CAMBRIDGE
International Education

# Cambridge International AS & A Level

**BIOLOGY** **9700/24**

Paper 2 AS Level Structured Questions **May/June 2025**

MARK SCHEME

Maximum Mark: 60

**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.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the May/June 2025 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.



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**PUBLISHED**

## 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 descriptions 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.

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| |
|---|
| GENERIC MARKING PRINCIPLE 5:<br><br>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:<br><br>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. |

**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<br><br>For questions that require ***n*** responses (e.g. State **two** reasons …):<br><br>• The response should be read as continuous prose, even when numbered answer spaces are provided.<br>• Any response marked *ignore* in the mark scheme should not count towards ***n***.<br>• Incorrect responses should not be awarded credit but will still count towards ***n***.<br>• 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.<br>• Non-contradictory responses after the first ***n*** responses may be ignored even if they include incorrect science. |

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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.

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**Annotations guidance for centres**

Examiners use a system of annotations as a shorthand for communicating their marking decisions to one another. Examiners are trained during the standardisation process on how and when to use annotations. The purpose of annotations is to inform the standardisation and monitoring processes and guide the supervising examiners when they are checking the work of examiners within their team. The meaning of annotations and how they are used is specific to each component and is understood by all examiners who mark the component.

We publish annotations in our mark schemes to help centres understand the annotations they may see on copies of scripts. Note that there may not be a direct correlation between the number of annotations on a script and the mark awarded. Similarly, the use of an annotation may not be an indication of the quality of the response.

The annotations listed below were available to examiners marking this component in this series.

**Annotations**

| Annotation | Meaning |
|---|---|
|  | correct point or mark awarded |
|  | correct awarding one mark from marking point or marking group 1.<br>similar numbered ticks are used for marking point or marking groups 2, 3, 4 etc. |
|  | incorrect point or mark not awarded |
|  | working towards marking point |
|  | information missing or insufficient for credit |
|  | used to highlight part of an extended response |
|  | used to highlight part of an extended response |
|  | allow or accept |
|  | benefit of the doubt given |

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| Annotation | Meaning |
|---|---|
| CON | contradiction in response, mark not awarded |
| ECF | error carried forward applied |
| I | incorrect or insufficient point ignored while marking the rest of the response |
| IRRL | irrelevant material that does not answer the question |
| NBOD | benefit of doubt was considered, but the response was decided to not be sufficiently close for benefit of doubt to be applied |
| O | or reverse argument |

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**Mark scheme abbreviations**

| | |
|---|---|
| **;** | separates marking points |
| **/** | alternative answers for the same point |
| **A** | accept (for answers correctly cued by the question, or by extra guidance) |
| **R** | reject |
| **I** | ignore |
| **( )** | the word / phrase in brackets is not required, but sets the context |
| **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 |
| **AVP** | alternative valid point |

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| Question | Answer | Marks |
|---|---|---|
| 1(a)(i) | metaphase **;** | **1** |
| 1(a)(ii) | telophase **;**<br>**I** *ref. to* early / late | **1** |
| 1(b)(i) | osmosis **;**<br><br>*any **two** from:*<br>water (molecules) move, down a water potential gradient / from high(er) to low(er) water potential / from less negative to more negative water potential **;**<br>**A** ψ for water potential<br>**I** *ref. to* concentration gradient<br><br>across the cell (surface) membrane **;**<br><br>passively / passive movement / no energy required / no ATP required **;** | **3** |
| 1(b)(ii) | single (partially permeable) membrane / tonoplast **;**<br>**A** membrane-bound / bound by a membrane<br>**R** envelope / membranes / double-membrane bound<br>**R** if tonoplast is also described as a wall<br><br>contains <u>cell sap</u><br>**or**<br>detail **;** e.g. (solution) containing dissolved (organic and inorganic) substances / AW<br>water and other substances | **2** |
| 1(c) | xylem drawn as cross or star <u>and</u> phloem drawn in areas between xylem **;**<br>**R** if vascular bundles around the edge<br><br>drawn centrally within whole section of root **;** | **2** |

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| Question | Answer | Marks |
|---|---|---|
| 1(d) | *any **four** from:*<br>**1** (because) presence of, sucrose / assimilates, causes water potential (inside phloem sieve tube) to, be lower / decrease / AW **;**<br>**I** water potential <u>gradient</u> decreases<br><br>**2** water enters, phloem (vessels) / sieve tubes, down a water potential gradient / by osmosis **;**<br>**I** down a concentration gradient<br>**I** higher water potential gradient to lower water potential gradient<br><br>**3** increase in volume **;** *in context of within sieve tubes, at source / in roots*<br><br>**4** (so) increase in / high(er), <u>hydrostatic</u> pressure **;** *must have hydrostatic once*<br>**A** builds up<br>**I** creates / forms<br><br>**5** unloading / removal, of, sucrose / assimilates, at, sink / growing areas, lowers <u>hydrostatic</u> pressure **;**<br>*context is water follows osmotically*<br><br>**6** (mass flow / bulk flow / movement) down pressure gradient / from high(er) to low(er) pressure **;** | **4** |

| Question | Answer | Marks |
|---|---|---|
| 2(a) | extracellular (enzyme) **;**<br>**R** exocellular | **1** |
| 2(b)(i) | arrow between O and CO on lower fatty acid residue **;** | **1** |
| 2(b)(ii) | hydrolysis **;**<br><br>ester **;** | **2** |

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| Question | Answer | Marks |
|---|---|---|
| 2(c) | substrate / olive oil, concentration **;**<br><br>for, lipase / the enzyme, to achieve, half, maximum rate (of reaction) / $V_{max}$ (at a temperature of 37 °C) **;**<br>**R** $K_m$ is half, maximum rate of reaction / $V_{max}$<br><br>*ref. to lipase / enzyme not needed if the context is correct*<br><br>'when the rate of reaction is half $V_{max}$ , the olive oil concentration is 91.76 mmol $dm^{-3}$' *is two marks* | **2** |

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| Question | Answer | Marks |
|---|---|---|
| 2(d)(i) | *any **four** from:*<br>*accept activity for percentage enzyme activity throughout*<br>*check for correct units – must be seen once*<br><br>**1** optimum temperature i**s** 80 °C **;**<br><br>**2** increasing temperature increases activity, up to, 80 °C / the optimum / the maximum **;**<br>**I** constant increase<br>**I** enzyme more active<br>**R** if implied a continued increase throughout the temperature range<br>*if mp not gained, allow extracted values:* from 25 °C to 80 °C, percentage / activity, from 57 to 100<br><br>**3** increased kinetic energy (of, substrate / enzyme, molecules) **;**<br>**A** increased energy if movement stated<br><br>**4** increase, in enzyme-substrate collisions / AW, (per unit time) **;**<br>**A** increase in number of enzyme-substrate complexes<br>*must be in context of only up to 80 °C*<br>*allow **ecf** if mp2 rejected*<br><br>**5** above, optimum / 80 °C, decrease in activity **;** ***ecf** for incorrect optimum*<br>**A** percentage activity, from 100 to 55 / 56 *for decrease in activity*<br><br>**6** partial (progressive) denaturation **;**<br>**A** enzyme begins to denature<br>**A** progressive denaturation<br>**ora** enzyme not completely denatured<br><br>**7** explanation of denaturation / partial denaturation **;** e.g. loss of, tertiary structure / shape of active site breakage of bonds between R-group breakage of two named bonds<br>**A** fewer enzyme-substrate collisions *if mp4 not gained*<br><br>**8** reason for, high optimum temperature / activity high at higher temperature **;** e.g. is a thermostable enzyme<br>enzyme has more bonds **R** more peptide bonds<br>enzyme more compact<br>extracted from bacteria living in hot springs<br>enzyme protected by other proteins | **4** |

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| Question | Answer | Marks |
|---|---|---|
| 2(d)(ii) | *any **two** from:*<br>active over a (much) narrower range of temperature **;**<br>optimum of / maximum activity at / peaks at, 35 °C to 40 °C **;**<br>steeper increase (from 25 °C) to optimum / maximum activity / peak and steeper decrease after optimum **;**<br>decreases to, zero / 0, (percentage) activity (after optimum) **;**<br><br>**A** becomes denatured when temperature higher than (approx. after) 40 °C<br>**I** will be 0 percentage activity at 120 | **2** |

| Question | Answer | Marks |
|---|---|---|
| 3(a)(i) | actual length = $\frac{\text{image length / length of X–Y}}{\text{magnification}}$ **;** *can be a rearranged formula*<br>*answer*<br>5.2 (µm) **;** *measured length 45 mm* **A** 5.0 / 5.1 / 5.3 / 5.4 | **2** |
| 3(b) | *any **one** from:*<br>able to see, surface contours / topography / AW **;**<br><br>not able to see thin section **;**<br>**A** not able to see internal, features / details<br><br>(appears as a) three-dimensional / 3D, image **;** **ora** not in 2D view<br><br>good / greater, depth of field / AW **; ora** | **1** |
| 3(c) | *any **one** from:*<br>two / sister, chromatids present (in each chromosome) **;**<br>**I** two identical DNA molecules<br><br>centromere present (per chromosome)**;**<br><br>it is at the (late) prophase / prometaphase / metaphase, stage of mitosis (which is after the S phase) **;** | **1** |

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| Question | Answer | Marks |
|---|---|---|
| 4(a) | protoctist **;**<br>**A** Protoctista<br>**I** species names<br>**I** eukaryote | **1** |
| 4(b) | bulge in centre / swollen in centre / lost (full) biconcave shape **; ora**<br>**A** misshapen / shape not regular | **1** |
| 4(c) | *any **one** from:*<br>(merozoites) break down (haemoglobin) to produce amino acids **;**<br>(merozoites) use the amino acids for growth **;**<br>**A** protein used for growth<br><br>(merozoites) use the amino acids to synthesise other proteins **;**<br>(merozoites) use the protein to provide energy **;**<br>**I** use haemoglobin for energy<br><br>AVP **;** e.g. red blood cells absorb water | **1** |

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| Question | Answer | Marks |
|---|---|---|
| 4(d) | | **4** |

| correct sequence | step |
|---|---|
| 1 | D ; |
| 2 | F ; |
| 3 | B |
| 4 | **H** |
| 5 | A ; |
| 6 | E |
| 7 | G ; |
| 8 | **C** |

| Question | Answer | Marks |
|---|---|---|
| 4(e) | *any **four** from:*<br>**1** *ref. to* folding / coiling, of polypeptide chain **;** *in correct context of formation of secondary / tertiary structure*<br><br>**2** contains, α- / alpha-, helix / helices **or** β- / beta-, pleated sheets**;**<br>**A** β- / beta-, pleats<br>**R** beta-plates<br>**CON** if add incorrect idea e.g. also contains glucose<br><br>**3** interactions / bonds form, between, R-groups / side chains **;**<br>**R** if linked to secondary structure<br><br>**4** two or more named bonds (between R-groups) **;**<br>**R** if peptide or other bonds included<br>*two from*<br>hydrogen bonds<br>disulfide, bridges / bonds<br>**I** covalent bonds<br>ionic / electrostatic, bonds<br>hydrophobic interactions<br>**I** hydrophilic interactions<br>**I** van der Waals forces<br><br>**5** AVP **;** e.g. *ref. to* secondary structure random coil<br>more detail of secondary structure<br>e.g. H-bonds between (H of) N-H group and (O of) C=O group (of the polypeptide backbone)<br>**A** amine / amino for NH and carboxyl for C=O<br><br>(alpha-helix) pattern of H-bonds every, 3.6 amino acid (residues) / fourth amino acid / third or fourth amino acid<br><br>(beta-pleated sheet) H-bonds between areas of polypeptide lying parallel<br><br>more detail of tertiary structure bonds between R-groups<br>e.g. ionic bonds between $NH_3^+$ and $COO^-$<br>disulfide between sulfur atoms<br>hydrophobic – between non-polar R-groups<br>hydrogen – between oxygen atoms on C=O groups and hydrogen atoms on NH groups (of R-groups) | **4** |

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| Question | Answer | Marks |
|---|---|---|
| 4(f) | *any **four** from:*<br>*allow MSP1 for antigen*<br><br>**1** memory cells formed **;**<br><br>*plus **three** from:*<br>**2** detail of events occurring related to clonal selection leading to memory cell formation **;**<br>e.g. phagocytosis of antigen leads to antigen presentation<br>antigen recognition by / binding of antigen to, (specific B- / T-) lymphoctyes<br>activation / growth, of (specific) lymphocytes<br>triggers, humoral / cell mediated, response<br>**I** *ref. to* stimulating events occurring after clonal expansion *for mp2*<br>**'***MSP1 / antigen**, stimulates B-cell to divide' is mp2* ***not** mp3*<br><br>**3** clonal expansion / increase in numbers by many mitoses (to form memory cells) **;**<br><br>**4** (B- and T-) <u>memory cells</u>, long-lived / remain in circulation / AW **;**<br>**I** kept in body<br>**I** live longer *unless qualified that they are present when actual antigen is present*<br><br>**5** presence of, merozoite / actual antigen / AW, produces a <u>secondary immune response</u> **;**<br>**A** secondary response *if primary immune response introduced for mps1–3*<br><br>*detail of why person, is immune / does not have symptoms of disease*<br>**6** increased presence / great number, of (memory) lymphocytes increases chance of fast recognition (of antigen) AW<br>**or**<br>more / AW, of any two from, B-lymphocytes / plasma cells / T-helper cells / **A** B-cells T-killer cells<br>*if only 'more B-cells and T-cells' stated, check for T-cells if Th and Tk types noted previously*<br><br>**7** higher levels / faster production / AW, of antibody **;**<br>**R** if produced by T-lymphocytes<br><br>**8** AVP **;** e.g. binding of antibody to antigen prevents entry of merozoite into red blood cell<br>T-helper cells to secrete cytokine / T-killer cells qualified<br>*in context of secondary response* | **4** |

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| Question | Answer | Marks |
|---|---|---|
| 4(g) | *any **three** from:*<br>**1** stop female producing eggs by preventing access to blood meals **;** AW<br><br>**2** example **;** e.g. use (mosquito) nets, at night / while sleeping / to prevent blood being taken<br>wear clothes, that cover bare skin / as a barrier / AW insect repellents *allow* AW if qualified e.g. on body / on clothes<br>insect sprays, qualified e.g. prevents mosquito landing on person to feed<br>mosquito coils / AW must be qualified as a repellent / barrier<br><br>**3** example of use of, insecticides / pesticides / named (to kill mosquitoes) **;**<br>e.g. treat nets with insecticide / ITNs / insecticide-treated nets<br>LLINs / long-lasting insecticide-treated (bed) nets<br>indoor residual spraying / described **A** IRS<br>use mosquito coils / insect repellents *allow once only*<br>use of aerial sprays in, wetlands / AW<br><br>**4** *ref. to* treat water to disrupt / AW, egg-laying, eggs, larvae / pupae **;**<br><br>**5** example **;** e.g. remove bodies of water<br>cover water tanks **I** cover rivers **A** ponds<br>(spray) oil on, water / ponds / (small) lakes / swamps<br>use biological control / predators / mosquitofish / other named<br><br>**6** AVP **;** e.g. *ref. to* use of sterile males (irradiated or genetically modified)<br>**I** sterile females<br>use of drugs to kill *Plasmodium* in (female) mosquitoes<br>**I** medicine | **3** |

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| Question | Answer | Marks |
|---|---|---|
| 5(a)(i) | *'if qualified' = ref. to reduced, gas exchange/diffusion*<br><br>*idea that* (ciliated epithelial cells),not thin enough / too thick / not flat / AW **;**<br>**A** thicker / thick, if qualified<br><br>*plus **one** from*:<br>*context is movement of, $O_2$ / $CO_2$ / respiratory gases, across cells*<br><br>diffusion too slow **;** AW<br>**A** slow / slower, if qualified<br><br>diffusion distance too great **;**<br>**A** increases / increased, if qualified<br><br>cilia, action / AW, may affect efficiency of gas exchange **;**<br>**A** examples<br>e.g. may use up oxygen (so less available for gas exchange) may affect role of surfactant | **2** |
| 5(a)(ii) | *any **two** from:*<br>mucus, wafted / moved, qualified **;** e.g. to / towards, mouth / (back of) throat away from, alveoli / gas exchange surface / lungs out of the air ways / upwards<br>AW for *idea of* moving to back of throat<br>**I** 'out of the body' / 'to the stomach'<br>**R** if implied cilia are in the gut<br><br>(for movement of mucus, cilia show) synchronous rhythm / metachronal rhythm **;**<br>**A** described e.g. all move at once / wavelike action<br><br>otherwise mucus (with pathogens) accumulates / AW, with consequence **;** e.g. increased risk of infection AW<br>reduced flow of air AW<br>**no** ora for this mp | **2** |

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| Question | Answer | Marks |
|---|---|---|
| 5(b) | *any **four** from:*<br>*allow $O_2$ for, oxygen / oxygen molecules*<br><br>**I** *ref. to* damage to gas exchange system *as the person is stated as healthy*<br><br>*suggestion that*<br>**1** haemoglobin has higher affinity for, pollutants / named, than oxygen**;**<br>**A** haemoglobin has decreased affinity for oxygen<br><br>**2** pollutants (may) bind to haemoglobin, with consequence **;**<br>e.g. so, fewer oxygen molecules bind / less oxygen binds<br>fewer Hb binding sites available, for oxygen molecules / oxygen<br>changes Hb shape / affects (R-group) bonds, so oxygen binding hindered<br>**I** *ref. to* carbon dioxide<br><br>**3** (pollutants) lower, proportion / partial pressure / concentration, of oxygen in (atmospheric / alveolar) air, so less, diffuses to blood / diffuses into capillary / enters red blood cells / binds to haemoglobin **;**<br><br>**4** polluted air leads to less steep, diffusion / concentration, gradient between, alveolar air / alveolus, and, blood / capillary)**;**<br>**A** smaller difference in concentration<br><br>**5** pollutant, presence / binding, affects, haemoglobin allostery / cooperative binding / described **;**<br>**ora** e.g. because without pollutant the first $O_2$ binding to Hb makes it easier to bind the next $O_2$ | **4** |

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| Question | Answer | Marks |
|---|---|---|
| 6(a)(i) | coronary (artery) **;** | **1** |
| 6(a)(ii) | *slow rate of ventricular contraction*<br>suggests that impulse generation / AW, (from SAN) is, slower rate / too slow<br>**I** not at the correct rate<br>**or**<br>(SAN) initiating heartbeat / acting as pacemaker / setting heart rate, is, abnormal / faulty **;**<br><br>described relationship between SAN and ventricles **;**<br>e.g. SAN sends out, wave of excitation / electrical impulses / impulses / AW, across atria<br>**I** signals<br>**R** nerve impulses<br>**R** electronic impulses / electricity impulses<br><br>impulses reach ventricles (for contraction) through AVN | **2** |
| 6(b) | (impulse via alternative pathway will) increase, heart rate / rate of ventricular contraction **;**<br><br>*plus **one** from*:<br>(because normally) AVN, delays / slows, impulse (conduction to ventricles) **;**<br>**A** pathway does not have AVN, so not delayed<br><br>ventricles, contract / in systole, too soon / prematurely<br>**or**<br>atria (still) contracting when ventricles (begin) contracting **;** | **2** |

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