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**BIOLOGY**

**9700/04**

Paper 4 A Level Structured Questions

**For Examination from 2016**

SPECIMEN MARK SCHEME

**2 hours**

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**MAXIMUM MARK: 100**

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This document consists of **10** printed pages.

Mark scheme abbreviations:

;	separates marking points
/	alternative answers for the same point
<b>R</b>	reject
<b>A</b>	accept (for answers correctly cued by the question, or by extra guidance)
<b>AW</b>	alternative wording (where responses vary more than usual)
<b><u>underline</u></b>	actual word given must be used by candidate (grammatical variants excepted)
<b>max</b>	maximum number of marks that can be given
<b>ora</b>	or reverse argument
<b>mp</b>	marking point (with relevant number)
<b>ecf</b>	error carried forward
<b>I</b>	ignore
<b>AVP</b>	alternative valid point (examples given as guidance)

Numbers against mark points are for examiner reference only; they do not reflect relative importance of answers or a required sequence of answers.

- 1 (a) *corals*  
(cells) have no chloroplasts ;  
(cells) have no, cell walls / large vacuoles ;  
are heterotrophic / not autotrophic / not photosynthetic ; [max 2]
- (b) biotic and abiotic components or living and non-living components ; correct ref. to interaction ; [2]
- (c) (i) Indian Ocean = 22(%)  
Pacific Ocean = 9(%) ;  
*both correct for 1 mark* [1]
- (ii) 1. named marine pollutant ; e.g. oil / sewage  
2. example of climate change ; e.g. sea level rising / change in sea temperature / decrease in oxygen concentration of sea  
3. (increasing carbon dioxide) decrease in pH of sea ;  
4. intensive fishing ;  
5. tourism qualified ;  
6. removal of parts of reef ;  
7. reclaiming land ; [max 3]

[Total:8]

- 2 (a) (i) substrate level ;  
protein synthesis / DNA replication / glycogenesis / polymerisation ;  
active transport / movement of chromosomes / sliding filaments / movement of vesicles /  
AW ; [3]
- (ii) water ; [1]
- (iii) ATP, synthase / synthetase ; **R** ATPase [1]
- (b) (i) (converted to) glycogen / lipid ;  
(used in) glycolysis / respiration ; [max 1]
- (ii) *anaerobic*  
less ATP / only 2 ATP ;  
per mol glucose ;  
lactate still contains energy / only glycolysis involved  
/ stages other than glycolysis not involved ;  
not sustainable / cannot go on indefinitely / AW ; [max 2]
- (iii)
- | process                   | precise location                         |
|---------------------------|--|
| glycolysis                | cytoplasm / cytosol ;                    |
| link reaction             | mitochondrial matrix ;                   |
| Krebs cycle               | mitochondrial matrix ;                   |
| oxidative phosphorylation | inner mitochondrial membrane / cristae ; |
- [4]
- (iv) cannot pass through phospholipid bilayer ;  
too big to fit through (glucose's) protein channel ;  
no specific transport protein ;  
AVP ; e.g. used up as soon as it is made [max 2]
- (v) oxygen debt ; [1]

[Total: 15]

- 3 (a) (i) 17.9 ;;  
accept  $\frac{125}{700} (\times 100)$  or 17.8 for one mark [2]
- (ii) *fluid can pass through glomerular capillaries because fenestrations in capillary endothelium ; A hole / pores / gaps basement membrane acts as a filter ; no substances > 68 000 MM can get through ; no cells can get through ;* [max 2]
- (b) produce ATP / provide energy ;  
for active transport of Na<sup>+</sup> ;  
out (of cell) ; [max 2]
- (c) *mark first two answers*  
any named ion / mineral ions ;  
vitamins ;  
amino acids ;  
glucose ;  
some urea ; [max 2]
- [Total: 8]

- 4 (a) (guard cell) thicker inner / unevenly thickened, cell wall ; ora  
ref. to differences in, size / shape ; [max 1]
- (b) (i) (receptors) on plasma / cell surface, membrane (of guard cells) ; [1]  
(ii)  $K^+$  / potassium ; [1]  
(iii) (guard cell has) higher water potential than epidermal cell ; ora [1]  
(iv) decrease ; [1]
- (c) (i) provides carbon dioxide ; [1]  
(ii) 0.1 ;  
% per minute ; **R plural** [2]  
(iii) 0–10 min / initially, rate for **B** is faster than rate for **A** ;  
10–20 min / AW, rate decreases for **B** and not for **A** / rate decreases more for **B** ;  
paired figs ; **A & B % at same time (minutes)** [max 2]  
(iv) no, photosynthesis / light dependent reaction ;  
oxygen used up in respiration ; [2]  
(v) temperature ; [1]
- (d) **X** = reduced NADP ;  
**Y** = ATP ; [2]
- [Total: 15]

- 5 (a) *heterozygous*  
two different alleles of a gene / different allele pair for a gene / AW ;  
produces gametes with different genotypes ; (*max 1*)
- genotype*  
alleles present in an organism / particular alleles of a gene / genetic constitution / AW ;  
[max 2]

- (b) *parental genotypes*  
**AaDd × AaDd** ;
- gametes*  
**AD Ad aD ad × AD Ad aD ad** ;
- two marks for correct Punnett square ;; *deduct one mark for each mistake*  
(all 4) phenotypes linked correctly to genotypes ;  
(probability of yellow offspring) 3 out of 16 **or** 0.19 **or** 19% ; [6]

[Total: 8]

6 (a) *any five from:*

1. allopatric speciation ;
2. fish populations isolated ;
3. geographical / physical / land, barrier ;
4. no, breeding / allele flow / gene flow, between populations ;
5. mutations occur ;
6. different selection pressures / different (environmental) conditions ;
7. advantageous alleles selected for / advantageous alleles passed on ;
8. change in, allele frequency / gene pool ;
9. (can result in) different chromosome numbers ;
10. genetic drift ;
11. ultimately, reproductively isolated / cannot interbreed ;

[max 5]

(b) *any three from:*

1. numbers of all species increase initially ;
2. due to more, breeding space / food ;
3. competition between (four) species ;
4. (possible) reduction in numbers within, some / all, species ;
5. not all species (may) survive ;
6. different species, restricted to different areas / occupy different niches ;
7. interbreeding / hybridisation ;
8. AVP ; e.g. ref. new selection pressure

[max 3]

[Total: 8]

7 (a) *any five from:*

1. (touching hairs causes), action potential / depolarisation ;
2. auxin increase triggered in hinge cells ;
3. H<sup>+</sup> / hydrogen ions, pumped into cell walls ;
4. calcium pectate 'glue' in cell wall dissolved ;
5. Ca<sup>2+</sup> ions enter hinge cell ;
6. water follows by osmosis ;
7. hinge / midrib, cells expand ;
8. trap lobes, flip from convex to concave / change in elastic tension ;

[max. 5]

(b) (i) random sampling using frame quadrats ;

[1]

(ii) Simpson's index of diversity ;

[1]

(iii) Spearman's rank correlation coefficient ;

[1]

[Total: 8]

- 8 (a) (i) general description of the trend ;  
 steepest / fastest, increase between 1996 and 1999 ;  
 comparative data quote either for Bt cotton or HT cotton ;  
 e.g. Bt cotton increased from 16% (in 1996) to 75% in 2013  
**or**  
 HT cotton increased from 2% (in 1996) to 82% in 2013  
 ref. most cotton is modified to be both Bt and HT ; [max 3]
- (ii) *Agrobacterium tumefaciens* / Ti plasmid / pGreen plasmid ; [1]
- (iii) to check whether gene transfer was successful ;  
 to see which parts of plant expressed new genes ;  
 GUS marker easy to, use / track / see (compared to antibiotic resistance markers) ; [max 2]
- (b) (i) number (of glyphosate-resistant weed species) only increased after 1995 / 1996 ;  
 this was when, GM crops resistant to herbicide / HT crops, were introduced ; [2]
- (ii) no triazine-resistance genes existed in crops but weeds developed triazine resistance ;  
 idea that triazine resistance in weeds pre-dates, gene technology / genetic modification ; [max 1]
- (iii) spontaneous / random, mutation ;  
 weeds without, allele / mutation, die ; ora  
 when / so long as, (named) herbicide (still) applied ;  
 new allele / mutation, selected for / gives selective advantage ; ora  
 survivors, breed / reproduce / pass on, allele / mutation ; ora  
 frequency of, new allele / mutation, increases ; [max 4]
- (c) *any suitable suggestions, such as:*
1. the damage done by the insect pests surveyed ;
  2. the number of reports of resistance for each species ;
  3. the proportion of populations with the highest percentage of resistant individuals ;
  4. the effect on the crops concerned of pest resistance at the levels given (<1%, etc.) ;  
 e.g. the losses in yield
  5. the geographical spread of the insect pest species that show resistance ;
  6. AVP ;
  7. AVP ; [max 2]

[Total: 15]

- 9 (a)
1. glucagon binds to receptors in cell surface membrane (of liver cell) ;
  2. receptor changes conformation ;
  3. G-protein activated ;
  4. adenylate cyclase activated ;
  5. ATP converted to cyclic AMP / cyclic AMP made ;
  6. (cyclic AMP is) second messenger ;
  7. (cyclic AMP) activates kinase protein ;
  8. ref. enzyme cascade ;
  9. ref. phosphorylase enzyme(s) / glycogen phosphorylase ;
  10. glycogen broken to glucose ;
  11. glucose, diffuses / passes out, of (liver) cell (into the blood) ;
  12. through GLUT2 transporter proteins ;
  13. AVP ; e.g. ref. to stimulating gluconeogenesis

[max 9]

**(b) method**

1. stick dipped into urine ;
2. glucose oxidase (on stick) reacts with glucose (in urine) ;
3. forms gluconolactone ;
4. and hydrogen peroxide ;
5. (hydrogen peroxide) reacts with chromogen (on stick) ;
6. catalysed by peroxidase enzyme ;
7. colour produced matched against chart ; (*max 4*)

*advantages*

8. electronic biosensor does not involve colour matching ; ora  
**A** ref to subjectivity of results from dip sticks
9. gives a specific reading, not a range of values (if not an exact match to a colour) ; ora
10. biosensor gives a digital reading so no need to interpret a colour chart ;
11. biosensor can be re-used again ; ora (*max 3*)

[max 6]

[Total: 15]

- 10 (a)**
1. regulatory gene codes for repressor protein ;
  2. (repressor protein) binds to operator region ;
  3. (repressor protein) blocks promoter region ;
  4. lactose binds to repressor protein which changes shape ;
  5. (repressor protein with bound lactose) breaks away from operator region ;
  6. promoter region now unblocked, so RNA polymerase binds to promoter region ;
  7. structural genes transcribed ;
  8. and translated ;
  9. enzymes formed ;
  10. ref. lactose permease and uptake of lactose from medium ;
  11. ref.  $\beta$ -galactosidase and breakdown of lactose ;
  12. into, glucose / galactose ;
- [max 9]

- (b)**
1. DELLA proteins inhibit germination ;
  2. seed absorbs water ;
  3. stimulates production of gibberellin ;
  4. by embryo ;
  5. gibberellin causes breakdown of DELLA proteins ;
  6. leads to transcription of mRNA coding for amylase ;
  7. in aleurone layer ;
  8. (amylase) hydrolyses starch to maltose ;
  9. ref. maltose converted to glucose ;
  10. glucose respired by embryo during germination ;
- [max 6]

[Total: 15]