

Cambridge  
International  
AS & A Level

**Cambridge International Examinations**  
Cambridge International Advanced Subsidiary and Advanced Level

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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
R	reject
A	accept (for answers correctly cued by the question, or by extra guidance)
AW	alternative wording (where responses vary more than usual)
<u>underline</u>	actual word given must be used by candidate (grammatical variants excepted)
max	maximum number of marks that can be given
ora	or reverse argument
mp	marking point (with relevant number)
ecf	error carried forward
I	ignore
AVP	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 ; [max 2]  
no cells can get through ;
- (b) produce ATP / provide energy ;  
for active transport of Na<sup>+</sup> ; [max 2]  
out (of cell) ;
- (c) mark first two answers  
any named ion / mineral ions ;  
vitamins ;  
amino acids ;  
glucose ; [max 2]  
some urea ;
- [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

- 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

- 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]