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BIOLOGY **9700/42**

Paper 4 A Level Structured Questions **May/June 2016**

MARK SCHEME

Maximum Mark: 100

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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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)
underline	actual word given must be used by candidate (grammatical variants accepted)
max	indicates the maximum number of marks that can be given
ora	or reverse argument
mp	marking point (with relevant number)
ecf	error carried forward
I	ignore

1 (a) (i) three phosphates ;
ribose / pentose ;
adenine ; **I** nitrogenous base [max 2]

(ii) combines with, acetyl group / acetate ;
ref. to link reaction ;
(delivers, acetyl group / acetate) to the Krebs cycle ;
(acetyl group / acetate) combines with oxaloacetate ;
R Acetyl CoA combines with oxaloacetate [max 3]

(b) (i) muscle / liver ; [1]

(ii) facilitated diffusion ; [1]

(iii) **F** – condensation / polymerisation / anabolic / glycogenesis / dephosphorylation ;
G – hydrolysis / catabolic / glycogenolysis / phosphorylation ; [2]

(iv) glycolysis / respiration / lipid synthesis ; [1]

[Total: 10]

2 (a) *describe*
1 increased temperature increases the rate of photosynthesis at high light intensities ;
2 increased temperature has little effect at low light intensity ;

explain
3 increased kinetic energy ;
4 (leads to) increased, no. of collisions / (rate of) enzyme activity / ESCs / enzyme-subtrate complexes ;
5 (high light intensity) temperature is the limiting factor ;
6 (low light intensity) light intensity is the limiting factor ; [4 max]

(b) (i) *absorption spectrum*
shows the, absorbance / absorption, of different wavelengths
(of light by chloroplast pigments) ;

action spectrum
shows the rate of photosynthesis at different wavelengths (of light) ; [2]

(ii) *idea that* light / energy, (absorbed by the pigments) is used in photosynthesis ;
idea that greater rate of photosynthesis at wavelengths that are absorbed most ;
ora [2]

(c) passes energy to, chlorophyll a / primary pigment / reaction centre ;
may absorb light wavelengths that, chlorophyll a / primary pigment / reaction centre, does not absorb ;
forms part of, light-harvesting cluster of pigments / photosystem / antenna complex ;
[max 2]

[Total: 10]

3 (a) *explain (max 3)*
1 cuts DNA at specific, site / base sequence **;**
2 detail of cut **;** e.g. palindromic or blunt / sticky, ends or staggered cut
3 enzyme derived from, bacteria / prokaryotes **;**
4 *ref. to* destroys viral DNA in bacteria **;**

suggest
5 only X chromosome has the I-PpoI, restriction / recognition, site **;** ora
6 X and Y chromosomes are different in, size / shape / base sequence **;** [max 4]

(b) as a marker **;**
to identify the GM mosquitoes
or
to see which, cells / mosquitoes, have the gene (for I-PpoI) **;**
transformed cells / GM mosquitoes, glow / fluoresce **; R** gene glows [max 2]

(c) zygotes contain an X chromosome **;**
from female **;**
X chromosome (in zygote) destroyed (by I-PpoI) **;**
(so) zygote will, die / not develop **;** [max 2]

(d) (i) *describe*
1 generally more females in **A** than in **B ;**
2 numbers of females, remain high / oscillate, in **A** but fall in **B ;**

suggest (max2)
3 in **A** GM males have no effect on the number of females **;**
4 in **A** all offspring were from non-GM males
or
all offspring from GM males die **;**
5 in **B**, no female offspring from GM males **;**
6 because GM males cannot produce a sperm carrying an X chromosome **;** [max 3]

(ii) *idea that* large numbers of GM males needed to affect the wild population **;**
inflow of non-GM mosquitoes from other areas **;**
GM males might not survive in the wild / AW **;**
people not prepared to accept the release of (GM) mosquitoes **;** [max 2]

[Total:13]

4 (a) 1 *ref. to* humans (select) **;**
2 cross / breed, plants with desirable characteristic **;**
3 named desirable characteristic **;** e.g. bigger ears / more grains per ear / bigger grains / higher yield / fast-growing / tolerance to high temperature / disease-resistant / pest-resistant
4 over several generations **;**
5 (only) using offspring with desirable characteristic(s) **;**
6 frequency of desirable allele(s) increases **;**
7 AVP **;** e.g. polyploidy / hybridisation of ancestor grasses [max 4]

(b) range of, phenotypes / heights **;** AW
normal distribution **;** **A** described or drawn
polygenic / genes or alleles have an additive effect **;**
environment has an effect **;**
named environmental factor **;** e.g. nutrients / light intensity / (soil) water availability / soil pH / soil mineral availability / disease or pest attack / temperature / wind [max 3]

(c) *description*
1 as area increases number of resistant weed species increases / positive correlation **;**
2 figure quote **;** (year, area with units and number of resistant weed species)
3 later figure quote **;** (later year, area with units and number of resistant weed species)

explanation
4 mutations in weed (species) **;**
5 chance / random / spontaneous (mutations) **;**
6 *idea that* resistant weeds have selective advantage **;** [max 4]

(d) *social*
increased yield / more food / cheaper food **;**

environmental
glyphosate, less hazardous than other weed killers / breaks down in soil
or
less fertiliser used (because weed competition reduced) **;** [2]

[Total: 13]

5 **(a)** **1** mark-release-recapture **;** AW
2 detail of trapping **;** e.g. live mammal trap
bait with, food / chocolate / peanut butter
3 detail of marking **;** e.g. paint / clipping fur / not to have adverse effects
4 time of second trapping detail **;** e.g. not too soon or mixing won't occur / not too long after as migration may occur
5 detail of calculation **;** e.g. Lincoln / Petersen, index
or
population size = $\frac{\text{number caught / marked, time 1 x no. captured time 2}}{\text{number of marked individuals recaptured time 2}}$
6 public reports **;** e.g. online site / use of reporting app
7 detail of reporting, time frame / areas **;** e.g. raccoon spotting week
8 detail of calculating numbers per unit area / use of computer modelling ; [max 3]

(b) **(i)** Eukarya **;** **A** Eukaryota **R** eukaryotes [1]

(ii) **1** (cells) have a nucleus **;**
2 (cells) contain membrane-bound organelles **;** **A** mitochondria / ER / golgi
3 ribosomes are, large / 22 nm / 80S **;**
4 DNA is linear **;**
5 histones present **;**
6 *ref. to* cytoskeleton / microtubules / undulipodia / cilia **;** [max 3]

(c) *max 2 for mp1–4*
1 may compete with other species for, food / habitat **;**
2 may be predators of other species **;**
3 may spread disease to other species **;**
4 may reduce population sizes / cause extinction of other species **;**
5 may spread, disease / rabies, to humans **;**
6 may bite humans **;** [max 3]

[Total: 10]

6 **(a)** codominance **;**
sex linkage **;** [2]

(b) (male) $\mathbf{C^BC^BZ^aZ^a}$ **;** x (female) $\mathbf{C^SC^SWZ^A}$ **;**

(gametes) $\mathbf{C^BZ^a}$ $\mathbf{C^SZ^A}$ **or** $\mathbf{C^SW}$ **;**

$\mathbf{C^BC^SZ^AZ^a}$ **;** (male, blue, barred)

$\mathbf{C^BC^SWZ^a}$ **;** (female, blue, non-barred)

accept other symbols but only with key [5]

(c) blue colour is, heterozygous / $\mathbf{C^BC^S}$ **;**
test cross *;*
with non-barred female **;**
if all offspring barred, must be $\mathbf{Z^AZ^A}$ / homozygous **;**
if offspring not all barred, must be $\mathbf{Z^AZ^a}$ / heterozygous **;** [max 3]

[Total: 10]

7 **(a)** deamination / amine group removed **; A** amino / NH_2
ammonia / NH_3, formed **;**
combined with carbon dioxide **;**
urea cycle **; A** ornithine cycle [max 3]

(b) **1** (diameter of lumen of) afferent arteriole wider than efferent arteriole **;**
2 (leads to) high, blood / hydrostatic, pressure **;**
3 plasma / fluid, passes through, gaps / fenestrations, between endothelial cells (of capillaries) **;**
4 *ref. to* basement membrane acts as a, filter / selective barrier **;**
5 red cells / large proteins / molecules greater than 68 000(MM), cannot pass through **;**
6 podocytes qualified **;**
7 (filtrate) passes into (renal) capsule **;** [max 4]

(c) *(passes through the medulla)* collecting duct / loop of Henle ;
(glucose is reabsorbed into the blood) proximal convoluted tubule / PCT ;
(ADH acts on its walls) collecting duct / distal convoluted tubule / DCT ;
(most of the water is reabsorbed into the blood) proximal convoluted tubule / PCT ; [max 4]

[Total: 11]

8 (a) **X** – label line to an invagination of the membrane ;
Y – label line to post-synaptic membrane ;
Z – label line to synaptic cleft ; [3]

(b) acts as a competitive inhibitor ;
complementary (shape) to active site ;
binds with / blocks, active site ;
ACh not, broken down / hydrolysed ; [max 3]

(c) ensure one-way transmission ;
allow interconnection of nerve pathways / AW ;
involved in, memory / learning ;
idea of filtering out, less frequent impulses / low level stimuli / AW ; [max 2]

[Total: 8]

9 (a) **1** lysis / splitting / break down, of glucose ; **R** sugar splitting
2 (glucose) phosphorylated by ATP ;
3 raises energy level / to activate the reaction / reduces activation energy / to make it reactive ;
4 fructose (1,6) bisphosphate ;
5 (breaks down to) two, triose phosphate / TP ;
6 hydrogen removed by NAD ; **A** triose phosphate oxidised by NAD
7 reduced NAD formed ;
8 pyruvate produced ;
9 small yield of ATP ; [max 6]

(b) **1** oxaloacetate accepts, acetate / acetyl group / 2C fragment ;
2 to form citrate ;
3 4C to 6C ;
4 decarboxylation ;
5 CO_2 released ;
6 dehydrogenation / oxidation ;
7 reduced NAD produced ;
8 reduced FAD produced ;
9 ATP produced ;
10 substrate-linked / substrate-level, phosphorylation ;
11 *ref. to* intermediate compounds ;
12 enzyme-catalysed reactions ;
13 oxaloacetate regenerated ; [max 9]

[Total: 15]

10 (a) **1** chiasma / crossing over **;**
2 between *non*-sister *chromatids* **;**
3 of, homologous chromosomes / bivalent **;**
4 in prophase 1 **;**
5 exchange of, genetic material / DNA **; R** genes unqualified
6 linkage groups broken **;**
7 new combination of alleles **;**
8 random / independent, assortment of, homologous chromosomes / bivalents (at equator) **;**
9 (during) metaphase 1 **;**
10 random / independent, assortment (of, sister chromatids / chromosomes) at metaphase 2 **;**
11 possible chromosome mutation **;**
12 random mating **;**
13 random, fusion / fertilisation, of gametes **;** [max 8]

(b) **1** *ref. to* regulatory gene **;**
2 codes for repressor protein **;**
3 (repressor protein) binds to operator **;**

In presence of lactose
4 lactose binds to repressor protein **; A** allolactose
5 (repressor protein) changes shape **;**
6 (repressor protein), moves away from / no longer binds to, operator **;**

In absence of lactose
7 repressor protein blocks promoter **or** promoter region now unblocked **;**
8 RNA polymerase cannot bind to promoter **or** RNA polymerase can now bind to promoter **;**
9 (named) gene cannot be transcribed / mRNA not synthesised **or** (named) gene now, transcribed / 'switched on' **;**
10 enzymes / named enzyme, cannot be synthesised **or** enzymes / named enzyme, can now be synthesised **;** [max 7]

[Total: 15]