ISAAC NEWTON ACADEMY

SCIENCE

AQA

A-level Biology

Summer Learning and Preparation Pack

Name: _____

You're studying A-level Biology, congratulations!

Biology is the study of living things, but not just animals and plants. You'll also learn about the molecules that make living things work, the cells that they're made from, the systems within plants and animals, and the interconnections between organisms.

Biology is different from physics and chemistry, in that living things don't always do what you expect them to do. You can't test one organism and assume all the rest will be the same, so you'll learn about the statistical analysis behind making claims.

At first, you may find the jump in demand from GCSE a little daunting, but if you follow the tips and advice in this guide, you'll soon adapt.

We recommend you keep this pack somewhere safe, as you may like to refer to the information in it throughout your studies.

Why study A-level Biology?

Biology A-level will give you the skills to make connections and associations with all living things around you. Biology literally means the study of life - and if that's not important, what is? Being such a broad topic, you're bound to find a specific area of interest, plus it opens the door to a fantastic range of interesting careers.

Many people use an AS or A-level in Biology in their future studies or work. Even if you don't decide to work in biology, studying it still develops useful and transferable skills for other careers. You'll develop research, problem solving and analytical skills, alongside teamwork and communication. Universities and business regard all of these very highly.

Possible degrees and career options

According to bestcourse4me.com, the top seven degree courses taken by students who have A-level Biology are:

- Biology
- Psychology
- Sport and exercise science
- Medicine
- Anatomy
- Physiology and pathology pharmacology
- Toxicology and pharmacy chemistry.

This list is by no means exhaustive. Biology can prove useful for a wide variety of degree courses. For more details, go to the bestcourse4me.com, or UCAS.

Studying Biology at A-level or degree opens up all sorts of career opportunities, such as:

- doctor
- clinical molecular geneticist
- nature conservation officer
- pharmacologist
- research scientist
- vet
- secondary school teacher
- marine biologist
- dentist.

Specification at a glance

Year 12

1 Biological molecules.

2 Cells.

3 Organisms exchange substances with their environment.

4 Genetic information, variation and relationships between organisms.

Year 13

5 Energy transfers in and between organisms.

6 Organisms respond to changes in their internal and external environments.

7 Genetics, populations, evolution and ecosystems.

8 The control of gene expression.

A-level Biology is assessed through 3 terminal exams:

Paper 1	Paper 2	Paper 3
What's assessed • Any content from topics 1–4, including relevant practical skills	**What's assessed** • Any content from topics 5–8, including relevant practical skills	**What's assessed** • Any content from topics 1–8, including relevant practical skills
Assessed • written exam: 2 hours • 91 marks • 35% of A-level	**Assessed** • written exam: 2 hours • 91 marks • 35% of A-level	**Assessed** • written exam: 2 hours • 78 marks • 30% of A-level
Questions • 76 marks: a mixture of short and long answer questions • 15 marks: extended response questions	**Questions** • 76 marks: a mixture of short and long answer questions • 15 marks: comprehension question	**Questions** • 38 marks: structured questions, including practical techniques • 15 marks: critical analysis of given experimental data • 25 marks: one essay from a choice of two titles

Places to go for help

1. The AQA website is a great place to start

The Biology webpages are aimed at teachers, but you may find them useful too. Information includes:

- The specification – this explains exactly what you need to learn for your exams.
- Practice exam papers
- Lists of command words and subject specific vocabulary – so you understand the words to use in exams
- Practical handbooks explain the practical work you need to know
- Past papers and mark schemes from the old specifications. Some questions won't be relevant to the new AS and A-level, so please check with your teacher.
- Maths skills support

2. Royal Society of Biology

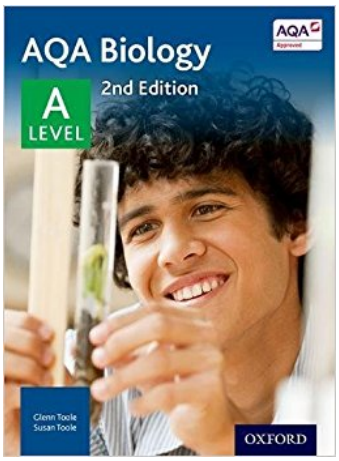
"A single unified voice for biology". They work with everyone from government policy makers to students, as well as universities and researchers studying biology. Their website includes a dedicated student section. Have a look at rsb.org.uk

3. The Student Room

Join the A-level Biology forums and share thoughts and ideas with other students if you're stuck with your independent learning. Just be very careful not to share any details about your assessments, there are serious consequences if you're caught cheating. Visit thestudentroom.co.uk

4. Textbooks

During the course we will refer to the approved textbook published by Oxford University Press. Others are available by Collins and Hodder.



5. Revision guides

These are great if you want a quick overview of the course when you're revising for your exams. Remember to use other tools as well, as these aren't detailed enough on their own.

6. YouTube

YouTube has thousands of Biology videos. Just be careful to look at who produced the video and why because some videos distort the facts. Check the author, date and comments – these help indicate whether the clip is reliable. If in doubt, ask your teacher.

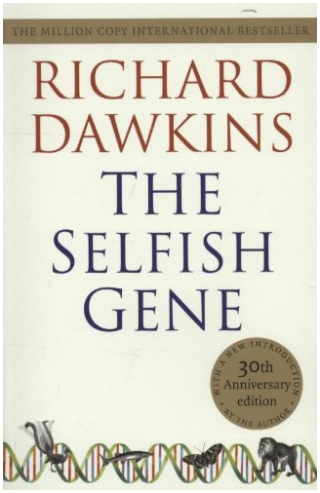
7. Magazines

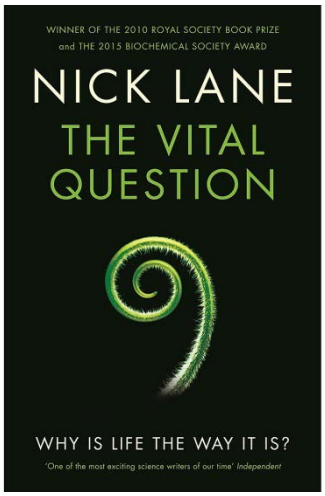
Focus, New Scientist or Philip Allan updates can help you put the biology you're learning in context. We recommend buying a subscription to *Biological Sciences Review* (Hodder Education), which gives students the edge needed to achieve the best grades through topical, A-level focused content that deepens subject knowledge and builds independent learning and exam skills.

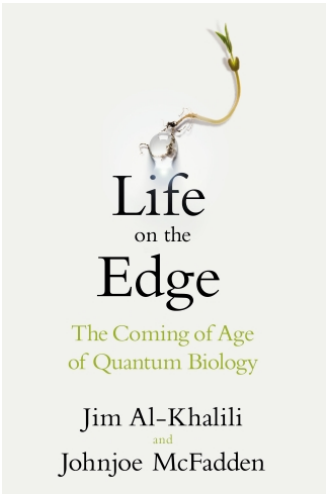
Places to feel inspired!

Studying any A-level is about a lot more than just looking at the course content to pass your exams. It's about immersing yourself in that world and reading around the subject, as well as taking an interest in the latest developments.

Recommended books to read







Places to visit

The Old Operating Theatre: Europe's oldest surviving operating theatre (SE1 9RY) http://oldoperatingtheatre.com/

Grant Museum of Zoology: a natural history museum part of University College London (WC1E 6DE) https://www.ucl.ac.uk/culture/grant-museum-zoology

The Wellcome Collection: a collection of medical antiquities as well as modern displays and scientific exhibitions (NW1 2BE) https://wellcomecollection.org/

Science Museum: blockbuster exhibitions and interactive experiences at one of London's top attractions (SW7 2DD) http://www.sciencemuseum.org.uk/

KS4 Transition Tasks

Cells

All life on Earth exists as cells. These have basic features in common.

Complete the following table.

Structure	Function
Cell-surface membrane	
Chloroplast	
Cell vacuole	
Mitochondria	
Nucleus	
Cell wall	
Chromosomes	
Ribosomes	

Bioenergetics

Two of the most important reactions that take place in living things are photosynthesis and respiration. They both involve transfer of energy.

	Photosynthesis	**Aerobic respiration**
Which organisms carry out this process?		
Where in the organisms does the process take place?		
Energy store at the beginning of the process	Sun	
Energy store at the end of the process		In cells
Reactants needed for the process		
Products of the process		
Overall word equation		
Balanced symbol equation for the overall process		

Genetic Inheritance

Huntington's disease is an example of a disease where the mutation causing the disease is dominant.

h: normal (recessive) H: mutation(dominant)

		Paternal alleles	
		H	h
Maternal alleles	h		
	h		

Cystic fibrosis is an example of a disease where the mutation causing the disease is recessive.

F: normal (recessive) f: mutation (dominant)

		Paternal alleles	
		F	f
Maternal alleles	F		
	f		

For each of the Punnett squares:

Complete the diagrams to show the alleles for each child.

State which parent and child is:

- healthy
- has the disease
- a carrier.

Each of the following statements is false. Re-write each one so that it becomes true.

The first Punnett square shows that one in every four children from this couple will have Huntington's disease.

The second Punnett square shows that there is a one in three chance that a child born to this couple will have cystic fibrosis.

All children of the second couple will either be carriers or suffer from cystic fibrosis.

The percentage of children who are sufferers on the diagram is the same as the percentage of children each couple will have who are sufferers.

Having one child who is born with cystic fibrosis means that the next three children will not have the disease.

A 50:50 chance is the same as a 0.25 probability.

Analysing Data

A student investigated an area of moorland where succession was occurring. She used quadrats to measure the area covered by different plant species, bare ground and surface water every 10 metres along a transect. She also recorded the depth of soil at each quadrat. Her results are shown in the table.

	Area covered in each quadrat A to E in cm^2				
	A	B	C	D	E
Bog moss	55	40	10	–	–
Bell heather	–	–	–	15	10
Sundew	10	5	–	–	–
Ling	–	–	–	15	20
Bilberry	–	–	–	15	25
Heath grass	–	–	30	10	5
Soft rush	–	30	20	5	5
Sheep's fescue	–	–	25	35	30
Bare ground	20	15	10	5	5
Surface water	15	10	5	–	–
Soil depth /cm	3.2	4.7	8.2	11.5	14.8

– indicates zero cover.

Calculate:

the mode area of soft rush in the sample

the mean soil depth

the median amount of bare ground in the sample.

Analysing Tables

Lung cancer, chronic bronchitis and coronary heart disease (CHD) are associated with smoking. Tables 1 and 2 give the total numbers of deaths from these diseases in the UK in 1974.

Table 1 Men

Age (years)	Number of deaths (in thousands)		
	Lung cancer	Chronic bronchitis	Coronary heart disease
35-64	11.5	4.2	31.7
65-74	12.6	8.5	33.3
75+	5.8	8.1	29.1
Total (35-75+)	29.9	20.8	94.1

Table 1 Women

Age (years)	Number of deaths (in thousands)		
	Lung cancer	Chronic bronchitis	Coronary heart disease
35-64	3.2	1.3	8.4
65-74	2.6	1.9	18.2
75+	1.8	3.5	42.3
Total (35-75+)	7.6	6.7	68.9

1. Of the men who died aged 35-64 from one of these three causes, what percentage of them died of lung cancer?

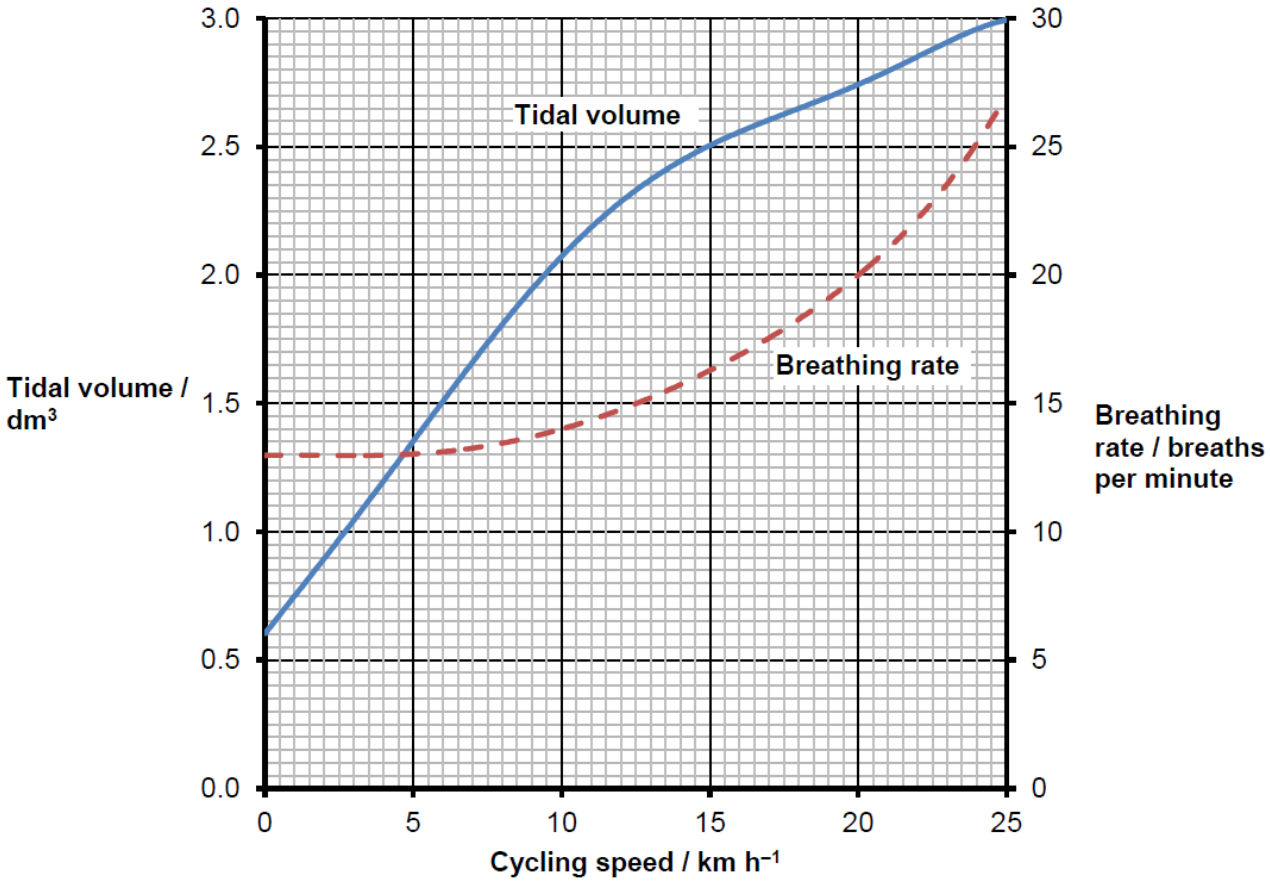
2. What percentage of deaths from chronic bronchitis in women happened to women aged 65-74?

3. Deaths from lung cancer drop as people get older. Is there a bigger percentage difference for men or women from 35-64 to 75+?

4. What fraction of coronary heart disease deaths of men over 34 are in the 75+ bracket? What about for women?

Analysing Graphs

The volume of air breathed in and out of the lungs during each breath is called the tidal volume. The breathing rate and tidal volume were measured for a cyclist pedaling at different speeds. The graph shows the results.

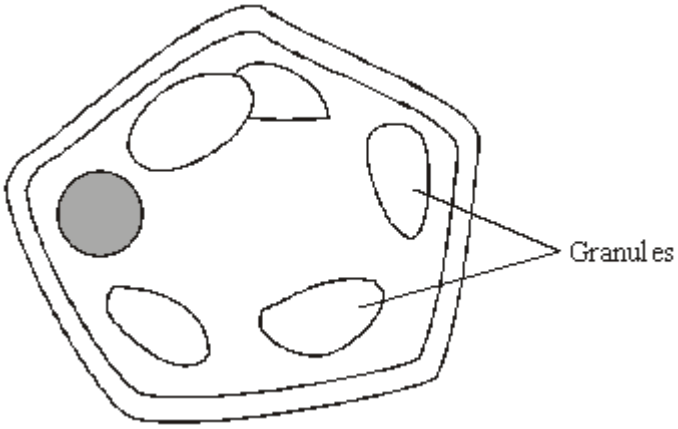


1. What was the tidal volume when the cycling speed was 17 km h^{-1}?
2. What was the breathing rate when the cycling speed was 8 km h^{-1}?
3. What was the change in breathing rate when the cyclist changed from 10 to 20 km h^{-1}? Express this as a percentage.
4. At what speed did the breathing rate start to increase?
5. The tidal volume increased linearly with cycling speed up to about 10 km h^{-1}. Calculate the increase in volume for each increase in speed of 1 km h^{-1}.
6. For this initial linear section, what is the equation of the tidal volume line?
   Hint: use $y=mx+c$

A-level Exam Questions

This section contains exam questions based on the first two A-level topics you will study that you may be able to answer with GCSE knowledge and a little extra reading in places.

Q1. The diagram shows a cell from a potato.



(a) Give **two** features which may be found in a prokaryotic cell which would not be found in this cell.

1 .....

2 .....

(2)

(b) (i) Describe how you could confirm that the granules contained starch.

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(1)

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(ii) Name **one** polysaccharide other than starch that would be found in this cell.

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(1)

(c) Explain **one** advantage of storing starch rather than glucose in potato cells.

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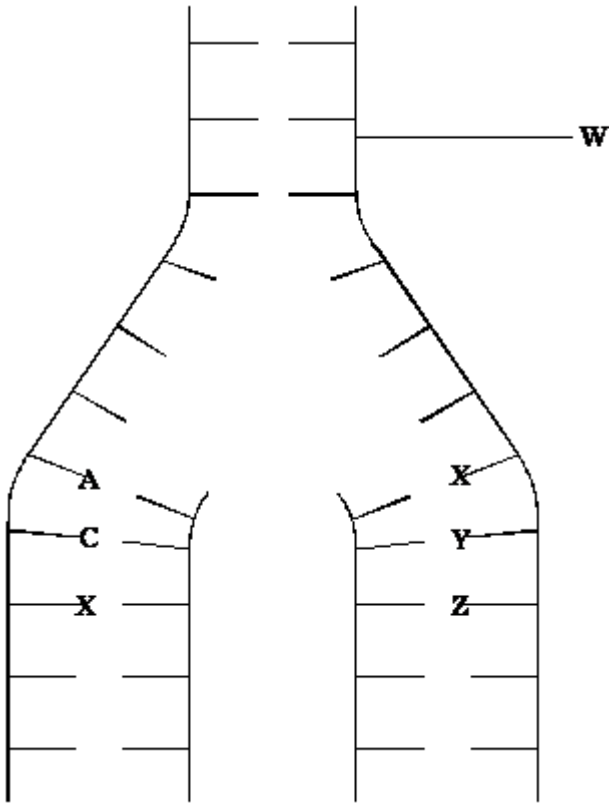
(2)

(Total 6 marks)

Q2. The diagram shows the process of DNA replication. The horizontal lines represent the positions of bases.



(i) What is represented by the part of the DNA molecule labelled **W**?

.....

(1)

(ii) In the diagram, **A** represents adenine and **C** represents cytosine.

Name the base found at

position **X**; .....

position **Y**; .....

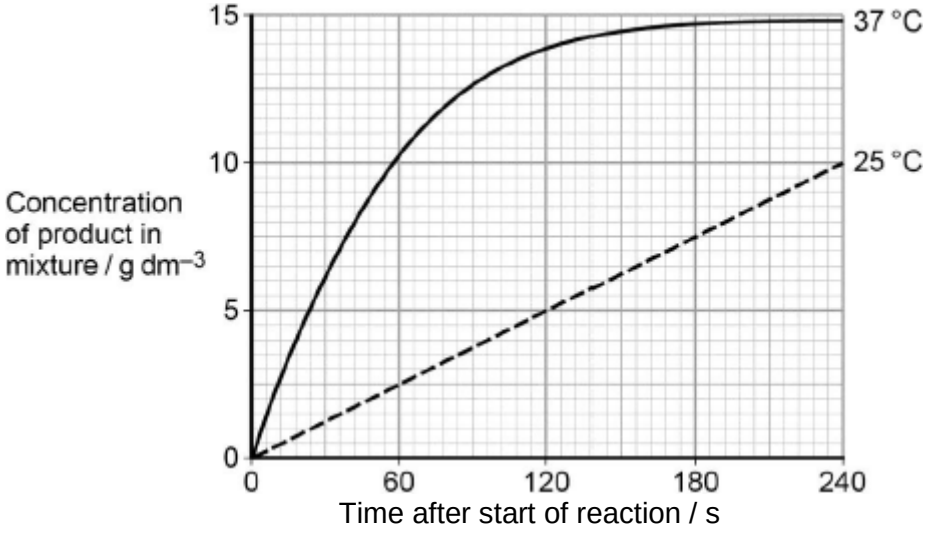
position **Z**. .....

(3)

(Total 4 marks)

Q3. A technician investigated the effect of temperature on the rate of an enzyme-controlled reaction. At each temperature, he started the reaction using the same volume of substrate solution and the same volume of enzyme solution.

The figure below shows his results.



(a) Give **one** other factor the technician would have controlled.

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(1)

(b) Calculate the rate of reaction at 25 °C.

Answer .....

(2)

(c) Describe and explain the differences between the two curves.

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(Extra space) .....

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(5)
(Total 8 marks)

Q4. New alleles arise as a result of mutations in existing genes. These mutations may occur during DNA replication.

(a) Explain what is meant by an allele.

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(1)

(b) Explain how DNA replicates.

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(4)

(c) Explain why a mutation involving the deletion of a base may have a greater effect than one involving substitution of one base for another.

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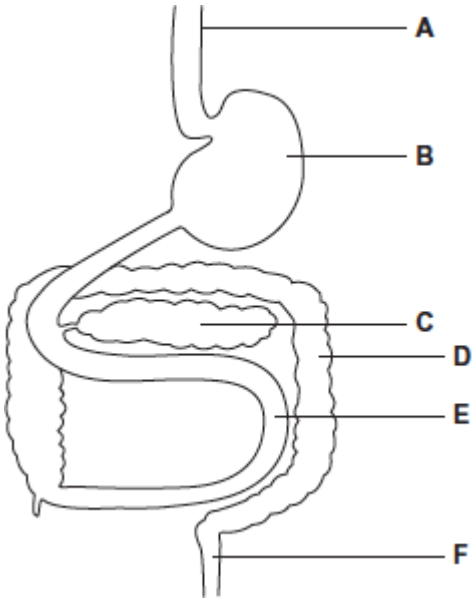
(3)
(Total 8 marks)

Q5. The diagram represents part of the human digestive system. The organs are labelled **A–F**.



(a) Give the letter of the organ that produces amylase.

(1)

(b) Give the letter of the organ that produces maltase.

(1)

(c) Maltose is hydrolysed by the enzyme maltase.

Explain why maltase catalyses only this reaction.

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[Extra space] .....

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(3)

(Total 5 marks)

Q6. (a) Nucleic acids, such as DNA, are polymers, made up of many repeating monomer units. Name the monomer from which nucleic acids are made.

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(1)

(b) The table shows the percentage of different bases in the DNA of some organisms.

Organism	Percentage of each base			
	Adenine	**Guanine**	**Cytosine**	**Thymine**
Human	31.2	18.8	18.8	31.2
Cow	27.9	22.1	22.1	27.9
Salmon	29.4	20.6	20.6	29.4
Rat	28.6			
Virus	24.7	24.1	18.5	32.7

(i) Calculate the missing figures for rat DNA and write them into the table.

(2)

(ii) The virus has single-stranded DNA as its genetic material. Explain the evidence from the table which suggests that the DNA is single-stranded.

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(2)

(Total 5 marks)

Q7. (a) Complete the table to show **two** differences between the structure of DNA and RNA.

DNA	RNA

(2)

(b) Explain how a gene codes for a protein.

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(2)

(c) What are homologous chromosomes?

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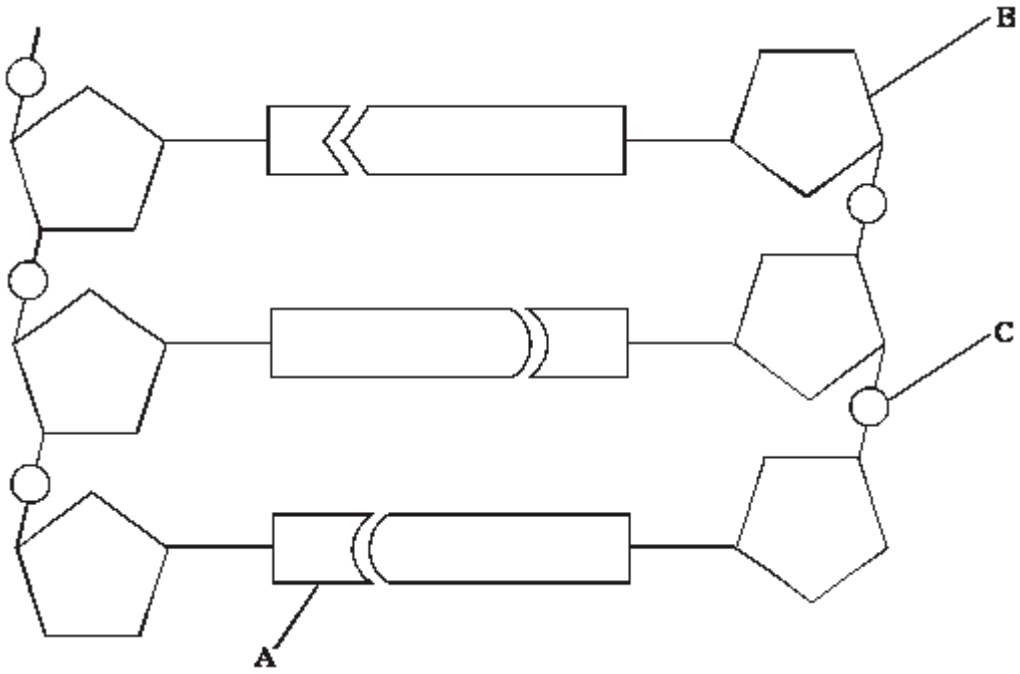
(2)

(Total 6 marks)

Q8. The diagram shows a short section of a DNA molecule.



(a) On the diagram draw a box round **one** nucleotide.

(1)

(b) Use the letters in the diagram to indicate a part of the molecule which

(i) is **not** a base and is different in an RNA molecule;

.....

(ii) contains nitrogen.

.....

(2)

(c) (i) The sequence of bases on one strand of DNA is important for protein synthesis. What is its role?

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(1)

(ii) How are the two strands of the DNA molecule held together?

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(1)

(iii) Give **one** advantage of DNA molecules having two strands.

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(1)

(Total 6 marks)

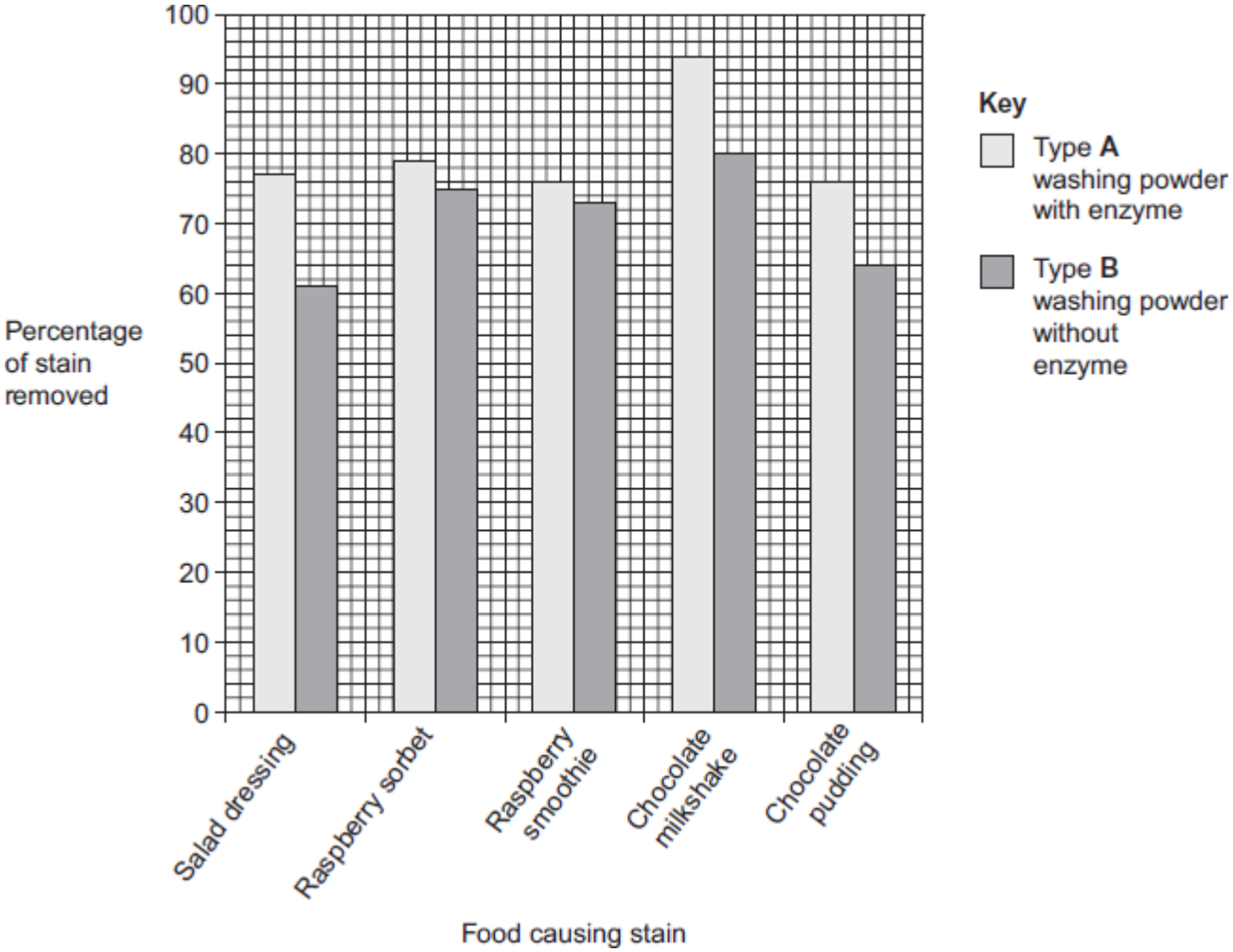
Q9. Biological washing powders contain enzymes which hydrolyse substances that cause stains on clothes.

A manufacturer tested the ability of two types of the same brand of washing powder to remove different food substances that stain clothes.

- Type **A** contained an enzyme.
- Type **B** was identical to **A** except it did **not** contain the enzyme.

Figure 1 shows the results.

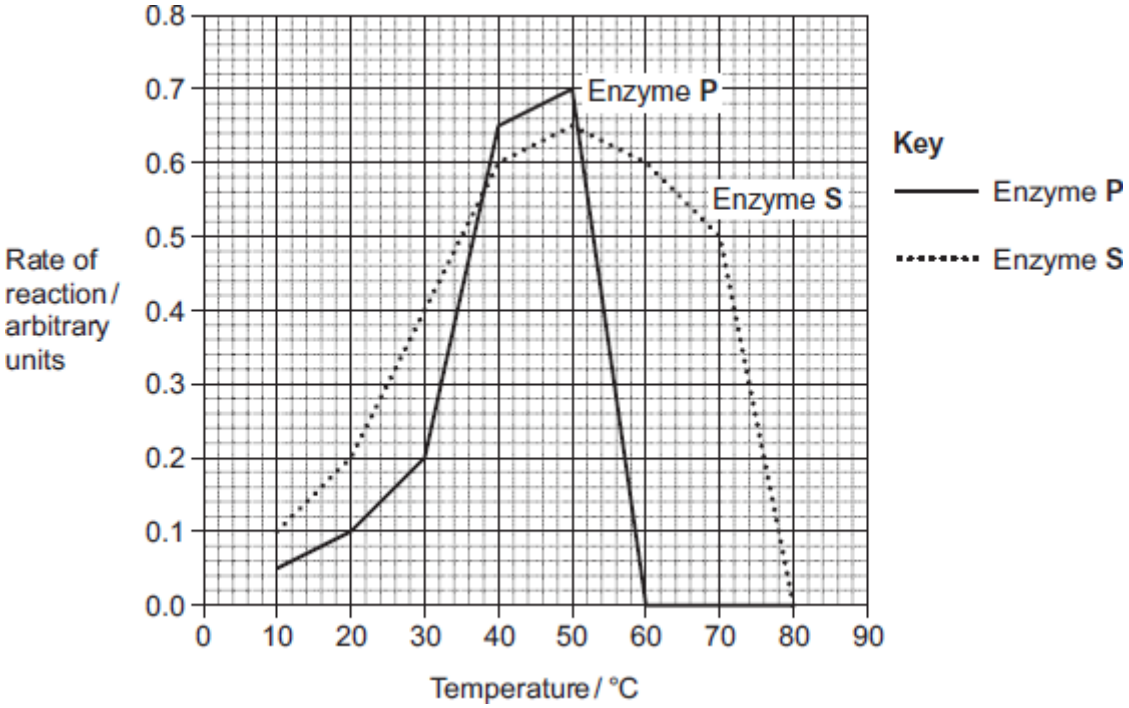
Figure 1



A scientist worked for a company that wanted to develop a biological washing powder that was effective over a range of temperatures. He investigated the effect of temperature on the rates of the reaction catalysed by two enzymes, **P** and **S** used in biological washing powders.

Figure 2 shows his results.

Figure 2



(a) Many of the substances causing the food stains are large, insoluble proteins.
Suggest how a biological washing powder removes this type of stain.

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(2)

(b) The manufacturer of type **A** and type **B** washing powder claimed that these results showed that biological washing powders are better at removing stains from clothes.

Use the information in **Figure 1** to evaluate this claim.

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(Extra space) .....

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(4)

(c) Most customers want a washing powder which removes stains from clothes over a range of temperatures. After obtaining the results shown in **Figure 2**, which enzyme should the scientist recommend for use in a biological powder?

Give reasons for your answer.

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(Extra space) .....

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(3)

(d) Biological washing powders often contain a number of different enzymes. This enables them to remove a wider range of stains from clothes.
Explain why a number of enzymes are required to remove a wider range of stains.

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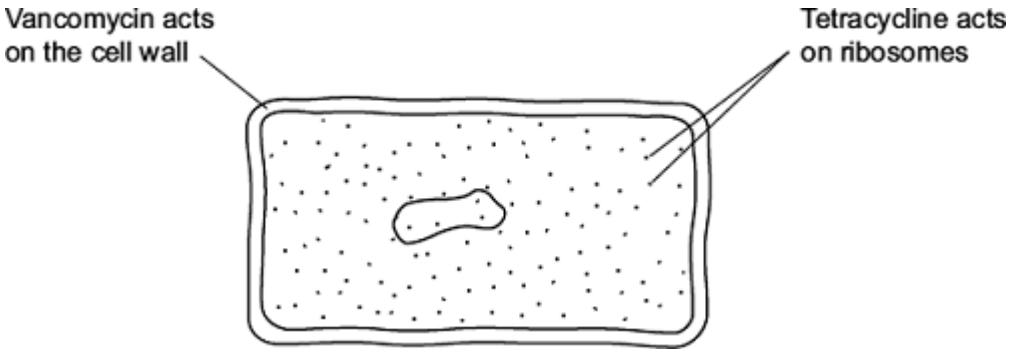
(3)

(Total 12 marks)

Q10. The diagram shows the structure of a bacterium and the sites of action of two antibiotics.



(a) (i) Use information in the diagram to explain why vancomycin does **not** affect human cells.

.....

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(1)

(ii) Use information in the diagram to explain how tetracycline prevents bacterial growth.

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(1)

(b) Frequent treatment with vancomycin can result in resistant strains of bacteria. Explain how.

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(Extra space) .....

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(2)

(Total 4 marks)

Q11. (a) Complete the table to give **two** differences between DNA and RNA.

Difference	DNA	RNA
1		
2		

(2)

(b) Describe the part played by RNA in protein synthesis.

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(Extra space) .....

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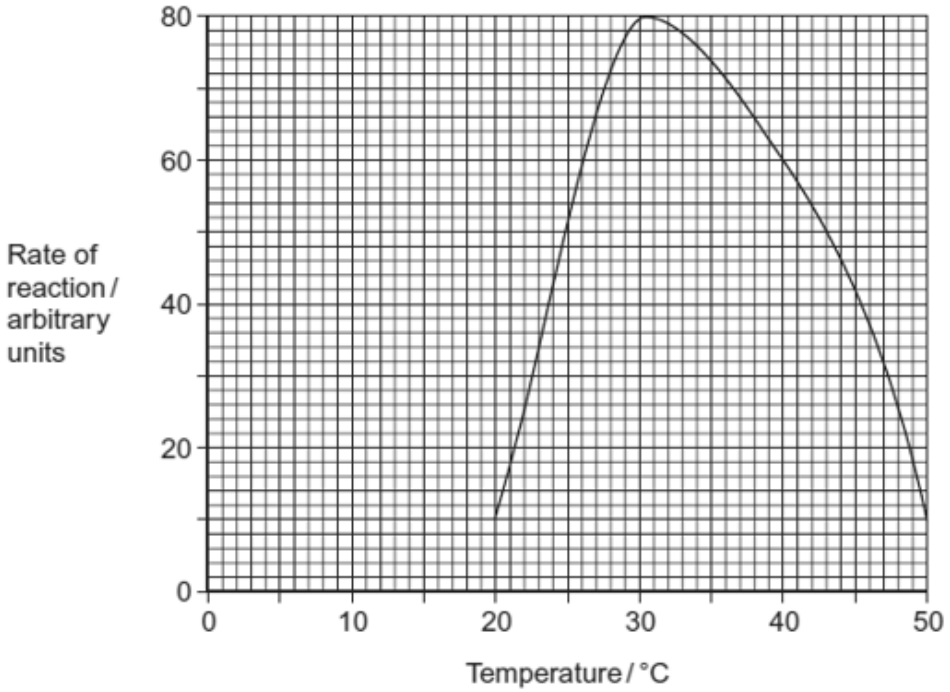
(3)

(Total 5 marks)

Q12. A protease is an enzyme that digests protein. The graph shows how the activity of a protease varies with temperature.



(a) (i) Describe what the graph shows about the effect of temperature on the rate of reaction.

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(1)

(ii) Explain the shape of the curve between 30 °C and 50 °C.

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(Extra space) .....

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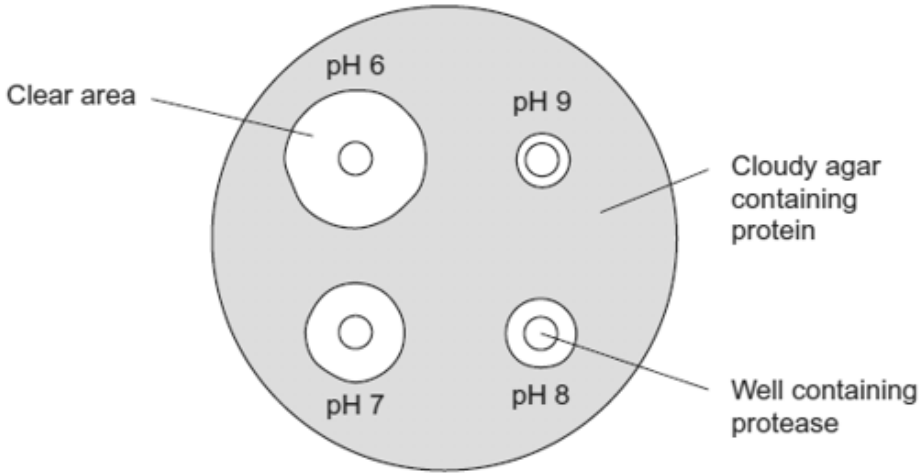
(3)

(b) Students investigated the effect of pH on the activity of the protease.

- The students used agar plates containing protein. The protein made the agar cloudy.

- They made four wells of equal size in the agar of each plate.
- They added a drop of protease solution to each of the wells. The protease solution in each well was at a different pH.
- The students incubated the agar plates for 4 hours at a constant temperature.

The diagram shows the agar plates after they were incubated and the pH of the protease solution in each well.



(i) How should the students make sure that the pH of the protease solution did **not** change?

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(1)

(ii) Use the graph to suggest a suitable temperature for incubating the agar plates.

Explain your answer.

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(1)

(iii) Use the diagram to describe the effect of pH on the activity of this protease.

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(1)

(Total 7 marks)

Essay question

At the end of Paper 3, you will be asked to write a synoptic essay on one from the choice of two titles.

Use this opportunity to practice writing an essay on the title below, using your GCSE knowledge (and any extra knowledge you may have picked up!)

Guidance: You should aim to cover content from 5 different areas in your answer and include any relevant details from reading you have done that is beyond the specification, showing a breadth of knowledge. Answer the question on lined paper.

You should write your essay in continuous prose.

Your essay will be marked for its scientific accuracy.

It will also be marked for your selection of relevant material from different parts of the specification and for the quality of your written communication.

The maximum number of marks that can be awarded is

Scientific	16
Breadth of knowledge	3
Relevance	3
Quality of written communication	3

The importance of membranes to organisms

(Total 25 marks)