# KEYSTONE QUESTIONS FOR PASCC ANSWERS

## I. BASIC BIOLOGICAL PRINCIPLES –

1 C
2 D
3 D
4.C

### CONSTRUCTED RESPONSE

Prokaryotic cells are generally much smaller than eukaryotic cells.
**Part A:** Identify a structural difference between prokaryotic cells and eukaryotic cells that is directly
related to their difference in size.
**Part B:** Based on the structural difference, explain why prokaryotic cells can be much smaller than eukaryotic cells.
**Part C:** Describe one similarity between prokaryotic cells and eukaryotic cells that is independent of size.

**PART A** Prokaryotes do not have a nucleus or membrane bound organelles which allows them to be smaller whereas eukaryotes have a nucleus and many different organelles. Therefore they need to be larger in order to maintain all the complex structures that are contained within them.

**PART B** Prokaryotes have no membrane bound organelles including a nucleus therefore can be smaller unlike the Eukaryotes which have many membrane bound organelles including a nucleus so they need more to room and are much bigger.

**PART C** They both have cell membranes. They both have ribosomes and cytoplasm.

## II. CHEMICAL BASIS OF LIFE –

1C
2B
3D
4A
5D

## CONSTRUCTED RESPONSE

**Answer to Constructed Response**
Part A: Describe the general composition of a protein molecule.
Part B: Describe how the structures of proteins differ from the structures of carbohydrates.
Part C: Describe how the functions of proteins differ from the functions of carbohydrates.

**Part A (1 point):**
• Proteins are composed of amino acid molecules linked together by peptide bonds. C, H, N, S, and O are typical atoms that compose amino acids.
**Part B (1 point):**
• The amino acids contain amino and carboxyl groups. Primary, secondary, tertiary, and quaternary structures of a protein molecule are necessary for the protein to function correctly. Interactions occur between amino and carboxyl groups of amino acids. Carbohydrates are composed of C, H, and O. Monosaccharides are the building blocks of carbohydrates. Two monosaccharides form a disaccharide. Many monosaccharides form a polysaccharide, such as starch, cellulose, or chitin.

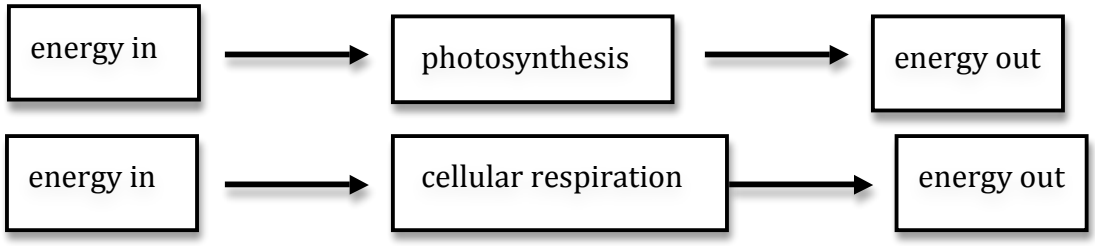
**Part C (1 point):**
• Proteins function as enzymes, anti bodies, and structural components. Carbohydrates function in short-term energy storage (starch, glycogen) or structural components (chitin, cellulose, glycogen).

# III. BIOENERGETICS –

**1B**
**2A**
**3 2**
**4 C**

## CONSTRUCTED RESPONSE

**Use the diagrams below to answer the question.**




**Part A:** Complete the chart below by describing energy transformations involved in each process.

During the process of photosynthesis, $CO_2$ and $H_2O$ are converted into glucose and oxygen with energy from the sun that is captured by the chlorophyll contained in the chloroplasts.

During the process of cellular respiration, the stored energy in glucose is used to create energy that the cell can use in the form of ATP. This process takes place in the mitochondria.

| **Process** | **Energy Transformations** |
|---|---|
| **photosynthesis** | **$6CO_2 + H_2O$ + light energy (sun) ➔ $C_6H_{12}O_6 + 6O_2$** |
| **cellular respiration** | **$C_6H_{12}O_6 + 6O_2$ ➔ $6CO_2 + 6H_2O$ + ATP (energy)** |

**Part B:** Describe how energy transformations involved in photosynthesis are related to energy transformations involved in cellular respiration.

The energy from the sun was used to create glucose by transforming $CO_2$ and $H_2O$. The stored energy in glucose is consumed by heterotrophs and transformed into ATP so the cells can use the energy to carry out all life functions.

# IV. HOMEOSTASIS & TRANSPORT –

**1 B**
**2 B**
**3 A**

## CONSTRUCTED RESPONSE

Some animals can produce a potassium ion concentration inside their cells that is twenty times greater than that of their environment. This ion concentration gradient is maintained by the plasma membrane.
**Part A:** Identify the process in the cell membrane that produces this difference in concentration.
**Part B:** Explain the process that occurs as the cell produces the ion concentration gradient.
**Part C:** Compare the process of potassium ion transport to another mechanism that moves material across the plasma membrane.

**PART A** The process is the sodium potassium pump which is an example of active transport.

**PART B** Protein transports sodium and potassium ions across cell membranes against their concentration gradients. Sodium is normally moved from the inside of the cell, where its concentration is low, to the extracellular fluid, where its concentration is much higher. Potassium is moved in the opposite direction. Energy for the pump is obtained from ATP.

**PART C** The potassim ion transport system needs energy because it is moving potassium

against the concentration gradient and it needs a protein to help potassium get through the membrane to the inside of the cell. Facilitated diffusion also needs a protein to move substances across the membrane but it moves them with the concentration gradient so it does not need energy. Could have also used osmosis, endocytosis, exocytosis.

# V. CELL GROWTH & REPRODUCTION –

**1C**
**2D**
**3D**
**4D**

## CONSTRUCTED RESPONSE

Patau syndrome can be a lethal genetic disorder in mammals, resulting from chromosomes failing to separate during meiosis.
**Part A:** Identify the step during the process of meiosis when chromosomes would **most likely** fail to separate.
**Part B:** Describe how chromosome separation in meiosis is different from chromosome separation in mitosis.
**Part C:** Compare the effects of a disorder caused by chromosomes failing to separate during meiosis, such as Patau syndrome, to the effects of chromosomes failing to separate during mitosis.

**Also called Trisomy 13**

**Part A: The chromosomes would most likely fail to separate during Anaphase 1 of Meiosis 1. The homologous pairs line up during Metaphase 1 and are pulled apart by the spindle fibers (kinetochore microtubules) during Anaphase 1.**

**Part B: During Meiosis 1, homologous pairs of chromosomes go through the process of crossing over and are pulled apart into individual chromosomes. During Meiosis 2, the individual chromosomes are pulled apart into chromatids. Four haploid cells are created that are not identical to the original diploid parent cell.**

**During mitosis, there is no crossing over and the chromosomes do not line up in homologous pairs. The chromosomes are pulled apart into chromatids during Anaphase and two diploid cells are created that are identical to the parent cell.**

**Part C: The process of meiosis produces the sex cells (gametes, eggs, sperm). If the homologous chromosomes fail to separate properly (nondisjunction), then the eggs or sperm that are produced will have**

**the incorrect number of chromosomes. Some may have too many chromosomes (Trisomy) or too few (monosomy). When the gametes unite to form a zygote, every cell in that individual will be affected (except in cases like Down Syndrome Mosaism). These genetic disorders often have physical and mental impairments that are easily recognizable.**

**Mitosis occurs in somatic cells; this means that it takes place in all types of cells that are not involved in the production of gametes. Prior to each mitotic division, a copy of every chromosome is created; thus, following division, a complete set of chromosomes is found in the nucleus of each new cell. Apart from random mutations, each successive duplicate cell will have the same genetic composition as its parent, due to the inheritance of the same chromosome set and similar biological environment. This works well for replacing damaged tissue or for growth and expansion from an embryonic state**.

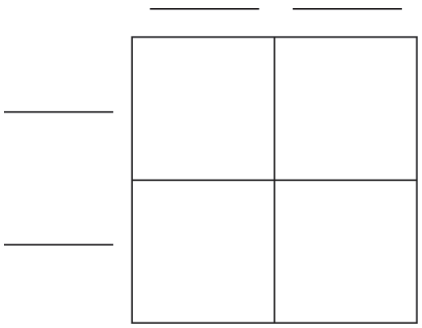
# VI. GENETICS –

**1 B**
**2 C**
**3 A**
**4 D**
**5 D**

## CONSTRUCTED RESPONSE

A cattle farmer genetically crosses a cow (female) with a white coat with a bull (male) with a red coat. The resulting calf (offspring) is roan, which means there are red and white hairs intermixed in the coat of the calf. The genes for coat color in cattle are co-dominant.

**Part A:** Although a farm has cattle in all three colors, the farmer prefers roan cattle over white or red cattle. Use the Punnett square to show a cross that would produce only roan offspring.



You would cross RR (red cow) and a white (rr) and the offspring would all be Rr (Roan) since it is incomplete dominance.

**Part B:** Explain how a roan calf results from one white- and one red-coated parent. In your explanation, use letters to represent genes. Be sure to indicate what colors the letters represent.
**The trait is incomplete dominance so you get a blend of both traits in the heterozygous**

**form. rr (white) x RR (Red) , when parents mate their offspring are Rr (Roan) and produce a blend of both red and white coats.**

**Part C:** Predict the possible genotypes and phenotypes of the offspring produced from two roan cattle. Rr x Rr 1 RR 2 Rr 1 rr - genotype
1 Red, 2 Roan, 1 White- phenotype

# VII. THEORY OF EVOLUTION –

**1 B**
**2 C**
**3 D**
**4 D**

## CONSTRUCTED RESPONSE

**Use the table below to answer the question.**

| **Sequence Differences between COII Genes in Some Animals** | |
|---|---|
| **Animal** | **Number of Base Differences from a Rat** |
| mouse | 101 |
| cow | 136 |

The gene COII is in the genome of many organisms. A comparison of the number of base differences between the COII gene in a rat and that of two other animals is shown.
**Part A:** Based on the data, describe a possible evolutionary relationship between rats, mice, and cows.
**Part B:** Describe how different organisms having a common gene such as COII supports the theory of evolution.
**Part C:** The COII gene of a monkey has 203 base differences from the same gene in a rat and 210 base differences from the same gene in a mouse. Compare the evolutionary relationships between the monkey, the rat, and the mouse.

**PART A:**
The rat is more closely related to the mouse than the cow because there are a fewer number of base differences: mouse: 106 and cow: 136

**PART B:**
Organisms that have a common gene must share a common ancestor.

**PART C:**
Monkey: 203 base differences from rat
210 from mouse

The monkey is more closely related to the rat than the mouse because there are fewer base differences in the makeup of this gene. Based on this information, the mouse must have evolved first, then the rat, followed by the mouse.

# VIII. ECOLOGY –

**1 C**
**2 C**
**3 B**
**4 D**
**5 C**
**6 B**

## CONSTRUCTED RESPONSE

**Part A:** Describe one limiting factor for the moose population.
**Part B:** Explain one likely reason why the wolf population rapidly increased between 1975 and 1980.
**Part C:** Predict what will happen to the moose population's size after 1994 by describing the shape of
the curve. In your answer, be sure to explain the reasoning behind your prediction

**Part A (1 point):**
• One limiting factor for the moose population is predation. The moose population will decrease as wolves prey upon moose. Predation would decrease the population.
**OR**
• One limiting factor for the moose population is habitat destruction. Since the moose are on an island, if their habitat is destroyed or affected, their population could decrease.
**OR**
• Other limiting factors could include shelter, natural disturbances, fresh water supply, food supply, and disease. These would all serve to decrease the moose population.
**Part B (1 point):**
• The wolf population rapidly increased between 1975 and 1980 because there was an ample food supply. From about 1970–1975, the moose population was at a high level. Because wolves prey upon moose, there was an ample food supply to support a larger population of wolves.
**Part C (1 point):**
• The moose population curve after 1994 would drop and then level off between 1,400 and 1,200 moose. Because the moose live on an island, there is a limited amount of resources available and the population would stabilize around its carrying capacity.
**OR**
• The moose population curve after 1994 would drop below 1,000 moose if the wolf population increases. The increase of the wolf population would be due to the increased availability of moose, which would result in a decline in the moose population.