%)
7. Equals trout (10%)
8. Equals muskie (5%)