Rewarding Learning

ADVANCED
General Certificate of Education
2011

Biology

Assessment Unit A2 2

assessing

Biochemistry, Genetics and Evolutionary Trends

[AB221]

THURSDAY 26 MAY, AFTERNOON

MARK SCHEME

/ denotes alternative points
; denotes separate points
Comments on mark values are given in bold
Comments on marking points are given in italics

Section A

1 **(a)** 1 = ectoderm;
2 = endoderm;
3 = mesoderm; [3]

(b) B;
triploblastic organism with no coelom (acoelomate) [*both terms required*]; [2]

(c) A; [1]

(d) C; [1] 7

2 **(a)** **(i)** It requires products (NADPH and ATP) from the light-dependent reaction/does not require direct light for reactions to take place; [1]

(ii) Stroma of (chloroplast); [1]

(iii) In the darkness NADPH and ATP are no longer made;
glycerate phosphate not converted to triose phosphate;
triose phosphate used up as converted to RuP/glucose/starch/other carbohydrate/protein/lipid;
[*must be NADPH – not confused with NADH*] [3]

(b) Action spectrum shows the rate of photosynthesis across the range of wavelengths; [1]

(c) **Any four from**

- use red and blue filters to provide red and blue light respectively
- measure length/volume of oxygen bubble (using Audus apparatus)
- over a defined period of time
- calibration of scale using syringe/bore diameter
- hydrogen carbonate solution supplies CO_2 (ensures CO_2 not limiting)
- water bath to maintain temperature/method of controlling light intensity
- replication (at least 3 times) to improve reliability/allow statistical analysis

[4] 10

3 **(a)** **(i)** Glycolysis; [1]

(ii) Carbon dioxide; [1]

(iii) Cristae (inner mitochondrial membrane); [1]

(iv) **Any four from**
- hydrogen enters ETC/carried by NADH/$FADH_2$
- hydrogen atoms passed initially, with electrons passing along thereafter
- one carrier is oxidised as hydrogen/electron is removed so that the next carrier is reduced
- carriers at successively lower energy levels
- sufficient energy available at certain stages to produce ATP/for oxidative phosphorylation
- 3 ATP produced from NADH and 2ATP from $FADH_2$

[*must be NADH – not confused with NADPH*] [4]

(b) Lipid/fat/oil/fatty acid;
aerobic and anaerobic; [2] 9

4 **(a)** t RNA; [1]

(b) **Any four from**
- (lysine) tRNA leaves the ribosome (so that P-site becomes vacant)
- ribosome moves along by one codon length
- so that the Thr-tRNA/ACC is now in the P-site
- UCG codon is available for translation /AGC tRNA enters/serine is brought in
- condensation/peptide bond forms between amino acids [4]

(c) More than one codon can code for a particular amino acid;
in diagram two combinations code for Phe (UUC and UUU); [2]

(d) **Any three from**
- base deletion is frameshift mutation/affects all subsequent codons/affects rest of genetic code
- therefore all amino acids affected after mutation point
- base substitution only affects one codon/one amino acid
- if third base substituted in code that is degenerate, e.g. Phe, no change to amino acid produced [3] 10

5 (a) (i) parental genotypes aaBb aaBb;
gametes aB ab aB ab;

	aB	ab
aB	aaBB	aaBb
ab	aaBb	aabb

;

offspring phenotypes: vestigial wing normal body 3
vestigial wing ebony body 1; [4]

(ii) Metaphase 1 (of meiosis); [1]

(b) (i) There is no significant difference between the observed and the expected offspring numbers/any difference between observed and expected results is due to chance; [1]

(ii)

Category	*O*	*E*	*(O – E)*	$(O - E)^2$	$\frac{(O-E)^2}{E}$
Normal body Normal winged	471	500	29	841	1.68
Normal body Vestigial wing	519	500	19	361	0.72
Ebony body Normal wing	479	500	21	441	0.88
Ebony body Vestigial wing	531	500 ;	31	961	1.92

$\chi^2 = 5.20$; [2]

(iii) 3 degrees of freedom;
0.5 > p > 0.1 **[consequent to part (ii) choice]**;
accept null hypothesis **[consequent to p value]**; [3]

(iv) The results of the cross are a good fit to a 1:1:1:1 ratio
(the expected results)/the alleles assort independently; [1]

(c) (i) $176 \div 1100 = q^2 = 0.16$;
therefore q = 0.4 therefore p = 0.6;
2pq = 2 × 0.24 = 48%: 48% of 1100 = 528; [3]

(ii) Large population/no migration; [1] 16

6 **(a)** **(i)** Paul receives a (recessive) allele from each parent/each parent must carry the recessive allele;
one of each set of grandparents is heterozygous/must carry the recessive allele; [2]

(ii) **Any three from**

- only affects cells that aerosol or liposomes make contact with/insufficient cells targeted/not all cells take the gene up
- short lived (as new cells continually produced)/treated cells die/treatment needs repeated
- not passed on to next generation/gene not replicated
- (use of virus) can cause lung infection
- (gene therapy) is associated with cancer/leukaemia
- possible disruptive effects on host DNA
- use of virus is associated with an allergic reaction [3]

(b) **Any two from**

- the use of microbial strains ill-adapted to human physiology (e.g. grow more slowly and so would be out-competed by normal strains, intolerant of human body temperature so that they will not multiply there)
- use of microbial strains that contain "suicide genes" (which are activated if conditions move outside certain pH or temperature limits)
- (legislation) where work on potentially dangerous GMs is restricted to purpose-built laboratories/is carried out by highly trained staff
- use of containment mechanisms (e.g. highly efficient air filters along with regular monitoring of the atmosphere in purpose-built laboratories)
- use of plants which do not produce viable pollen
- field tests to ascertain potential problems
- GM foods tested to ensure that there are no potential problems (e.g. that there might be allergens present)
- other appropriate response [2]

(c) **(i)** The complete nucleotide/base sequence of an organism's DNA (in a haploid set of chromosomes); [1]

(ii) A drug which matches a person's genetic profile/matches a patient so avoiding an adverse drug response/for which the dosage can be matched to the patient's metabolism/pharmacogenomics; [1] 9

7 **(a)** **(i)** No correlation between mean leaf length and soil nitrate level;
positive correlation between mean leaf width and soil nitrate level; [2]

(ii) Genetic;
leaf width was different in the experimental garden where nitrate levels were the same/experimental garden values mirror natural habitat where nitrate levels were different; [2]

(b) **(i)** **Any five from**

- Ballinderry and Marble Arch populations geographically isolated/populations restricted to damper sites/allopatric speciation may take place
- aided by poor seed dispersal
- little gene flow between populations
- leaf width has strong genetic component/gene (for leaf width) passed on
- (ancestral) population was genetically variable
- new alleles introduced by mutation
- differential/directional selection operate/allele frequency changes
- narrow leaf width favoured where there are low soil nitrate levels (as in Marble Arch)
- wide leaf width favoured where there are high soil nitrate levels (as in Ballinderry) [5]

(ii) Plants from two sites crossed;
if fertile offspring produced still same species/if not possibly different species; [2] 11

Section A **72**

Section B

8 (a) Any ten from

- in flowering plants the (diploid) sporophyte is the dominant stage/leafy plant
- the gametophyte is reduced to a short stage within the flower
- microspores are produced in the anther/develop into pollen grains
- by meiosis
- the pollen grain is the male gametophyte
- pollination by wind or insect (both required)
- pollen grains germinate on a (receptive) stigma
- the (pollen grain) nucleus divides by mitosis to produce the generative nucleus and the tube nucleus
- the (generative) nucleus divides again (by mitosis) to create two male gametes
- cell in the ovule (megasporangium) divides to produce the embryosac (megaspore)
- by meiosis (allow only once)
- the embryosac is the female gametophyte
- the embryosac undergoes (three) mitotic divisions that results in an egg nucleus and two polar nuclei (as well as five other 'redundant' nuclei which degenerate)
- double fertilisation
- one male nucleus (gamete) fertilises the egg (nucleus)
- the second male nucleus joins with the two polar nuclei to make a (triploid) endosperm [10]

(b) Any six from

- mosses have rhizoids (instead of true roots) that do not penetrate deeply into the soil
- fern gametophytes have rhizoids
- and are thus confined to moist places/ions and water absorbed directly into leaves
- in ferns/flowering plants the leaves have a waterproof cuticle
- can control opening and closing of their stomata
- possess well developed roots which can absorb water from (deeper in) the soil
- possess a (well developed) vascular system
- in mosses/ferns water is needed for the motile sperm cells to swim to the egg cells
- which means they are dependent on moist places for reproduction
- in flowering plants the male gametes are enclosed in a (waterproof) pollen grain/tube
- which can travel in air to the female egg cell, thus making them more independent of water [6]

Quality of written communication:

2 marks:	The candidate expresses ideas clearly and fluently through well-linked sentences, which present relationships and not merely list features. Points are generally relevant and well-structured. There are few errors of grammar, punctuation and spelling.	
1 mark	The candidate expresses ideas clearly, if not always fluently. The account may stray from the point or may not indicate relationships. There are some errors of grammar, punctuation and spelling.	
0 marks	The candidate produces an account that is of doubtful relevance or obscurely presented with little evidence of linking ideas. Errors in grammar, punctuation and spelling are sufficiently intrusive to disrupt the understanding of the account. [2]	18
	Section B	**18**
	Total	**90**