

| SOLUTIONS: Combined Science Sample Paper 2022/2023 | | |
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| 1(a) | alternative / different / one form of a gene Or mutation of a gene | [1] |
| 1(b) | Has two alleles that are the same | [1] |
| 1(c) | <p style="text-align: center;">Woman</p> <p style="text-align: center;">Man</p> | [2] 1 mark for correctly completed for parents 1 mark for correctly completed for children |
| 1(d) | they have one dominant allele / heterozygous / B or brown allele / dominant allele / B is expressed even if only on one chromosome | [1] Answer must refer to the presence of the dominant allele in each child. 'because the brown allele is dominant' alone is insufficient. Accept converse i.e. blue only expressed if both alleles are recessive (homozygous recessive) |
| 2(a) | Willow tree | [1] |
| 2(b) | Caterpillar | [1] |
| 2(c) | Numbers of organisms in each trophic level | [1] |
| 2(d) | | [2] 1 mark for correct shapes 1 mark for correct labels |
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Turn over ►

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| 2(e) | Any two from: <ul style="list-style-type: none"> • Pyramid shape • Different organisms have different masses / different bar widths • Less mass further up pyramid • Willow tree have greatest biomass | [2] 1 mark per correct answer. |
| 2(f) | Any two from: <ul style="list-style-type: none"> • Used for life processes / respiration / movement • Used as heat energy • Faeces passed to decomposers • Death • Not digested • Not eaten fully | [2] 1 mark per correct answer. Allow other sensible suggestions for energy loss at each level. Accept any two named life processes for 2 marks. |
| 2(g) | Any one biotic factor from: <ul style="list-style-type: none"> • Food availability / competition • Predators • Disease • Parasitism • Presence of pollinating insects • Availability of nesting locations Any one abiotic factor from: <ul style="list-style-type: none"> • Climate • Light intensity • Temperature • Amount of rainfall / water availability • Amount of sunlight / hours of daylight • Soil conditions (any relevant points) | [2] 1 mark for correct factor. Award max 1 mark if answers do not indicate whether the factor(s) is biotic or abiotic. Accept deforestation as either biotic or abiotic with correct justification. |
| 3(a) | Any two from: <ul style="list-style-type: none"> • larger / longer / thicker • fewer (bones in total) • fewer bones touching the ground | [2] 1 mark per correct answer. |
| 3(b) | variation / mutation (in size / number / arrangement of bones) | [1] |
| | those with large(r) / few(er) bones more suited to running or run faster (on harder / drier ground) | [1] |
| | These survive / avoid predation and breed and Genes / DNA / alleles of these passed on | [1] |
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Turn over ►

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|-------------|---|--|
| 4(a) | Carbon Dioxide + Water -> Glucose + Oxygen | [2] 1 mark for correct products 1 mark for correct reactants |
| 4(b) | Sunlight | [1] |
| 4(c) | Any two from: <ul style="list-style-type: none"> • Light intensity • Carbon dioxide concentration • Temperature • Water / rainfall amount | [2] 1 mark per correct answer. |
| 4(d) | All four from: <ul style="list-style-type: none"> • Let pondweed acclimatize to new light intensity / leave for several minutes / ensure constant temperature • Count number of bubbles given off (in one minute) • Move light further back (10 cm) • Repeat | [4] 1 mark per correct point. Accept measurement of decrease in water level (per unit time) as measurement of rate of photosynthesis Ignore answers that refer to the effect of temperature change due to the proximity of the light. |
| 4(e) | Any two from: <ul style="list-style-type: none"> • Size of pondweed • Volume of water • Temperature (of water and/or surroundings) • CO₂ levels | [2] 1 mark per correct answer. Allow ecf based on their experimental procedure outlined in part (d). Allow suitable alternatives. |
| 4(f) | More oxygen bubbles when light closer to beaker | [1] |
| | Greater light intensity gives greater rate of photosynthesis | [1] Allow converse arguments. Allow ecf from part (d). |
| 5(a) | The nucleus contains protons and neutrons | [1] |
| 5(b) | An atom has no overall charge because there are an even number of protons and electrons | [1] |
| 5(c) | Atoms bond together to form molecules | [1] accept compounds. |
| 6(a) | D (increasing particle size) | [1] |
| 6(b) | Catalyst | [1] |
| 6(c) | When the temperature of reaction mixture increases, the particles gain more kinetic energy. | [1] |
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Turn over ►

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| 7(a) | water and oxygen | [1] both conditions required |
| 7(b) | Coated with a layer of zinc | [1] |
| | Any one from: <ul style="list-style-type: none"> zinc is more reactive than iron (higher in reactivity series) water / oxygen reacts more readily with zinc zinc corrodes instead of iron zinc coating acts as a barrier to iron as long as it is unscratched | [1] |
| 8(a) | Addition of bromine water | [1] accept bromine solution |
| | From orange / brown to colourless | [1] must include colour before and after. |
| 8(b) | Potassium | [1] |
| 8(c) | $\text{Na}_2\text{CO}_3 + 2 \text{HCl} \rightarrow 2 \text{NaCl} + \text{H}_2\text{O} + 2 \text{CO}_2$ | [3] 1 mark for correct products 1 mark for correct reactants 1 mark for correct balancing |
| 8(d) | Bubble through limewater | [1] |
| | Turns cloudy | [1] Accept a description of collecting gas in a test tube to demonstrate extinguishing of a lit splint for 2 marks |
| 9(a) | | [3] 1 mark for each correct match Lose 1 mark for extra lines drawn |
| 9(b) | Strong covalent bonds | [1] must include covalent |
| | Many bonds must be broken | [1] Must indicate many bonds/ extended structure (owtte) |
| | Requires a large amount of energy to break | [1] Accept high temperature for large amount of energy |
| 9(c) | | [2] 1 mark for each correct match Lose 1 mark for extra lines drawn |
| 10(a) | B ($\text{C}_n\text{H}_{2n+2}$) | [1] |
| 10(b) | Butane | [1] |
| 10(c) | monomers | [1] |

Turn over ►

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| 10(d) | $\left(\begin{array}{c} \text{H} & & \text{H} \\ & & \\ \text{---} & \text{C} & \text{---} & \text{C} & \text{---} \\ & & \\ \text{H} & & \text{H} \end{array} \right)_n$ | [1] |
| 10(e) | Cannot be broken down by bacteria in the environment | [1] |
| 10(f) | <p>Any two from:</p> <ul style="list-style-type: none"> • Ugly • Smelly • Noisy • Large amount of land usage • Destruction of habitats • Pollution of nearby areas • Waste takes thousands of years to degrade | [2] 1 mark per correct answer. |
| 10(g) | <p>Any two from:</p> <ul style="list-style-type: none"> • Expensive • Produces greenhouse gases • Produces toxic gases • Waste products must be disposed of | [2] 1 mark per correct answer. |
| 11(a) | | [5] 1 mark for each correct match Lose 1 mark for extra lines drawn |
| 11(b) | Gamma rays: cancer or mutation in DNA or damage to tissues/organs | [1] |
| | Ultraviolet: damage to surface cells or blindness or sunburn or skin cancer | [1] |
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Turn over ►

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|--------------|---|---|
| 12(a) | 70% of the input energy is transferred to useful energy / light energy or 30% of the input energy is transferred to non-useful energy | [2] Accept power instead of energy Accept lost instead of transferred Correct formula gains 1 mark if no other mark scored |
| 12(b) | (Power is) the rate of transfer of energy | [1] allow alternate wording |
| 12(c) | Energy = 15×30 | [1] |
| | 450 (J) | [1] Allow 2 marks if no working shown |
| 12(d) | Efficiency = $\frac{16}{20} (\times 100)$ | [2] |
| | 0.8 (80%) | [1] Allow 2 marks if no working shown |
| 12(e) | (Principle of) conservation of energy | [1] owtte |
| 13(a) | Any two from: <ul style="list-style-type: none"> • High energy • High frequency • Short wavelength • No mass • No charge | [2] 1 mark per correct answer. |
| 13(b) | Alpha radiation is highly ionising | [1] Allow particles for radiation Allow 'it' for alpha radiation |
| | (so) alpha radiation can't penetrate the skin / exit the body or more likely to cause damage to cells / more dangerous | [1] |
| 13(c) | GM tube and counter | [1] allow suitable alternatives |
| 13(d) | 20 | [1] |
| 13(e) | 6 hours | [1] |
| 13(f) | To reduce the time the patient is contaminated | [1] |
| | Since radiation is harmful – allow specified risk e.g. can cause damage to cells etc. | [1] |
| | Count rate will not change enough | [1] |
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Turn over ►

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|--------------|---|--|
| 14(a) | <p>Any five statements from:</p> <ul style="list-style-type: none"> • Car C reaches a maximum speed of 15 m/s (at 12 s) • Car D reaches a maximum speed of 30 m/s (at 10 s) • Car C travels for 4 s longer than car D • Car C has an acceleration of 1.25 m/s^2 (from 0s to 12 s) • Car D has an acceleration of 5 m/s^2 (from 4 s to 10 s) • Car C travels a total distance of 120 m • Car D travels a total distance of 210 m | <p>[5] 1 mark per correct statement Ignore statements not supported by calculation or data Comparative statements with 2 mentions of data can gain 2 marks Max of 3 statements per car</p> |
| 14(b) | 40×3.7 | [1] |
| | $= 148$ | [1] Allow 2 marks for correct answer of 148 provided no subsequent step shown |
| | Newtons (N) | [1] |
| | | |

END