OCR
Oxford Cambridge and RSA

GCE

Science

Unit **G642**: Science and Human Activity

Advanced Subsidiary GCE

Mark Scheme for June 2016

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All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

Question			Answer/Indicative content	Mark	Guidance
1	a	i	Ozone absorbs uv radiation (from sun); **More** uv radiation reaches surface AW; (Uv radiation) causes **skin** cancers /melanoma / damages **cells** / damages or mutates DNA AW;	3	Mention of IR radiation being absorbed is CON for final MP ACCEPT "penetrates through atmosphere" REJECT "stops UV", "prevents UV reaching surface IGNORE references to warming effect NOT "mutation" alone ALLOW cataracts form
		ii	Provide alternative pathway / route / mechanism; With lower activation energy; OR speed up reactions; Is not permanently changed / not used up **at end of reaction;**	2	ALLOW react (to form an intermediate) followed by reforming of catalyst OR example of such a pathway; Answer can be on basis of either description of catalyst (but not a mixture of both)
	b	i	C is +, Cl is –; Both charges shown as δ+, δ-;	2	2nd MP depends on correct polarity of bond IGNORE polarity of C-F bond, but any **+ve** charges on other Cl atoms CONs 1st MP IGNORE numbers on charges
		ii	Biggest difference in electronegativity (between C and F);	1	Must be comparative i.e. REJECT "big difference in electronegativity" Comparison between Cl and F is CON
		iii	Tetrahedral	1	ACCEPT drawing of a tetrahedral structure Mention of other shapes e.g. square planar CONs this mark
	c		HCFC 123; Not lowest ODP, but is acceptable given other factors; Boiling point of HCFC123 is similar to CF-11 / is liquid at room temperature; HCFC123 (or 134a) is non-flammable;	4	Mention of any other compound as suitable is CON unless it is clear that HCFC is the best choice Last 2 MP can be scored even if incorrect replacement chosen Look for idea of compromise between ODP and other factors MP 3 and 4 are independent of choice of replacement ACCEPT propane not suitable as it is flammable

Question			Answer/Indicative content	Mark	Guidance
2	a		Nucleotides Phosphate Double Hydrogen Codon Amino acids	4	6 correct = 4 5 correct = 3 3,4 correct = 2 1,2, correct = 1
	b		Brings (correct) **amino acid** (to ribosome); **Anticodon on tRNA** (attaches to / binds to mRNA) Recognises / bonds to / complements AW **codon on mRNA** AW;	2	If in doubt, look for idea of amino acid being attached to tRNA NOT "finds amino acid". "codes for amino acid" Any implication that tRNA contains more than one anticodon is CON Need some indication of an interaction between tRNA and codon ALLOW **3 bases** / **triplet of bases on mRNA**

Question			Answer/Indicative content	Mark	Guidance
3	a	i	**Molecules / particles** have kinetic energy / moving randomly; Collide with **surfaces / walls** (of a container) AND exert a force; Pressure = force / area ACCEPT N per m^2;	3	Must clearly link to particles IGNORE vibration Must be a clear link between collision and force ACCEPT "hits", "bounces off" etc Mark independently
		ii	F = P x A ; 5.05 AND 10^7;	2	ALLOW substitution of relevant numbers i,e 1.01 (x 10^5) x 500 5.05 x 10^7 scores both marks
	b	i	Arrow pointing from W to E	1	Allow arrow starting from any direction between NW and SW Opposing arrows are CON
		ii	Winds blow / air moves from high to low pressure; **Deflected** clockwise / to the R (in the N hemisphere)	2	"Pressure moves" is CON IGNORE reference to Coriolis effect without a description
	c		The positions of (high pressure and low) pressure would be reversed; High pressure over Iceland OR low pressure over Portugal AW	2	High pressure over Iceland AND low pressure over Portugal scores 2 Need to specify position of pressure for 2nd MP
	d	i	Off coast of N. Norway OR off coast of SW Greenland;	1	Marked point should be close to end of shading representing the current Other incorrect crosses CON this mark
		ii	Sea water becomes denser OR dense water sinks; Due to evaporation of water OR **increase** of salt concentration /**increase** in salinity; And cooling effect (of winds, contact with melting ice)	3	IGNORE reference to ice formation

Question			Answer/Indicative content	Mark	Guidance
4	a	i	(Oxygen) is **reduced;** From 0 to -2;	2	"oxidation is reduced" is CON ALLOW oxidation number/ state goes down AW by 2 IGNORE reference to S atoms
		ii	2; H_2O;	2	ALLOW ½ in front of O_2 and all other numbers = 1 or no number added
		iii	Dissociates / ionises / splits up AND **produces H+** ions; Completely / fully; $H_2SO_4 \rightarrow H+ + HSO_4-$ or $2H+$ and $SO_4^{2-;}$	3	H+ part of mark can be awarded if H+ appears **as a product** in equation (even if the equation is not correct) Needs to be linked to dissociation etc(even if 1st MP is not awarded) Equation must balance
	b		**Titration method** 1.Place alkali in (conical) flask AND place (first sample of) acid rain in burette ; 2.Using (volumetric) **pipette** 3.Add **few drops** of indicator; 4.Add acid to alkali (or vice versa) AND slowly / drop-by-drop (near end point); 5.Until indicator changes colour; 6.Repeat and **take averages of consistent / concordant results** AW **Comparing acids** 1.Repeat with **second** sample of acid rain; 2.Most acidic sample will produce smallest titre (if acid added to alkali) OR largest titre if alkali added to acid;	8	ALLOW acid and alkali swopped around Use of Universal Indicator is CON for this mark Or gives example of a colour change e.g. goes pink 5 max if steps are not in correct order Look carefully to see if 2nd sample is referred to. Do not award for simply describing repeating the process ACCEPT "repeat with each sample"

Question			Answer/Indicative content	Mark	Guidance
5	a	i	Vibrates (with greater energy)	1	IGNORE reference to kinetic energy
		ii	Wavelength is 1/3000 cm (= 3.33 x 10^{-4} cm); 3.33 x 10^{-6} m;	2	Ecf from incorrect wavelength ALLOW any no of sig figs inc use of recurring 3 0.03(3) scores 1 without any working
		iii	Frequency = c / λ; = 3 x 10^{8} / 7.69 x 10^{-6} = 3.9 x 10^{13} (Hz);	2	Or substitutes numbers into rearranged equation ALLOW any number of sig figs NO ecf from incorrectly rearranged formula
	b	i	Same number of protons AND different number of neutrons ; Specifies 6 protons AND 6 / 7 neutrons;	2	ALLOW same atomic number AND different mass / nucleon number NOT "same element" Specfiies atomic number = 6 and mass numbers 12/13
		ii	**Frequency / wavenumber** / wavelength **of IR absorbed / peaks** will be different; **Frequency** depends on mass (of atoms in the bonds)	2	ALLOW extra **peak** at different frequency / wavenumber seen if ^{13}C present. Must refer to spectrum IGNORE references to height /intensity of peaks ALLOW Mass of C atoms is different if frequency mentioned in 1st MP
	c	i	$^{14}_{7}N$	2	1 mark for each number
		ii	Carbon 14 has a half-life of 5740 years; After millions of years there would be (almost) no carbon-14 remaining;	2	 QWC: must clearly link to **short half-life and great length** of time since organisms might have been alive
	d		1.**Visible / high frequency** radiation from Sun; 2.Absorbed (by Earth) / warms surface (of Earth); 3.Earth emits infrared radiation; 4.Infrared radiation is absorbed by greenhouse gases / methane; 5.increases energy of **molecules** in atmosphere; 6. Reradiate energy back to surface / pass on energy by collision ; 7. Prevents radiation being emitted into space ANY 5	5	ACCEPT uv NOT sunlight ALLOW "trapped (by greenhouse gases) Reflects IR is CON to mp6 ALLOW "leaves the atmosphere"

Question			Answer/Indicative content	Mark	Guidance
6	a		Carbon dioxide AND water	1	Any other ticks are CON
	b		A: (alpha) helix B: active site C: (beta pleated) sheet	1	All 3 necessary for 1 mark
	c	i	Activity **increases with pH** AW (e.g. between pH 7 and pH 8.3; Reached **maximum at pH 8.3** No / little change in activity **above pH 8.3;** OR fastest rate of change AW between 7.5 and 8.0	3	REJECT e.g. increases between pH 7 and pH 8.3 ALLOW **maximum at pH 9** ALLOW optimum activity (but not "optimum pH" alone ALLOW (very) little change between 8.3 and 9. NOT doesn't change above REJECT little change above **pH 8**
		ii	Substrate must **fit into / bond to active site**; (Changes in pH) affect **charges** on (amino acid side groups in active site); Alters **shape** of **active site** OR ability of **active site** to **bond to** substrate	3	IGNORE "react with active site", "entering active site", IGNORE lock and key ALLOW affects **ionic** bonding IGNORE reference to other types of bond IGNORE "denatures enzyme" Active site must be mentioned for MP 1 and 3 e.g. "Alters shape of **active site** so that substrate cannot fit " scores 2 (MPs 1 and 3) Reference to substrate changing shape is CON for 3rd MP
	d	i	**Prevents / reduces /slows** global warming / greenhouse effect	1	REJECT "CO_2 is a greenhouse gas"
		ii	High temperatures **break bonds** holding **tertiary structure / 3-D structure / shape of active site;** Hydrogen bonds; Denatures enzyme;	3	NOT bonds in enzyme / bonds holding amino acids together
		iii	(No) because enzymes are **specific**(to one substrate) OR CO and CO2 have different shapes; CO cannot **fit into / cannot bond to** active site / enzyme; AW (Yes) because CO has a similar shape / structure / size to CO_2; CO might also be able to fit into active site	2	ALLOW only complementary to one substrate AW

Question			Answer/Indicative content	Mark	Guidance
	e		**7-8 marks** **Describes at least one valid advantages and disadvantages of each of the 4 methods** **OR describes at least 3 methods in detail (e.g if fission and fusion discussed together)** **AND** **Evaluates the relative strength of some of these advantages and disadvantages to make a reasoned case for choice of strategy** *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.Clear and confident knowledge of relevant technical language.* **4-6 marks** **Describes at least one advantage and disadvantage for 2 or 3 methods** **AND** **Provides brief justification for chosen strategy, with some reference to the advantages and disadvantages described** *There is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence.* *Sound grasp of relevant technical language* **1-3 marks** **Describes a limited range of advantages and / or disadvantages for one or more of the strategies** **AND** **Probably selects a strategy but with little justification attempted** *The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.*		Points to be made could include: • Nuclear fission can be achieved using available technology • (relatively) cheap source of radioactive fuel • Risk of leaks, explosions or use by terrorists • Large decommissioning cost for power stations • Nuclear fusion not yet possible • Nuclear fusion uses only hydrogen (from water) • No radioactive emissions from nuclear fusion • Carbon capture allows fossil fuels to be burnt • Need to find somewhere to store carbon dioxide (safely) • Technology not yet developed • Technology expensive • Alternative energy can be used on local or small scale • No emissions or other pollutants • May be ugly or affect wildlife • May be unreliable (winds, sun, waves etc) IGNORE reference to no CO2 produced for any of the energy sources If no strategy is selected, then maximum mark = 3

Method	Advantages	disadvantages
Carbon capture	Allows fossil fuels to continue to be burnt; Power stations use available technology Can remove co2 already in the atmosphere	Need to find somewhere to store CO2; Technology not yet developed / likely to be expensive Other pollutants / SOx etc can still reach atmosphere
Nuclear fission	Uses available technology Relatively cheap / available nuclear fuel Produces a lot of energy from **small mass of fuel**	Risk of leaks / explosions / radioactive waste Risks of use of nuclear fuel by terrorists Large decommissioning cost for power stations / storage of nuclear waste
Nuclear fusion	Uses only hydrogen (from water) Produces a lot of energy from **small mass of fuel** No / little radioactive emissions	Technology not yet developed More energy needed to create high temperatures than is released by fusion / high temperature needed
Alternative energy	No emissions or pollutants Renewable Can be cheap / can be used on small scale Uses available technology Not very efficient / doesn't produce	May be ugly or affect wildlife May be unreliable / e.g. lack of wind or sunlight

Question			Answer/Indicative content	Mark	Guidance
7	a	i	Region (of space) in which a force; ..is experienced by a magnetic pole / moving charge AW;	2	ACCEPT area etc ACCEPT attraction etc ACCEPT magnet. 2nd MP is dependent on 1st
		ii	Lines are closer together / flux density increases AW ora	1	NOT just "more lines"
	b	i	Current is alternating; So **direction** of field (lines) alternates;	2	ACCEPT "magnetic field (line) reverses"
		ii	To reduce power loss;	1	Accept energy / heat loss NOT "no heat loss"
	c	i	I = W / V; 3150 x 10^6 / 650 x 10^3 (=4846); 4850 (3 s.f.) A;	4	4846 scores 2 even without working 3rd MP can be scored from any answer to 3 s.f. based on a calculation using both pieces of data 4.85 scores 2. 4.846… etc scores 1 4840 (i.e. incorrect rounding) scores 2 Accept 4.85 kA for 4 marks
		ii	Fields are not **alternating** / only **alternating fields** likely to cause health risks	1	

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