Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

Biology **9700/42**

Paper 4 A Level Structured questions **March 2023**

Maximum Mark: 100

STANDARDISATION

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Cambridge International Examinations – Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:
Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts

GENERIC MARKING PRINCIPLE 2:
Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:
Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:
Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5:
Marks should be awarded using the full range of marks defined in the mark scheme for the question. (However, the use of the full mark range may be limited according to the quality of the candidate responses seen).

GENERIC MARKING PRINCIPLE 6:
Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

STANDARDISATION

Science-Specific Marking Principles

1	Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly.
2	The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored.
3	Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane/ethene, glucagon/glycogen, refraction/reflection).
4	The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted.
5	'List rule' guidance (see examples below) For questions that require ***n*** responses (e.g. State **two** reasons…): • The response should be read as continuous prose, even when numbered answer spaces are provided. • Any response marked *ignore* in the mark scheme should not count towards ***n***. • Incorrect responses should not be awarded credit but will still count towards ***n***. • Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should **not** be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response. • Non-contradictory responses after the first ***n*** responses may be ignored even if they include incorrect science.
6	Calculation specific guidance Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states 'show your working'. For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values. For answers given in standard form, (e.g. $a \times 10^n$) in which the convention of restricting the value of the coefficient (a) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme. Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.
7	Guidance for chemical equations Multiples/fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme. State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

Examples of how to apply the list rule

State **three** reasons…. [3]

A	1	Correct	✓	**2**
	2	Correct	✓	
	3	Wrong	×	
B	1	Correct, Correct	✓, ✓	**3**
(4 responses)	2	Correct	✓	
	3	Wrong	ignore	
C	1	Correct	✓	**2**
(4 responses)	2	Correct, Wrong	✓, ×	
	3	Correct	ignore	
D	1	Correct	✓	**2**
(4 responses)	2	Correct, CON (of 2)	×, (discount 2)	
	3	Correct	✓	
E	1	Correct	✓	**3**
(4 responses)	2	Correct	✓	
	3	Correct, Wrong	✓	
F	1	Correct	✓	**2**
(4 responses)	2	Correct	✓	
	3	Correct CON (of 3)	× (discount 3)	
G	1	Correct	✓	**3**
(5 responses)	2	Correct	✓	
	3	Correct Correct CON (of 4)	✓ ignore ignore	
H	1	Correct	✓	**2**
(4 responses)	2	Correct	×	
	3	CON (of 2) Correct	(discount 2) ✓	
I	1	Correct	✓	**2**
(4 responses)	2	Correct	×	
	3	Correct CON (of 2)	✓ (discount 2)	

Question	Answer	Marks
1(a)	<table><tr><th></th><th>region of kidney</th></tr><tr><td>location of loop of Henle</td><td>**C**</td></tr><tr><td>location of Bowman's capsule</td><td>**A**</td></tr><tr><td>location of glomerulus</td><td>**A**</td></tr><tr><td>contains urine</td><td>**B + D**</td></tr></table> **;** **;** **;** **;** consider ignoring **A** if included in location of loop of Henle (standardisation issue)	**4**
1(b)	*any **three** from:* 1 (aquaporins are) channel proteins that allow water through **;** 2 (they) increase the permeability of collecting duct, cells / cell surface membranes, to water **;** 3 ref. to changing numbers of aquaporins changes cell surface membrane permeability **;** 4 AVP **;** e.g. ADH and adding more aquaporins to cell surface membrane when water potential of blood too low allow more water to be reabsorbed from filtrate allow a greater quantity of water across the membrane (per unit time) ref. to aquaporins in vesicles	**3**
1(c)	*any **three** from:* 1 detected by osmoreceptors **;** 2 in hypothalamus **;** 3 osmoreceptors send fewer impulses to posterior pituitary **;** 4 less ADH released **;** 5 by posterior pituitary gland **;**	**3**

Question	Answer	Marks
2(a)(i)	*any **two** from:* 1 codes for repressor protein that binds to operator **;** 2 prevents, transcription of *IFNA2* / RNA polymerase binding after promoter **;** 3 AVP **;** e.g. low level production of IFN-α because *lac* operon is 'leaky'	**2**

Question	Answer	Marks
2(a)(ii)	*any **three** from:* 1 concentration of IFN-α produced, peaks / increases and then decreases **;** 2 peak is, at 8 hours / 4 hours after addition of IPTG **;** 3 increase immediately after addition of IPTG **;** 4 concentration of IFN-α decreases more rapidly from 8 hours to 16 hours than from 16 hours to 22 hours / AW **;** 5 data quote **;**	**3**
2(a)(iii)	*any **one** from:* 1 time delay as lactose has to be (enzymatically) converted to allolactose **;** 2 *idea that* lactose is broken down so, has to be continually taken up by *E*. *coli* / not enough to bind all repressors **;** 3 IPTG will be at higher concentration than allolactose **;** 4 IPTG has higher affinity for repressor protein than allolactose **;** **accept** lactose 5 lactose may be used up by the *E*. *coli***;** 6 AVP **;**	**1**
2(a)(iv)	*any **one** from:* 1 less, glucose / amino acids / nutrients, remaining in growth medium (than at start) **;** (Note from Product Manager – I'm not sure that mp1 is valid. The concentration decreases. Lack of nutrients would lead to a decreased rate of production or even to levelling off, but would not lead to decrease in concentration) 2 (recombinant) IFN-α is, unstable / breaks down **;**	**1**
2(b)	*idea that* only *E*. *coli* that have taken up the plasmid will, grow / survive, in the presence of ampicillin **;**	**1**

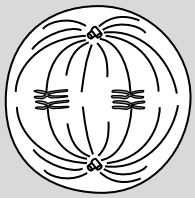
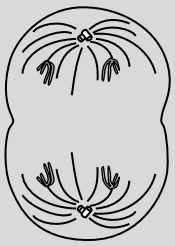
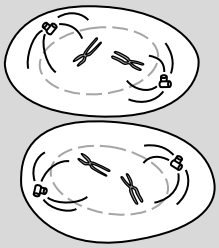
Question	Answer	Marks
2(c)	*any **five** from:* 1 ref. to chance mutation **;** 2 ref. to natural selection **;** 3 ref. to directional selection **;** 4 antibiotic acts as selection pressure **;** 5 bacteria with, mutation / gene / allele, that codes for antibiotic resistance, have selective advantage / survive / reproduce **;** 6 pass on, gene / allele, that codes for antibiotic resistance to daughter cells by, vertical transmission / asexual reproduction / binary fission **;** 7 pass on, gene / allele, that codes for antibiotic resistance to other bacteria by, horizontal transmission / transduction / transformation / conjugation **;** 8 AVP **;** e.g. increased chance of resistance if people do not finish full course of antibiotics some antibiotics may act as mutagens transferred using plasmids	**5**

Question	Answer	Marks
3(a)	*any **three** from:* *max **two** from:* 1 phenotypes that change gradually over a range of values / phenotypes that do not fall into distinct, groups / classes **;** 2 intermediates connect the extremes **;** 3 ref. to normal distribution **;** *max **two** from:* 4 polygenic / controlled by many genes **;** 5 different genes have additive effects **;** 6 environmental factors contribute to the variation **;**	**3**
3(b)(i)	difference between means = 1.7**;** denominator = 0.23 (0.2288492) **;** **allow** 0.22 t = 7.56 **;** **allow** ECF	**3**

Question	Answer	Marks
3(b)(ii)	*any **three** from:* 1 *t* value / 7.56, is greater than, 2.01 / critical value, so, difference between the means (Of the two groups) is significant / null hypothesis rejected **;** 2 *t*-test may not be valid due to unequal, standard deviations / variances **;** 3 overlap in data range means not effective for all salmon **;** 4 ref. to correlation does not prove causation **;** 5 ref. to this is only at 5% probability so may not actually be different / AW **;** 6 ref. to this is only a single, investigation / experiment / set of results, so, needs repeating / needs reproducing / confidence in conclusion reduced **;** 7 AVP **;** e.g. both groups show an increase in body mass from start of experiment	**3**
3(b)(iii)	*any **one** from:* 1 GM salmon may grow even faster **;** 2 *idea of* less labour intensive **;** e.g. non need for weekly injections 3 *idea that* growth hormone, concentrations are more consistent / is continuously produced **;** 4 *idea of* less stressful on GM salmon (so less effect on quality of meat) **;** 5 risk of infection with injections **;** 6 approval for GM salmon obtained (in some countries) (but not for regular injections) **;** 7 AVP **;**	**1**

Question	Answer	Marks
4(a)	*any **three** from:* 1 isolate / extract, DNA, from, cells / tissue **;** 2 denature into single-stranded DNA **;** 3 cut DNA into small fragments **;** 4 add fluorescent tag **;**	**3**

Question	Answer	Marks
4(b)(i)	2 500 000 **;** *check at STM* **accept** 2 400 000 or 2 600 000	**1**
4(b)(ii)	*any **three** from:* 1 DNA from DiGeorge syndrome and control DNA labelled with different coloured fluorescent tags **;** 2 probes on microarray have complementary sequence to (region of) chromosome 22 **;** 3 compare fluorescence of individual with DiGeorge syndrome and control **;** 4 in DiGeorge syndrome, less / 50%, DNA binds to (part of chromosome 22) probes on microarray than control DNA **;** 5 all other / 100%, DNA binds equally to probes for other parts of, genome / chromosome 22 **;**	**3**
4(b)(iii)	*any **three** from:* 1 chromosomal deletion may be a different number of nucleotides **;** 2 (so) different number of genes deleted **;** 3 *idea that* individuals may have, inherited / deleted, different alleles of the same gene **;** e.g. remaining allele may be recessive in one individual but dominant in another 4 individuals have different environments **;** **accept** diet 5 some individuals may have both chromosome 22s affected, others just one **;** 6 AVP **;** e.g. described example of mp3 such as enzymes or transcription factors	**3**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>5(a)</td><td>
<table>
<tr><th>stage of meiosis</th><th>spindle fibres</th><th>diagram</th></tr>
<tr><td>metaphase I</td><td>attach to centromeres and arrange homologous pairs of chromosomes at the equator of the cell</td><td>  </td></tr>
<tr><td>anaphase I</td><td>contract to pull centromeres / chromosomes, towards poles / to centrioles ;</td><td>  </td></tr>
<tr><td>prophase II ;</td><td>re-form spindle in daughter cells</td><td>  </td></tr>
<tr><td>telophase II</td><td>disassemble</td><td>diagram showing:
(forming) four daughter cells ;
two chromosomes each with a single chromatid inside a (re-forming) nuclear envelope ;</td></tr>
</table>
</td><td>4</td></tr>
</table>

Question	Answer	Marks
5(b)	*any **four** from:* 1 meiosis produces gametes for sexual reproduction **;** 2 at fertilisation two gametes fuse to form a zygote **;** 3 ref. to zygote will have chromosomes from both gametes (combined) **;** 4 (so) gametes must, be haploid / have *n* chromosomes / have half the number of chromosomes **;** 5 (reduction division) prevents, a ploidy change / an increase in the normal number of chromosomes / an increase in the number of sets of chromosomes **;** **accept** descriptions e.g. if gametes are, not haploid / diploid / 2*n*, then when they fuse the zygote will be, tetraploid / 4*n* / AW 6 so that when haploid gametes fuse, the diploid number / 2*n* / 2 copies of each chromosome, is restored in the zygote **;**	**4**

Question	Answer	Marks
6(a)(i)	**D ;**	**1**
6(a)(ii)	**C** <u>and</u> **D ;**	**1**
6(b)	*any **three** from:* 1 location of enzymes (for, link reaction / Krebs cycle) **;** 2 site of, link reaction / Krebs cycle **;** 3 ref. to, DNA / ribosomes, for production of, enzymes / electron carriers **;** 4 production of, reduced FAD / reduced NAD, for oxidative phosphorylation **;** 5 ref. to substrate-linked phosphorylation **;**	**3**

Question	Answer	Marks
6(c)	*any **four** from:* *process, stops / decreases, because:* 1 no / fewer, electrons accepted by oxygen **;** 2 no / fewer, electrons along, electron transport chain **;** **accept** ETC for electron transport chain 3 no /fewer, H^+ pumped into intermembrane space **;** 4 no / less, chemiosmosis **;** 5 reduced NAD / reduced FAD, not oxidised **;** 6 no / less, ATP produced **;** 7 AVP **;** e.g. no / less, pyruvate enters mitochondrion	**4**

Question	Answer	Marks
7(a)	*any **four** from:* 1 with 0.1 g dm^{-3} (solution) chemoreceptor, does not release neurotransmitter (into the synapse) / is not depolarised **;** 2 so dendrite of sensory neurone remains at resting potential **;** 3 with, 1.0 g dm^{-3} / 10.0 g dm^{-3}, solution chemoreceptor, releases neurotransmitter / membrane potential increases to +30 mV / is depolarised **;** 4 membrane potential of sensory neurone increases to +40 mV **;** 5 so, action potential / depolarisation, in dendrite of sensory neurone **;** 6 ref. to threshold / all or nothing law (in context of either cell) **;** 7 AVP**;**	**4**

Question	Answer	Marks
7(b)	*any **three** from:* 1 sensory neurone carries impulses from receptor to CNS vs motor neurone carries impulses from CNS to effector **;** 2 cell body of sensory neurone between, afferent axon / dendron, and axon vs cell body at end in motor neurone **;** **accept** in ganglion for sensory neurone 3 sensory neurone has, afferent axon / dendron, **and** axon vs motor neurone has long axon **;** 4 no dendrites from cell body of sensory neurone vs dendrites extend from cell body of motor neurone **;** *max **two** if no direct comparisons*	**3**

Question	Answer	Marks
8(a)	*any **seven** from:* 1 location of, photosynthetic / light absorbing, pigments **;** **accept** named pigments 2 further detail **;** e.g. photoactivation leading to emission of electrons ref. to, light harvesting clusters / antennae complex ref. to photosystems pigments arranged for maximum light absorption 3 site of, (cyclic / non-cyclic) photophosphorylation / light-dependent stage **;** 4 site of photolysis / location of oxygen-evolving complex **;** 5 location of (electron) carriers of the electron transport chain **;** **accept** ETC for electron transport chain 6 location of ATP, synthase / synthetase, complexes **;** 7 production of, ATP / reduced NADP (for Calvin cycle) **;** 8 ref. to chemiosmosis **;** 9 enclose thylakoid space for, accumulating protons / H^+ / hydrogen ions **;** 10 stacked to form grana **;** 11 gives large surface area **;** 12 AVP ; e.g. ref. to inter-granal lamellae mainly photosystem I for cyclic photophosphorylation	**7**

Question	Answer	Marks
8(b)	*any **four** from:* *describe:* 1 **A** activity increases steeply (at first) then, increases less steeply / starts to level off **and B** activity remains low **;** 2 comparative data quote **;** *explanation:* 3 RA /rubisco activase, changes the active site of rubisco **;** 4 RA / rubisco activase, enables rubisco to bind more readily with RuBP / AW **;** 5 ref. to more, enzyme–substrate complexes **;** **accept** ESC for enzyme–substrate complex 6 enables products to leave active site more quickly **;** 7 AVP **;**	**4**

Question	Answer	Marks
9(a)(i)	**P** pointing to thin filament **;** **R** pointing to thick filament **;**	**2**
9(a)(ii)	A-band: stays the same **;** I-band: gets narrower / AW **;**	**2**
9(b)(i)	*any **four** from:* 1 ref. to competes with, acetylcholine / neurotransmitter **or** blocks receptors **;** 2 no / fewer, sodium ions enter muscle fibre **;** 3 so, no / less, depolarisation of sarcolemma **;** 4 no / fewer, action potentials spread across muscle fibre **;** 5 no / fewer, Ca^{2+} ions released by sarcoplasmic reticulum **;** 6 AVP **;** e.g. ref. to fewer cross bridges 7 AVP **;** *for valid alternative suggestion*	**4**

Question	Answer	Marks
9(b)(ii)	*any **two** from:* 1 affects, rib muscles / intercostal muscles / diaphragm **;** 2 (so) unable to breathe **;** 3 affects cardiac muscle **;** 4 stops blood circulation **;** 5 AVP **;** 6 AVP **;**	**2**

Question	Answer	Marks
10(a)	abundance / numbers / population size **;** Simpson's **;** **accept** alternatives such as Shannon's genes / characteristics traits **;** alleles **;** adapt / evolve **;** habitats / niches **;**	**6**
10(b)(i)	$\frac{14\,234 - 7851}{12}$ **;** 532 **;**	**2**
10(b)(ii)	*any **four** from:* *fish:* 1 overfishing **;** 2 on water / at sea, difficult to enforce protective, laws / regulations **;** ora for mammals on land 3 ref. to climate change qualified **;** 4 ref. to pollution qualified **;** e.g. plastics in the sea 5 there are more species of fish than there are species of mammals **;** *mammals:* 6 *idea that* public are more aware leading to conservation action **;** ora for fish 7 laws in place banning hunting **;** 8 AVP **;**	**4**