Solutions

Each answer shows the steps, then the **result**.

2.1

- peptide bond; a water molecule is removed

2.2

(a)

- quaternary

(b)

- primary

(c)

- tertiary

3.1 B

- A glycosidic bond joins sugars, not amino acids

3.2 B

- Joining 120 amino acids needs 119 peptide bonds, so 119 water molecules are released

3.3

(a)

- two or more polypeptide chains joined into one protein; haemoglobin has four chains — two α and two β — each with a haem group

(b)

- the iron atom is where one oxygen molecule binds; four haem groups let one haemoglobin carry four O_2 molecules

3.4

(a)

- three polypeptide chains wound into a triple helix held by hydrogen bonds; many molecules lie side by side, staggered and cross-linked into fibres

(b)

- the triple helix and cross-links make it very strong when pulled, suiting it to support skin, tendons and bone

3.5

(a)

- A central carbon bonded to an amino group $-NH_2$, a carboxyl group $-COOH$, a hydrogen and an R group. A peptide bond forms by **condensation**: the $-OH$ of one carboxyl group and an $-H$ of the next amino group leave as water, giving a $-CO-NH-$ link

(b)

- Primary — the sequence of amino acids. Secondary — regular folding into an α helix or β pleated sheet, held by hydrogen bonds. Tertiary — the overall three-dimensional fold, held by hydrogen, ionic and disulfide bonds and hydrophobic interactions. Quaternary — two or more polypeptide chains, plus any prosthetic group, assembled into one functional molecule

(c)

- Haemoglobin is **globular**, collagen **fibrous**; haemoglobin's function depends on tertiary and quaternary structure — the haem pockets — while collagen's depends on its primary structure, the glycine at every third residue that lets three chains wind together; haemoglobin is soluble because its hydrophilic R groups face outwards, collagen is insoluble

(d)

- The R group is part of the tertiary structure, so exchanging a charged R group for a non-polar one changes which bonds can form; a hydrophobic patch now sits on the outside of the molecule; molecules stick to one another and the haemoglobin polymerises, distorting the whole cell — so one substitution changes the quaternary behaviour