

2025 Bi H2 Q15

Section: Metabolism and Survival

Topic: Adverse Conditions and Growth Phases

Question Summary:

This extended-response question allows students to choose either: A — survival mechanisms used by animals in adverse conditions, or B — the phases of growth in micro-organisms. This solution provides a complete set of notes for both branches.

Worked Solution

Part A: How Animals Survive Adverse Conditions

Animals encounter adverse conditions such as extreme temperatures, drought, food shortages, or seasonal changes. To survive, they use a range of strategies that reduce metabolic demands or avoid harmful environments.

1. Dormancy

Dormancy is a period of reduced metabolic activity that allows survival when normal metabolic costs would be too high. - **Predictive dormancy** occurs before the onset of adverse conditions. - **Consequential dormancy** occurs after conditions worsen unexpectedly.

Types of Dormancy:

- **Hibernation:** Used by mammals in winter. Metabolic rate, heart rate, breathing rate, and body temperature all decrease significantly. This conserves energy when food is scarce.
- **Aestivation:** Occurs during hot, dry periods to prevent dehydration and overheating.

- **Daily torpor:** Short-term reduction in activity and metabolism, often used by small animals with high metabolic rates (for example, hummingbirds).

2. Migration

Migration is the movement of animals to a more suitable environment. It requires energy but allows access to food, breeding grounds, or favourable climates. Navigation may involve environmental cues such as magnetic fields or celestial navigation.

3. Metabolic Adjustments

Animals may reduce energy consumption by lowering metabolic processes or entering energy-saving physiological states.

4. Environmental Adaptations

Physical adaptations (such as insulation, fat reserves, or waterproofing) help animals cope with temperature extremes or moisture loss.

Part B: Phases of Growth of Micro-organisms

When micro-organisms are cultured in a closed system with fixed nutrient supply, they show characteristic phases of population growth.

1. Lag Phase

Cells adjust to new conditions; enzymes are induced; DNA replicates. There is little or no increase in cell number.

2. Log (Exponential) Phase

Cells divide rapidly. - Nutrients are plentiful. - Metabolic activity is high. - Most growth occurs here.

3. Stationary Phase

Cell division slows and equals cell death. - Nutrients become depleted.
- Toxic metabolites accumulate. - **Secondary metabolites** such as antibiotics may be produced, reducing competition.

4. Death Phase

Cells die due to lack of nutrients and toxic accumulation of metabolites. Total cell count includes live and dead cells, while viable count includes only living cells.

Final Answer:

Part A: Animals survive adverse conditions through dormancy, migration, metabolic and physiological adaptations, and energy-saving strategies. **Part B:** Micro-organisms show lag, log, stationary, and death phases due to changes in nutrients, enzyme induction, and toxic by-product accumulation.

Revision Tips

- Dormancy reduces metabolic rate to survive harsh conditions.
- Migration avoids adverse environments. - Growth phases reflect nutrient levels and population dynamics.
- Secondary metabolites provide ecological advantages in competition.