



Year 12

Student Pack



**Subject:**

**Biology**

Section	Contents
1	- Online resources
2	- Revision tasks
3	- Additional work and learning resources

### **Online Science resources**

- Kerboodle – [www.kerboodle.com](http://www.kerboodle.com) Online access to textbooks and other resources
- Seneca – [www.senecalearning.com](http://www.senecalearning.com) Revision activities
- Memrise – [www.memrise.com](http://www.memrise.com) Keyword revision
- OCR – [www.ocr.org.uk](http://www.ocr.org.uk) Exam board specific resources
- Revision science – [www.revisionscience.com](http://www.revisionscience.com) Online revision resources

Please use the resources above, your notes and your textbooks to work through the following exam style questions.

These are based on topics previously covered in Year 12.

Mark schemes will be emailed to you to allow you to self-assess your work.

**1** State the correct term for each of the following definitions.

**a** A structure within cells consisting of microtubules and microfilaments.

..... (1 mark)

**b** A graduated measuring scale placed on the microscope stage.

..... (1 mark)

**c** The two parts of a light microscope that magnify the specimen.

.....  
..... (2 marks)

**d** The dark-staining region of a cell where ribosomes are made.

..... (1 mark)

**e** The detailed structure of cells visible only with an electron microscope.

..... (1 mark)

**2** Eukaryotic cells can be seen and studied at relatively low magnification with a light microscope, but prokaryotic cells are best viewed with an electron microscope which has better resolution.

Describe **one** difference between:

**a** eukaryotic and prokaryotic cells

.....  
..... (2 marks)

**b** light microscope and electron microscope imaging advantages

.....  
..... (2 marks)

**c** magnification and resolution.

.....  
..... (2 marks)

- 3** A student used the following procedure to view her own cheek epithelium cells. She:

1. rubbed a cotton wool bud inside her cheek
2. rubbed this onto a clean microscope slide
3. added three drops of methylene blue solution
4. angled a cover slip over this and lowered it gently
5. set the microscope to its lowest magnification
6. placed the slide on the stage
7. looked through the eyepiece to search for cells.

**a** Explain why:

- i** methylene blue was added

..... (1 mark)

- ii** the cover slip was lowered gently

..... (1 mark)

- iii** the microscope was set to its lowest magnification.

..... (1 mark)

- b** No cells were visible at the lowest magnification. Describe how the student can achieve a good focus on low power before looking for cells at a higher magnification.

..... (1 mark)

- c** The student had eaten cereal and not cleaned her teeth before making her cheek cell slide. Plaque bacteria and pieces of fibrous plant material were visible on the slide. Suggest how the bacterial and plant cells could be distinguished from the cheek cells.

.....  
..... (2 marks)

- 4** Look at Figure 1 on the photo support sheet. The micrograph shows cells from the intestine of a small mammal.

- a** State, with a reason, how many cells can be seen.

.....  
..... (2 marks)

- b** These cells are specialised for absorbing nutrients by having their plasma membrane folded into microvilli.

Calculate the mean length of a microvillus. Show your working.

.....

.....

.....

(4 marks)

- c** Explain how the structure of microvilli relate to their function in the small intestine.

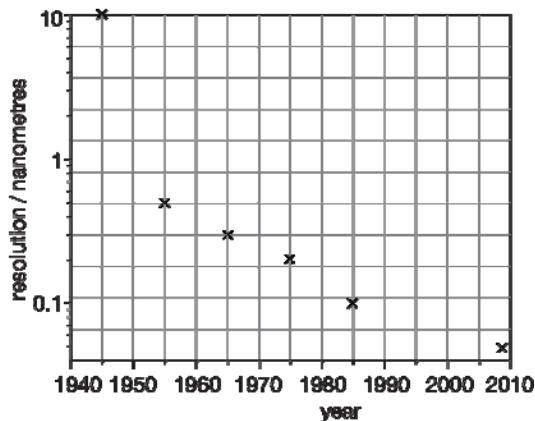
.....

.....

(2 marks)

- 5** Our knowledge of cells has been aided by several developments in imaging techniques.

- a** The graph shows how the resolution of the transmission electron microscope has improved over time.



Use the graph to evaluate whether the following could have been visualised in 1940:

- i** mitochondrion

..... (1 mark)

- ii** nuclear membrane

..... (1 mark)

iii DNA molecule

.....

..... (2 marks)

b Comment on the scale chosen for the y-axis.

..... (1 mark)

c Another advance in cell imaging that began shortly after 1940 is called immunohistochemistry. Here antibodies attached to a fluorescent labelling molecule bind to a specific protein in the cell.

i Name the microscope most suited to gaining a 3D view of a specimen emitting fluorescence as a result of having bound to labelled antibodies.

..... (1 mark)

ii In an experiment, a ciliated protist was exposed to fluorescent antibodies specific to the protein tubulin. Describe the pattern of fluorescence you would expect to see.

.....

..... (2 marks)

(8 marks)

6 Look at figure 2 on the photo support sheet, it shows some biological structures at a magnification of  $\times 500$ .

a Calculate the percentage difference in the size of cell **A** compared to cell **B**.

.....

..... (1 mark)

b Identify the type of microscope used to obtain this image.

..... (1 mark)

c Use your observations of the micrograph to evaluate the truth of these suggestions:

..... (2 marks)

i The structures shown are animal cells.

..... (1 mark)

- ii The structures shown are viruses.

..... (1 mark)

- iii The structures shown are of different species.

..... (1 mark)

State the correct term for the following definitions:

- a** the number of species in a habitat (1 mark)
- b** the existence of more than two alleles at a gene locus (1 mark)
- c** the relative abundance of the different species in a habitat (1 mark)
- d** an agricultural practice where only one species is grown over a large area (1 mark)
- e** maintaining a population outside its normal habitat (e.g. in a zoo or botanic garden) (1 mark)
- f** a species that has a disproportionately large effect on its environment relative to its abundance (1 mark)

**2** List the equipment required to measure the following and name the type of sampling involved in each case:

- a** the abundance of a ground beetle species in a meadow (2 marks)
- b** the zonation of seaweed species on a rocky shore (2 marks)
- c** the percentage cover of plant species in dune slacks (hollows) and on the slopes of sand dunes (2 marks)

**3** Non-invasive genetic sampling (NGS) is an important tool for monitoring populations of mammals, such as the brown bear in the Italian Alps. DNA can be obtained from hair samples and from faeces.

Maximum useful data can be obtained by combining systematic sampling (using hair traps and collecting hair and faeces along transects) with opportunistic collection of hair and faeces samples.

- a** Explain how the NGS approach allows individual bears to be identified. (1 mark)
- b** Suggest how combining systematic and opportunistic sampling leads to more useful data. (2 marks)
- c** Explain how in a long-term study this method allows the reproductive success of adults to be measured. (2 marks)
- d** Explain why it is important to monitor population trends, spatial distribution, reproductive success, and genetic diversity in small populations of rare animals. (2 marks)

**4** A study was carried out into the effect of a drainage ditch on the vegetation of a blanket bog. Transects were laid perpendicular to the ditch. At 2 m intervals along each transect the frequency of round-leaved sundew plants was recorded. The presence of round-leaved sundew is an indicator of high soil moisture.

The results are shown in the table.

Distance from ditch/m	Frequency of round-leaved sundew			
	Transect 1	Transect 2	Transect 3	Mean
0	0	0	0	0.0
2	0	0	1	0.3
4	2	1	0	1.0
6	3	6	4	4.3
8	5	7	7	6.3
10	9	12	11	10.6
12	8	10	12	10.0
14	14	11	15	13.3
16	13	14	16	14.3
18	15	13	12	13.3

- a** Suggest why data were collected at several transects. (1 mark)
- b** Use Spearman's rank correlation test to assess whether there is a significant correlation between distance from the ditch and the mean frequency of round-leaved sundew. Show your working and explain your conclusion.

**Spearman's Rank Correlation Coefficient**

$$r_s = 1 - \frac{6\sum d^2}{n(n^2 - 1)}$$

Critical values for Spearman's rank correlation coefficient:

	10%	5%	2%	1%
<i>n</i>				
1	—	—	—	—
2	—	—	—	—
3	—	—	—	—
4	1.0000	—	—	—
5	0.9000	1.0000	1.0000	—
6	0.8286	0.8857	0.9429	1.0000
7	0.7143	0.7857	0.8929	0.9286
8	0.6429	0.7381	0.8333	0.8810
9	0.6000	0.7000	0.7833	0.8333
10	0.5636	0.6485	0.7455	0.7939
11	0.5364	0.6182	0.7091	0.7545
12	0.5035	0.5874	0.6783	0.7273
13	0.4835	0.5604	0.6484	0.7033
14	0.4637	0.5385	0.6264	0.6791
15	0.4464	0.5214	0.6036	0.6536

(5 marks)

- c** Suggest how this investigation could be improved. (2 marks)
- d** An intact blanket bog has high moisture, low pH, and a unique community of plants including round-leaved sundew.  
Suggest why ditches were dug in bogs in the past and the effect these ditches are having on bog ecosystems. (2 marks)
- e** Damaged bogs in the south-west of England are being 'restored' by having their ditches dammed. Explain why conservation of bog biodiversity is a desirable activity. (2 marks)

- 5 Dung beetles feed on the faeces of larger animals. A study recorded numbers of dung beetles on grazed and ungrazed sites in Nebraska, USA. The results are shown in the table.

Species	Number on grazed site	$n/N$	$(n/N)^2$	Number on ungrazed site	$n/N$	$(n/N)^2$
<i>Onthophagus pennsylvanicus</i>	4267	0.610	0.372	6641		
<i>Canthon ebenus</i>	2005	0.286	0.082	774		
<i>Canthon pilularius</i>	353	0.050	0.003	108		
<i>Onthophagus hecate</i>	218	0.031	0.001	85		
<i>Aphodius lentus</i>	24	0.003	0.000	115		
<i>Aphodius rubeolus</i>	62	0.008	0.000	41		
<i>Phaneus vindex</i>	49	0.007	0.000	17		
<i>Melanocanthon nigricornis</i>	4	0.001	0.000	46		
<i>Geotrupes opacus</i>	3	0.000	0.000	2		
<i>Copris fricator</i>	14	0.002	0.000	9		
<i>Onthophagus orpheus pseudorpeus</i>	1	0.000	0.000	14		
Totals	7000		0.458	7872		

- a Simpson's Index of Diversity ( $D$ ) for the grazed site has been calculated as 0.542. Calculate Simpson's Index of Diversity ( $D$ ) for the ungrazed site and populate the table.

<DE>

Simpson's Index

$$D = 1 - \left( \sum \left( \frac{n}{N} \right)^2 \right)$$

</DE>

(3 marks)

- b Describe, and suggest a reason for, the difference in diversity between the grazed and the ungrazed sites.

(2 marks)

- c Dung beetles are considered to be keystone species in grazed habitats. Suggest **three** ways in which they may affect other species in the grassland community.

(3 marks)

- 1 a Complete the table to show the relationship between some monomers and their related macromolecules.

Monomer(s)	Macromolecule
	polypeptide
$\beta$ -glucose	
	triglyceride lipid
ribonucleotides ATP, CTP, GTP, UTP	

(4 marks)

- b Give the correct chemical symbols for:

- i **one** positive inorganic ion important in human metabolism.

..... (1 mark)

- ii **one** negative inorganic ion available to plant roots in the soil.

..... (1 mark)

- 2 a Describe **one structural** difference between:

- i  $\alpha$ -glucose and  $\beta$ -glucose

..... (1 mark)

- ii secondary and tertiary folding of proteins

.....  
..... (2 marks)

- iii amylose and glycogen.

..... (1 mark)

- b State **one functional** difference between:

- i lipids and carbohydrates

.....  
..... (2 marks)

ii DNA polymerase and RNA polymerase

.....

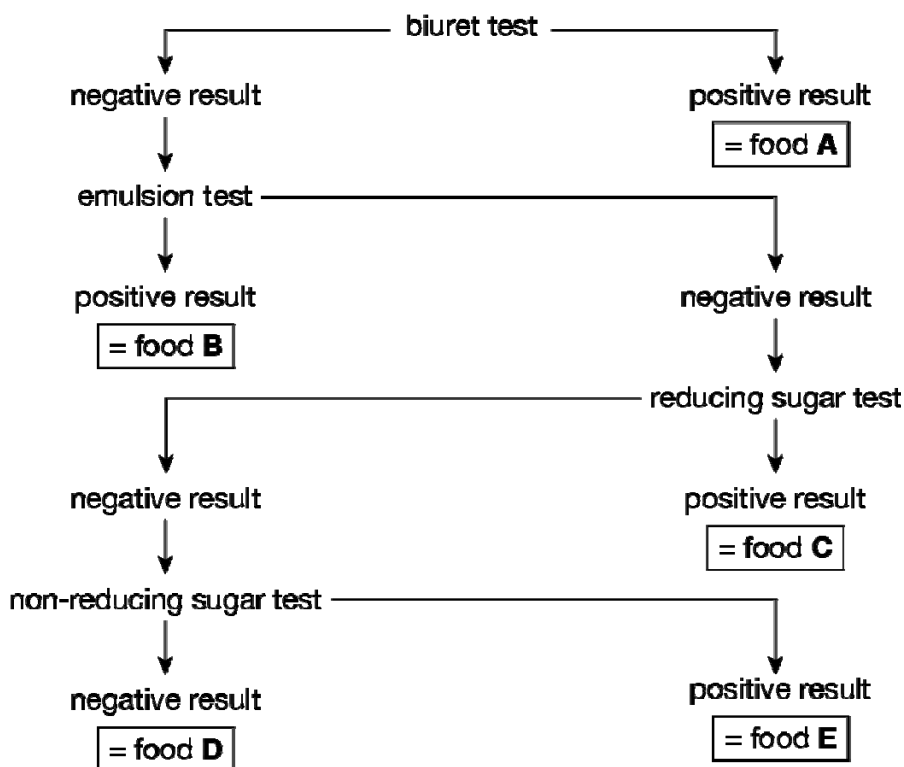
..... (2 marks)

iii collagen and elastin.

.....

..... (2 marks)

3 The flow chart shows the results of some tests that were carried out on samples of five foods: potato flour, table sugar, egg white, olive oil, and ripe banana.



a Identify foods A–E in the flow chart.

A .....

B .....

C .....

D .....

E .....

(5 marks)

- b** Describe how you could show the existence of a carbohydrate other than reducing sugar in Food C under the microscope.

.....

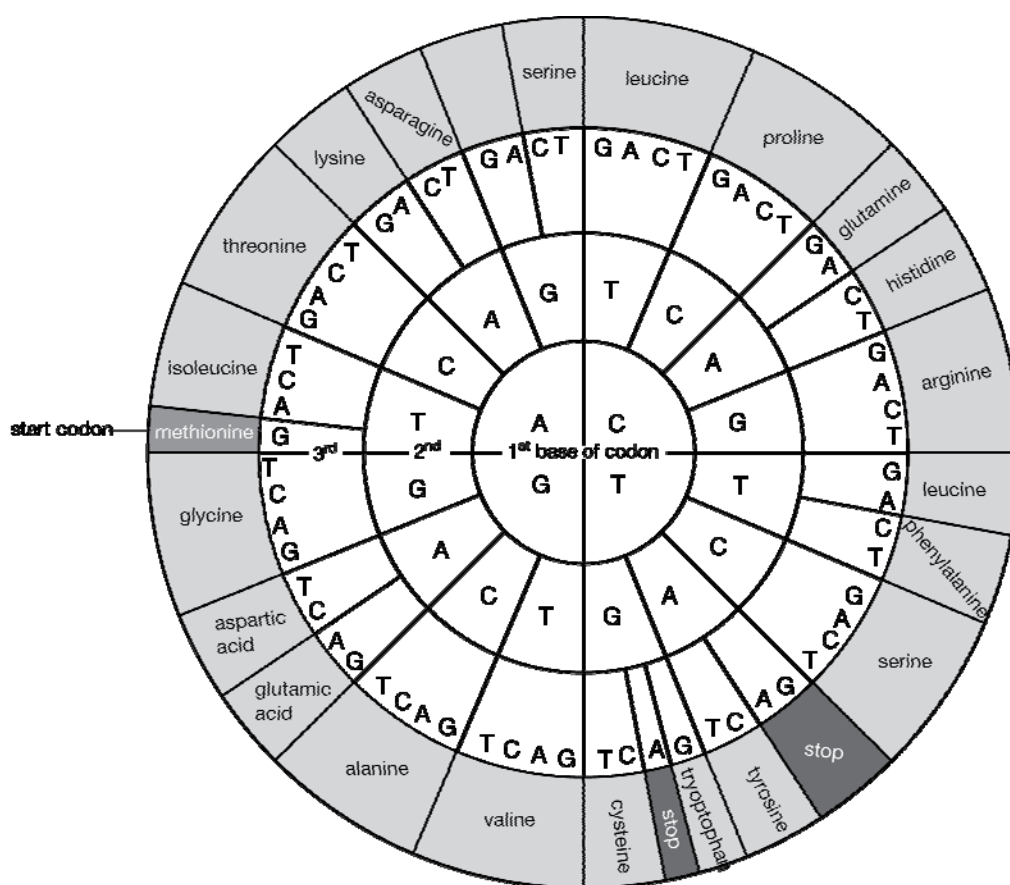
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.....

(3 marks)

- 4** The diagram is a circular representation of the genetic code.



- a** This diagram shows a sequence of bases coding for a sequence of amino acids. The name of the third amino acid in the sequence has been filled in.

AUG	—	AGG	—	AAG	—	ACA	—	UGG
1	—	2	—	lysine	—	4	—	5

- i Identify the remaining amino acids in the sequence.

1. ....

2. ....

3. **lysine**

4. ....

5. ....

(1 mark)

- ii State the name of the stage of protein synthesis shown and name the organelle in the cell where this takes place.

.....

..... (2 marks)

- iii Identify the type of nucleic acid that holds the sequence of bases shown.

..... (1 mark)

- b** Keratin is a fibrous protein found in skin, hair, and nails. 14% of the keratin polypeptide is made up of the amino acid cysteine. Covalent cross-links form between cysteine residues in adjacent keratin molecules.

- i Name the bond formed between adjacent cysteine residues.

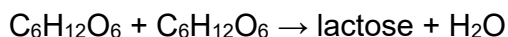
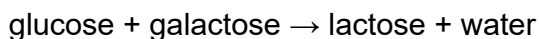
..... (1 mark)

- ii Explain the effect on the structure of keratin of a mutation which changed one base triplet from ACG to ACT.

.....

..... (2 marks)

- 5** Lactose is a disaccharide sugar, made according to the following equation:



- a** i Use the information given to state the molecular formula of lactose.

.....

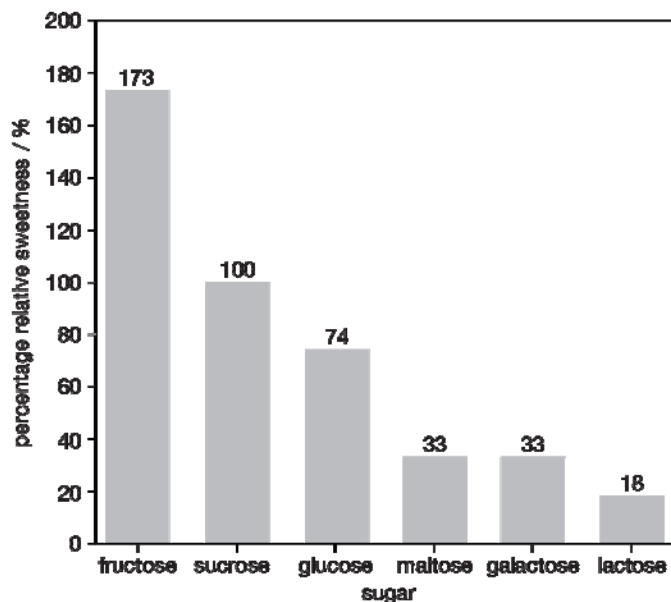
..... (1 mark)

- ii Name the type of chemical reaction shown in the equation.

.....

..... (1 mark)

- b The bar chart compares how sweet different sugars are perceived to taste by humans.



- i Relative sweetness was estimated compared to the reference sugar sucrose. Suggest why sucrose was chosen for this role.

..... (1 mark)

- ii Calculate the mass of fructose that would be needed to sweeten a pie to the same degree as 40 g of sucrose.

.....

..... (2 marks)

- iii Describe how the sweetness of disaccharides compares to their constituent monosaccharides and suggest a reason for this.

.....

.....

..... (3 marks)

1 State the correct terms for the following definitions:

- a system of placing organisms into a hierarchy of groups (1 mark)
- b evolutionary history of taxonomic groups (1 mark)
- c observable dissimilarities in organisms of the same species (1 mark)
- d environmental factor that kills less well-adapted individuals in a population (1 mark)
- e caterpillars that survive insecticide application (1 mark)

2 a Complete the table showing the classification of the African bush elephant..

1 .....	Eukarya
Kingdom	2 .....
3 .....	Chordata
4 .....	Mammalia
Order	Proboscidea
5 .....	Elephantidae
6 .....	<i>Loxodonta</i>
7 .....	<i>africana</i>

(7 marks)

- b African elephants have a number of adaptations to suit their habitat and niche. These include:
- A the upper lip and nose form a long flexible trunk
  - B heat is lost through the large surface area of the thin, well-vascularised ears
  - C the upper incisor teeth form elongated tusks
  - D elephants graze at ground level in the rainy season and from trees in the dry season
  - E elephants bathe in mud and water to remove parasites and cool down
  - F snorkelling is enabled by a unique lung pleural cavity arrangement

State the letters of the statements that correspond to:

- two anatomical adaptations
- two behavioural adaptations
- two physiological adaptations.

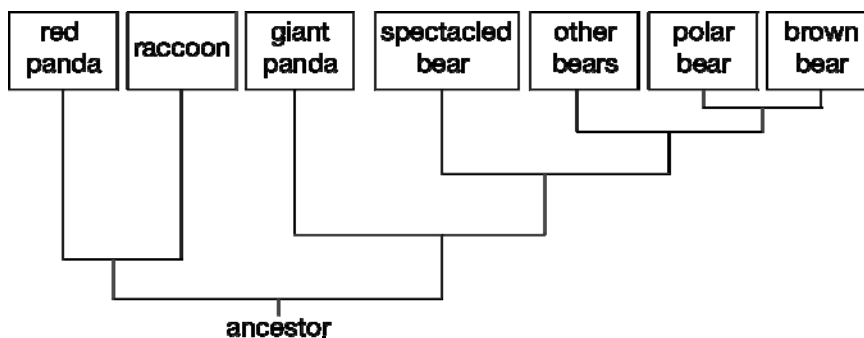
(3 marks)

- 3** A number of different species and subspecies of desert pupfish inhabit shallow creeks and ponds in hot, dry states of the USA such as Arizona, Nevada, and California.

20 000 years ago large lake systems occurred in these areas, but they have since dried up and fragmented, leaving small scattered pools.

- Explain how the changing landscape favoured evolution of several different species of pupfish. (4 marks)
- Suggest how sequencing the DNA of pupfish can help reveal the evolutionary history of these species. (3 marks)
- Desert pupfish can survive in hotter temperatures and much saltier water than most species of freshwater fish. Suggest one behavioural, one anatomical and one physiological adaptation they might have to be able to survive in these conditions. (3 marks)

- 4** The diagram shows a suggested tree of evolutionary relationships between bears, pandas, and raccoons. The diagram is based on comparative DNA sequence information.



Some of these species are pictured below. The geographic distribution of each species is also given. <See AW doc>

[Suggestion: great photos on Shutterstock for these. I think these aw's look very childlike for Alevel. I have sourced images and placed ID from shutterstock in red below]



**raccoon,**  
**North America**

654579865]

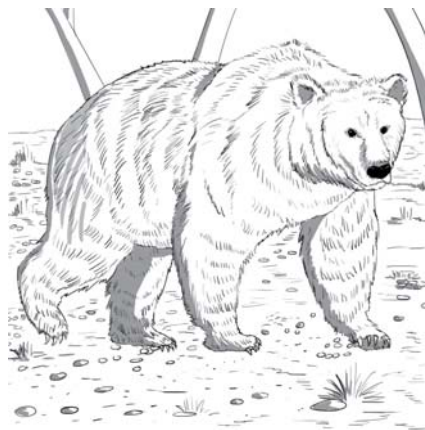


**giant panda,**  
**Asia** [555729070

]

**red panda,**  
**Asia** [1169501845

]



**brown bear,**  
**North America**  
**and Northern**  
**Europe** 270172469

**polar bear,**  
**Arctic circle**

[1316939030

]

- a**
- i** Two **pairs** of species each have a common ancestor not shared by any other living species. Name these two **pairs** of species. (2 marks)
  - ii** Use the pictures and your answer to **a i** to decide which pair of species is most genetically similar and explain your reasoning. (2 marks)
  - iii** Suggest what information is given by the length of the vertical lines on the evolutionary relationship diagram. (2 marks)
  - iv** For many years the red panda was thought to be the closest living relation of the giant panda. What evidence provided here gives some support to this view? (1 mark)
  - v** Describe two external phenotypic features that suggest red pandas and raccoons are closely related to each other, but not to the group including giant panda and bears. (4 marks)
  - vi** Apart from appearance and molecular evidence, what other type of evidence may help us work out the phylogenetic relationships of these animals? (1 mark)
- b** Giant panda sequence data were also compared to some other species. A protein called crystallin and the gene that codes for it were sequenced and compared. The results are shown in the table.

Mammal	Percentage of sequence that is identical
--------	--

	with giant panda sequence	
	DNA nucleotides	Amino acids in protein
human	93.0	98.3
mouse	91.5	97.1
ox	95.3	99.4

- i Calculate the mean DNA and protein sequence similarity between the giant panda and other mammals. Round your answers to one decimal place. (2 marks)
- ii Explain why the two figures you calculated for **b i** are not the same. (2 marks)

1 State the correct term for the following definitions:

- a a microorganism that causes disease (1 mark)
- b a disease that can be passed on from one individual to another (1 mark)
- c an organism that transmits a pathogen between individuals of another species (1 mark)
- d a disease where tissue is damaged by the action of the body's own lymphocytes (1 mark)
- e antibodies that mark antigens to enable phagocytosis. (1 mark)

**(5 marks)**

2 a Ring rot, ringworm, black sigatoka, malaria, tuberculosis (TB), and late blight are caused by pathogens. Classify these pathogens by inserting their names in the correct places in the table:

	Infects plants	Infects animals
bacterium		
protocist		
fungus		

(6 marks)

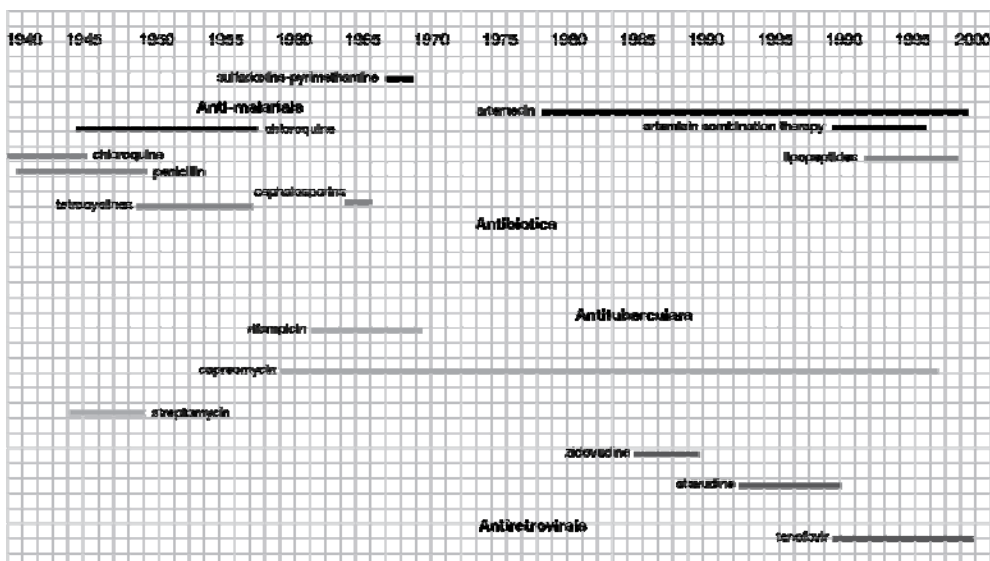
b Describe the similarity in the mode of transmission of:

- i tobacco mosaic virus (TMV) and malaria (3 marks)
- ii TB and blight. (3 marks)

c Identify one similarity and one difference in the non-specific ways in which plants and animals defend themselves against infection when wounded. (3 marks)

**(15 marks)**

3 Over the past 75 years the use of medical drugs to treat disease has seen many changes. The bar chart shows when some different drugs were introduced (start of bar) and when resistance to them was first reported (end of bar).



- a** Calculate the mean time span for which the antibiotics penicillin, lipopeptides, tetracyclines and cephalosporins remained effective. Show your working. (2 marks)
- b** State the meaning of the term ‘resistance’ and explain how it arises. (5 marks)
- c** Suggest a reason for each of the following:
- i** the adoption of artemisinin combination therapy to treat malaria (i.e., artemisinin is used in combination with other drugs) (1 mark)
  - ii** the introduction of the first antiretroviral was much later than the other classes of drugs, in 1985 (1 mark)
  - iii** the long period of efficacy of capreomycin. Capreomycin is only prescribed as a second or third-line treatment for drug-resistant TB. (1 mark)
- (10 marks)**

- 4** The table shows a timescale of events in a person who catches flu (viral influenza).

Day	Event
1	person attends concert indoors in winter with 5000 other people
5	symptoms start: fever, headache, muscle pains, fatigue
6	symptoms continue plus swollen lymph glands
7	symptoms continue plus sneezing and cough
10	fever, headache, muscle pains cease
14	sneezing ceases
21–28	cough continues

- a** Explain how the flu virus could have entered the person’s body on day 1. (1 mark)
- b** Describe the inflammatory response that leads to the symptoms seen on day 5. (3 marks)
- c** Explain how the specific immune response brings about the end of most symptoms by day 14. (4 marks)
- d** Suggest why the person continues to cough for another two weeks. (1 mark)
- e** A friend of this person who attended the same concert experienced milder flu-like symptoms that lasted only two days. Suggest a reason for this lower response to the virus. (1 mark)
- f** Discuss what options are available for treating a viral disease like flu, including both useful and non-useful interventions. (2 marks)
- (12 marks)**

**1** State the correct term for each of the following definitions.

**a** The cleft on an enzyme molecule to which the substrate temporarily binds.

..... (1 mark)

**b** The idea that the shape of an enzyme changes when it binds the substrate.

..... (1 mark)

**c** A substance additional to the enzyme and substrate that is also needed for the reaction to occur.

..... (1 mark)

**d** A substance that binds to an allosteric site on an enzyme and impairs its function.

.....  
..... (2 marks)

**e** Regulation of a metabolic pathway that occurs when the last substance made negatively affects an enzyme at an early stage in the process.

..... (1 mark)

**2** The rate of an enzyme-catalysed reaction can, in principle, be investigated either by measuring:

- how fast the substrate disappears
- how fast the products are made.

The method chosen depends upon the chemical properties of the substrate and product.

**a** Explain why:

**i** the rate of amylase action is found by measuring substrate disappearance.

.....  
..... (2 marks)

**ii** the rate of catalase action is found by measuring product build-up.

.....  
..... (2 marks)

- b** A series of experiments to measure the effect of different temperatures on the rate of a reaction was carried out. In each case, the volume of enzyme used was much smaller than the volume of substrate. Explain the reason for this.

.....

..... (2 marks)

- 3 a** Metabolism in living organisms relies upon enzyme-catalysed reactions. Complete the following passage about the synthesis and roles of enzymes.

..... enzymes are those that control metabolism inside cells, as opposed to other enzymes that carry out their function outside their cells of origin. All enzymes are made according to the coding on a DNA sequence, which is relayed via mRNA to the ..... for translation. Enzymes destined for secretion, like ..... which acts in the small intestine, move in vesicles from the cell's ..... to the plasma membrane.

An example of a multi-step metabolic process controlled by a series of enzymes inside animal cells is ..... The digestive enzymes in the small intestine catalyse ..... reactions, characterised by the breaking of bonds by addition of a molecule of water. (6 marks)

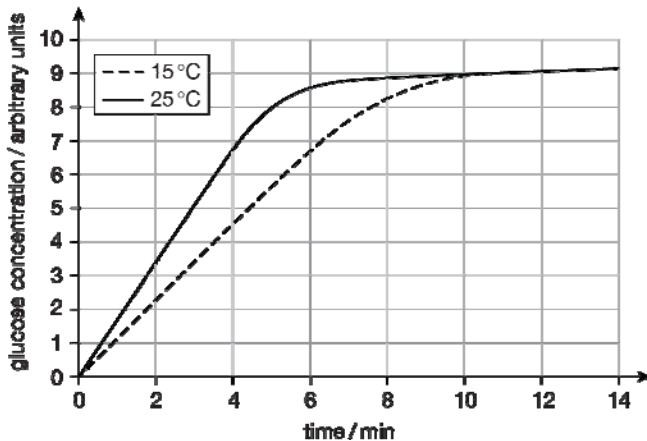
- b** Explain with reference to an example how competitive inhibitors can be used to treat people suffering from bacterial infections.

.....

.....

..... (3 marks)

- 4 Invertase is an enzyme which catalyses the breakdown of sucrose to its constituent monosaccharides, fructose and glucose. The graph shows the concentration of glucose produced when invertase was added to sucrose at two different temperatures. Apart from temperature, all other variables were controlled and kept the same.



a Explain why:

- i after 5 minutes, more glucose has been produced at 25 °C than at 15 °C.

.....  
 ..... (2 marks)

- ii after 10 minutes, there was no difference in the concentration of glucose at the two temperatures.

.....  
 ..... (2 marks)

- b On the graph sketch the results curve you would expect to see if the experiment was repeated at 25 °C with the same volume and concentration of invertase as before but with a higher concentration of sucrose solution.

.....  
 ..... (2 marks)

- c Use the graph to evaluate whether  $Q_{10} = 2$  for this reaction at the temperatures shown.

.....  
 ..... (2 marks)

**5** A handbook on preserving food states:

‘The aim of preserving is to slow down the activity of microorganisms and enzymes or destroy them altogether.’

**a** Explain how these food preservation methods work:

**i** Placing peas in boiling water for 1 minute and then freezing them at  $-18^{\circ}\text{C}$ .

.....

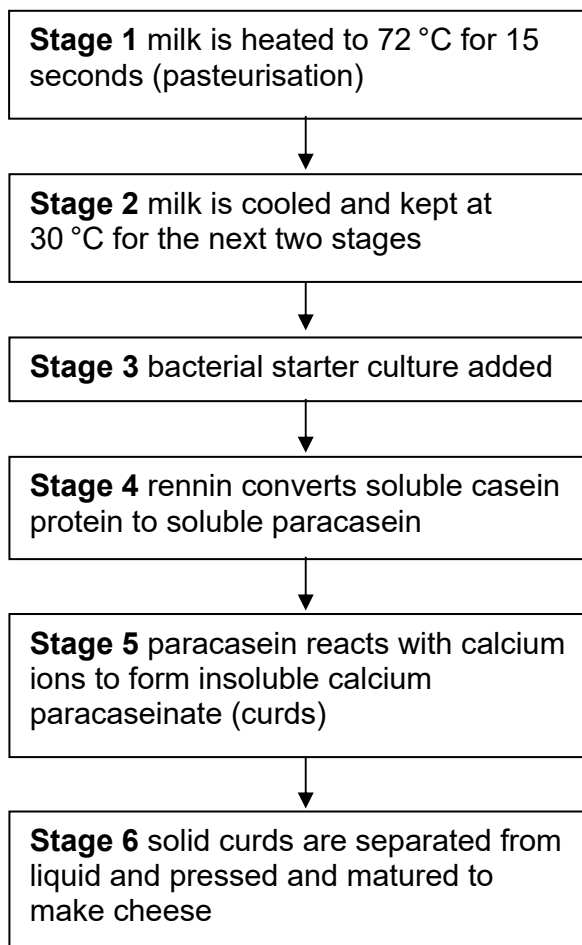
..... (2 marks)

**ii** Dipping rings of apple in lemon juice and drying them in a dehydrator.

.....

..... (2 marks)

**b** Making cheese is a way of preserving both the fat and the protein (casein) in milk for longer. The following flow diagram shows the main steps in making cheese. Rennin is an enzyme.



- i List **two** benefits of stage 1.

.....

..... (2 marks)

Samples of the mixture at stage 4 were taken at different times after the addition of rennin and were placed in a filter funnel lined with filter paper. The following table shows the time of taking the sample (after addition of rennin) and the time taken for liquid to finish draining from the filter funnel.

sampling time / minutes after adding rennin	time taken for liquid to drain / s
10	8
30	15
50	87
70	600
90	no drainage

- ii Describe and explain the results of this investigation.

.....

..... (2 marks)

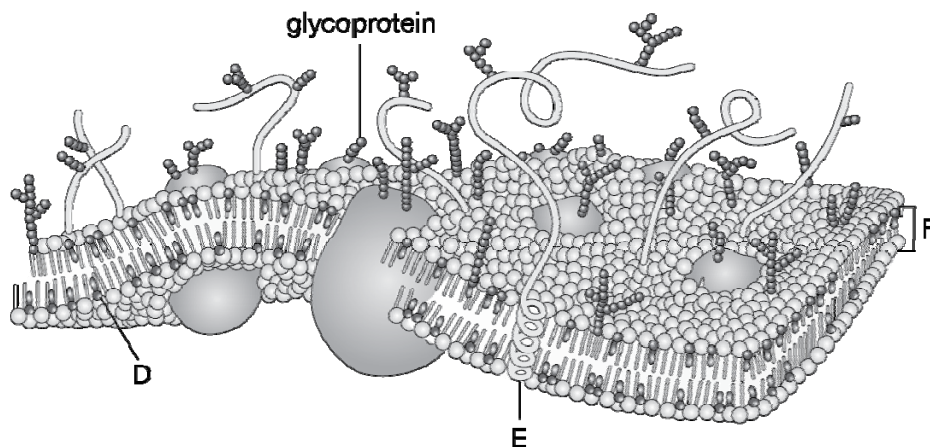
- iii The rate of drainage can be calculated as  $\frac{100}{t}$ . Use the data in the table to explain whether or not the rate of drainage is directly inversely proportional to sampling time.

.....

.....

..... (3 marks)

- 1 The diagram shows the structure of a plasma (cell-surface) membrane.



- a Name the components of the plasma (cell-surface) membrane labelled **D**, **E**, and **F**.

.....  
 .....  
 ..... (3 marks)

- b State **one** function for each of the components **D**, **E**, and **F**.

.....  
 .....  
 ..... (3 marks)

- c Glycoprotein molecules are positioned in the plasma (cell-surface) membrane with the carbohydrate chain outside the cell. This is to allow the glycoproteins to act as receptors in the process of cell signalling. Explain what is meant by the term 'cell signalling'.

.....  
 ..... (2 marks)

- 2 Describe **two** differences between: (2 marks)

- a active transport and facilitated diffusion

.....  
 ..... (2 marks)

**b** bulk transport and osmosis

.....  
 ..... (2 marks)

**c** the structure of a cell-surface membrane at 20 °C and 80 °C.

.....  
 ..... (2 marks)

**3** The table shows the proportions of proteins, lipids, and carbohydrates found in some different types of membrane.

Type / location of membrane	% protein	% lipid	% carbohydrate
unicellular prototist cell-surface membrane	54	42	4
liver cell-surface membrane	54	36	10
nuclear envelope	66	32	2
Golgi membrane	64	26	10
mitochondrion outer membrane	54	45	1
mitochondrion inner membrane	78	22	0

**a** Identify, with reasons, the membrane or membranes that is / are:

**i** most likely to be involved in cell signalling

.....  
 ..... (2 marks)

**ii** most likely to be the site of chemical reactions

.....  
 ..... (2 marks)

iii most effective as a barrier to polar substances.

.....

..... (2 marks)

b Suggest a reason for the differences in percentage composition between the two cell-surface membranes.

.....

..... (2 marks)

c List the chemical elements present in each membrane component.

.....

.....

..... (3 marks)

4 A practical investigation to find the solute potential of rhubarb cells was carried out in this way:

- 5 mm squares of rhubarb epidermis were soaked in different concentrations of sucrose solution for 20 minutes.
- After this time the tissue was mounted on a slide and observed under a microscope.
- The number of plasmolysed cells in a sample of 50 cells was counted.

a Suggest a range of concentrations for the sucrose solutions.

.....

..... (2 marks)

b Predict the shape of the results curve on a graph of sucrose solution (x-axis) against percentage of cells plasmolysed (y-axis).

.....

..... (2 marks)

c Explain how this graph can be used to find the solute potential of rhubarb cells.

.....

..... (2 marks)

- 5** The photomicrograph on the photo support sheet shows cells from a leaf of Canadian pondweed, *Elodea canadensis*, which lives in fresh water. Look at the photo on the support sheet.

**a** Use the scale bar to calculate the magnification of the photograph.

.....

..... (2 marks)

**b** A leaf of Canadian pondweed, which had been kept out of water for a short time, was seen to have wilted (its cells were no longer turgid).

Explain, **in terms of water potential**, what would happen to its cells if the leaf was then placed in distilled water with a water potential ( $\psi$ ) of 0.

.....

.....

.....

..... (4 marks)

**c** A student wanted to find out more about the structures labelled **A**. Use of an electron microscope revealed that each structure labelled **A** is surrounded by two membranes.

**i** Name structure **A**.

..... (1 mark)

**ii** Suggest a function of these membranes around structure **A**.

..... (1 mark)

**d** Some cells of Canadian pondweed were broken open using a liquidiser and some of the structures labelled **A** were released intact. What would happen to an intact structure **A** if it were then placed into distilled water with a water potential ( $\psi$ ) of 0?

.....

..... (2 marks)

- 1 State the correct term for the following definitions:
  - a the pull of water into venules due to the presence of albumin in blood plasma (1 mark)
  - b a circulatory system where blood flows freely through body cavities (1 mark)
  - c the patch of tissue generating electrical impulses on the right atrium of the heart (1 mark)
  - d the negative ion produced by the dissociation of carbonic acid (1 mark)
  - e the detachment of oxygen molecules from oxyhaemoglobin (1 mark)

**(5 marks)**
  
- 2 Explain the difference between:
  - a tissue fluid and lymph (2 marks)
  - b a single and a double circulatory system (2 marks)
  - c tachycardia and bradycardia. (2 marks)

**(6 marks)**
  
- 3 The diagram on the photo support sheet shows two blood vessels labelled **A** and **B** at a magnification of  $\times 2.5$ . <See image in Media doc folder>
  - a Identify **A** and **B**, explaining the reasons for your choices. (2 marks)
  - b Calculate the mean thickness of the tunica media of **A**. Show your working. (2 marks)
  - c Describe how **B** is adapted for its function. (1 mark)

**(5 marks)**
  
- 4 Saturation of haemoglobin with oxygen increases as the partial pressure of oxygen available rises, as shown in the table.

Partial pressure of oxygen available / kPa	Percentage saturation of haemoglobin
0	0
2	24.0
4	57.5
6	80.0
8	88.0
10	94.0
12	96.5
14	98.0

- a Describe and explain the shape of the curve produced if these data are plotted on a graph. (2 marks)

- b** Use the information already given and your own knowledge to complete the following table comparing the oxygen saturation of haemoglobin at respiring muscle tissue and at the alveoli.

(4 marks)

	Respiring muscle tissue	Alveoli
partial pressure of oxygen / kPa	2	12
percentage saturation of haemoglobin	24.0	.....
mean number of oxygen molecules bound to each haemoglobin	.....	4
mean number of oxygen atoms bound to each haemoglobin	.....	.....
volume of oxygen attached to 1 g of haemoglobin	.....	1.27 cm <sup>3</sup>

- c** The presence of carbon dioxide at respiring tissues increases the volume of oxygen offloaded by haemoglobin. This is called the Bohr effect or Bohr shift. Explain the molecular basis of the Bohr effect.

(4 marks)

- d** Different species of mammals vary in the degree to which carbon dioxide increases oxygen unloading. For example, the Bohr effect is particularly large in seals that dive deep underwater for long periods of time, but it is small in hibernating hedgehogs. Suggest an explanation for the difference in magnitude of the Bohr effect in seals and hedgehogs.

(4 marks)

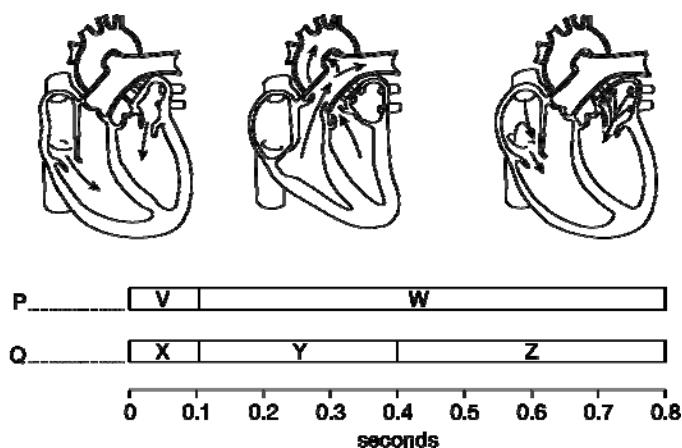
**(14 marks)**

- 5 a** Explain the need for transport systems in multicellular animals.

(3 marks)

- b** The diagrams show the sequence and duration of events in one cardiac cycle in the mammalian heart.

- The letters **P** and **Q** refer to two different types of heart chambers.
- The letters **V**, **W**, **X**, **Y**, and **Z** refer to periods of contraction or relaxation of the muscular walls of these chambers. <See Media folder>



- i Identify the type of chamber labelled as **P** and describe stages **V** and **W** of the cardiac cycle. (3 marks)
- ii State the name given to stage **Y**. (1 mark)
- iii Describe the mechanism that allows the **Y** stage in chamber **Q** to occur shortly after the **V** stage in **P**. (3 marks)
- iv Describe how a named piece of apparatus can be used to measure the length of stages **V** and **Y**. (4 marks)

**(14 marks)**

**Wider reading to support your studies in Biology**

<b>Title</b>	<b>Author/Contributor</b>	<b>Topic</b>
The Selfish Gene The Blind Watchmaker. Unweaving the Rainbow Climbing Mount Improbable The Ancestor's Tale	Richard Dawkins	Biodiversity
Y: The Descent of Men In the Blood: God, Genes and Destiny Almost Like a Whale: The 'Origin of Species' Updated	Steve Jones	Genetics Evolution
Genome: The Autobiography of a Species in 23 Chapters The Red Queen: Sex and the Evolution of Human Nature	Matt Ridley	Genetics
Mutants: On the Form, Varieties and Errors of the Human Body	Armand Marie Leroi	Human biology
The Machinery of Life	David S. Goodsell	Biological processes
A Short History of Nearly Everything	Bill Bryson	All
Oliver Sachs	The Man Who Mistook His Wife For A Hat	The nervous system

### Useful websites to support your studies in Biology

Website	Website Link	Topic
Natural history museum	<a href="http://www.nhm.ac.uk">http://www.nhm.ac.uk</a>	All
British medical journal	<a href="http://www.bmj.com">http://www.bmj.com</a>	Human Biology
The Royal Society	<a href="http://royalsociety.org">http://royalsociety.org</a>	All
The Scientific journal	<a href="http://nature.com">http://nature.com</a>	All
Nobel prize	<a href="http://nobelprize.org">http://nobelprize.org</a>	All
DNA code	<a href="http://www.dnai.org/a/index.html">http://www.dnai.org/a/index.html</a>	Genetics Biological molecules
The world of electron microscopy	<a href="http://www.uq.oz.au/nanoworld">http://www.uq.oz.au/nanoworld</a>	Cells