

The question paper is divided into 3 SECTIONS.

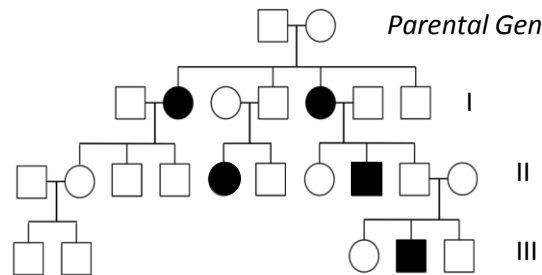
Answer all parts of the same section together; if you jumble them up, your answers won't be evaluated.

Write answers as briefly as possible. Unnecessarily long answers won't be considered.

Section "A"

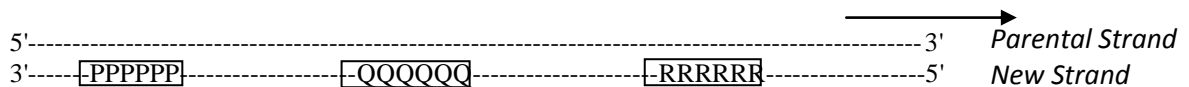
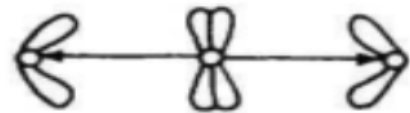
1.

- If the diploid chromosome number of an organism is 18, how many different possible combinations of homologous chromosomes would be present in Metaphase I? [1.0]
- A gene has 20 alleles existing in the population. What is the maximum number of alleles an organism of this species can have at the locus for the gene? [0.5]
- In cats, the gene for coat color is an autosomal, and **black** coat color (B) is dominant over **grey** (b). A female black cat, that has a mother with grey coat mates with grey male. This female has a litter of six kittens, what is the probability that three are black and three are grey? Show calculations. [2.0]
- The following pedigree represents inheritance of which particular trait (**dominant or recessive**)? Justify your answer. [1.5]



2.

- What are the possible cell division phases (of mitosis and/or meiosis) represented in the adjoining figure depicting chromosomal movements? [1.0]
- A scientist while investigating the function of an eukaryotic gene, observed 4 types of mRNAs in the cell cytoplasm which have resulted from the same gene of his interest. His colleagues stated that it must be an error in interpretation. Do you agree with it? Justify your answer. [2.0]
- Shown below is a snapshot of DNA fragment undergoing replication. The primers are represented by boxes of PP/QQ/RR. Arrow indicates direction of movement of replication fork.



- Which among these primers (P/Q/R boxes) would be the first to be incorporated as part of Okazaki fragment? Explain diagrammatically. [1.5]
- What is the chemical nature of the primers? [0.5]

Section "B"

- 3.
- a. Excess ATP accumulation in a cell inhibits cellular respiration reactions from continuing. Comment briefly on the biochemical mechanism involved in this event. [1.5]
 - b. Your younger sister who is in high school has recently become very health-conscious. You learn that she has developed a great deal of aversion for the words "cholesterol" and "fats" and feels that these are completely useless substances in the human body! As a student of *General Biology*, explain why fats are both useful and harmful(*one point each*). [2.0]
 - c. Explain briefly as to why do you think nature chose phospholipids to form the cell membrane bi-layer rather than any other classes of bio-molecules. [1.5]
- 4.
- a. What is the role of oxygen in photosynthesis? Justify your answer. [1.5]
 - b. How does lactic acid fermentation help a cell to continue with respiration? Justify. [1.5]
 - c. Name an intracellular organelle that distinguishes a plant cell from a member of Kingdom Fungi. [0.5]
 - d. A research student was observing the ultra-structure of an animal cell under a microscope. He could observe net like membranous superposed complex of flat sacs with round vesicles detaching from its extremities. Some of those vesicles were found in close proximity to the plasma membrane of the cell too. Mention the name of the cellular structure the researcher was observing and state its function? [1.5]

Section "C"

- 5.
- a. You have just joined a research lab. Your supervisor wants to test your knowledge of biology. He asks you to filter out bacteria from a mixture. You could only find a 25µm pore sized filter paper in the lab. Would you be able to accomplish your task? Justify. [1.0]
 - b. The sequence given below is of part of a gene, with its promoter underlined. Transcription begins from the **G/C** base pair (**given in bold**), including them.

5' AGCTACCATA GCGTA GTAAT AGGAC **G**TTAAC GCTAC AACGA TGCGA TGCCA TCCGA 3'
3' GCGATGGTAT CGCAT CATTA TCCTG **CA**ATTG CGATG TTGCT ACGCT ACGGT AGGCT 5'

- i. Write the sequence of the first 5 nucleotides, with proper label (**mark 5' and 3'**) of the mRNA transcript encoded by the gene? [2.0]
 - ii. Write the sequence of the **first three** amino acids translated from this mRNA transcript. (refer to the codon table in the next page). [2.0]
- 6.
- a. Why a cell still may escape damage even if its lysosomal contents are released into the cytoplasm? [1.5]
 - b. Name the cell/s of your body that do not possess any homologous chromosomes (exclude cells without any chromosomes at all)? [1.0]
 - c. A case was brought before a judge in which a woman of blood group "O", presented a baby of blood group "O" which she claims as her child. She further claims a man of blood group "AB" as the father. Just based on this information of the blood types, can her claim be accepted? Explain your answer. [2.5]

*****Best of Luck*****