PEARSON EDEXCEL A-LEVEL BIOLOGY B · 9BI0

BIOLOGY



EXAM QUESTION PACK

TOPIC 1: BIOLOGICAL MOLECULES

PROTEINS

SCORE	PERCENTAGE
/65	%

STEMUP

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Q1.

Sickle cell anaemia is caused by a mutation in the β-globin gene which codes for part of haemoglobin.

The diagram shows the first 10 amino acids in this part of haemoglobin, in a healthy person and in a person with sickle cell anaemia.

Healthy person:	val – his – leu – thr – pro – glu – glu – lys – ser - ala
Person with sickle cell anaemia:	val – his – leu – thr – pro – val – glu – lys – ser – ala

Explain why the haemoglobin in a person with sickle cell anaemia will fold differently from the haemoglobin of a healthy person.

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Q2.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Palm plants and cocoa plants are used to produce lipids for the food industry.

Palm oil is produced from palm plants. Cocoa butter is produced from cocoa plants.

The fatty acid compositions of palm oil and cocoa butter are shown in the table.

Fatty acid	Chemical formula of fatty acid	Percentage of fatty acid found in palm oil and cocoa butter (%)	
		Palm oil	Cocoa butter
palmitic acid	$C_{16}H_{32}O_2$	45	27
oleic acid	$C_{18}H_{34}O_2$	40	31
linoleic acid	$C_{18}H_{32}O_2$	10	3
myristic acid	$C_{14}H_{28}O_2$	1	1
stearic acid	$C_{18}H_{36}O_2$	4	38

(i) How many of the named fatty acids shown in the table are saturated?

(1)

☒ **A** 1

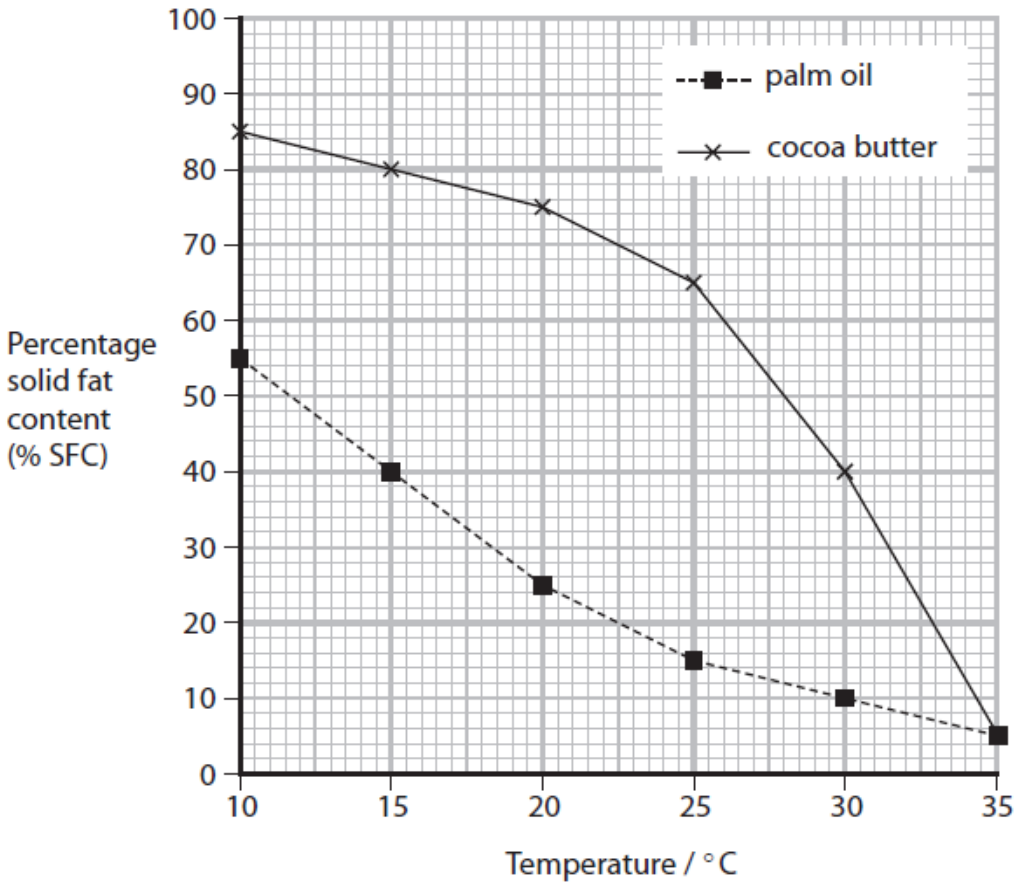
☒ **B** 2

☒ **C** 3

☒ **D** 4

(ii) The percentage solid fat content (% SFC) is a measure of how much of a lipid is solid at different temperatures.

The graph shows the effect of temperature on the % SFC for palm oil and for cocoa butter.



Comment on the effect of temperature on the % SFC of palm oil and of cocoa butter.

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(Total for question = 5 marks)

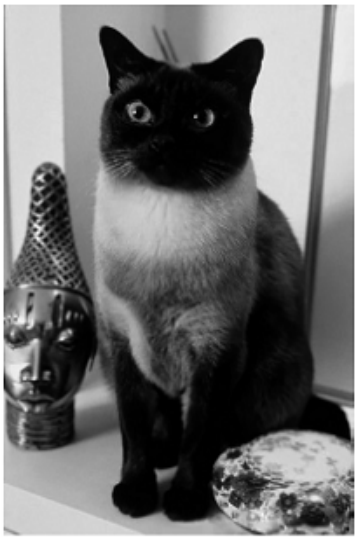
Q3.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

The photographs show a black cat and a Siamese cat.

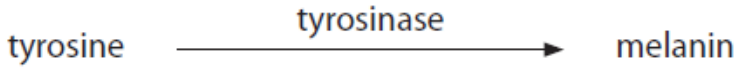


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The pigment melanin causes the fur to turn black.
This pigment is produced by tyrosinase, an enzyme coded by the TYR gene.



Siamese cats have a mutation in their TYR gene.
This changes the secondary and tertiary structures of tyrosinase.

(i) Which of the following shows the type of bonding involved in both the secondary and tertiary structures of a protein?

(1)

☒ **A** hydrogen only

☒ **B** hydrogen and ionic

☒ **C** ionic and disulfide

☒ **D** ionic only

(ii) Explain why the cooler regions of a Siamese cat have dark coloured fur and the warmer regions have lighter coloured fur.

(3)

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(Total for question = 4 marks)

Q4.

The order of bases in a section of DNA codes for a sequence of amino acids in a protein.

Draw a diagram to show the structure of an amino acid.

(2)

(Total for question = 2 marks)

Q5.

Doxorubicin (Dox) is a drug used to treat cancer.

Cancer is caused when cells divide uncontrollably.

This drug works in two ways:

- it becomes inserted into the DNA and holds the two strands together.
- it binds to an enzyme that repairs DNA.

Explain how Dox prevents cancer cells from dividing.

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(Total for question = 5 marks)

Q6.

Sickle cell anaemia is caused by a mutation in the β-globin gene which codes for part of haemoglobin.

The diagram shows the first 10 amino acids in this part of haemoglobin, in a healthy person and in a person with sickle cell anaemia.

Healthy person:	val – his – leu – thr – pro – glu – glu – lys – ser - ala
Person with sickle cell anaemia:	val – his – leu – thr – pro – val – glu – lys – ser – ala

The allele that leads to sickle cell anaemia is known as HbS.

From 1990 to 1996, all newborn infants in California were screened for the presence of the HbS allele.

The data in the table show the ratio of individuals with and without the HbS allele, in various ethnic groups.

Ethnic group	HbS allele : no HbS allele
African American	1:14
Asian	1:1336
Caucasian	1:625
Hispanic	1:183
Middle Eastern	1:360
Native American	1:176

A chi squared test was used to analyse the raw data.

The null hypothesis was: "There is no difference between the frequency of the HbS allele in African Americans and in all other ethnic groups combined."

The calculated value of chi squared was 450 615.

The table shows some critical values for the chi squared distribution, with one degree of freedom.

probability, *p*	0.005	0.010	0.025	0.050	0.100
critical value	7.879	6.635	5.024	3.841	2.706

Malaria is a major cause of death in Africa.

Assess the effect that this might have on the frequency of the HbS allele in African populations.

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Q7.

Many of the chemicals found in living organisms are polymers.

Which of the following molecules are all polymers?

(1)

☒ **A** polypeptides, nucleotides, starch

☒ **B** polypeptides, starch, lipids

☒ **C** proteins, carbohydrates, lipids

☒ **D** proteins, nucleic acids, starch

Q8.

Macrophages are involved in response to infection.

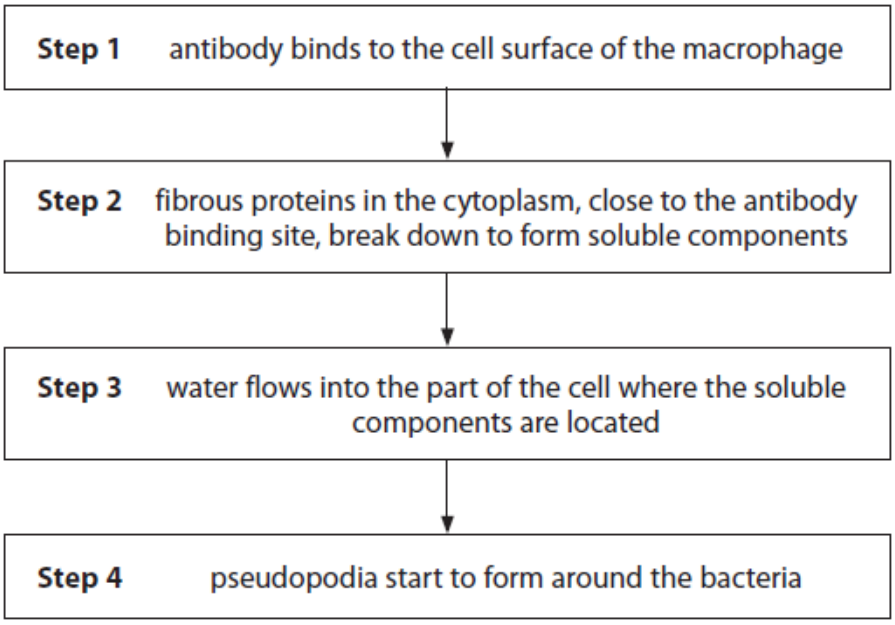
Macrophages engulf bacteria by surrounding the bacteria with pseudopodia.

The image shows a macrophage forming pseudopodia around some bacteria.



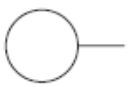
(Source: © urfin/Shutterstock)

The flow chart shows one theory for the formation of pseudopodia.

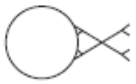


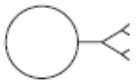
(i) Which diagram shows one antibody binding to the surface of a macrophage (**Step 1**)?

(1)

☒ **A** 

☒ **B** 

☒ **C** 

☒ **D** 

(ii) Actin is a fibrous protein.

Which row of the table describes the breakdown of actin (**Step 2**)?

(1)

		monomer formed	process by which bond is broken
☒	**A**	amino acid	condensation
☒	**B**	amino acid	hydrolysis
☒	**C**	nucleotide	condensation
☒	**D**	nucleotide	hydrolysis

(iii) Explain why water flows into the part of the cell where the soluble components are located (**Step 3**).

(2)

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(iv) Describe the events that take place resulting in T helper cell activation, following the formation of pseudopodia by the macrophages (**Step 4**).

(3)

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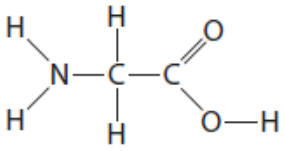
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(Total for question = 7 marks)

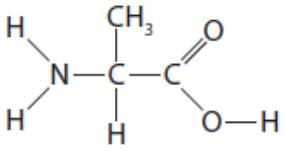
Q9.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

The diagram shows two amino acids found in the primary sequence of collagen.



glycine



alanine

(i) Which is the R-group for alanine?

(1)

☒ **A** CH_3

☒ **B** COOH

☒ **C** H

☒ **D** NH_2

(ii) Draw the products of a condensation reaction between glycine and alanine.

(2)

(iii) Describe the structure of collagen.

(3)

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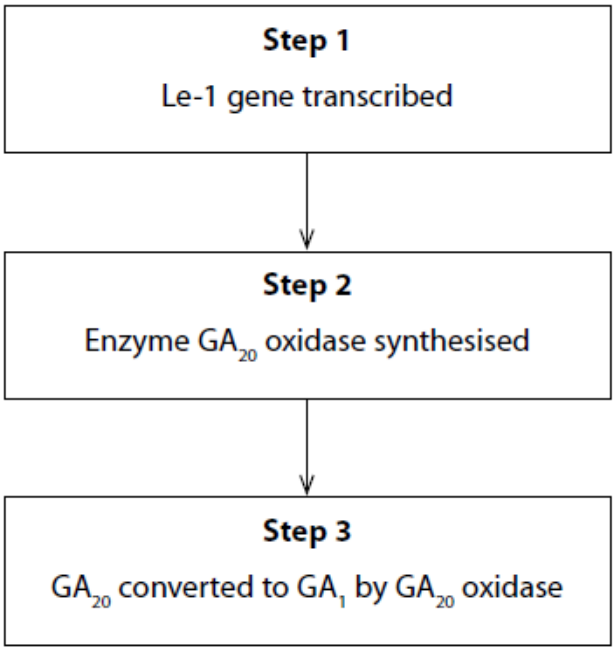
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(Total for question = 6 marks)

Q10.

'DELLA' proteins normally prevent transcription factors from binding to important growth-stimulating genes in the cells of plant stems.

The diagram below shows part of the biochemical pathway leading to the synthesis of an active plant growth substance called gibberellin (GA_1). GA_1 reduces the effect of 'DELLA' proteins.



(a) The Le-1 gene codes for the enzyme GA_{20} oxidase. A mutation of this gene forms a recessive allele which, when translated, leads to a single amino acid change in this enzyme. This change significantly reduces the activity of GA_{20} oxidase.

Explain how a single amino acid change can bring about a change in the structure and activity of GA_{20} oxidase.

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(b) (i) Explain why homozygous recessive plants will have short stems.

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(ii) An ecological survey of a stable population of one species of plant found that 36% had short stems.

Calculate the percentage of heterozygous individuals in this population.
Assume that there are only two alleles for this gene.

(4)

Answer .....

(Total for question = 12 marks)

Q11.

Antibiotics can affect bacteria.

The table describes the mode of action of four antibiotics.

Antibiotic	Mode of action
benzylpenicillin	disrupts peptidoglycan structure
streptomycin	binds to 70S ribosomes
ciprofloxacin	inhibits enzymes involved in prokaryotic DNA replication
rifamycin	inhibits prokaryotic RNA polymerase

Mutations in the DNA of bacteria can enable them to be resistant to antibiotics.

(i) A single bacterium can produce 2×10^{10} new cells per day by cell division.

The mean mutation rate in one day is 1 in 10 million new cells produced.

Calculate the mean number of bacteria with mutations that could be produced in one day from a single bacterium.

(2)

Answer .....

(ii) Explain how bacteria may become resistant to streptomycin if a mutation changes the primary structure of a protein.

(3)

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(Total for question = 5 marks)

Q12.

Mitochondria can be extracted from liver cells.

In order to monitor the purification of a sample of mitochondria,
a protein concentration : enzyme activity ratio can be determined.

Describe the structure of a globular protein.

(2)

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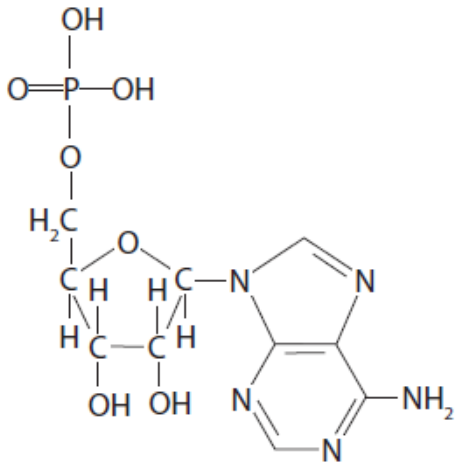
(Total for question = 2 marks)

Q13.

Many of the chemicals found in living organisms are polymers.

The diagram shows the structure of a monomer.

(1)



This monomer is found in

☒ **A** DNA

☒ **B** DNA polymerase

☒ **C** haemoglobin

☒ **D** mRNA

Q14.

The egg of a hen contains albumin, a globular protein.

Describe the tertiary structure of a globular protein.

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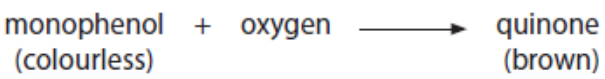
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(Total for question = 3 marks)

Q15.

Polyphenol oxidase is an enzyme found in many plant cells.

This enzyme catalyses the following reaction



This reaction causes cut fruit to turn brown when exposed to air.

Plant breeders have developed a grape variety that produces inactive polyphenol oxidase.

The bonding in this enzyme is changed and this prevents the juice from turning brown.

(i) Which of the following bonds are used to form the tertiary structure of enzymes?

(1)

☒ **A** hydrogen, glycosidic and ester

☒ **B** hydrogen, ionic and disulfide

☒ **C** ionic, glycosidic and disulfide

☒ **D** ionic, disulfide and ester

(ii) The base sequence of this polyphenol oxidase gene is different in this grape variety.

Explain how this leads to the production of inactive enzyme.

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(Total for question = 4 marks)