11 In some people a mutation can affect the beta chains in their haemoglobin molecules. As a result polar amino acids on the outer surfaces of the chains are replaced by non-polar amino acids.

What will be the effect on haemoglobin?

A Haemoglobin will become less soluble.

B Haemoglobin will become more soluble.

C Hydrophobic interactions between amino acids will decrease.

D More hydrogen bonds will form in the molecule.

10 Which bonds between amino acids hold the shape of the secondary structure and also the tertiary structure of proteins?

A peptide bonds

B disulfide bonds

C hydrogen bonds

D ionic bonds

11 Resilin is a protein found in the wings of insects. It is an elastic, fibrous protein and scientists have suggested that it may have an important role in allowing the wings of an insect to fold and unfold without damage.

Peptidyl transferase is an enzyme which catalyses the condensation of amino acids during translation to form resilin.

Which statements are correct?

1 Peptidyl transferase and resilin have structural roles in the insect.

2 Peptidyl transferase is a globular protein.

3 Peptidyl transferase is soluble in water.

A 1 and 2 **B** 1 and 3 **C** 1 only **D** 2 and 3

12 Collagen is a protein that helps to strengthen and increase the elasticity and hydration of the skin. Aging can lead to dry skin and the formation of wrinkles, due to the body producing less collagen.

Which row is correct for the structure of collagen in the skin?

	every fourth amino acid is glycine	fibrous protein
A	✗	✗
B	✓	✓
C	✗	✓
D	✓	✗

key

✓ = correct

✗ = **not** correct

11 Thermostable enzymes can maintain their tertiary structure at high temperatures.

Scientists studying the primary structure of a thermostable enzyme found that the enzyme contained:

- more charged amino acids
- fewer polar amino acids that are **not** charged
- more hydrophobic amino acids

than enzymes that are **not** thermostable.

Which row shows a correct comparison between this thermostable enzyme and an enzyme that is **not** thermostable?

	number of amino acids forming interactions at the centre of a thermostable enzyme compared to an enzyme that is **not** thermostable	number of ionic bonds in a thermostable enzyme compared to the number in an enzyme that is **not** thermostable
A	less than	more than
B	less than	less than
C	more than	less than
D	more than	more than

12 Collagen is a strong, elastic molecule that is often found in the connective tissues of animals. Glycine is an amino acid found at regular positions in the primary structure of a collagen polypeptide.

Which row shows features of collagen that contribute to its strength and elasticity?

	glycine is found on the outside of the helical polypeptides to allow them to lie closer together	disulfide bonds form between glycine amino acids to join the polypeptides together
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

key

✓ = contributes to the strength and elasticity of collagen

✗ = does **not** contribute to the strength and elasticity of collagen

2 Collagen is a fibrous protein found in many tissues in animals.

Fig. 2.1 shows the composition of a collagen fibre.

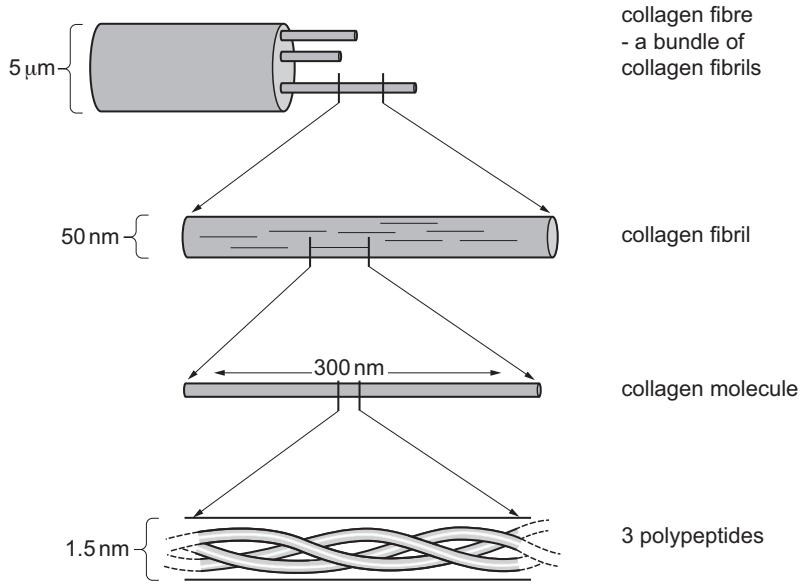

Fig. 2.1

(a) **(i)** Describe the arrangement of the 3 polypeptides in each molecule of collagen.

.....

.....

.....

.....

.....

..... [2]

(ii) With reference to Fig. 2.1, explain how the molecules of collagen are arranged **and** held together in a collagen fibril.

.....

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.....

.....

[3]

(b) Collagen fibres and elastic fibres are found in the structures of the gas exchange system of mammals.

(i) Suggest **two** properties of collagen that contribute to the function of cartilage in the trachea in the gas exchange system.

.....

.....

.....

.....

..... [2]

(ii) State the function of elastic fibres in the alveoli in the lungs.

..... [1]

(c) Table 2.1 shows the DNA triplets in the two strands of DNA in part of a gene that codes for one of the polypeptides in collagen.

Table 2.1

non-transcribed strand	GGT	CCA	ATG	GGT	CCC	CGA	GGT	CCC	CCA	GGT
template strand	CCA	GGT	TAC	CCA	GGG	GCT	CCA	GGG	GGT	CCA
amino acid	gly									

Table 2.2 shows the triplets of bases in **DNA** and the amino acids for which they code.

The table can be used to determine the sequence of the amino acids in a polypeptide.

Table 2.2

first base	second base: T		second base: C		second base: A		second base: G		third base
T	TTT	phe	TCT	ser	TAT	tyr	TGT	cys	T
	TTC		TCC		TAC		TGC		C
	TTA	leu	TCA		TAA	stop	TGA	stop	A
	TTG		TCG		TAG		TGG	trp	G
C	CTT	leu	CCT	pro	CAT	his	CGT	arg	T
	CTC		CCC		CAC		CGC		C
	CTA		CCA		CAA	gln	CGA		A
	CTG		CCG		CAG		CGG		G
A	ATT	ile	ACT	thr	AAT	asn	AGT	ser	T
	ATC		ACC		AAC		AGC		C
	ATA		ACA		AAA	lys	AGA	arg	A
	ATG	met	ACG		AAG		AGG		G
G	GTT	val	GCT	ala	GAT	asp	GGT	gly	T
	GTC		GCC		GAC		GGC		C
	GTA		GCA		GAA	glu	GGA		A
	GTG		GCG		GAG		GGG		G

(i) Complete Table 2.1 to show the amino acids coded by the DNA nucleotide sequence in Table 2.1. [1]

(ii) The sequence of amino acids that you have worked out is representative of the whole of the collagen polypeptide.

Explain how the sequence of amino acids makes the polypeptide suitable as a component of a collagen molecule.

.....

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.....

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.....

..... [3]

(iii) Two mutations, **P** and **Q**, can have an effect on the primary structure of the polypeptide.

- Mutation **P** is a deletion of the first nucleotide pair in the DNA nucleotide sequence shown in Table 2.1.
- Mutation **Q** is a substitution of G with T as the first base in the DNA nucleotide sequence shown in Table 2.1.

State the effects of the mutations, **P** and **Q**, on the primary structure of the polypeptide.

mutation **P** .....

.....

.....

mutation **Q** .....

.....

.....
[2]

[Total: 14]