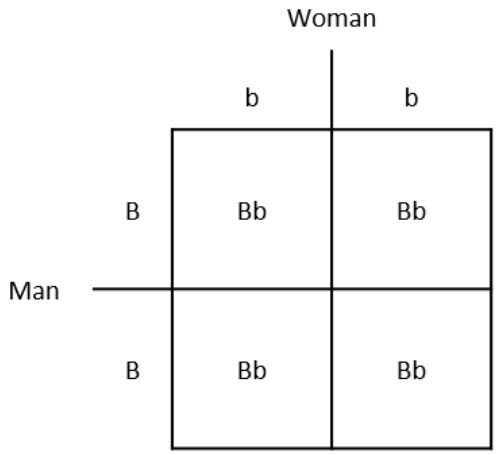
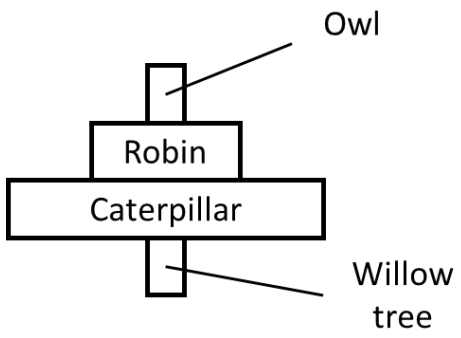
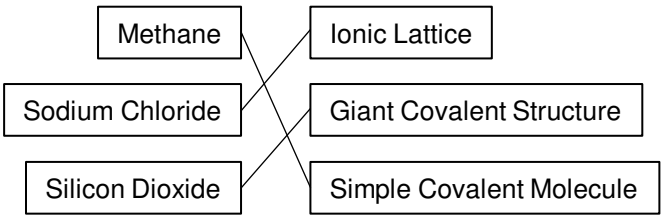
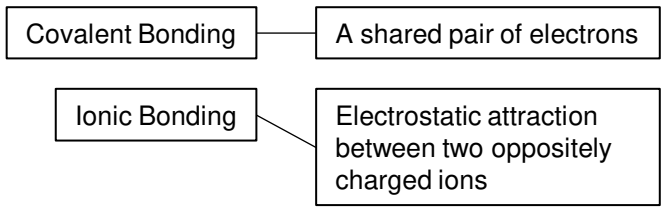
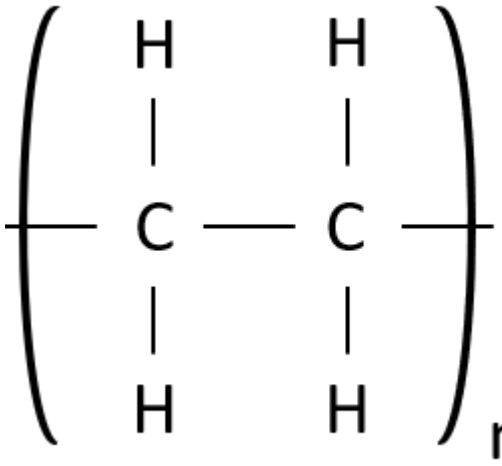
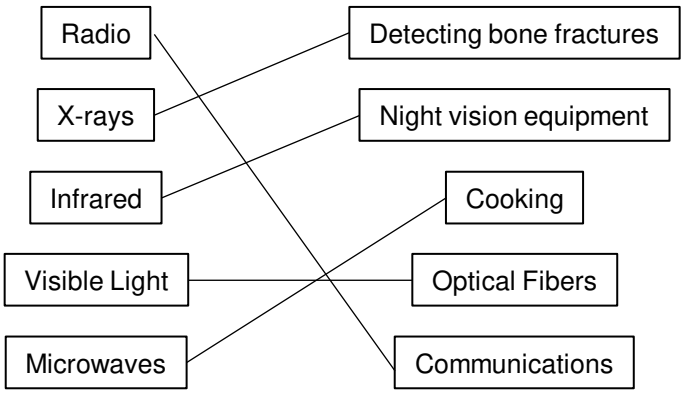
	SOLUTIONS: Combined Science Sample Paper 2022/2023	
1(a)	alternative / different / one form of a gene Or mutation of a gene	[1]
1(b)	Has two alleles that are the same	[1]
1(c)		[2] 1 mark for correctly completed for parents 1 mark for correctly completed for children
1(d)	they have one dominant allele / 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

2(e)	Any **two** from: • 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: • 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: • Food availability / competition • Predators • Disease • Parasitism • Presence of pollinating insects • Availability of nesting locations Any **one** abiotic factor from: • 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: • 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]

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: • Light intensity • Carbon dioxide concentration • Temperature • Water / rainfall amount	[2] 1 mark per correct answer.
4(d)	All **four** from: • 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: • 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]

7(a)	water and oxygen	[1] both conditions required
7(b)	Coated with a layer of zinc	[1]
	Any **one** from: • 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)	$Na_2CO_3 + 2\ HCl \rightarrow 2\ NaCl + H_2O + 2\ CO_2$	[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 (C_nH_{2n+2})	[1]
10(b)	Butane	[1]
10(c)	monomers	[1]

10(d)		[1]
10(e)	Cannot be broken down by bacteria in the environment	[1]
10(f)	Any **two** from: • 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)	Any **two** from: • 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]

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 $= 15 \times 30$	[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: • 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]

14(a)	Any **five** statements from: • Car C reaches a maximum speed of $15\ \mathrm{m/s}$ (at $12\ \mathrm{s}$) • Car D reaches a maximum speed of $30\ \mathrm{m/s}$ (at $10\ \mathrm{s}$) • Car C travels for $4\ \mathrm{s}$ longer than car D • Car C has an acceleration of $1.25\ \mathrm{m/s^2}$ (from 0s to $12\ \mathrm{s}$) • Car D has an acceleration of $5\ \mathrm{m/s^2}$ (from $4\ \mathrm{s}$ to $10\ \mathrm{s}$) • Car C travels a total distance of $120\ \mathrm{m}$ • Car D travels a total distance of $210\ \mathrm{m}$	[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
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