Cells & Organelles

A Level

Part A Cell types

The table below compares different types of cell.

Place a tick (✓) or a cross (✕) in each box to indicate whether or not each feature can be found in that cell type. The first row has been completed for you.

	Cell type		
Feature	**Plant cell**	**Animal cell**	**Bacterial cell**
mitochondria	✓	✓	✕
chloroplasts			
cellulose cell wall			
spindle fibres			
ribosomes			

Items:

✓ ✕

Part B Organelle characteristics

In an investigation, cells were broken up (homogenised) and the component organelles were separated into tubes.

Each tube was then tested to determine the identity of the component organelle(s). The results are shown in the table below.

Match the organelle to the tube.

Test for the...	Tube			
	1	2	3	4
ability to make ATP	no ATP produced	ATP produced	no ATP produced	no ATP produced
presence of DNA	DNA present	trace amount	no DNA present	no DNA present
ability to produce proteins	no proteins made	no proteins made	no proteins made	proteins made
ability to digest bacteria	none	none	some ability	none
organelle				

Items:

mitochondria **ribosomes** **nuclei** **lysosomes**

Part C Organelle size

Which of the organelles listed below is the smallest in size?

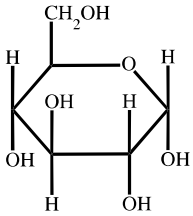
- nucleus
- lysosome
- ribosome
- mitochondrion

Adapted with permission from OCR AS Level Biology A, January 2013, Cells, Exchange and Transport, Question 5

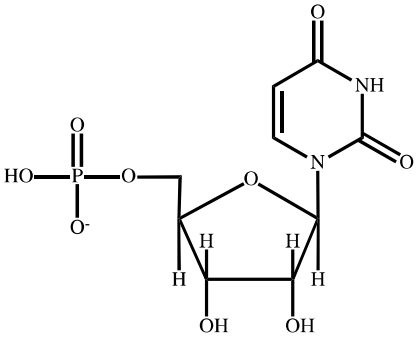
Types of Molecules

A Level

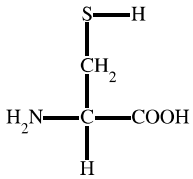
The images below show six biological molecules, labelled A to F.



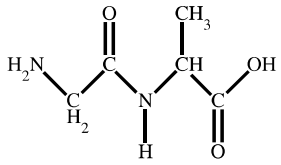
A



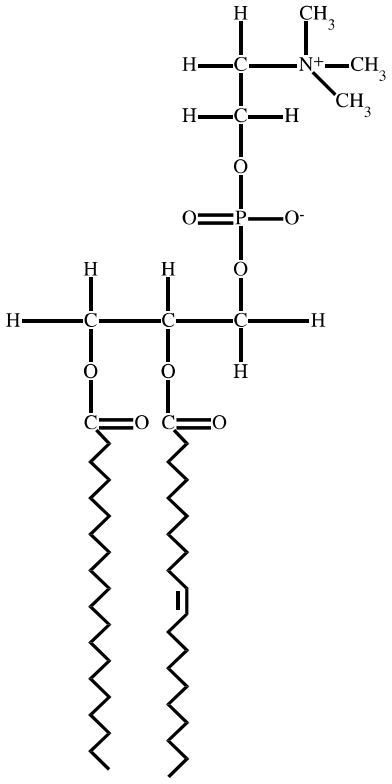
B



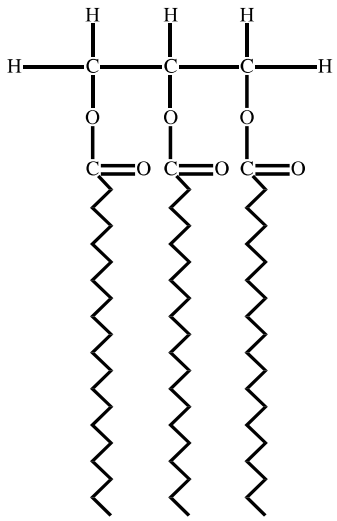
C



D



E



F

Part A Molecule statements

In the table below, match the image to the statement.

Statement	Letter
a component of RNA	
a molecule that is polymerised to form glycogen	
a molecule with a peptide bond	
an important store of energy, insoluble in water	
a molecule with hydrophilic and hydrophobic regions	
an amino acid that forms disulfide bonds in proteins	

Items:

A B C D E F

Part B Complementary base

Molecule B contains a nitrogenous base that is not found in DNA.

Give the name of its complementary base.

Part C Saturation levels

Molecules E and F both contain fatty acids. Fill in the table below to show how many fatty acids they have of each type (saturated, unsaturated, and polyunsaturated).

	Molecule E	Molecule F
Saturated fatty acid(s)		
Unsaturated fatty acid(s)		
Polyunsaturated fatty acid(s)		

Items:

0 1 2 3

Adapted with permission from CIE AS Level Biology, June 2008, Paper 2, Question 3

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Fruit Fly DNA

A Level

Part A DNA length

Even the smallest DNA molecules are very long.

- A kilobase (Kb) is a unit equivalent to 1000 base pairs of a DNA molecule.
- $1\,\mathrm{Kb}$ of double stranded DNA has a length of $0.34\,\mu\mathrm{m}$.

The DNA in the nucleus of a cell from a fruit fly (*Drosophila*) is $5.6\,\mathrm{cm}$ long.

Calculate the number of Kb in the DNA of the fruit fly.

Give your answer to 2 significant figures.

Part B Base percentages

The DNA of the fruit fly was analysed and 22% of the bases were adenine.

What $\%$ of the bases were guanine?

Part C Number of guanine bases

Using your answers in parts A and B, calculate the number of guanine bases in the fruit fly's genome.

Give your answer to 2 significant figures.

Part D Nucleotide addition

A DNA molecule contains two polynucleotide strands.

Individual nucleotides are joined together to make a polynucleotide strand.

What type of chemical reaction takes place when two nucleotides in a single polynucleotide strand are joined together?

What is the name given to the bond formed between the two nucleotides within a single polynucleotide strand?

Name the chemical released when this bond is formed between the two nucleotides.

Part E Hydrogen bonds

A DNA molecule contains two polynucleotide chains, which are held together by hydrogen bonds between complementary bases on opposite strands.

Fill in the table below to describe this complementary base pairing.

Base	Binds with...	Number of hydrogen bonds
adenine		
cytosine		
guanine		
thymine		

Items:

adenine **cytosine** **guanine** **thymine** 2 3

Adapted with permission from OCR AS Level Biology A, June 2016, Breadth in biology, Question 22

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Sequence Transcription and Translation

A Level

Part A DNA to mRNA

A region of the sense/coding DNA strand within a gene contains the following base sequence (from $5'$ to $3'$):

$$\mathrm{CTGAAGTTGCCA}$$

Enter the sequence of the mRNA that would be transcribed from this gene region (from $5'$ to $3'$).

Enter your answer in all caps and without spaces.

A region of mRNA contains the following base sequence (from $5'$ to $3'$):

$$\mathrm{UUACAGCUUAAG}$$

Enter the sequence of the antisense/template DNA strand that this mRNA region was transcribed from (from $3'$ to $5'$).

Enter your answer in all caps and without spaces.

Part B mRNA to tRNA

A region of mRNA contains the following base sequence (from $5'$ to $3'$):

$$\text{GACAAGUCUGGC}$$

Enter the tRNA anticodon sequence (from $3'$ to $5'$) that would bind to this mRNA strand during translation. Assume that the first three bases of the mRNA sequence correspond to one codon.

Enter your answer in all caps and with a space between each anticodon.

Four consecutive tRNA anticodons have the following base sequence (from $3'$ to $5'$):

$$\text{AAG UGA UUU CCG}$$

Enter the sequence of the mRNA (from $5'$ to $3'$) that would produce this sequence of tRNA anticodons during translation.

Enter your answer in all caps and without spaces.

Part C DNA to tRNA

A region of the sense/coding DNA strand within a gene contains the following base sequence (from $5'$ to $3'$):

$$\mathrm{TTCCGGCCCGGA}$$

Enter the corresponding tRNA anticodon sequence (from $3'$ to $5'$) that would be produced during translation. Assume that the first three bases of the DNA sequence correspond to one codon.

Enter your answer in all caps and with a space between each anticodon.

Four consecutive tRNA anticodons have the following base sequence (from $3'$ to $5'$):

$$\mathrm{AAC\ UUG\ CCA\ AAA}$$

Enter the corresponding sequence of the antisense/template DNA strand (from $3'$ to $5'$).

Enter your answer in all caps and without spaces.

Part D DNA to amino acid

The table below shows the corresponding tRNA anticodon(s) for a selection of amino acids.

Amino acid	tRNA(s) ($3'$ to $5'$)
glutamine	GUU, GUC
glycine	CCA, CCG, CCU, CCC
lysine	UUU, UUC
methionine	UAC
phenylalanine	AAA, AAG
proline	GGA, GGG, GGU, GGC
tyrosine	AUA, AUG
valine	CAA, CAG, CAU, CAC

A region of the sense/coding DNA strand within a gene contains the following base sequence (from $5'$ to $3'$):

TACGGACAGATG

Enter the amino acid sequence that would be produced from this gene region during translation. Assume that the first three bases of the DNA sequence correspond to one codon.

Enter the amino acid sequence from left to right, with the first amino acid on the left.

[ ] – [ ] – [ ] – [ ]

Items:

glutamine | glycine | lysine | methionine | phenylalanine | proline | tyrosine | valine

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Mitosis and Meiosis Revision

A Level

C C C

Part A Cell cycle phases

In the table below, match the name of the cell cycle phase to the description, and specify the order in which the phases occur with interphase first.

Phase	Description	Order
	sister chromatids are pulled apart to opposite ends of the cell as the spindle fibres shorten	
	DNA replication occurs, the centrosome duplicates, and the cell grows in size	
	the cell splits into two new daughter cells	
	spindle fibres move the chromosomes to line up along a plane in the middle of the cell	
	chromosomes condense, the nuclear membrane breaks down, and the two centrosomes move to opposite sides of the cell	
	nuclear membranes form around the separated sister chromatids (now called chromosomes) which decondense	

Items:

anaphase cytokinesis interphase metaphase prophase telophase 1^{st} 2^{nd} 3^{rd} 4^{th} 5^{th} 6^{th}

Part B Mitosis vs meiosis

The table below lists some facts relating to nuclear division. In each case, indicate whether the fact relates to mitosis and/or meiosis by placing, in the appropriate column, a tick (✓) if it occurs and a cross (✕) if it does not.

The first line of the table has been completed for you.

	Mitosis	Meiosis
takes place at plant root tips	✓	✕
spindle formed		
homologous chromosomes pair		
chiasmata form		
chromatids separate		
chromosome number of the daughter cells is the same as that of the parent cell		

Items:

✓ ✕

Part C Independent assortment and crossing over

Meiosis produces variation in the daughter cells due to independent assortment and crossing over. Which of the following statements explain how these processes produce variation in daughter cells? Select all that apply.

- [ ] independent assortment ensures that each gamete receives the correct number of chromosomes
- [ ] independent assortment ensures that each chromosome contains some maternal DNA and some paternal DNA
- [ ] independent assortment ensures that each gamete receives a combination of both maternal chromosomes and paternal chromosomes
- [ ] crossing over ensures that each gamete receives the correct number of chromosomes
- [ ] crossing over ensures that each chromosome contains some maternal DNA and some paternal DNA
- [ ] crossing over ensures that each gamete receives a combination of both maternal chromosomes and paternal chromosomes

Part D Chromosome numbers

The diploid chromosome numbers for koalas, american badgers, and guinea pigs are as follows:

- Koala (*Phascolarctos cinereus*): 16
- American badger (*Taxidea taxus*): 32
- Guinea pig (*Cavia porcellus*): 64

A cell is taken from one of these organisms and viewed under a microscope. 32 individual chromosomes are lined up along the middle of a cell.

Which of the following cell types could it be?

- [ ] a koala cell undergoing mitosis: metaphase
- [ ] a koala cell undergoing meiosis I: metaphase I
- [ ] a koala cell undergoing meiosis II: metaphase II
- [ ] an American badger cell undergoing mitosis: metaphase
- [ ] an American badger cell undergoing meiosis I: metaphase I
- [ ] an American badger cell undergoing meiosis II: metaphase II
- [ ] a guinea pig cell undergoing mitosis
- [ ] a guinea pig cell undergoing meiosis I: metaphase I
- [ ] a guinea pig cell undergoing meiosis II: metaphase II

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Examples of Membrane Transport

A Level

Part A The sodium-potassium pump

The sodium-potassium pump is a membrane protein that uses ATP to transport Na^{+} ions out of the cell and K^{+} ions into the cell. Both types of ion are transported against/up their concentration gradients. For every molecule of ATP, $3\ \mathrm{Na}^{+}$ ions are moved out of the cell and $2\ \mathrm{K}^{+}$ ions are moved into the cell.

What is the specific name given to this type of membrane transport?

Part B Oxygen and carbon dioxide

In mammalian lungs, oxygen moves directly across cell membranes from the alveoli to the blood and carbon dioxide moves directly across cell membranes from the blood to the alveoli.

What is the specific name given to this type of membrane transport, in which molecules move directly across the cell membrane (i.e. directly through the phospholipid bilayer)?

Part C Glucose in the proximal convoluted tubule

In the proximal convoluted tubules of the nephrons, glucose that has been filtered out of the blood is reabsorbed back into the blood. Glucose is transported out of the proximal convoluted tubule by sodium-glucose transport proteins, which transport Na^+ ions and glucose molecules out of the tubule. The Na^+ ions are transported with/down their concentration gradient, whereas the glucose molecules are transported against/up their concentration gradient.

What is the specific name given to this type of membrane transport?

Part D Glucose in the islets of Langerhans

In the β cells of the islets of Langerhans (in the pancreas), glucose is transported with/down its concentration gradient across the membrane through glucose transporters.

What is the specific name given to this type of membrane transport?

Part E Water in the collecting duct

In the collecting ducts of the kidneys, membrane proteins called aquaporins allow the reabsorption of water. Water molecules move from a lower solute concentration in the collecting duct to a higher solute concentration in the surrounding cells.

What is the specific name given to this type of membrane transport?

Part F Water transport

Oxygen and carbon dioxide can move directly through cell membranes, whereas water requires specific protein channels (aquaporins) to move across membranes efficiently. Which of the following statements explain why this is the case? Select all that apply.

- [ ] water molecules are too small to move across the membrane
- [ ] water molecules are too large to fit between the phospholipids
- [ ] water molecules are **polar**
- [ ] water molecules are **non-polar**
- [ ] the interior of the phospholipid bilayer is **polar**
- [ ] the interior of the phospholipid bilayer is **non-polar**

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