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BIOLOGY EXERCISES for S5 MCB and PCB in this confinement period

S4 contents

1. Abiotic factors are the non-living physical aspects of the environment.
2. Capture –recapture is a method used to integrate the numbers of mobile animals in a particular place.
3. A correlation coefficient of 0 means that there is no correlation at all.
4. A sample is a portion, piece, or segment that is representative of a whole area of study.
5. In the Simpson's index, N represents the total number of organisms of a particular species

Section B: Long and short answer based questions

6. What do you understand by the term biodiversity?
7. What do you think would happen to plants if there were no insects?
8. Suggest different ways to conserve our forests.

4. A student has randomly collected 5 types of species at the following frequencies.

Species A	A	B	C	D	E
Frequency (n)	2	6	3	4	2

Calculate the Simpson's diversity index of this community.

5. A team of students conducted the capture- recapture sampling method of tilapia from lake Muhazi at different times of the day as recorded in the data below:

Time/Hours	12:00	15:00	18:00	21:00	00:00	03:00	06:00	09:00
Number of fish	24	12	8	2	1	4	6	24

a. Plot the graph for the date provided and describe the shape of the graph.
b. From the graph, determine the appropriate time to have the most catch.

9. a) Explain the difference between species richness and species evenness.

b) Explain how a habitat with high diversity tends to be more stable than one with low diversity.

10. Evaluate the contribution of biodiversity to human wellbeing.

11. a) Differentiate between species richness and evenness. [1]

b) Suggest why tropical rainforests have a high biodiversity of animal species. [1]

c) The following table shows some plant species (trees) in GAKO forest.

Tree species	Numbers
A	56
B	48
C	12
D	6
E	3

i) Calculate the Simpson's diversity index of the above forest. /2marks

ii) Explain why a habitat with high diversity is thought to be more stable (2marks)

iii) Discuss why is it important to maintain biodiversity. /7marks

12. Which one of the following living organisms belongs to domain bacteria?

a. Euglena
b. Vibrio cholerae
c. Paramecium
d. moulds

13. The group of classification where organisms resemble one another and are capable of interbreeding together to produce viable offspring is known as:

a. Species
b. kingdom
c. Genus
d. Phylum

14. Which one of the following is not a kingdom of living organisms?

a. Monera
b. Animalia
c. Annelida
d. Protoctista

15. Which one of the following is a characteristic feature common to fish, reptiles and birds but absent in mammals?

a. Possession of scales

b. Has no limbs

c. Possession of feathers

d. Undergo internal fertilization

16. Which one of the following statements about fish is not correct?

a. Fish live both in water and on land and undergo external fertilization.

b. Most fish have bones while others are cartilaginous

c. Most fish have streamlined body, lateral line and swim bladder.

d. Gills are organs for gaseous exchange in fish

17. Which one of the following is not a characteristic of all insects?

a. They have three body parts namely head, thorax and abdomen.

b. They have three pairs of jointed legs attached on segment of the thorax.

c. They have four pairs of jointed legs

d. They have a pair of antennae attached on the head.

18. The following are characteristics of all mammals except;

a. They have mammary glands to secrete milk feed their young ones.

b. Their skin is covered with hair.

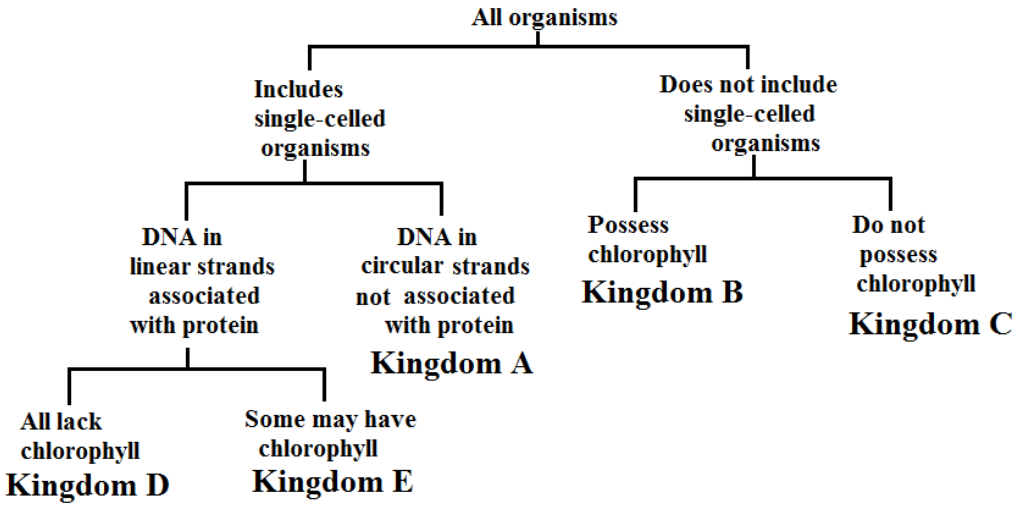
c. Undergo internal fertilization and internal development of the embryo.

d. They have a pair of wings made up feathers.

19. a) Explain the difference between taxonomy and classification.

b) Why do we study how closely related we are to other organisms?

20. The diagram below shows how organisms may be separated into five kingdoms.



a) i) Name Kingdom B. /1mark

ii) Give one characteristic, other than the possession of chloroplasts, which could be used to distinguish cells of organisms in Kingdom B from those in Kingdom C. /1mark

b) Which of the Kingdoms A, B, C, D or E represents the Fungi? /1mark

c) Microactinium is a single-celled eukaryotic organism. It is an autotroph. Which of kingdoms A, B, C, D, or E includes Microactinium? /1mark

21. a) Differentiate between a bacteriophage and a retrovirus?

b) Do you think viruses should be considered as a form of life? Give reasons for your answer.

22. a) What are the four main things that all members of a species share?

b) What are the three features of a natural system of classification?

23. A species may be defined in terms of observable similarities and ability to produce fertile offspring.There are however problems when using this definition in practice.

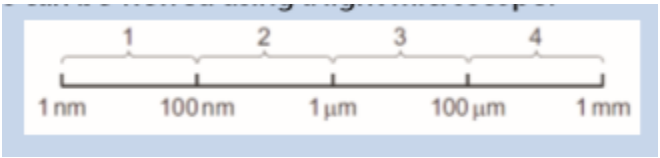
a) Even where groups of extinct organisms have left fossil records, it is very difficult to distinguish different species. Suggest two reasons why?

b) Suggest reasons why it is often difficult to classify organisms as distinct species.

24. Complete the table to summarize the characteristics of each class of phylum Arthropoda.

Characteristic	Insecta	Arachnida	Crustacea	Chilopoda	Diplopoda
Number of body parts					
Number of limbs or legs					
Gaseous exchange structure					
Number of antenna					
Number of wings					
Number and nature of eyes					

25. Which ranges can be viewed using a light microscope?



a. 4 only

b. 1 and 2 only

c. 2 and 3 only

d. 3 and 4 only

26. The figure below shows a mitochondrion drawn from an electron micrograph. Study it carefully and answer the following questions.

If the length of the mitochondrion line X Y is 3000 nm. What is the magnification of the drawing of the mitochondrion?

a. ×100

b. ×1000

c. ×10 000

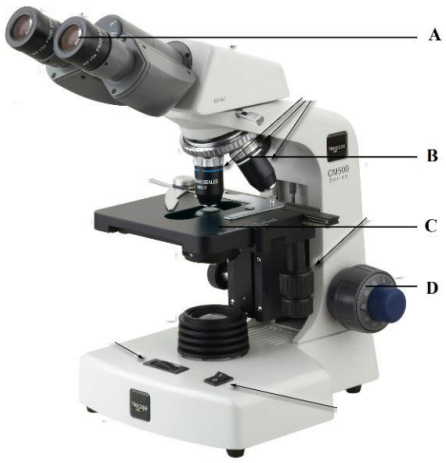
d. ×100 000

27. A light microscope is used to observe two membranes that are 200 nm apart. How far apart are the membranes when the objective lens is changed from low power (×40) to high power (×400)?

a. 2 µm
b. 20 µm
c. 200 nm
d. 2000 nm

28. Contrast how an optical microscope and transmission electron microscope work and contrast the limitations of their use when studying cells.

29. The photo below shows a light microscope.



a) Identify the parts represented by the letters A, B, C and D.
b) What is the difference between magnification and resolution?
c) State advantages of an electron microscope over a light microscope and 2 advantages of a light microscope over an electron microscope.

30. How does a cell membrane differ from a cell wall?

31. Name the structures that animal and plant cells have in common, those found in only plant cells, and those found only in animal cells.

32. List: a. Three organelles each lacking a boundary membrane b. Three organelles each bounded by a single membrane c. Three organelles each bounded by two membranes (an envelope)

33. Identify each cell structure or organelle from its description below.

a. Manufactures lysosomes and ribosomes

b. Site of protein synthesis

c. Can bud off vesicles which form the Golgi body

d. Can transport newly synthesized protein round the cell

e. Manufactures ATP in animal and plant cells

f. Controls the activity of the cell, because it contains the DNA

g. Carries out photosynthesis

h. Can act as a starting point for the growth of spindle microtubules during cell division

i. Contains chromatin

j. Partially permeable barrier only about 7 nm thick

k. Organelle about 25 nm in diameter nucleus contain their own DNA?

34. Describe the structure and function of the cell membrane and cell wall.

35. Describe the basic structure of the cell membrane.

36. Explain two common characteristics of chloroplasts and mitochondria. Consider both function and membrane structure.

37. Suggest why :

a) Chloroplasts are moved around plant cells.

b) White blood cells need to be able to move.

38. a) Explain why differentiation to produce erythrocytes involves a change in shape.

b) Red blood cells cannot divide as they have no nucleus. State two other processes that red blood cells cannot carry out.

c) Describe how the following are specialized for their role:

i) Neutrophil,

ii) sperm

iii) root hair.

39. Mitochondria and chloroplasts contain small loops of DNA.
They also contain ribosomes that are the same size as prokaryotic ribosomes.
Suggest an explanation for these features.

40. Human breast milk is produced and secreted by gland cells. These gland cells have adaptations that include many mitochondria and many Golgi vesicles.The milk contains a high concentration of protein.
Explain the role of these adaptations in the production and secretion of breast milk.

S5 contents

I. Choose whether the given statements are True (T) or False (F)

1. Organisms' interaction does only harm.

2. Commensalism harms both species.

3. Competing for food is an example of interspecific competition.

4. Herbivory is the act of predation.

5. Predation never promotes species richness.

6. There is a regular pattern of increase and decrease population in oscillation.

7. Parasitism doesn't promote coexistence of biodiversity.

II. Multiple Choice Questions

1. Both species are denoted by (+, +) in

(a) Mutualism

(b) Saprophytism

(c) Commensalism

(d) Protocooperation

2. When two species compete for a shared resource, it is called

(a) Predation

(b) Exploitative competition

(c) Interference competition

(d) Apparent competition

3. Adaptations of a predator are

(a) Sharp teeth of lion

(b) Acute sense of smell of moles

(c) Echolocation of bats

(d) All the above

4. Mineral recycling in a rainforest is done by a

(a) Saprophyte

(b) Commensal

(c) Predator

(d) Ectoparasite

5. Brood parasitism is an interaction where

(a) A parasite kills the host

(b) A parasite lives in the host

(c) A parasite deposits its sperms to the other species' nest

(d) A parasite deposits its eggs to the other species' nest

6. In sexual cannibalism, normally

(a) Males eat females

(b) Males eat the younger males

(c) Females eat males

(d) Females eat the younger females

7. A flea on a dog is an example of

(a) Parasitism

(b) Commensalism

(c) Predation

(d) Coevolution

8. Saprophytes are

(a) Predators

(b) Plants

(c) Parasites

(d) Detrivores

9. A commensal is

(a) species that benefits association

(b) species that benefits from the association

(c) species that is negatively affected from the association

(d) species that negatively affects the association

10. The interaction of bees and flowers is an example of

(a) Protocooperation

(b) Commensalism

(c) Mutualism

(d) None of these

III. Long Answer Type Questions

1. Giving suitable examples, explain the various interactions of organisms in nature.

2. Giving examples, describe in your own words, the adaptations of predator species to catch and kill prey and the adaptions of prey species to avoid predators.

3. What are saprophytes? With one example, describe how saprophytes help in recycling minerals.

4. Briefly compare interspecific and intraspecific competitions with suitable examples.

5. Draw a predator-prey relationship graph and interpret it.

6. Give two examples of the following: (a) Predation (b) Parasitism (c) Commensalism (d) Mutualism

7. How does interrelationship among organisms commit for a sustainably developed environment? Cite examples to support your answer.

8. With examples, state in your own words, the significance of organisms' interactions in nature.

UNIT2

I. Choose whether the given statements are True (T) or False (F)

1. Passive transport occurs by diffusion or osmosis.

2. Simple diffusion involves uphill transport of ions or molecules.

3. Osmosis is the movement of water or solvent molecules from the region of their higher chemical potential (free energy) to the region of their lower chemical potential (free energy) across a semipermeable membrane.

4. Not all transport mechanisms occurring across a cell membrane require ATP utilization.

5. Molecules or substances that are large in size are transported across the membrane by active transport.

6. In the human body, nutrients (in the form of ions and small molecules) are absorbed from the food by the surrounding blood cells in the vessels by way of osmosis.

7. Purification of blood by kidneys involves diffusion.

8. Reverse osmosis is used to purify water.

9. In the intestinal lining, glucose is absorbed by active transport from a lower concentration to a higher concentration in the cells lining the intestine.

10. Salting is one of the oldest methods of preserving food.

II. Multiple Choice Questions

1. …….. is the movement of ions or molecules from a region of lower concentration to higher concentration across the plasma membrane.

(a) Active transport

(b) Passive transport

(c) Pinocytosis

(d) Exocytosis

2. In the absence of …….. eyes would dry out.

(a) osmosis

(b) diffusion

(c) endocytosis

(d) exocytosis

3. Gaseous exchange during the process of respiration and photosynthesis takes place with the help of

(a) osmosis

(b) diffusion

(c) endocytosis

(d) exocytosis

4. Transpiration involves the process of

(a) osmosis

(b) diffusion

(c) endocytosis

(d) exocytosis

5. …… is important for the transport of nutrients into the cells and toxic substances out of the cell.

(a) Active transport

(b) Passive transport

(c) Pinocytosis

(d) Exocytosis

6. For transport by simple diffusion,

(a) Particles should be small in size

(b) Particles should be soluble in lipid

(c) Both of the above

(d) None of the above

7. Which of the following transport mechanisms describes the process by which a macrophage engulfs bacteria?

(a) Passive transport

(b) Active transport

(c) Endocytosis

(d) Transcytosis

III. Long Answer Type Questions

1. In your own words, explain the processes by which materials move in and out of cells.

2. Give four examples, showing significance of diffusion in living systems.

3. Give four examples, showing the importance of osmosis in living systems.

4. In your own words, explain the significance of Active transport in living organisms.

5. With examples, explain how can you apply the knowledge of hypertonic environments in food preservation by salting?

6. How do plants and animals adapt to salty conditions?

7. Distinguish between endocytosis and exocytosis giving suitable examples.

Other activities

1. a) Compare and contrast active transport and facilitated diffusion.
   b) Explain why active transport allows substances to be accumulated in an area whereas facilitated diffusion doesn't.
2. Explain why a single-cell organism such as amoeba can gain enough oxygen for its respiration through simple diffusion across its membrane.
3. a) How is osmosis different from diffusion?
   b) Potato strips were left in various liquids. The percentage changes in mass gain (+) or loss (-) are given below:

Concentration of glucose solution	0	5	10	15	20

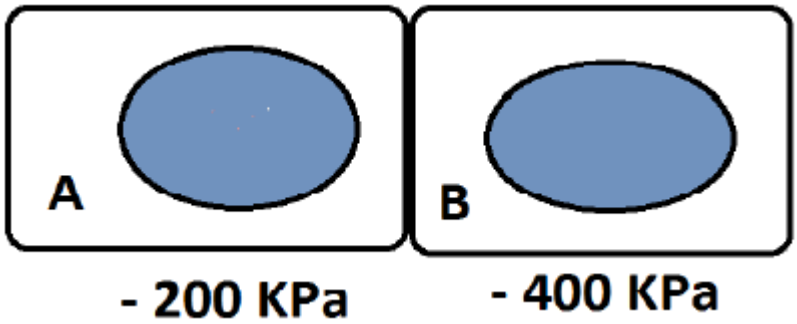
Percentage change.	+15	+5	4	-11	-16

i) In which liquid did the potato strips increase in mass? Explain your answer.

ii) If the potato strips had been smaller, what effects would this had had on the activity? Explain why.

iii) What change would you expect if the potato strips had been boiled?

4. Two neighbouring plant cells are shown below:



a) In which direction would there be net movement of water molecules?

b) Explain what is meant by net movement.

c) Explain your answer on (a)

d) Explain what would happen if both cells were placed in:

i) Pure water

ii) A 1 mol.dm^{-3} sucrose solution with a water potential of -3510 Kpa.

5. Starch in the diet is digested by the enzymes amylase and then maltase to form glucose. Glucose must be absorbed into the body so that it can be used by cells as substrate for respiration. The glucose is absorbed from the exchange surface of the small intestine into the epithelial cells that line it. This absorption occurs partly by diffusion.

a) Glucose molecules mostly diffuse into the cells through the pores in the proteins that span the phospholipid bilayer. Why do they not pass easily in the phosphor lipid layer?

b) State the two changes to the structure of plasma membranes that would increase the rate at which glucose diffuses into a cell.

c) The other molecule required by cells for respiration is oxygen. This diffuses into the blood through the epithelial layers of the alveoli and blood capillaries. By

how much would each of the following changes increase or decrease the rate of oxygen?

i) The surface area of the alveoli is doubled.
ii) The surface area of the alveoli is halved and the oxygen concentration gradient is doubled.
iii) The oxygen concentration gradient is halved and the total thickness of the epithelial layers is doubled.

The oxygen concentration of the blood is halved and the carbon dioxide concentration of the alveoli is doubled

UNIT 3

1. In your own words, describe the composition of chromosomes.

2. List at least six differences between the structures of DNA and RNA.

3. Why is DNA important in chromosomes?

4. What is telomere? Give the significance of telomere in replication and its importance in cancer treatment.

5. Describe structure of a Genetic code.

6. In your own words, explain why the structure of DNA is described as a ladder twisted into a spiral. 7. Draw the structure of DNA having at least 6 base pair sequence.

8. How did Watson and Crick determine the nucleotide base pairing pattern? Explain in your own words.

9. In your own words, describe the nature of genes.

Other activities

1. a) Explain why nucleic acids are named after the sugar they contain.
   b) How many molecules of water will be produced when a nucleotide is made from its separated component parts?
2. a) A DNA strand has the base sequence ATTAGGCTAT. Write down the complementary strand sequence.

b) A DNA molecule is 20% thymine (T). What percentage of each of the other types of base would it contains?

3. Make a table to compare and contrast the structure of DNA with that of RNA.
4. a) Explain why the mRNA strand produced in the nucleus is complementary to the template strand, and a copy of the coding strand.

b) Suggest why mRNA is less stable than DNA and explain why this is a necessary feature of mRNA.

5. a) What is the function of the protein found in chromosomes?

b) How is the considerable length of a DNA molecule compacted into a chromosome?

c) Suppose the total length of all the in a single human muscle cell is 2.3 meters.
   i) If all the DNA were distributed equally between the chromosomes.
   What would be the length of DNA in each one?
   ii) What do you think the length of DNA is in a brain cell?

6. Compare and contrast the DNA in eukaryotic cells with the DNA in prokaryotic cells.

UNIT 4

Unit 6:

I1. In your own words, state features of a genetic code.

2. Describe the process of transcription in bacteria.

3. Using diagrams, compare the process of bacterial and eukaryotic transcriptions.

4. Describe the process of translation in bacteria.

5. State the roles of t-RNA, m-RNA, and ribosomes in the formation of polypeptides.

6. What is sickle-cell anaemia? Explain its cause and symptoms.

7. In Genetic code (Figure 6.2), CUU codes for leucine (leu) amino acid. If we change the third letter of CUU i.e., U with C, A, G, which amino acid will the changed codon code for during translation?

Original codon	Change codon	Amino acid
CUU	CUC	
CUU	CUA	
CUU	CUG	

8. UUU codon codes for phenylalanine (Phe). If we change the third base "U" with C, A, G, which amino acid will the changed codon code for during translation?

Original codon	Change codon	Amino acid
UUU	UUC	
UUU	UUA	
UUU	UUG	

9. During translation, what will happen if there is mutation on a codon UAU (codes for tyrosine) where the third letter "U" is replaced by either one of the bases A or G or C?

Original codon	Change codon	Amino acid
UAU	UAA	
UAU	UAC	
UAU	UAG	

10. State that ribosomes provide surface area for the attachment of mRNA during polypeptide synthesis.
11. Construct a flow chart, in proper sequence, for the stages of transcription and translation.

12. Using the evidence, predict the effect of change in genetic code on the structure of the protein manufactured during protein synthesis. 13. Briefly describe the alteration of nucleotide sequence attacking the deadly AIDS. Also show how it can be an essential step towards poverty alleviation.

13. Describe how mRNA is produced in a plant cell.

14. a) The table shows the base sequence of part of pre-mRNA molecule from eukaryotic cell. Complete the table with the base sequence of the DNA strand from which this pre-mRNA was transcribed.

									DNA
A	C	G	C	A	U	U	A	U	Pre-mRNA

b) In an eukaryotic cell, the base sequence of the mRNA might be different from sequence of pre-mRNA. Explain why?

15. a) Complete the table below on the information about protein synthesis.

Stage of synthesis	**Site**
Formation of mRNA	
Collection of amino-acids by tRNA	
Formation of codon-anticodon links	

b) After protein synthesis, what finally happens to:

i) the RNA transfer molecules?

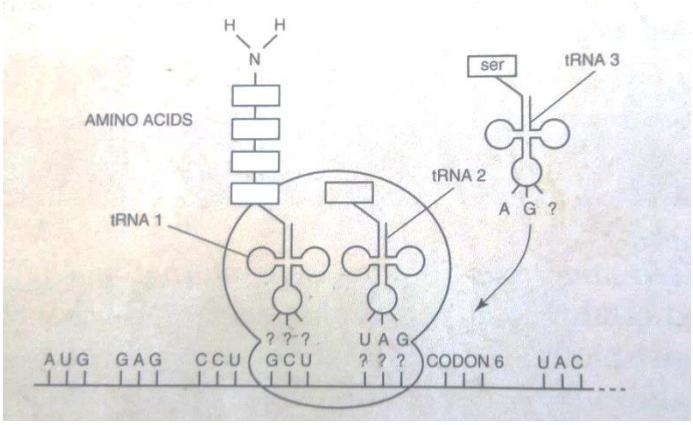
ii) the RNA messenger molecules?

iii) the completed protein?

16. The following codon dictionary shows all 64 triplet codons which may occur in mRNA and the amino acids that are coded, as well as the chain termination coon

First base	Second base U	Second base C	Second base A	Second base G	Third base
U	UUU Phenylalanine	UCU Serine	UAU Tyrosine	UGU Cysteine	U
	UUC Phenylalanine	UCC Serine	UAC Tyrosine	UGC Cysteine	C
	UUA Leucine	UCA Serine	UAA Stop	UGA Stop	A
	UUG Leucine	UCG Serine	UAG Stop	UGG Tryptophan	G
C	CUU Leucine	CCU Proline	CAU Histidine	CGU Arginine	U
	CUC Leucine	CCC Proline	CAC Histidine	CGC Arginine	C
	CUA Leucine	CCA Proline	CAA Glutamine	CGA Arginine	A
	CUG Leucine	CCG Proline	CAG Glutamine	CGG Arginine	G
A	AUU Isolecine	ACU Threonine	AAU Asparagine	AGU Serine	U
	AUC Isolecine	ACC Threonine	AAC Asparagine	AGC Serine	C
	AUA Isolecine	ACA Threonine	AAA Lysine	AGA Arginine	A
	AUG Methionine (Start)	ACG Threonine	AAG Lysine	AGG Arginine	G
G	GUU Valine	GCU Alanine	GAU Aspartic acid	GGU Glycine	U
	GUC Valine	GCC Alanine	GAC Aspartic acid	GGC Glycine	C
	GUA Valine	GCA Alanine	GAA Glutamic acid	GGA Glycine	A
	GUG Valine	GCG Alanine	GAG Glutamic acid	GGG Glycine	G

Use this dictionary to answer questions about the diagram below which summarizes the processes of protein synthesis:



a. Which is the first codon used in protein synthesis from this mRNA? /1 mark
b. What is the sequence of the first 4 amino acids from the amino terminal of the growing polypeptide? /1 mark
c. What is the anticodon sequence in tRNA 1? /1 mark
d. Give the codon which is recognized by tRNA 2. /1 mark
e. Explain what changes will occur in the translation apparatus to allow codon 6 to be translated. /2 marks
f. What are the possible codon sequences for codon 6? /2 marks
g. The figure above gives information about the seven amino acids of an 80 amino acid polypeptide. What would be the effect on this polypeptide if there was a base substitution in the DNA sequence of the gene so that the UAC codon in the diagram became a UAG codon? /2 marks

17. **a**) Distinguish between a codon and an anticodon.

b) Explain why a genetic code is described as:

i) Universal
ii) Degenerate
iii) Non-overlapping

c) Why is splicing of pre-mRNA necessary?

d) A gene is made up of 756 base pairs. The mRNA that is transcribed from this gene is only 524 nucleotides long. Explain why there is this difference

18. There are 20 different amino acids which cells use for making proteins.
    a. How many different amino acids could be coded for by the triple code?
    b. Suggest how the spare triplets might be used.
    c. Explain why the code could not be a two-letter code.

19. Which of the following could or could not be carried out by a red blood cell? In each case, briefly justify your answer:

a. Protein synthesis
b. Lipid synthesis
c. Cell division
d. Active transport

20. A section of DNA has the following sequence of bases along it:
TACGCTCCGCTGTAC.

All of the bases are part of the code for amino acids. The first base in the sequence is the start of the code.

a. How many amino acids does the section of DNA code for?
b. Two of the amino acids coded for will be the same, which ones?
c. It is possible that this sequence codes for many different amino acids or many copies of the same amino acid, from your knowledge of the genetic code, explain how this can happen.
d. Explain how a change in one base along a DNA molecule might result in an enzyme becoming non-functional.