Markscheme

May 2017

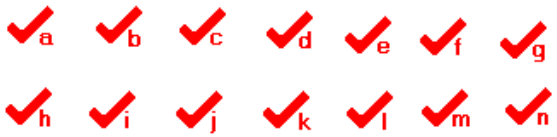
Nature of Science

Standard level

Paper 1

15 pages

The following are the annotations available to use when marking responses.

Annotation	Explanation	Shortcut
	Correct point (automatically awards 1 mark when stamped)	ALT 1
	These are annotations which can be used to show which marking point was used to award a mark. It is easier to use these than to pick up the tick stamp and then the text box (they each automatically award 1 mark when stamped)	
	Quality marks awarded for clarity and structure (these each automatically award 1 mark when stamped)	
	Pointer (use when you want to delete an annotation or change colour)	
	Benefit of the doubt	ALT 5
	Error carried forward	
	Irrelevant, a significant amount of material that does not answer the question	ALT 4
	Contradiction	
	Omission/incomplete	ALT 3
	Too vague	
	No working shown	
	Unclear	ALT 2

Annotation	Explanation	Shortcut
	This is a dynamic annotation; it can be used to surround work	
	This is a dynamic, vertical wavy line that can be expanded (for instance, to highlight a section of irrelevant work)	
	This is a dynamic, vertical wavy line that can be expanded (for instance, to highlight a section of irrelevant work)	
	Valid part (to be used when more than one element is required to gain the mark e.g. drawings)	
	Same as	
	Or words to that effect	ALT 6
	Advantage / pro (to identify elements in an unclear discussion when pairs are required).	
	Disadvantage / con (to identify elements in an unclear discussion when pairs are required)	
	Difference (to identify elements in an unclear comparison)	ALT 7
	Similarity (to identify elements in an unclear comparison	ALT 8
	Highlight, stamp and drag out to highlight an area of the script	
	Text box used for additional marking comments. It can be linked to a specific tick if that is appropriate (please see pages 7–8 for more information)	
	Seen; to be stamped on parts of a question or option which have been left blank.	ALT 9
0	Zero; to be used when a question part is not worthy of credit. Awards zero for the question part.	ALT 0

You **must** make sure you have looked at all pages. Please put the  annotation on any blank page, to indicate that you have seen it.

General Marking Instructions

Assistant Examiners (AEs) will be contacted by their team leader (TL) through RM™ Assessor, by e-mail or telephone – if through RM™ Assessor or by e-mail, please reply to confirm that you have downloaded the markscheme from IBIS. The purpose of this initial contact is to allow AEs to raise any queries they have regarding the markscheme and its interpretation. AEs should contact their team leader through RM™ Assessor or by e-mail at any time if they have any problems/queries regarding marking. For any queries regarding the use of RM™ Assessor, please contact emarking@ibo.org.

1. Follow the markscheme provided, award only whole marks and mark only in **RED**.

2. Make sure that the question you are about to mark is highlighted in the mark panel on the right-hand side of the screen.

3. Where a mark is awarded, a tick/check (✓) **must** be placed in the text at the **precise point** where it becomes clear that the candidate deserves the mark. **One tick to be shown for each mark awarded.**

4. Sometimes, careful consideration is required to decide whether or not to award a mark. In these cases use RM™ Assessor annotations to support your decision. You are encouraged to write comments where it helps clarity, especially for re-marking purposes. Use a text box for these additional comments. It should be remembered that the script may be returned to the candidate.

5. Personal codes/notations are unacceptable.

6. Where an answer to a part question is worth no marks but the candidate has attempted the part question, use the “ZERO” annotation to award zero marks. Where a candidate has not attempted the part question, use the “SEEN” annotation to show you have looked at the question. RM™ Assessor will apply “NR” once you click complete.

7. If a candidate has attempted more than the required number of questions within a paper or section of a paper, mark all the answers. RM™ Assessor will only award the highest mark or marks in line with the rubric.

8. Ensure that you have viewed **every** page including any additional sheets. Please ensure that you stamp “SEEN” on any additional pages that are blank or where the candidate has crossed out his/her work.

9. Mark positively. Give candidates credit for what they have achieved and for what they have got correct, rather than penalizing them for what they have got wrong. However, a mark should not be awarded where there is contradiction within an answer. Make a comment to this effect using a text box or the “CON” stamp.

Subject details: Nature of science standard level paper 1 markscheme

Candidates are required to answer **all** questions in Section A and Section B. Maximum total = **60 marks**.

1. Each row in the "Question" column relates to the smallest subpart of the question.

2. The maximum mark for each question subpart is indicated in the "Total" column.

3. Each marking point in the "Answers" column is shown by means of a tick (✓) at the end of the marking point.

4. A question subpart may have more marking points than the total allows. This will be indicated by "**max**" written after the mark in the "Total" column. The related rubric, if necessary, will be outlined in the "Notes" column.

5. An alternative word is indicated in the "Answers" column by a slash (*/*). Either word can be accepted.

6. An alternative answer is indicated in the "Answers" column by "***OR***". Either answer can be accepted.

7. An alternative markscheme is indicated in the "Answers" column under heading **ALTERNATIVE 1** *etc*. Either alternative can be accepted.

8. Words inside chevrons **« »** in the "Answers" column are not necessary to gain the mark.

9. Words that are <u>underlined</u> are essential for the mark.

10. The order of marking points does not have to be as in the "Answers" column, unless stated otherwise in the "Notes" column.

11. If the candidate's answer has the same "meaning" or can be clearly interpreted as being of equivalent significance, detail and validity as that in the "Answers" column then award the mark. Where this point is considered to be particularly relevant in a question it is emphasized by ***OWTTE*** (or words to that effect) in the "Notes" column.

12. Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.

13. Occasionally, a part of a question may require an answer that is required for subsequent marking points. If an error is made in the first marking point then it should be penalized. However, if the incorrect answer is used correctly in subsequent marking points then **follow through** marks should be awarded. When marking, indicate this by adding **ECF** (error carried forward) on the script.

14. Do **not** penalize candidates for errors in units or significant figures, **unless** it is specifically referred to in the "Notes" column.

Section A

Question			Answers	Notes	Total
1.			D		**1**
2.			B		**1**
3.			C		**1**
4.			D		**1**
5.			A		**1**
6.	**a**		0.3×10^9 ***OR*** 3×10^8 ***OR*** 300 million ***OR*** 0.3 billion **«**years**»** ✓		**1**
	b		radioactive dating ***OR*** comparing radioactive isotopes found in rocks ***OR*** Uranium dating ✓ using elements with long half-lives ***OR*** named verifiable examples ✓ using known decay rates ✓		**2 max**
	c		plate tectonics ***OR*** Earth's crust is made up of moving plates ✓ surface of Earth constantly changing ***OR*** seismic/volcanic activity ✓ lava formation ***OR*** Earth's surface **«**only**»** partially solidified at that time ✓		**2 max**

<table>
<tr><th colspan="3">Question</th><th>Answers</th><th>Notes</th><th>Total</th></tr>
<tr><td>7.</td><td>a</td><td></td><td>ranked by mass within a group ✓
«Mendeleev» arranged elements into groups with similar properties ✓
«model based on» observed patterns in chemical characteristics/properties of elements ✓
predicted the properties/existence/characteristics of missing elements ✓</td><td></td><td>2 max</td></tr>
<tr><td></td><td>b</td><td></td><td>
<table>
<tr><th>Early Greek understanding</th><th>Current understanding</th></tr>
<tr><td colspan="2">both used models ✓</td></tr>
<tr><td colspan="2">both used speculation and logic ✓</td></tr>
<tr><td>not based on experimental evidence</td><td>based on experimental evidence ✓</td></tr>
<tr><td>all matter made up of four elements OR fire, earth, air and water</td><td>many «about 92 naturally occurring» elements known ✓</td></tr>
<tr><td>solid atom the smallest particle that existed</td><td>atoms have an internal structure OR protons, neutrons, electrons OR existence of subatomic particles ✓</td></tr>
</table>
</td><td>Both early Greek understanding and current understanding needed for each mark.
Answers do not have to be given in a table.
Award mark for other relevant comparative discoveries.</td><td>3 max</td></tr>
</table>

Question			Answers	Notes	Total
8.	a	i	vitamin A an essential nutrient ✓ to prevent a deficiency of vitamin A ✓ to prevent «night» blindness ✓ to prevent dryness ***OR*** thickening ***OR*** xerophthalmia of eye ✓		**1 max**
	a	ii	data obtained using scientific methodology ***OR*** tested experimentally ***OR*** results published in peer reviewed scientific journals ✓ recognises health benefits of Golden Rice ✓ identifies possible consequences *eg loss of biodiversity* ✓ ethical aspects *eg* fair access/cost/company bias ✓		**3 max**
	b		nutrients provide «bio» chemicals (essential)/which we need for life ***AND*** additives are substances added to food for some named benefit *eg* preserve/enhance flavour/extend shelf life/improve appearance/ nutritional content ✓	*Please remember to apply OWTTE*	**1**

Section B

Question			Answers	Notes	Total
9.	**a**		«ancestral» population cut off from other islands ✓ variation in colour among individuals ✓ pink colour provided advantage/increased fitness *eg* camouflage ✓ individuals with pink colour survive/reproduce «more» successfully ✓ favorable colour characteristic ***OR*** alleles passed on to next generation ✓ «over time» accumulation of changes results in speciation/evolution ✓	*Mention of Lamarckianism, explicit or otherwise, reveals a lack of understanding of evolution eg they changed pink in their lifetime.*	**4 max**
	b		geographical distribution of species ***OR*** specific example of geographical distribution of species ✓ fossil record ✓ homologous anatomical structures of different mammals ✓ selective breeding ***OR*** artificial selection ✓		**2 max**
	c		evolution theory did not agree with the scientific thinking of the time ✓ challenged religious beliefs ✓ theory «of evolution by natural selection» also developed independently by Wallace ✓ logical sequence of ideas ***OR*** explanatory power ✓ Darwin's theory based on evidence *eg* fossils ✓ theory has not been falsified ✓	*Award **[2 max]** for answers that do not include both nonsupport and acceptance aspects.*	**3 max**
	d		comparing/testing/analyzing DNA ***OR*** genetic testing ***OR*** proteins between iguanas ✓ mitochondrial DNA ***OR*** mtDNA ***OR*** cytochrome C ✓	*Please remember to apply OWTTE*	**1 max**

(continued…)

(Question 9 continued)

Question			Answers	Notes	Total
	e		removal process itself difficult ✓ necessary to remove iguanas from natural habitat ✓ introduction of alien species ***OR*** introduction of diseases ***OR*** competition with native species✓ human intervention needed ***OR*** may interfere with natural processes ✓ cost/funding required for relocation ***OR*** pink land iguanas may have future value ✓ unethical to let species go extinct ✓ presence of predators ***OR*** availability of food source ✓	*Please remember to apply OWTTE*	**4 max**

10.	**a**	**i**	0.38 «natural gas» ✓		**1**
	a	**ii**	efficiency factor of wind much higher than coal ***OR*** wind efficiency is 11.64 and coal is only 0.29 ***OR*** wind has 40 times the efficiency factor of coal ✓		**1**
	a	**iii**	drilling ✓ piping ✓ insulation ✓ conversion of heat energy to electricity ✓ dismantling of facilities ✓ any other specific geothermal energy related factor ✓	*Cannot simply restate factors in stem of question or be general. Answer must relate specifically to geothermal energy.*	**2 max**

(continued…)

(Question 10 continued)

Question			Answers	Notes	Total
10.	**b**		*Advantages:* high thermal content/high J/kg/high energy density ✓ low production/running costs ***OR*** low costs of building and operating generating plant ✓ readily available resource ✓ cleaner than other fossil fuels ✓ *Disadvantages:* low efficiency factor ✓ non-renewable energy ***OR*** fossil fuel ***OR*** unsustainable ✓ high carbon emissions/footprint ***OR*** global warming ✓ security of supply ✓ cost of liquefaction ✓ safety ✓	*Award **[3 max]** for answers that do not include both advantages and disadvantages.*	**4 max**
	c	**i**	uranium-235/U-235/^{235}U/plutonium-239/Pu-239/^{239}Pu ✓		**1**

(continued…)

(Question 10c continued)

Question			Answers	Notes	Total
		ii	*Positive:* high energy density of nuclear fuel ***OR*** less fuel needed ✓ greater efficiency of energy conversion than fossil fuels ✓ lower greenhouse emissions ***OR*** lower carbon footprint **«**than fossil fuels**»** ✓ low accident rate ✓ radiation therapy ***OR*** production of medical isotopes ✓ medical diagnostics ✓ *Negative:* high cost of building/decommissioning nuclear reactors ✓ disposal of nuclear waste ✓ serious **«**health**»** consequences/accidents/meltdowns ***OR*** radiation poisoning ***OR*** increased cancer rate ✓ environmental/health impact of mining ✓ uranium is non-renewable ✓ terrorist threat ✓ production of fuel for nuclear weapons ✓	*Award **[3 max]** for answers that do not include both positive and negative issues.*	**4 max**
	d		lower cost ✓ batteries that store more electricity ***OR*** extended/increased range/efficiency of batteries ✓ lighter ***OR*** safer batteries ***OR*** eco-friendly✓ accessible chargers ***OR*** faster charging capabilities ***OR*** cheaper charging ✓ government support ***OR*** legislation *eg* climate change agreements/lower taxes/subsidies ✓ higher oil prices ***OR*** disruption of oil supplies ✓		**2 max**

Question			Answers	Notes	Total
11.	**a**	**i**	slow start 1960–1970/bigger slope at the end ✓ % of women using contraceptive drugs increases ✓ steep increase in contraceptive drug use between 1970 and 1976 ***OR*** from 2 to 20 % ✓ slower increase in contraceptive drug use after 1976 ***OR*** from 20 to 33 % ✓	*Allow 1969/71 to 1975/77.* *Allow 1975/77.*	**2 max**
	a	**ii**	overall decrease ✓ slight increase in number of births from 1960 to 1965 ✓ number of births decrease from 1964 to 1975 ✓ temporary increase from 1975 to 1980/1995 to 2000 ✓ number of births levels off ***OR*** plateaus ✓ accept any other valid statement from graph ✓	*Allow 1963/65 to 1974/76.* *Allow 1974/76 to 1979/81.* *Allow 1981 to 1983.*	**2 max**
	b		*Hypothesis is supported:* decrease in total number of births per woman as contraceptive drug use increases ✓ *Hypothesis not supported:* exception/periods where total number of births per woman increases ✓ contraceptive drug use continues to increase as total number of births per woman levels off ✓	*Allow 1976/78 to 1979/81.*	**2 max**

(continued…)

(Question 11 continued)

Question			Answers	Notes	Total
11.	**c**		contraceptive drug use prevents pregnancy ✓ data shows **«**strong**»** correlation between contraceptive drug use and total number of births per woman ✓ other factors/example **«***eg* economy/education**»** may contribute to total number of births ✓ leveling off of total number of births per woman when contraceptive drug use is increasing **«**shows contribution of other factors**»** ✓ there are other forms of contraception ✓ correlation does not confirm causation ✓ only 33% use pill, so there are confounders ✓		**2 max**
	d		companies/research organizations must sponsor/fund process **«**of testing a new drug**»** ✓ evidence from laboratory/animal experiment needed before human testing to determine safety/efficiency of drug ✓ clinical studies/testing on humans conducted ✓ prevention of pregnancy ***OR*** fertility measured/tested ✓ side effects measured/tested ✓ double blind testing provides most reliable data ✓ safety/effectiveness of drug must be demonstrated ✓ needs to be approved by an authority **«**national/international/legal**»** ✓		**3 max**