



Markscheme

May 2018

Nature of Science

Standard level

Paper 2

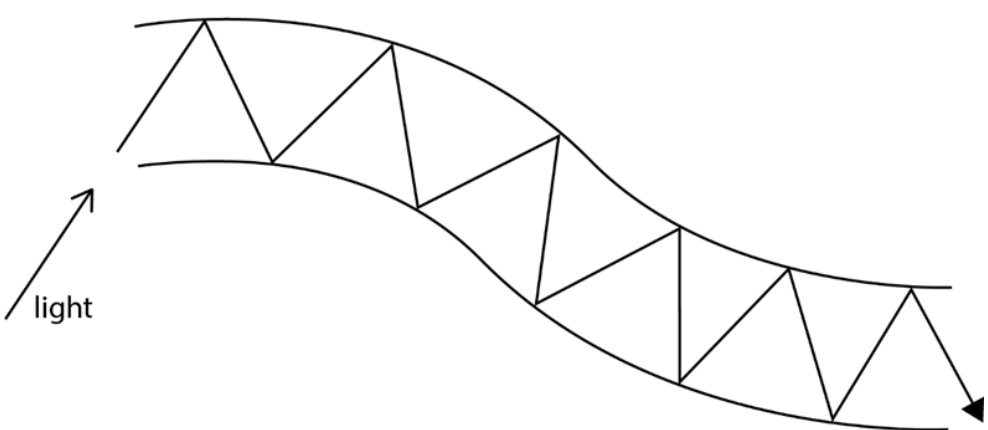
This markscheme is the property of the International Baccalaureate and must **not** be reproduced or distributed to any other person without the authorization of the IB Global Centre, Cardiff.

Question			Answers	Notes	Total
1.	a		a. fossils/rock samples from deep ocean ✓ b. absolute/radioactive/radiometric dating of rocks ✓ c. comparison with other «dated» fossils ✓	<i>Do not accept “C¹⁴”.</i>	2 max
1.	b		a. early atmosphere did not contain oxygen ✓ b. absence of photosynthetic bacteria/cyanobacteria ✓ c. no sunlight «in deep ocean» ✓	<i>Accept descriptions of Earth’s atmosphere without oxygen.</i>	2 max
1.	c		<i>Hypothesis supported:</i> a. high concentration/variety of chemicals «in hydrothermal vents» OR simple organic/carbon-forming reactions may have occurred «in this environment» ✓ b. age of fossils «found in region of hydrothermal vents» support existence of life ✓ <i>Hypothesis not supported:</i> c. cannot replicate «prehistoric» conditions ✓ d. cannot test/falsify hypothesis ✓	<i>mp a: Do not accept “nutrients”.</i>	3 max
1.	d		a. results can be replicated ✓ b. experiments provide verifiable evidence «that organic molecules can be produced» ✓ c. «laboratory» conditions are controlled/not the same as Earth’s early atmosphere ✓ d. “most” organic molecules cannot copy themselves/replicate ✓ e. cannot confirm that life originated from these organic molecules/building blocks of life ✓ f. Miller-Urey experiments demonstrate the origin of organic molecules ✓	<i>mp d: Accept “amino acids” for “organic molecules”.</i>	3 max

(continued...)

Question 1 continued)

Question			Answers	Notes	Total
1.	e		a. to confirm their existence/origin of life OR to determine whether they are active ✓ b. to detect the possibility of life ✓ c. to compare conditions on the moons with the early conditions on Earth/ a model of early Earth ✓		2 max

Question			Answers	Notes	Total
2.	a		a. radical/revolutionary change in understanding/current thinking «of vision and optics» ✓ b. earlier theories overthrown by new evidence/ideas ✓		1 max
2.	b	i		Award the marks for straight lines and angles; if arrows are missing do not award mp b.	2
2.	b	ii	«total» internal reflection ✓		1

(continued...)

(Question 2 continued)

Question			Answers			Notes	Total
2.	c			Optical fibres	Copper wires	mp a: do not accept “higher” or “lower” bandwidth.	3 max
			a.	greater bandwidth/more information/signals transmitted	lesser bandwidth/less information/signals transmitted ✓		
			b.	smaller cross-sectional area needed/less space	thicker cables/more space needed ✓		
			c.	greater «tensile» strength	less «tensile» strength ✓		
			d.	last longer/resists corrosion	must be replaced sooner/corrodes over time ✓		
			e.	less signal loss/signal travels farther «before amplification is needed» OR less interference	more signal loss over shorter distance OR more interference ✓		
			f.	messages transported by light signals	messages transported by electric signals ✓		
2.	d		a. make/record observations ✓ b. develop/test a hypothesis/make predictions ✓ c. collect evidence/data from «controlled» experimentation ✓ d. use of technology/computing power/models ✓ e. repeat experiments/measurements ✓ f. support results by scientific theory/mathematical analysis ✓			4 max	

Question			Answers	Notes	Total
3.	a	i	radio/microwaves ✓		1
3.	a	ii	a. «chemical/molecular» composition of universe/galaxies/stars ✓ b. identification/origin/development of stars and galaxies ✓ c. distribution of gas/dust in the Milky Way/universe ✓ d. strength/nature of the solar wind ✓ e. possible evidence of extraterrestrial life ✓ f. cosmic background radiation ✓	Accept “particles”.	2 max
3.	b		a. less water vapour in the air/water vapour absorbs radiation ✓ b. low dust/pollution levels ✓ c. cooler temperatures/heat generated by ALMA lost in cold air ✓	OWTTE but do not accept “weather”.	2 max
3.	c		a. shared costs/funding is easier ✓ b. exchange of information/debate/team work ✓ c. analysis from different perspectives ✓ d. less «political» bias ✓ e. information may be used for peaceful purposes ✓	OWTTE OWTTE	3 max

Question			Answers	Notes	Total
4.	a	i	a. gold foil experiment/Rutherford scattering ✓ b. most «alpha» particles pass straight through ✓ c. some particles deflected ✓ d. most of atom's mass found in small positively-charged core/«dense» nucleus ✓ e. nucleus surrounded by/atom is empty space and «negative» electrons ✓		3 max
4.	a	ii	a. peer-review/results reviewed/challenged by other scientists for accuracy/reliability ✓ b. other scientists could repeat experiment/test the theories ✓ c. contributed to increased understanding of atomic structure ✓	OWTTE	2 max
4.	b		a. experiments showed the presence/characteristics/behaviour of unknown/new fundamental particles/antimatter ✓ b. quarks/leptons/fermions/gluons discovered ✓ c. Higgs boson identified ✓ d. standard model tested ✓ e. allowed new theories to be developed ✓ f. most powerful collider enables experiments not possible somewhere else ✓		3 max

Question			Answers	Notes	Total
5.	a		40 % OR 50 % ✓	% must be mentioned.	1
5.	b		a. heating temperature ✓ b. age/length of storage of milk ✓ c. fat content of milk ✓ d. source of milk/breed of cow ✓ e. method of nutrient testing ✓	Any other reasonable variable, eg “volume”, do not accept “time”.	2 max
5.	c		a. time/temperature must be sufficient to kill «pathogenic» bacteria/microorganisms ✓ b. «some» nutrients/vitamins lost with increased heating time ✓ c. lost nutrients may be replaced ✓ d. no loss of vitamin A/riboflavin ✓ e. none of the nutrients are completely lost after 60 minutes ✓ f. extend shelf life ✓		3 max