

**Nuffield Advanced Chemistry Special Study *Biochemistry***

Exam questions: answers and marking guide

**Q1 [Adapted from Edexcel Chemistry (Nuffield)1996]**

- (a) (i) It is semi-permeable OWTTE (1) (1)  
(ii) Mitochondria (1) (1)  
(iii) DNA (1) (1)  
(iv) centrifugation (1) chromatography (1) filtration (1)  
*any two* (2)
- (b) (i) Ammonia is produced (1) which is alkaline (1) (2)  
(ii) stop reaction (1) inhibit enzyme (1) (2)  
(iii) maximum activity of enzyme at about 40°C (1) (1)  
(iv) acts as a control OWTTE (1) subtract this titration from  
others (1) (2)  
(v) tube 1 would involve a substantial titration (1) others  
very little (1) only area fits the active site of the  
enzyme (1) (3)
- (c) (i) glycolysis (1) (1)  
(ii) the O.N. of carbon increases (1) from 0 to +1 (1) (2)  
(iii) acetyl-CoA (1) (1)  
(iv) lactate in muscles produces the symptoms of cramp (1) (1)
- (d) (i) Use:  
  - Enzyme differences between organisms (1)
  - Structural differences between cells (1)
  - Differences of distribution between different types  
of cell (1)*Any two* (2)
- (ii) prevents formation of bacterial wall (1)  
inhibits the enzyme involved in synthesis of wall (1)  
without wall, bacterial cells burst (1)  
human cells do not have walls (1) (4)
- (iii) dimethoate is absorbed into plant cells (1)  
kills insects which bite/suck plant cells (1)  
pollinating insects don't bite plants so not affected (1)  
birds/mammals have enzymes which break down  
dimethoate so not affected (1) (4)

**TOTAL 30**

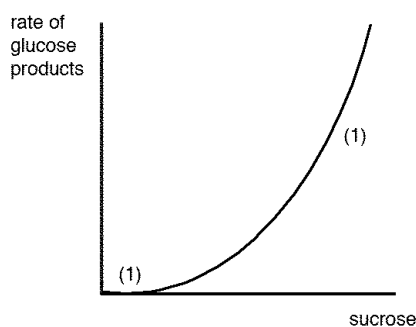
**Q2 [Adapted from Edexcel Chemistry (Nuffield)1997]**

- (a) (i) deoxyribonucleic acid (1) (1)  
 (ii) 3.4 nm: the turn/pitch/distance between maxima of the helix (1)  
 0.34 nm: the hydrogen bonded base-pairs (1) (2)  
 (iii) the four bases link only in specific pairs (1)  
 adenine/thymine      cytosine/guanine (1) (2)  
 (iv) 8 (1) (1)  
 (v) a section of DNA (1) responsible for a characteristic of the organism (1) (2)
- (b) (i) cells crushed to release contents (1)  
 centrifuging }  
 chromatography } *any two* (2)  
 filtration } (3)
- (ii) rate increases with conc (1) plenty of active sites available (1)  
 rate levels off (1)                      all sites full (1) (4)
- (iii) enzyme inactive/denatured (1) active site changes shape (1)  
 substrate no longer 'fits' (1) (3)
- (iv) enzyme not permanently affected by cooling and re-warming (1) results similar to those shown (1) (2)
- (c) (i) attaching enzyme to some other material to take it out of solution (1) (1)
- (ii) adsorption on insoluble support (1)  
 trapping in a gel (1)  
 covalent bonding to a support (1)  
 encapsulation behind semi-permeable membrane (1) } *any three* (3)
- (iii) can be re-used (1)  
 fewer side reactions (1)  
 quicker reaction (1)  
 can be continuously used (1) } *any two*
- higher concentrations used (1) (2)
- (iv) shape of two forms is different (1)  
 one is affected by the enzyme, other is not (1) (2)
- (v) nitrogen-containing fertilizers could be made (1)  
 without the need to manufacture ammonia synthetically (1) (2)

**TOTAL      30**

**Q3 [Adapted from Edexcel Chemistry (Nuffield) 1998]**

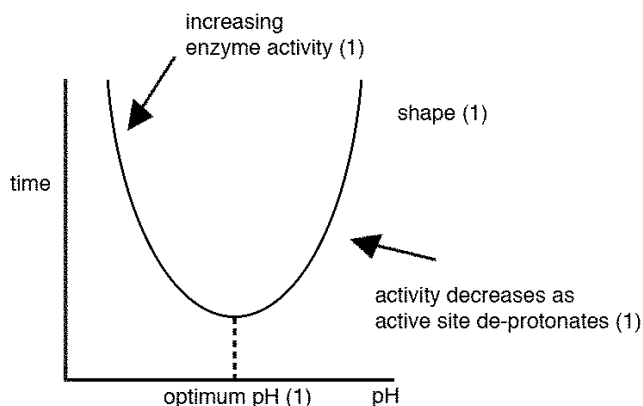
- (a) (i) hydrolysis (1) (1)  
 (ii) food storage (1) can be utilised when other sources of glucose fail (1) (2)  
 (iii) active site: place on an enzyme molecule into which substrate fits (1)  
 allosteric site: another place where attachment may alter active site (1) (2)  
 (iv) phosphorylation (1) (1)  
 (v) from carbon dioxide and water by photosynthesis (1) (1)
- (b) (i) messenger ribonucleic acid (1)  
 (ii) adenine, cytosine, guanine, thymine, uracil (all correct 4, each error -1) (4)  
 (iii) right-hand strand must be mRNA (1) has the uracil in it (1) (2)  
 (iv) 4 (1) each codon has 3 bases (1) (2)  
 (v) all codons after the omission would be different (1) different amino acids (1) (2)  
 (vi) hydrogen-bonding (1) (1)
- (c) (i) X: 1 (1) rate proportional to concentration (1)  
 Y: 0 (1) rate unaffected by conc (1) (4)  
 (ii) X: rate controlled by sucrose conc/plenty of sites available (1)  
 Y: sites getting fewer, increase of sucrose compensate (1)  
 Z: fewer sites available, increase of sucrose conc. less important (1) (3)  
 (iii) competitive inhibitor binds to active site (1) but is displaced at higher substrate concentrations (1)



**TOTAL 30**

**Q4 [Adapted from Edexcel Chemistry (Nuffield) 1999]**

- (a) (i) A: adenine (1)  
 B: deoxyribose (1)  
 C: phosphate (1) (3)
- (ii) hydrogen bonds (1)  
 adenine thymine (1) cytosine guanine (1) (any pairing allowed) (3)
- (iii) CTAAGGGT (1) (1)
- (iv) uracil instead of thymine (1) ribose, not deoxyribose (1) (2)
- (v) anticodon is a triplet of bases (1) corresponding to a codon on mRNA (1)  
 transfer RNA/tRNA (1) (3)
- (b) (i) maltose (1) (1)
- (ii) the sodium chloride is a co-factor (strictly it is the chloride ions) (1) necessary for enzyme activity (1)  
 without it the reaction would be much slower (1) (3)



- (iii) (4)
- (c) (i) compound which helps to co-ordinate the activity of cells (1) (1)
- (ii) insulin released (from pancreas) when sugar levels are high (1)  
 increases the passage of glucose through (same) cell walls (1)  
 stimulates glycogen formation in muscles (1)  
 stimulates glycolysis in the liver (1)  
 reduces synthesis of glucose from pyruvate (1) } *any three*  
 such behaviour accelerates glucose metabolism/reduces blood sugars (1) (4)
- (iii) gene for human insulin transferred to DNA of yeast (1)  
 yeast fermented with glucose and synthesises ( a precursor of) insulin (1)  
 insulin excreted by yeast and isolated (1) (3)
- (iv) made in large quantities (1)  
 identical to human insulin (animal insulin differs) (1) (2)

**TOTAL 30**

**Q5 Adapted from [Adapted from Edexcel Chemistry (Nuffield) 2000]**

- (a) (i) X: allows passage of certain components in and out of cell OWTTE (1)  
 Y: (cytoplasm) where many enzyme reactions occur (1)  
 Z: (mitochondrion) where citric acid cycle occurs (1) (3)
- (ii) cell wall (1) chloroplasts (1) (2)
- (iii) contains: ribose instead of deoxyribose (1) uracil instead of thymine (1) (2)
- (iv) codon (1) (1)
- (v) tRNA has anticodon at one end (1) amino acid at the other (1) anticodon has complementary bases to codon so specific amino acid is added (1) (3)
- (b) (i) to release contents of cells/break down cell walls (1) (1)  
 (ii) to minimise degradation of nucleic acids (1) (1)  
 (iii) denature enzymes (1) which would degrade DNA (1) (2)
- (iv) salts (1) enzymes (1) products of breakdown of plant cells (1) *any two* (2)
- (v) gel (1) electrophoresis (1) (2)
- (c) (i) substrate must fit active site (1) only one isomer has the right shape (1) (2)
- (ii) an enzyme fixed in position/not dissolved (1) absorbed on inert base (2) / trapped in gel (2) / covalently bonded to base (2) / use selectively permeable membrane (2) (3)
- (iii) advantage: reusable (1) / continuously useable (1) / higher concentrations (1) / fewer side sections (1) *any two* disadvantage : initially more expensive (1) (3)
- (d) (i) a length of DNA strand responsible for a characteristic of the organism (1) (1)
- (ii) gene responsible identified (1) gene removed or replaced (1) (2)

**TOTAL 30**

**Q6 [Adapted from Edexcel Chemistry (Nuffield) 2001]**

- (a) (i) adenosine triphosphate (1) (1)  
(ii) phosphorylation (1) (1)  
(iii) in animals: from oxidation of food (1)  
in plants: from oxidation of food (1) from  
photosynthesis (1) (3)  
(iv) glycolin (1) phosphorylation (1) citric acid cycle (1)  
*any two* (2)  
(v) reaction slow/activation energy high (1) catalysis by  
enzymes (1) (2)  
(vi) e.g. insulin (1)  
increases passage of glucose through cell membranes (1) /  
stimulates glycogen formation (1) / stimulates glycolysis (1) /  
reduces glucose formation (1)  
*any two points* (3)
- (b) (i)  $2\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2$  (ignore state symbols) (1) (1)  
(ii) to allow enzymes to diffuse out (1) (1)  
(iii) 20-40: normal increase of reaction rate due to more  
effective collisions (1)  
60-80: enzyme denatures (1) active site changes shape (1) (3)  
(iv) no/very little oxygen produced (1) (1)  
(v) use of fresh peas for each 'run' (1) might have different  
enzyme content (1) (2)
- (c) (i) a length of DNA strand (1) linked to a characteristic of  
the organism (1) (2)  
(ii) if bases are incorrect (1) codons changed (1) different  
amino acid inserted (1) (3)  
(iii) child has half its genes from each parent (1) affected parent  
may not pass on the faulty gene (1) (2)  
(iv) advantage: early warning of potential problem (1)  
treatment possible (1)  
can decide to abort (1)  
*any two* (2)  
disadvantage: worry about something which may not  
happen (1) difficulties over life insurance on mortgages (1)  
*any one* (1)

**TOTAL 30**