Cambridge International Examinations
Cambridge Pre-U Certificate

BIOLOGY **9790/01**

Paper 1 Structured **May/June 2017**

MARK SCHEME

Maximum Mark: 100

Published

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Question	Answer	Marks
1	D ;	**1**

Question	Answer	Marks
2	B ;	**1**

Question	Answer	Marks
3	A ;	**1**

Question	Answer	Marks
4	C ;	**1**

Question	Answer	Marks
5	C ;	**1**

Question	Answer	Marks
6	C ;	**1**

Question	Answer	Marks
7	C ;	**1**

Question	Answer	Marks
8	B ;	**1**

Question	Answer	Marks
9	B ;	**1**

Question	Answer	Marks
10	C ;	**1**

Question	Answer	Marks
11	D ;	**1**

Question	Answer	Marks
12	A ;	**1**

Question	Answer	Marks
13	C ;	**1**

Question	Answer	Marks
14	B ;	**1**

Question	Answer	Marks
15	B ;	**1**

Question	Answer	Marks
16	A ;	**1**

Question	Answer	Marks
17	phosphofructokinase **;** *treat as neutral PFK*	**1**

Question	Answer	Marks
18	DELLA (protein) **;**	**1**

Question	Answer	Marks
19	troponin **;**	**1**

Question	Answer	Marks
20	FSH / follicle stimulating hormone **;**	**1**

Question	Answer	Marks
21(a)	*any two from:* maintenance of / AW, a, constant / stable, environment / AW **;** *allow the following in context of above point* internal / cellular **;** qualified **;** e.g. within limits resulting from dynamic equilibrium in face of (internal and external) fluctuations using negative feedback mechanisms **I** described examples	**2**

Question	Answer	Marks
21(b)(i)	cortex **;**	**1**
21(b)(ii)	glomerulus **;**	**1**
21(b)(iii)	*max three for description of differences* *allow blood entering / in blood vessel entering / in afferent arteriole* *check for ora if written from point of view of blood leaving* *in afferent / blood entering* **D** higher pressure **;** **D** higher / larger, volume **;** **A** high vs low **E** (because) larger diameter of afferent arteriole (v smaller diameter of efferent arteriole) **;** AW **A** wider / larger, lumen **A** wider afferent / narrower efferent, arteriole *in afferent / blood entering* **D** lower proportion of, (red blood) cells / plasma proteins, (per unit volume of, plasma / blood) **;** AW **D** more / AW, water / glucose / urea / amino acids / named (mineral) ions **;;** **I** nutrients **I** minerals **A** dissolved solutes *if no named substances* *allow one mark only if not comparative (blood entering v blood leaving)* *max 1 if blood cells or plasma proteins are included* *(changes in component composition because)* **E** ultrafiltration / formation of glomerular filtrate, (will occur) **;** **A** description of ultrafiltration **R** if stated as diffusion AVP **;** e.g. higher <u>hydrostatic</u> pressure, higher <u>water potential</u>	**4**

Question	Answer	Marks
22(a)	*phenotypic variation in leaf dimension to max 4* **I** statements suggesting that variation in leaf dimension is, all / mostly, caused by, environmental / genetic, variation *Investigation 1:* *evidence for environmental contribution* *environmental contribution* **a** ref. link between patterns of, leaf dimensions / phenotypes, and different, geographic locations / habitats / environmental conditions **;** AW *comment about genetic contribution* **b** variation could be due to different, habitats / environments / geographic location, subjected to, different selection pressures / described **;** *evidence for genetic contribution* *Investigation 2 / 3:* **c** (plants grown under same conditions so that) no environmental variation (contributing to results) **;** **d** (no environmental variation but) genetic variation evident / if no genetic contribution then leaf dimensions would be the same / AW **;** **I** *idea that* phenotypic variation is, only / mostly, genetic variation **e** comparative data to support from, Investigation 3 / Table 22.1 **;** *Investigation 2 only:* **f** *idea that* dimensions still resemble original population despite being grown in conditions that are not the same as the original environment **or** dimensions still resemble original population despite being grown under uniform conditions **;**	**5**

Question	Answer	Marks
22(a)	*continuous variation* **g** range of / AW, colours / phenotypes **;** **A** described **h** overlaps in colours / not discrete groups **;** **A** (only) very small differences **i** detail **;** e.g. copper tinge can appear on an olive green leaf and on a clear green leaf ref. to different shades of green / some greens with different tinges **j** idea that, many / 7, different phenotypes (likely to be) due to many genes / polygenic, which is characteristic of continuous variation **;** **I** multiple alleles	
22(b)	*any three from:* ref. to, avoiding problems with inbreeding / heterozygosity maintaining fitness / AW **;** **A** described examples ref. to enables wide geographic range of species **;** ref. to (evolutionary advantage and) ability to cope with environmental change **;** **A** described examples e.g. response to new grazers competition from new plant arrivals arrival of (new), pathogens / disease aesthetic benefits / described **;** e.g. horticultural benefits ref. to medicinal benefits, of different oils extracted / different (compositions of) honey (from different varieties) **;** **I** find new drugs AVP **;** e.g. benefits of presence of plant in more extreme environments	**3**
22(c)	Prokaryotae / Prokaryote **;**	**1**

Question	Answer	Marks
22(d)	*any two from:* (penicillin) causes, cell lysis / AW **;** **A** prevents, cross-links forming (between peptidoglycan) / cell wall formation (in growing bacteria) Gram-positive bacteria susceptible (to penicillin) **;** AW cell wall, only of murein / not complex / no lipopolysaccharide layer / thick murein (layer) **;**	**2**
22(e)	(net) movement of, particles / AW, from an area of high concentration to an area of low concentration / down the concentration gradient / AW **;** **A** if in terms of the honey solution **R** if stated only as movement of a gas **R** if movement through a membrane	**1**
22(f)	*any three from:* *allow zone of inhibition for diameter of zone of inhibition throughout* *look for ora* **a** zones of inhibition only for, 30% and above for strain **A** and 20% and above for strain **B ;** **b** honey not effective / bacteria not susceptible / AW, to lower concentrations **;** **c** for, strain **A** / strain **B** / both strains, increasing the concentration increases the zone of inhibition **;** **d** the higher the concentration, the more effective the honey at killing the bacteria **;** **A** inhibiting growth **e** the mean zone of inhibition for strain **B** always higher than for strain **A ;** **f** strain **B** more susceptible to the honey than strain **A ;** AW **g** as concentration increases, smaller difference in susceptibility **;**	**3**

Question	Answer	Marks
22(g)	*idea that* (after 7 days) no, growth of bacteria in zone of inhibition **;** e.g. no hazy areas no colonies zones of inhibition unchanged *treat as neutral decrease in size of zone of inhibition / growth at edge of zone, unqualified*	**1**
22(h)	*any four from:* **a** arise by (spontaneous) mutation / formation of new alleles **;** **b** coding for a protein (associated with resistance) **;** **A** enzyme **A** named example **c** ref. to unfinished courses of antibiotics, leaving reservoir of bacteria / allowing time for a mutation to occur in surviving bacteria **;** **d** ref. to genes coding for antibiotic resistance (often) occurring on plasmids **;** **e** horizontal transfer (to susceptible bacteria) / described **;** **A** lateral transfer **f** vertical transfer / binary fission / asexual reproduction **;** **g** antibiotic presence acts as a selection pressure **;** **A** situation described **h** AVP **;** e.g. ref. to plasmid transfer to other bacterial species other named mode of horizontal transfer only one, gene / allele, so always shown in phenotype	**4**

Question	Answer	Marks
23(a)(i)	*any one from:* viral vectors infect dividing cells **;** stem cells are dividing cells **;** replacement back into the body will lead to, healthy / non-defective, cells being produced **;** *idea that* stem cells can (divide to) form differentiated cells **;** **A** multipotent **I** pluripotent / totipotent **R** can become any cell	**1**
23(a)(ii)	*any one from:* injection **; A** perfusion **R** vaccination within liposomes **; A** description (inhalation of) aerosols / nebulisers **; A** inhalers	**1**
23(b)	(RNA-dependent) RNA polymerase **;**	**1**
23(c)	*any two from:* targeting host cells **;** **A** recognising target cells **I** recognising human cells binding to host cell **;** infection of (specific) host cells **;** AW e.g. allows entry into (host) cells	**2**
23(d)(i)	synthesise (single-stranded, viral) DNA from (viral) RNA **;** AW	**1**
23(d)(ii)	integration / incorporation, of viral genome into (host) cell genome / DNA **;** AW	**1**

Question	Answer	Marks
23(e)	*any two from:* to make (viral vectors) safe for gene therapy **;** **A** idea of potential risk **I** trigger an immune response *in context of an immune response if virus becomes pathogenic* *'virus could have harmful effects' is neutral* to prevent them from replicating / no viral components made within the host cell (for replication) **;** further detail *(in context of viral replication)* **;** e.g. no, structural proteins / subunits / capsomeres / capsid / protein coat made no (viral) envelope proteins made AVP **;** e.g. to create room to insert the, desired / therapeutic, genes *idea of* viral proteins, inserting into cell surface membrane and immune response / acting as foreign antigens	**2**
23(f)	*any three from:* ref. to more than one treatment required / (single) treatment short-lived **;** *idea that* not all (defective) cells targeted **;** **A** not all targeted cells take up, virus / viral genome / AW **A** viral vector does not have a wide range for host cell allergic response to, viral vector / delivery method **;** **A** immune response *idea that* integration of viral genome (into host genome) may not be precise **;** e.g. may integrate within a gene controlling cell division may, stop / affect, expression of a gene ref. to, tumour formation / cancer / leukaemia **;** AVP **;** chance of viral vector entering non-defective cell and affecting cell functioning	**3**

Question	Answer	Marks
23(g)	*any four from:* susceptible to infectious diseases / longer recovery time from infection **;** *because* *B lymphocytes* plasma cells / antibodies, not produced **or** antibodies over-expressed **;** **R** if T-cells producing antibodies *T lymphocytes* cytokine not produced (by T-helpers) / humoral response not stimulated / macrophage response reduced / fewer T killer cells **; A** T-killer cells do not destroy pathogens *platelets* inability for blood to clot / bleeding that does not stop / longer clotting time **; A** haemorrhaging *(blood clotting is difficult)* AVP **;** e.g. ref. to repeat infections e.g. poor / no, secondary immune response no / few, memory cells vaccinations not effective (to prevent disease) may have autoimmune effect may lead to cancerous growth	**4**

Question	Answer	Marks
23(h)	*any three from:* *accept faulty allele or faulty X chromosome* **a** more males with the syndrome / rare for females to have syndrome **;** **A** only males / no females **b** *idea that for syndrome* males only need one copy of faulty allele (as XY) / females need both copies of faulty allele (as XX) **;** **A** females with faulty X more likely to be carriers **c** no / rare to have, cases of fathers and sons with syndrome **;** **d** fathers cannot pass on faulty X chromosome to sons / males pass Y chromosome to sons / males only pass faulty X chromosome to daughters **;** **R** fathers pass on faulty X chromosome to daughter, who will have the syndrome *unless qualified with genotype of mother* **e** male with syndrome will have mother who, is a carrier / has faulty X chromosome **;** **f** ref. to syndrome not evident in every generation owing to (healthy) carrier mothers **;** *check genetic crosses to help confirm points – these must be supported by a key to symbols used*	**3**

Question	Answer	Marks
24(a)	bacteria and, eukarya / eukaryota / eukaryotes **;**	**1**
24(b)	flagellum **;** **A** flagella **A** cilium / cilia **A** undulipodium / undulipodia	**1**

Question	Answer	Marks
24(c)	*max three if no attempt to suggest how halorhodopsin allows H. salinarum to survive* *accept ψ for water potential* *non-halophile* **a** ref. to difference in <u>water potentials / water potential</u> gradient exists **;** **A** external solution lower water potential than cells **A** (water moves from) higher water potential to lower water potential **A** (water moves from) a less negative water potential to a more negative water potential **b** water would leave (non-halophile) by <u>osmosis</u> **;** **c** cell would shrink / AW **;** **d** example of role of water (that could not occur within cell) **;** e.g. interfere with metabolic reactions *H. salinarum* / halophile **e** pumping in chloride ions (plus entry of, sodium ions / potassium ions) will, decrease water potential / make water potential more negative **;** **A** will make solute potential more negative **f** equals water potential inside and outside the cell / AW **;** **g** explanation of movement in of cations **;** e.g. to balance charge	**4**
24(d)	*any one from:* damages DNA (which needs repairing) **;** increases mutation rate **; A** causes mutation	**1**
24(e)(i)	phototaxis / phototactic response **;**	**1**

Question	Answer	Marks
24(e)(ii)	*allow pigment or membrane protein or rhodopsin for sensory rhodopsin I* *any four from:* **a** stimulus of (red-orange) light **;** **R** other colours of light **b** receptor is sensory rhodopsin I **;** **A** ref. to G-protein coupled receptor **c** ref. to specificity / only absorbs red-orange light **;** *treat as neutral* conformational change in sensory rhodopsin I **d** detail **;;** e.g. signal transduction activation of G protein activation of, another molecule / an enzyme **A** adenyl(yl) cyclase (many) second messengers produced **A** cAMP enzyme cascade / series of reactions triggered activate protein kinases idea of amplification ref. to phosphorylation **e** ref. to (cascade of events causing) change in cell functioning **;** e.g. flagellar movement movement towards red-orange light **A** light / lighter areas **R** if in response to a nerve impulse	**4**

Question	Answer	Marks
24(f)	alpha– / α–, helix **;** **R** alpha helix and beta-pleated sheet *plus one from* secondary (protein structure) **;** hydrogen bonding gives, stability / regular arrangement / AW **;** *structure maintained by hydrogen bonding* (H-bonding) between O of CO group and H of NH group (four amino acids ahead) **;**	**2**
24(g)(i)	ATP, synthase / synthetase **;** **R** ATPase	**1**
24(g)(ii)	bacteriorhodopsin arrow going into vesicle and enzyme complex arrow going out of vesicle and more H^+ in the vesicle than outside **;**	**1**

Question	Answer	Marks
24(g)(iii)	*assume chemiosmosis in mitochondrion* *any four from:* **a** ref. to different energy source (not light) to drive formation of protein gradient **;** e.g. NADH / FADH *idea of* energetic electrons (in context of from, NADH / FADH) *not in context of electron flow down ETC* *idea of* oxidation of a (Kreb's cycle) substrate **b** ref. involvement of, NADH / reduced NAD / FADH / reduced FAD **;** *in context of providing hydrogens / protons / electrons* **c** different membrane component allowing entry of protons / protons entering via cytochrome complex / protons do not enter via bacteriorhodopsin **;** **d** electron carriers (v bacteriorhodopsin) **;** **A** NADH dehydrogenase / other correct named **e** protons across, inner (mitochondrial) membrane / crista (membrane), (v vesicle bilayer) **;** **f** protons into, intermembrane space (v vesicle interior) **;** **g** protons from (NADH / FADH, in mitochondrial) <u>matrix</u> (v (vesicle) external medium) **or** protons pass into (mitochondrial) <u>matrix</u> **;** **h** ref. to (requires) ETC / electron flow **;** **i** oxygen present as final (electron) acceptor **;**	**4**

Question	Answer	Marks
25(a)	*any five from:* **a** (original) distribution of C4 plants in, hot (and dry) habitats and (original) distribution of C3 plants temperate **;** AW **A** temperate conditions described e.g. cooler, cloudier, more rainfall **b** greater area of globe grows C3 plants **;** AW **c** idea of adaptive advantage **;** **A** example e.g. ref. to different biochemistry for photosynthesis high temperatures / high light intensity / drought, favours C4 plants **;** **d** ref. to climate change, increasing global temperatures / changing rainfall pattern / changing temperatures **;** *allow answers referencing Table 25.1* ***e*** *idea that* balance, could / should / must, change to cope with, warmer / wetter climates **;** **f** ref. to research to convert C3 crops to C4 photosynthesis / AW **;**	**5**

Question	Answer	Marks
25(a)	**g** consequences to agriculture **; ;** e.g.(if hotter) yield of, C3 plants will decrease / C4 plants will increase **A** C4 plants more productive than C3 plants (in correct conditions) changed agricultural practices lack of knowledge on growing different crop changed, balance / interactions, with other organisms details e.g. pollinators may not be present situation with insect pests may alter (favourably or not) **h** changes in supply of different types of food in different parts of the world **;** **i** (so) more C4 (crop) growth may alleviate food shortage problems **;** **j** AVP **; ;** e.g. in the same region, C3 vs C4 favoured at different times of the year with different climate (e.g. changing precipitation) ref. to low temperatures damaging to chloroplasts in C4 plants ref. to C3 plants losing too much water with open stomata in hot climates	

Question	Answer	Marks
25(b)	*any four from:* **a** have nectaries / produce nectar (for insect feeding) **;** **b** ref. pollen **;;** **c** e.g. high nutritional quality sticky / barbed feature for collection or transfer (e.g. stigma sticky / anther located so insect makes contact) **d** flowers / petals, correctly qualified **;** **R** small flowers **R** coloured, petals / flowers, unqualified **e** produce, odour / scent **;** *scent of nectar mp a only* **f** ref. to nectar guides / floral guides / honey guides / described (seen with UV light) **;** **g** *idea of*, leaf / flower, architecture imitating female insects **;** **h** production of female insect (sex) pheromones **;**	**4**

Question	Answer	Marks
26(a)	*two marks if three or four rows correct* *one mark for one or two correct rows* reduced NADP / NADPH chlorophyll a / primary pigment / (chlorophyll a) reaction centre **A** P680 **R** reaction centre *if in context of (complete) photosystem* accessory pigments / the antenna complex / the light harvesting complex **A** light harvesting cluster **A** correct named pigments water / photolysis **R** hydrolysis of water **;;**	**2**
26(b)	*any two from:* *look for points on, a labelled / an annotated, diagram of a single guard cell* ref. to shape **;** e.g. kidney shaped cell wall detail **;** e.g. inner / curved, cell wall thicker than outer uneven thickening of inner vs outer cell wall no / very few, plasmodesmata ref. hooped arrangement of cellulose microfibrils contains chloroplasts **;** surround a <u>stoma</u> **; A** stomatal pore **I** stomata many mitochondria **;**	**2**