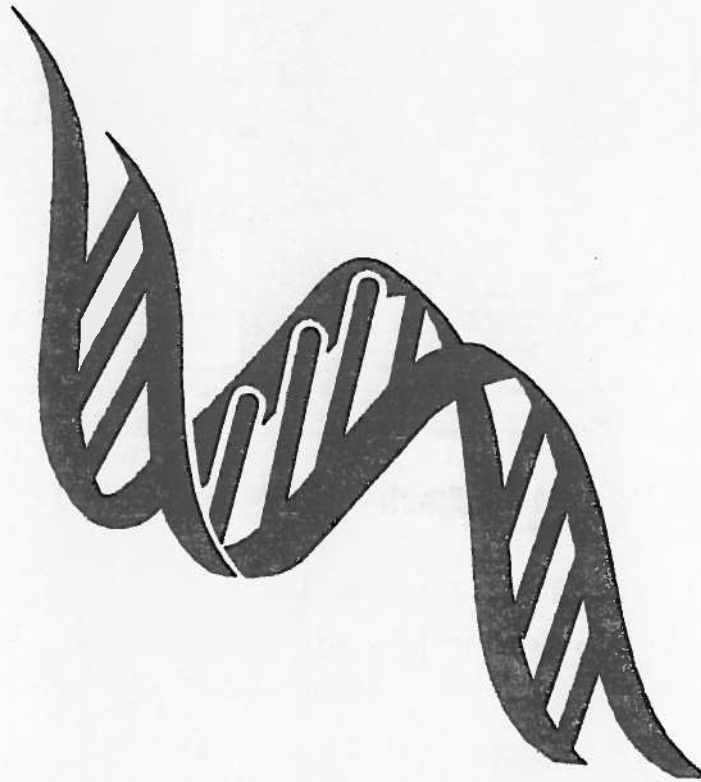


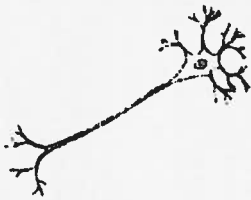
Higher Human Biology Homework



Unit 1: Cell biology

Differentiation in human cells.

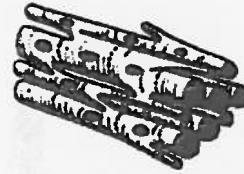
1. The human body contains hundreds of cell types all of which have developed from stem cells in the early embryo.



Nerve cells



Liver cells



Cardiac muscle cells

- (a) (i) What are stem cells?

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- (ii) Name **two** types of cell that may develop from tissue stem cells in red bone marrow.

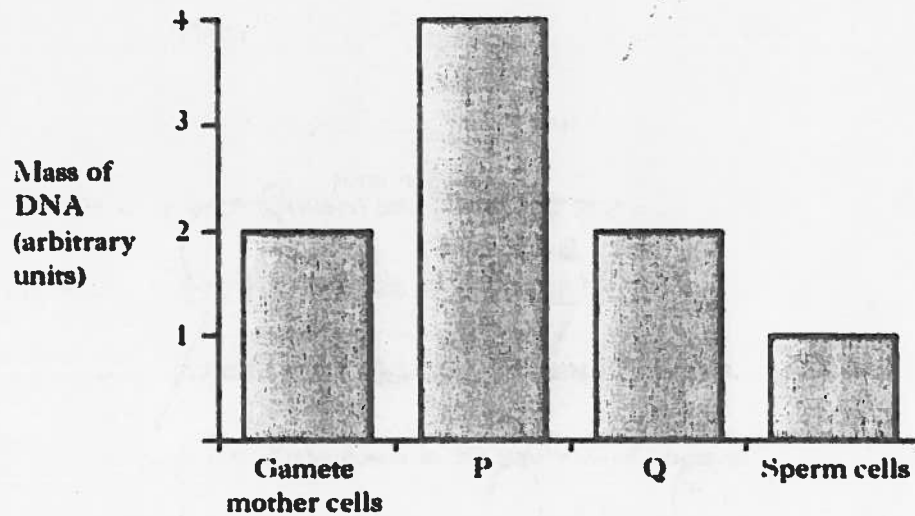
- (b) (i) What type of cell division **only** occurs in germline cells?

- (ii) Suggest why mutations in germline cells could have serious consequences.

- (c) A company has developed a drug that could treat the symptoms of an inherited disease. Before proceeding to clinical trials using volunteers, the company decides to carry out additional tests in the laboratory using stem cells.

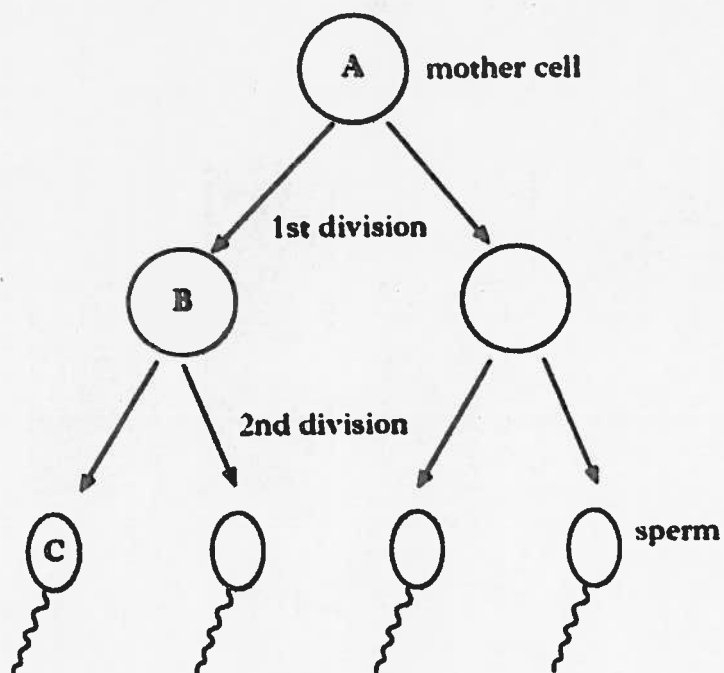
What ethical considerations might have influenced this decision to use stem cells?

3. The graph below shows the mass of DNA present as gamete mother cells develop into sperm cells during meiosis in the testes. P and Q represent cells at intermediate stages in this process.



- (a) Explain why the mass of DNA changes between
- the gamete mother cells and cell type P ____
 - cell types P and Q..

2. The diagram below represents stages in the production of human sperm.

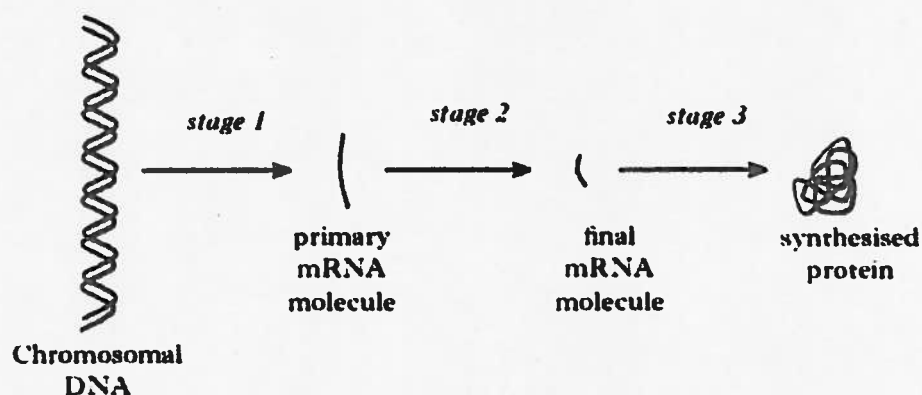


- (a) Name the type of cell division that produces sex cells.
- (b) State the number of chromosomes which would be present in the cells labelled A, B and C.

Structure and function of DNA.

1. Briefly describe the structure of DNA.
2. Draw and label a nucleotide of DNA.
3. Describe the base-pairings that take place on DNA.
4. How are adjacent nucleotides joined together on DNA?
5. What is the difference between the 3' and 5' ends of DNA?
6. Give an account of DNA under the following headings:
 - a) the structure of DNA;
 - b) DNA replication. (10)

7. What does the term 'gene expression' mean?
8. Describe the differences between DNA and RNA.
9. Name each type of RNA and state where it is found in a cell.
10. Describe the process of transcription and translation (10).
11. What is the difference between an intron and an exon?
12. What can occur in post-translation modification?
13. Name the two classes of proteins and give examples of each.
14. The diagram below shows stages in the synthesis of a protein.



(a) Complete the table below to name stages 1 and 3 and give the exact location within the cell where these stages occur.

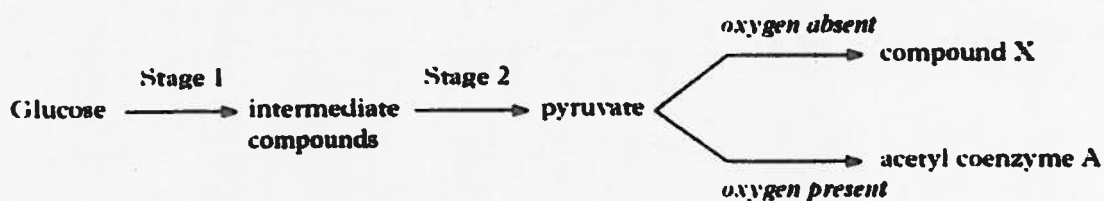
Stage	Name	Exact location
1		
3		

2

(b) Name the enzyme that catalyses stage 1 of this process.

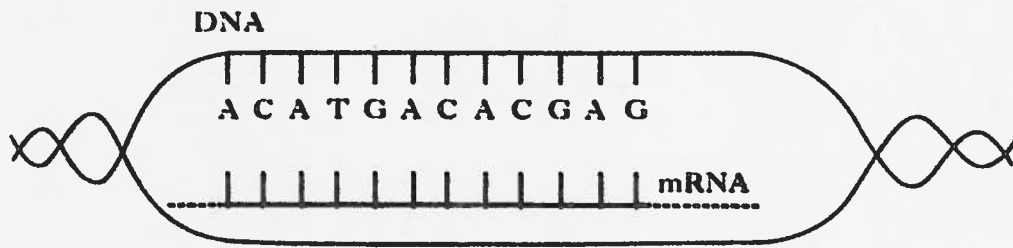
- (c) (i) Explain why a primary mRNA molecule is so much shorter than chromosomal DNA.
- (ii) Explain why a final mRNA molecule is shorter than a primary mRNA molecule.
- (d) Name two forms of RNA, not shown in the diagram, that are involved in protein synthesis.

15. The diagram below summarises part of the respiratory pathway within a cell.

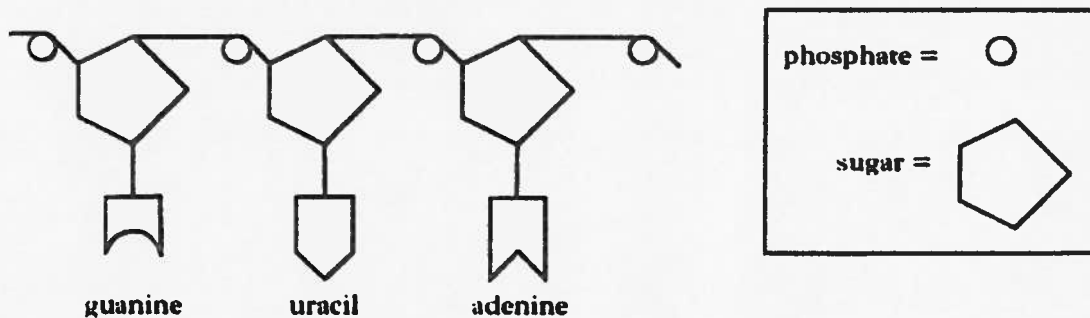


- (a) Stage 1 is the energy investment stage of glycolysis while stage 2 is the energy pay-off stage of glycolysis.
- (i) What happens during the energy investment stage?
- (ii) What happens during the energy pay-off stage?
- (b) During glycolysis hydrogen ions are released.
- (i) Name the type of enzyme that removes hydrogen ions from one of the intermediate compounds.
- (ii) Name the coenzyme molecule that the hydrogen ions are passed to.
- (c) (i) Name compound X.
- (ii) Describe what happens to acetyl coenzyme A in the next stage of the respiratory pathway.

16. (a) The diagram shows part of an mRNA molecule being formed on a strand of DNA.



- (i) In which part of the cell is mRNA formed?
- (ii) Complete the mRNA molecule by filling in the correct base sequence on the diagram.
- (iii) How many amino acids are coded for by this section of mRNA?
17. (a) The diagram below shows a section of a messenger RNA (mRNA) molecule.



- (i) Name the sugar that is present in mRNA.
- (ii) Which base found in mRNA is **not** shown in the diagram?

- (i) Insert the names of the DNA bases which pair with the RNA bases shown in the table below.

<i>DNA base</i>	<i>RNA base</i>
	adenine
	uracil
	guanine

1

- (ii) Apart from free RNA nucleotides and a DNA template, name **one** other molecule that is essential for mRNA synthesis.
- (iii) Describe the part played by an mRNA molecule in the manufacture of a cell protein.

18. A DNA molecule consists of 4000 nucleotides of which 20% contain the base adenine.

How many of the nucleotides in this DNA molecule will contain guanine?

- A 800
B 1000
C 1200
D 1600

(3)

19. The following information refers to protein synthesis.

<i>tRNA anticodon</i>	<i>amino acid carried by tRNA</i>
G U G	Histidine (his)
C G U	Alanine (ala)
G C A	Arginine (arg)
A U G	Tyrosine (tyr)
U A C	Methionine (met)
U G U	Threonine (thr)

What order of amino acids would be synthesised from the base sequence of DNA shown?

Base sequence of DNA

C G T T A C G T G

- A arg - tyr - his
B ala - met - his
C ala - tyr - his
D arg - tyr - thr
20. The function of tRNA in cell metabolism is to
- A transport amino acids to be used in synthesis
B carry codons to the ribosomes
C synthesise proteins
D transcribe the DNA code.

21. The table below refers to the mass of DNA in certain human body cells.

<i>Cell type</i>	<i>Mass of DNA in cell ($\times 10^{-12}$ g)</i>
liver	6.6
lung	6.6
P	3.3
Q	0.0

Which of the following is most likely to identify correctly cell types P and Q?

	<i>P</i>	<i>Q</i>
A	kidney cell	sperm cell
B	sperm cell	mature red blood cell
C	mature red blood cell	sperm cell
D	nerve cell	mature red blood cell

Mutations

- Name and describe three single nucleotide substitutions,
- What does the term 'frameshift mutation' mean?
- Name and describe three types of chromosome mutations.
- Design a revision aid to help you learn the different types of mutations.
- a) i) Sickle cell disease is caused by a substitution mutation in the gene that codes for haemoglobin.
 - Describe how this form of mutation affects the structure of the gene.
 - Suggest how this might change the structure of a protein such as haemoglobin.

DNA technology.

1. What is bioinformatics?
2. Research another species and compare its DNA to humans. Explain how the DNA can show any relationship to the other species.
3. Describe the process of PCR (use diagrams if required).
4. Give two uses of DNA profiling and explain how this technique works.

Metabolic pathways.

1. What do anabolism and catabolism mean? Describe in terms of energy being spent or used.
2. What controls metabolic pathways?
3. Describe the induced-fit model of enzyme action.
4. Describe (using diagrams if necessary) the difference between non-competitive and competitive inhibition.
5. What is end-product inhibition?

Cellular respiration

1. Discuss the production and use of ATP in the body (10).
2. What is ATP synthase?
3. What happens in the investment phase and energy pay-off stage?
4. What removes hydrogen ions throughout respiration?
5. What do the coenzymes NAD and FAD do?
6. What does phosphofructokinase do?

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7. Describe the role of the creatine phosphate system during strenuous muscle activity.

8. What conditions cause lactic acid formation and describe this process.

9. Describe the difference between slow and fast twitch muscle fibres.

10. A glucose molecule contains 6 carbon atoms.

How many carbon atoms are found in the following molecules?

Under normal circumstances carbohydrate is the main respiratory substrate.

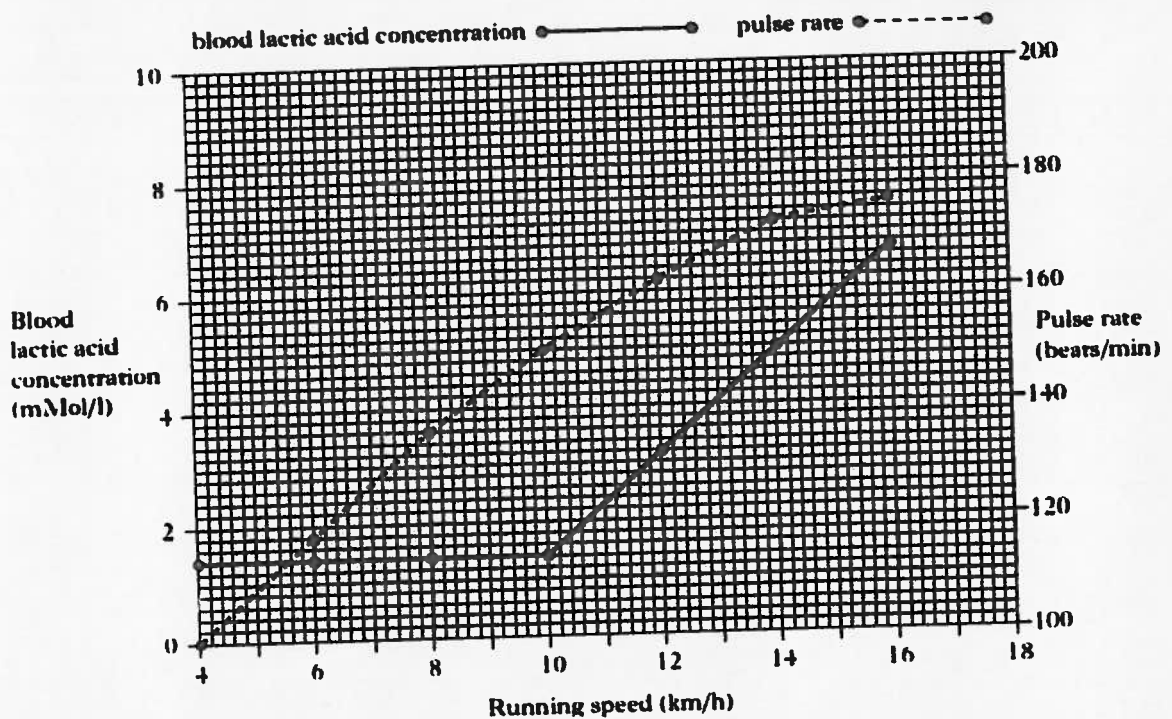
In each of the following extreme situations, state the alternative respiratory substrate and explain why the body has to use it.

<i>Situation</i>	<i>Respiratory substrate</i>	<i>Explanation</i>
Prolonged starvation		
Towards the end of a marathon race		

11. A long distance runner took part in some laboratory tests using a treadmill.

She was asked to use the treadmill at a setting of 4 km/h for three minutes during which her pulse rate was monitored. At the end of this time a blood sample was taken which was tested for lactic acid concentration. The procedure was then repeated a number of times at faster speeds.

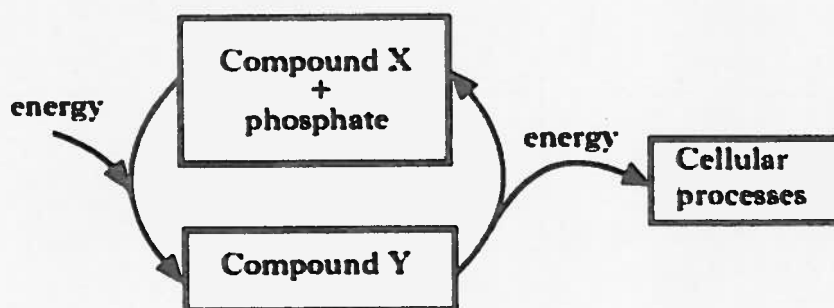
The results of the tests are shown in the graph below.



- (a) (i) What was the runner's pulse rate when she was running at 6 km/h?
- (ii) State the concentration of lactic acid in the runner's blood when her pulse rate was 172 beats/min.
- (iii) Predict what the runner's blood lactic acid concentration would be if she ran at 18 km/h for three minutes.
- (b) A build-up of lactic acid in muscles leads to fatigue.
- (i) Explain why lactic acid builds up in the muscles as running speeds increase.

(2)

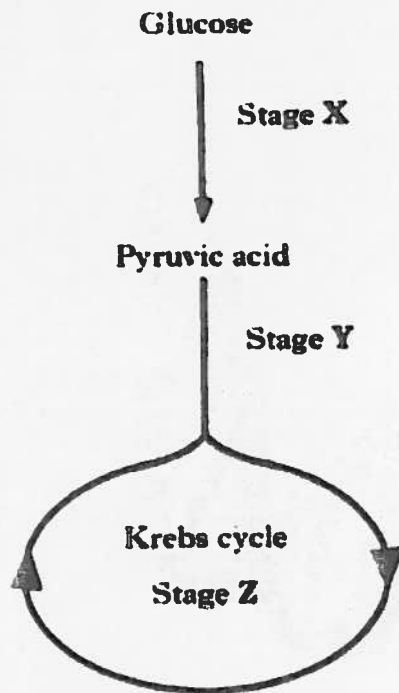
12. The diagram below shows energy transfer within a cell.



Which line in the table below identifies correctly compounds X and Y?

	X	Y
A	glucose	ATP
B	glucose	ADP
C	ADP	ATP
D	ATP	glucose

13. The following chart shows stages in the complete breakdown of glucose in aerobic respiration.



At which stage or stages is hydrogen released to be picked up by hydrogen acceptors?

- A Stages X, Y and Z
- B Stages X and Y only
- C Stages Y and Z only
- D Stage Z only