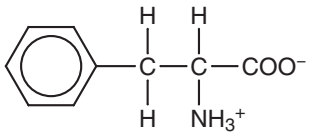
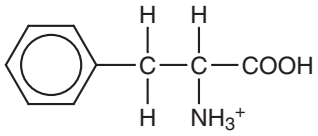
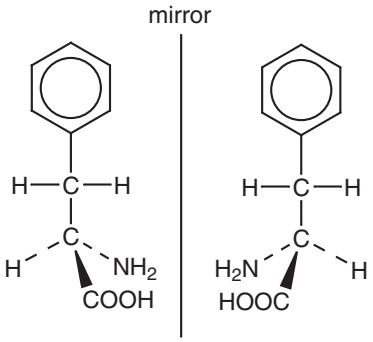
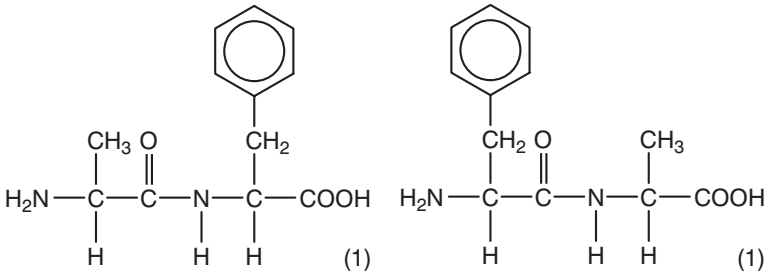
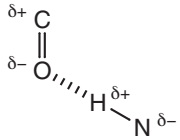
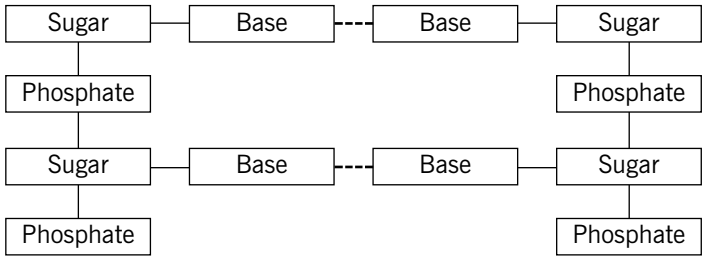
Answers to Engineering Proteins End of Unit Test

Q	Answer with marks	Marking suggestions
1(a)	COOH and NH_2 attached to same C (1)	
1(b) (i)	 COO^- (1); NH_3^+ (1)	
1(b) (ii)	 (1) Formation of this ion removes H^+ (1) from solution (1)	
1(c) (i)	Optical isomerism (1)	
1(c) (ii)	Two 3-dimensional structures (1) shown as object and mirror image (1), eg 	
1(d) (i)	 (1) (1)	
1(d) (ii)	Ring round CONH on one structure (1)	
1(d) (iii)	Reflux (1); with moderately concentrated (1) acid (1)	

Q	Answer with marks	Marking suggestions
2(a) (i)	The order of the amino acid (residues) (1)	
2(a) (ii)	Folding of the chain into a helix (1) or sheet (1)	
2(b)	 (1) for correct hydrogen bond (1) for charges related to hydrogen bond (1) for other charges	Ignore bond angles in diagram
2(c) (i)	The folding of a protein's chain gives it the right shape (1); it controls the shape of the active site into which the substrate fits (1)	Allow 'lock and key' for second mark *or* availability of reactive groups in active site to bind the substrate
2(c) (ii)	On heating, weak intermolecular forces such as hydrogen bonds are broken (1); thus the protein loses its tertiary structure (1)	
2(c) (iii)	COOH turned to COO^- on raising pH *or* on lowering pH, $-\overset{+}{N}H_3$ formed (1); the changes affect binding of substrate (1)	

Q	Answer with marks	Marking suggestions
3(a) (i)	Titrate/measure acid present (1); the increase in acidity is related to the amount of DIMP formed (1)	
3(a) (ii)	Three values in range 280–320 s (1) Working for all three shown on graph (2)	Working for one scores (1)
3(a) (iii)	First order (1) Constant half-lives (1)	
3(b)	Rate = $k[H^+][DIMP]$ (1) for $[H^+][DIMP]$ (1) for equation completely correct	

Q	Answer with marks	Marking suggestions
4(a) (i)	Sixth (1)	
4(a) (ii)	Glu/glutamic acid (1)	
4(b) (i)	 (1) for sugar–phosphate backbones (1) for bases attached to sugar (1) for bases on two chains adjacent	
4(b) (ii)	Hydrogen bonds (1); dotted lines on diagram (1)	
4(c) (i)	A gene (or DNA segment) which makes HbA would have to be taken from another organism (1); and placed in the cells of a patient with the disease (1)	
4(c) (ii)	Advantage (1), eg curing genetic disease, making crops resistant to pests/pesticides, making cheaper medicines, etc Disadvantage (1), eg effects unknown, pests resistant to all pesticides, etc	

Q	Answer with marks	Marking suggestions
5(a) (i)	$K_c = \frac{[C_2H_5OH]}{[C_2H_4]\,[H_2O]}$ (1) for top line; (1) for bottom line	
5(a) (ii)	$[C_2H_5OH] = K_c \times [C_2H_4]\,[H_2O] = 24 \times 0.45 \times 0.05$ (1); $= 0.54\ \text{mol dm}^{-3}$ (1) for number – *with error carried forward*; (1) for units (no ecf) and 2/3 sf.	
5(b) (i)	smaller (1); increasing the temperature makes equilibrium move in endothermic direction (1); by Le Chatelier's principle/ because it moves to oppose the change (1)	
5(b) (ii)	1. no effect (1) 2. more ethanol (1); *or* equilibrium moves in direction of fewer molecules (1)	
5(b) (iii)	It is not economical because running costs/capital costs too high/need thick-walled vessels/it is dangerous (1)	
5(c)	Ethanol (1); Three types of proton (1)	