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A-LEVEL

# Science in Society

SCIS1 Exploring Key Scientific Issues

Mark scheme

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2400

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Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from [aqa.org.uk](http://aqa.org.uk)

Question	Answers	Additional Comments	Mark
1(a)(i)	antibodies produced allows white blood cells engulf and destroy cell	allow toxins neutralised for 1 mark. accept 'raise temperature of body to kill fungus for 1 mark	2
1(a)(ii)	HIV destroys/weakens the immune system (therefore) patient does not have immune response to pathogens.	allow antibodies not produced	1
1(b)(i)	<ul style="list-style-type: none"> <li>• Details of randomisation / can't choose which group</li> <li>• Specific details of trial / medical worker / timescale of trial</li> <li>• Information about CM / medicines</li> <li>• any risks (side effects) of the <u>antifungal</u> treatment</li> <li>• that they can withdraw if they wish</li> <li>• how their data will be stored / used</li> </ul>	not 'one group will get better care'	2
1(b)(ii)	<ul style="list-style-type: none"> <li>• healthier patients put in the standard care group – might survive longer so treatment wouldn't look as good (and v.v.).</li> <li>• sicker patients put in the standard care group – wouldn't survive as well – treatment looks better</li> <li>• patients from particular area put into one group – might not be same level of fungus in the soil so will change results / not representative</li> </ul>	do not credit ' <i>will lead to biased results</i> '  for 2 marks must give some indication of how the outcomes would be effected.	2
1(b)(iii)	<ul style="list-style-type: none"> <li>• <u>compare</u> different health care practices (countries)</li> <li>• larger number of patients / logistics</li> <li>• take account of (control for) patient differences in different areas</li> <li>• results (trends) more representative</li> </ul>	allow ' <i>reduce effect of anomalies</i> '  allow ' <i>promote sharing of good practice</i> '	2
1(c)(i)	<ul style="list-style-type: none"> <li>• care+support always lower %mortality than standard care</li> <li>• mortality <u>rate</u> is lower in care+support / gradient lower</li> <li>• after 3 months mortality rate decreases (for both) / v.v.</li> <li>• after 6 months care+support %mortality shows less increase</li> <li>• difference in %mortality increases with time</li> </ul> <p>allow 1 additional mark for data to support any of the points given.</p>	do not credit incorrect uses of 'mortality rate'  allow 'mortality increases over time for both groups.'	3

1(c)(ii)	<p>% mortality in standard care = 20.5% (allow 20.4 – 20.6)</p> <p>% mortality in care+support = 15.8% (allow 15.7-16.0)</p> $\frac{(\%mortality\ standard - \%mortality\ care + support)}{\%care + support}$ <p>(20.5 – 15.8)/20.5 = 22.9% (allow 21.6 – 23.8)</p>	<p>both figures correct for 1 mark</p> <p>allow ecf for final mp</p>	2
<b>Total</b>			<b>1</b>
2(a)(i)	<p>carbon monoxide, / CO</p> <p>nitrous oxides / NO<sub>x</sub></p> <p>particulate matter / PM<sub>10</sub> / Soot</p> <p>sulfur dioxide</p>	<p>allow</p> <ul style="list-style-type: none"> <li>• water <u>vapour</u></li> <li>• SO<sub>x</sub></li> </ul>	2
2(a)(ii)	<p><i>The problem:</i></p> <p>emissions can cause health issues</p> <p>e.g. breathing difficulties /other named health issue</p> <p><i>Why EV improves:</i></p> <p>EV would reduce these local emissions – decrease in named issued - so health improves</p>	<p>accept named particulate linked to health issue</p> <p><b>accept</b> 'cleaner air' for 1 mark</p> <p><b>not</b> CO<sub>2</sub> / global warming</p>	2
2(a)(iii)	<ul style="list-style-type: none"> <li>• manufacturing processes likely to use fossil fuels – named example of processes e.g. car transporter / shipping</li> <li>• after purchase no CO<sub>2</sub> produced by car itself (BUT)</li> <li>• batteries have to be charged using electricity - mostly generated by burning <u>fossil fuels</u></li> </ul> <p>HOWEVER</p> <ul style="list-style-type: none"> <li>• Electricity could be generated from renewable sources</li> </ul>	<p>any point for 1 or 2 marks each</p>	2
2(b)(i)	<p>YES:</p> <ul style="list-style-type: none"> <li>• % of electric vehicles increasing – fewer emissions at point of use</li> </ul> <p>NO:</p> <ul style="list-style-type: none"> <li>• Little change between 2011 and 2014 – other explanation for increase, not government plan.</li> <li>• very small percentage (1%) of car registrations</li> <li>• doesn't know about change in other forms of transport</li> <li>• number of other cars could also be increasing</li> <li>• may burn fossil fuel to produce the electricity to charge battery</li> <li>• drops again in 2015</li> </ul>	<p>allow suitable data to support points for 1 mark</p> <p>max 2 if positive only</p>	3

2(b)(ii)	<p>yes</p> <ul style="list-style-type: none"> <li>• more expensive than normal cars</li> <li>• persuade more people to buy them / normalise ownership</li> <li>• could lead to improvement in health</li> <li>• help government to meet emissions targets</li> <li>• grants might be cheaper than other methods to reduce emission</li> </ul> <p>no</p> <ul style="list-style-type: none"> <li>• subsidising the well-off / no second-hand market</li> <li>• subsidise public transport more</li> <li>• could increase cost of petrol to reduce driving / other named measure to reduce CO<sub>2</sub> emissions</li> </ul>		2
<b>Total</b>			<b>11</b>
3(a)(i)	<ul style="list-style-type: none"> <li>• similar in initial health for comparison</li> <li>• easy to measure outcomes (as more likely to suffer another attack)</li> <li>• other recruits might not have a heart attack during the trial</li> <li>• have more incentive to take part</li> </ul>	<p><i>Allow diet may already be high in fat</i>  <i>allow men more likely to suffer from CHD</i></p>	1
3(a)(ii)	<ul style="list-style-type: none"> <li>• no women - might respond differently to changes in diet</li> <li>• mostly already ill – healthy people might be less prone to heart attacks so diet wouldn't help as much.</li> <li>• only over 30yrs – younger people might not need to reduce fat / less at risk.</li> <li>• Only under 70yrs – might have a higher rate of heart attacks.</li> </ul>	<p>any 1 or 2 for 1 or 2 marks</p>	2
3(b)	<p><b>RCT</b>  <i>benefits:</i>                  allows change to be made and outcome studied                  provide stronger evidence of causal links  <i>Disadvantage</i>                  only simple changes can be studied                  patients might not stick to diet regime                  expensive for large numbers                  tends to be shorter length                  ethical to encourage all to eat healthy diet if think there is benefit</p> <p><b>Cohort</b>  <i>benefits</i>                  long term                  gathers medical history of patient / identify other important factors                  larger scale</p>		4

	<p><i>disadvantages</i></p> <p>can't make changes in diet / just see what people do</p> <p>identify correlations, not causation</p> <p>self-report may be inaccurate, people misremember</p> <p>participants may drop out</p> <p>expensive to monitor for long time</p>		
3(c)	<ul style="list-style-type: none"> <li>• Overall risk ratio (diamond) is 1</li> <li>• Most studies (bars) crossed the RR = 1 line / show no benefit either way</li> <li>• All studies have quite small samples</li> <li>• studies with larger samples showed no significant difference between the groups.</li> <li>• Better quality study (F) has RR&lt;1</li> <li>• A/B have high RR, and low quality</li> <li>• G is only one with large square which shows RR&gt;1 (just)</li> </ul> <ul style="list-style-type: none"> <li>• Studies about risk of death, not 'living longer'</li> <li>• Not enough information about the type of fat</li> </ul>		3
3(d)	<p>Yes</p> <ul style="list-style-type: none"> <li>• Men: rate of decrease of CHD increases from about 1985</li> <li>• Women: less change than for men, but slope of graph is (slightly) steeper after 1985</li> <li>• delay in change - it might take a few years for advice to be taken up.</li> </ul> <p>No</p> <ul style="list-style-type: none"> <li>• were previous drops, and rate had dropped before 1983</li> <li>• may be other factors causing both to change – named example of other factor</li> <li>• Not as effective for women</li> </ul>		3
3(e)	<ul style="list-style-type: none"> <li>• different lifestyle factors involved in CHD - named example</li> <li>• genetic influence on CHD</li> <li>• long time scales involved in the disease</li> <li>• if use RCT hard to get people to change diet for a long time - don't follow instructions/stick to diet</li> <li>• if use cohort studies show correlation – link to another factor</li> <li>• health depends on whole of diet, not just one food group</li> </ul>		3
<b>Total</b>			<b>16</b>
4(a)(i)	<u>electromagnetic</u> waves / radiation		1
4(a)(ii)	<ul style="list-style-type: none"> <li>• mutations in DNA/genes/cancer</li> <li>• cell / tissue damage caused by ionisation</li> <li>• burns / heating effect</li> </ul>	do not credit <i>mutate cells.</i>	2

4(b)(i)	<ul style="list-style-type: none"> <li>reducing exposure time</li> <li>increasing distance / leaving room / shielding</li> <li>protective clothing</li> <li>monitor yearly exposure</li> </ul>		2
4(b)(ii)	<ul style="list-style-type: none"> <li>Radiation <u>damage</u> happens over time, so long term exposure important too.</li> </ul>	not ' <i>radiation builds up over time</i> '	1
4(b)(iii)	<ul style="list-style-type: none"> <li>couldn't do their job if level too low</li> <li>benefit to society</li> <li>chosen risk / aware of risks</li> <li>monitored more closely / general public not monitored</li> <li>value still chosen to limit damage / ALARA</li> </ul>	not ' <i>they're more used to it</i> '	2
4(c)(i)	<ul style="list-style-type: none"> <li>To compare with current best practice</li> <li>allow changes in data to be observed</li> </ul>		1
4(c)(ii)	<ul style="list-style-type: none"> <li>controlling other variables</li> <li>so differences weren't due to lack of training / different knowledge.</li> </ul>		1
4(d)(i)	<ul style="list-style-type: none"> <li>to ensure that differences weren't random / due to chance / natural variation</li> </ul>		1
4(d)(ii)	<ul style="list-style-type: none"> <li>(radiation invisible)</li> <li>beeping meant they knew radiation level during operation</li> <li>more conscious of the risks<sup>2</sup></li> <li>doctors could change procedure immediately</li> <li>leading to a reduction in exposure</li> <li>(doctors) without bleeper don't know exposure so can't react to it.</li> </ul>		3
<b>Total</b>			<b>14</b>
5(a)(i)	8.5–9.1 cm		1
5(a)(ii)	<ul style="list-style-type: none"> <li>only small proportion of any species is fossilised</li> <li>have to die in place where fossilisation likely to occur</li> <li>specific example of suitable / unsuitable place</li> <li>may have been small number of hominin in species</li> <li>species existed for short time</li> <li>fossils may have been destroyed over time</li> <li>(example of) difficulty of finding fossil</li> </ul>	not ' <i>fossil would decay over time</i> '	2
5(b)(i)	<ul style="list-style-type: none"> <li>change in environment / geographical separation of different groups of individuals</li> <li>variation in characteristics (cause by mutation)</li> <li>(animal) hominid with favourable characteristics survives and reproduces</li> <li>favourable characteristic spreads through population</li> </ul>		3

5(b)(ii)	<ul style="list-style-type: none"> <li>links between different hominid species</li> <li>more information about the human 'family tree'</li> <li>show different characteristics of hominid species (ancestors)</li> <li>show how characteristics have changed over time / cumulative changes / intermediate stages</li> <li>help support the theory of evolution</li> </ul>	accept 'show characteristics that were not advantageous and did not persist' or v.v.	2
5(c)	<ul style="list-style-type: none"> <li>Not human - same group but different species</li> <li>Not first - species might have existed for long time before one individual was fossilised</li> </ul>	any 1 or 2 for 1 or 2 marks  max 1 if don't realise that they are from a different species and are not human	2
<b>Total</b>			<b>10</b>
6(a)(i)	point in time when universe began.  all of space is creating (from nothing) in this event	do not penalise 'explosion'	1
6(a)(ii)	13.7 billion		1
6(a)(iii)	<ul style="list-style-type: none"> <li>to establish precedence</li> <li>desire to be first to find evidence</li> <li>raise the profile of the research / public engagement</li> <li>attract more funding</li> </ul>	allow 'to get more feedback from peers'.	1
6(b)(i)	<ul style="list-style-type: none"> <li>Big bang</li> <li>inflation</li> </ul>		1
6(b)(ii)	patterns in the CMB		1
6(b)(iii)	inflation <u>and</u> dust	need both for mark	1
6(c)	<ul style="list-style-type: none"> <li>different sensitivities of instruments / can look at different features of radiation</li> <li>different areas of expertise</li> <li>allows comparison - more confidence in results if they are similar – identify possibly anomalies</li> <li>results not due to method used</li> </ul>		2
6(d)	<ul style="list-style-type: none"> <li>Aim to get a good description of the world and phenomena. – this could be called 'truth'.</li> <li>scientific process –                             <ul style="list-style-type: none"> <li>suggest hypotheses,</li> </ul> </li> </ul>	max 2 marks for description	3



	<ul style="list-style-type: none"> <li>○ make predictions,</li> <li>○ gather data to eliminate ideas(hypotheses) that are incorrect.</li> <li>• ideas that survive are closer to 'the truth' than earlier ones.</li> <li>• aim is to disprove hypotheses (not prove them) / eliminate incorrect ideas</li> <li>• always a level of uncertainty</li> <li>• different interpretations (disagreements) amongst scientists</li> <li>• bicep2 was initially wrong – research discovered new information / ideas</li> </ul>	of scientific process	
<b>Total</b>			<b>11</b>
7(a)	<ul style="list-style-type: none"> <li>• each cell contains half of parents alleles</li> <li>• sperm and egg merge so offspring has full set of alleles</li> <li>• so combination produces random mix of characteristics in each child (fertilisation)</li> <li>• recessive / dominant genes affect characteristics</li> </ul>	accept use of 'gene' instead of allele. Accept correct use of chromosomes Accept 'alleles are randomly selected in egg / sperm' for one mark	3
7(b)	<ul style="list-style-type: none"> <li>• choosing which embryo will survive - deliberate destruction of one embryo</li> <li>• think that life begins at conception – effectively murder</li> <li>• Shouldn't alter the inherited characteristics of a child</li> <li>• eliminating disability</li> <li>• children won't know all their genetic history – could be other diseases that they may be susceptible</li> <li>• children may want to trace their third 'parent' / donor rights</li> <li>• 'three parents' against tradition</li> <li>• Develop alternative technique exists which doesn't destroy embryos'</li> </ul>	do not credit 'playing God' without additional explanation	3
7(c)	<ul style="list-style-type: none"> <li>• important that process is standard across country and providers</li> <li>• safeguard people wanting to use the process</li> <li>• set safety of process</li> <li>• independent from government and industry</li> <li>• researchers may want to be first with discovery, and not think about implications</li> <li>• ethical standards applied</li> <li>• prevent unethical practices e.g. eugenics</li> <li>• select/recommend best method from different options</li> </ul>		2

7(d)				6
Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response.				
<b>0 marks</b>	<b>Level 1 (1–2 marks)</b>	<b>Level 2 (3–4 marks)</b>	<b>Level 3 (5–6 marks)</b>	
	simplistic or generic answer about consequences of 'designer babies'	attempts to address practical and/or regulatory issues.	both practical and regulatory issues addressed  Must consider the difficulty of identifying all the genes for desirable traits such as IQ, height or even eye colour	
<p><b>examples of the points made in the response</b></p> <p><b>Practical</b></p> <p><i>Unlikely:</i></p> <ul style="list-style-type: none"> <li>• to choose most characteristics would need to alter many genes</li> <li>• don't know all genes for different characteristics</li> <li>• altering genes could lead to unexpected consequences</li> <li>• limited to those with money</li> </ul> <p><i>Likely:</i></p> <ul style="list-style-type: none"> <li>• Techniques for mitochondrial and IVF already possible – science will continue to develop</li> <li>• Could reduce incidence of <u>single gene</u> diseases</li> </ul> <p><b>regulatory</b></p> <p><i>Likely:</i></p> <ul style="list-style-type: none"> <li>• already a regulatory body to oversee any changes</li> <li>• regulations could limit cases that were acceptable.</li> <li>• Change only after public discussion</li> <li>• Possible development of existing techniques / uses</li> <li>• May happen in more unregulated countries</li> </ul> <p><i>Unlikely:</i></p> <ul style="list-style-type: none"> <li>• Mitochondrial technique doesn't affect the majority of characteristics of a person</li> <li>• currently illegal to alter DNA of nucleus (characteristics) for babies that are born</li> <li>• illegal to carry out sex selection of embryo</li> <li>• religious/ethical objections in general public</li> </ul>			<p><b>extra information</b></p> <p>Level 3 answers must include a recognition of the difficulty of multi-gene editing.</p>	