

Mark scheme January 2004

GCE

Biology A/ Human Biology

Unit BYA2

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Question 1

- (a) (i) sugar or phosphate / S-P / nucleotide chain/backbone / original/parent DNA; 1
- (ii) X thymine; Y guanine; Z adenine;
(Allow T, G and A) Reject: thiamine 3
- (b) here two chains constructed – in transcription only one /
base thymine would be used instead of uracil /
sugar would be deoxyribose instead of ribose /
produces DNA, not RNA /
both strands of DNA copied, not just sense strand /
uses different enzyme;
(Allow T,U) 1

Total 5 marks

Question 2

- (a) replication / duplication / doubling of chromosomes / replication of DNA /
transcription of DNA; 1
- (b) (i) cell to show correct number of chromosomes;
correct shape and position of centromere; 2
- (ii) as (i) except everything halved – *Ignore crossing over*;
(if mitosis and meiosis reversed, allow 1 if otherwise correct) 2
- (c) to replace cells; 1

Total 6 marks

Question 3

- (a) (i) A D C E B ; 1
- (ii) B / corpus luteum; 1
- (iii) stimulates growth of/maintains uterus lining/endometrium /
stimulates growth of blood vessels in uterus lining /
stimulates development of glands in uterus lining /
stimulates secretion of fluid in uterine lining /
stimulates invagination of uterine lining;
(Reject ref. repair/wall of uterus, Ignore contractions) 1
- (b) (i) day 12 / day 40; 1
- (ii) LH falls after peak / FSH and/or LH rise again in another cycle; 1

Total 5 marks

Question 4

- (a) (i) enzyme/lactase that is bound to surface / not allowed to dissolve in the reaction mixture; 1
- (ii) enzymes can be used again;
enzyme can be easily recovered;
product will not need to be purified/separated from enzyme / enzyme does not contaminate product;
thermostable/can tolerate high temperatures;
continuous process; max 2
- (b) (i) $113\text{--}115 \text{ dm}^3\text{hour}^{-1}$ at 15°C / $106\text{--}108 \text{ dm}^3\text{hour}^{-1}$ at 25°C ; 1
- (ii) $\frac{21.7 \text{ or } 21.8 - 17.5}{17.5} / \frac{4.2 \text{ or } 4.3}{17.5}$; 24.0 – 24.6;
(accept correct answer for 2, if readings incorrect but answer calculated correctly, allow 1) 2
- (iii) because another factor/temperature is limiting the process;
(Reject heat) 1
- (c) (i) because at higher temp. the flavour of milk might change / milk protein/enzyme may start to denature / costs more to heat milk / ref. souring/ref. bacterial action;
(Reject 'off'/spoiled unqualified) 1
- (ii) the reaction may not be complete / lactose not all broken down / maximises production of glucose; 1
- Total 9 marks
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Question 5

- (a) (i) mass produced increases then levels off at 17.1 kg m^{-2} / concentrations above 40 kg ha^{-1} ; 1
- (ii) replaces nutrients removed;
fertiliser provides nitrate needed for protein/amino acid production;
as more fertiliser added, there is more growth / protein/amino acid / yield; max 2
- (iii) plants already have enough nitrate / nitrate no longer limiting;
another named factor/element is limiting growth; 2
- (b) because cattle excreted / produced faeces/droppings/cowpats/manure;
in field B crop used elements/minerals/nitrates/nutrients last year; 2
- (c) (If no comparison made, assume candidate means 'compared with organic')
- advantages: easy to handle/apply/transport/store;
known chemical content / can supply specific needs;
easy to control mass that is added / less mass needed;
releases ions/nutrients quickly / soluble; max 2
- disadvantages: expensive / leads to eutrophication /
environmentally damaging /
uses resources to make it /
does not add to soil structure /
lacks some nutrients; 1
- (Accept converse if clearly identified)

Total 10 marks

Question 6

- (a) greenflies take in (small mass of) insecticide from roses/leaves;
ladybirds eat large numbers of/more/many greenflies;
bioaccumulation idea / insecticide cannot be excreted/remains in body/stored in fat/
not broken down; 3
- (b) (i) chemical: numbers fluctuate throughout year;
biological: numbers fairly constant throughout year / accurate description; 2
- (ii) number of plants drops because of spraying/reapplication, then rises because
insecticide washed away/new plants grow; 1
- (c) (i) chemical: some plants/parts of plants are not sprayed / spray washes off before
it has effect;
plant may be resistant to spray; (*Reject 'immune'*) 2
- (ii) biological: because biological control never eats all plants;
as weeds diminish so do control agents and/or *vice versa* / is balance between
food and consumer; 2

Total 10 marks

Question 7

- (a) (i) contains genes/nucleotides/sections of DNA/artificial DNA from two species/2 types of organisms; 1
- (ii) carries gene/DNA (into the other organism /gene carrier); 1
- (iii) expose cells to the fungus;
non-resistant ones die, resistant ones survive;
OR identify by adding marker gene/gene probe/(qualified) marker probe;
description of positive result e.g. radioactivity/fluorescence /
complementary base pairing; 2
- (b) EITHER 1 cut desired gene (from DNA) of oat plant;
2 using restriction endonuclease/restriction enzyme;
OR 1 use mRNA from oat which will code for resistance;
2 and use reverse transcriptase to form desired DNA;
OR 1 make artificial DNA with correct sequence of bases;
2 using DNA polymerase;

3 cut plasmid open;
4 with (same) restriction endonuclease/restriction enzyme;
5 ref. sticky ends/unpaired bases attached;
6 use (DNA) ligase to join / ref. ligation;
7 return plasmid to (bacterial) cells;
8 use of Ca^{2+} /calcium salts/electric shock;
(if ref. to 'insulin' allow 5 max.) max 6
- (c) (i) light intensity; 1
- (ii) as light (intensity) increases, so does the rate of photosynthesis; 1
- (iii) X marked somewhere on horizontal of lowest or middle line; 1
- (iv) higher CO_2 level shows higher rate of photosynthesis; 1
- (d) add manure/compost/decaying organic material / combustion / CO_2 cylinders; 1

Total 15 marks

Question 8

- (a) only small amounts obtained;
PCR increases the amount/mass of DNA;
so enough DNA available for genetic fingerprinting; max 2
- (b) (i) to separate the two strands of the DNA / to break the hydrogen bonds;
(Reject “*unzip*”) 1
- (ii) short lengths/fragments of DNA/nucleotides/single stranded DNA; 1
- (iii) to mark beginning and/or ends of the part of DNA needed / for attachment
of enzymes or nucleotides / initiator / keeps strands apart; 1
- (iv) would not be denatured;
must be heated to 95°C / must withstand high temps; 2
- c) 1 DNA extracted from sample;
2 DNA cut/hydrolysed into segments using restriction endonucleases;
3 must leave minisatellites/required core sequences intact;
4 DNA fragments separated using electrophoresis;
5 detail of process e.g. mixture put into wells on gel and electric current passed through;
6 immerse gel in alkaline solution / two strands of DNA separated;
7 Southern blotting / cover with nylon/absorbent paper (to absorb DNA);
8 DNA fixed to nylon/membrane using uv light
9 radioactive marker/probe added (which is picked up by required fragments) /
complementary to minisatellites;
10 (areas with probe) identified using X-ray film/autoradiography; max 6
- (d) adult 3;
this is only one which, (with number 1), can provide (all) the DNA fragments which
children have / all bars match; 2
(Reject ‘*genes*’)

Total 15 marks