Markscheme

May 2018

Nature of Science

Standard level

Paper 1

14 pages

Section A

Question			Answers	Notes	Total
1.			C		**1**
2.			B		**1**
3.			D		**1**
4.			A		**1**
5.			A		**1**

Question			Answers	Notes	Total
6.	**a**		$1\times(3\times10^{8})^{2}$ ✓ 9×10^{16} J ***OR*** $9\times10^{16}\,\text{kgm}^{2}\text{s}^{-2}$ ✓	*Units required for M2.* *Accept answers with other correct units.*	**2**
6.	**b**		the process where the nucleus **«**of an atom**»** is split into several smaller fragments/atoms/particles «and neutrons» ✓ chain reaction ✓ the final total mass is less than the initial mass ***OR*** the difference in mass/mass deficit/mass amount of energy appears as energy ✓		**2 max**
6.	**c**		energy density in uranium-235/U-235 much greater than in fossil fuels ✓	*OWTTE*	**1**

7.			understanding of scientific processes for use of raw materials/invention of new materials required ✓ some very rare/important materials required for high tech products ✓ availability/accessibility/geographic location/some raw materials are rare ✓ economic such as supply and demand/cost ***OR*** political situation/ethical issues, *eg* wars ✓ energy cost for each material/economic factors ✓ purity/concentration of the ores ✓ environmental impact, *eg* carbon footprint, recycling, pollution ✓ sustainability ✓		**3 max**

<table>
<tr><th colspan="3">Question</th><th>Answers</th><th>Notes</th><th>Total</th></tr>
<tr><td>8.</td><td>a</td><td></td><td>Any one of:
HIV, SARS, Ebola, bird/avian influenza, MERS/camel influenza, malaria, swine flu, cowpox, rabies ✓</td><td>Accept any other correct human disease.
Accept “AIDS” for “HIV”.</td><td>1</td></tr>
<tr><td>8.</td><td>b</td><td></td><td>
<table>
<tr><th>Correlative relationship</th><th>Causal relationship</th></tr>
<tr><td>similar pattern or trend between the disease and other variable</td><td>show a direct cause and effect evidence ✓</td></tr>
<tr><td>eg Ebola cases increased with increased consumption of bush meat</td><td>eg eating infected bush meat transfers the Ebola pathogen into humans and causes the disease ✓</td></tr>
<tr><td>named disease will continue to spread if correlative factors are removed</td><td>eradication of the cause stops the named disease from spreading ✓</td></tr>
</table>
</td><td>Award [1 max] if disease not named.
Each row is [1] mark. Need both parts in a row for mark.</td><td>2 max</td></tr>
<tr><td>8.</td><td>c</td><td></td><td>
<table>
<tr><td>poverty factor ✓</td><td>name of disease ✓</td></tr>
<tr><td colspan="2">Examples could include:</td></tr>
<tr><td>poor/lack of sanitation ✓</td><td>cholera/typhoid ✓</td></tr>
<tr><td>overcrowded/poor living conditions ✓</td><td>tuberculosis/TB ✓</td></tr>
<tr><td>unsafe sex/lack of education/access to condoms ✓</td><td>AIDS ✓</td></tr>
<tr><td>limited medical access contributes to progression from HIV infection to ✓</td><td>AIDS ✓</td></tr>
<tr><td>lack of protection against mosquitoes ✓</td><td>malaria ✓</td></tr>
</table>
</td><td>Accept “HIV” for “AIDS”.</td><td>2 max</td></tr>
</table>

(continued…)

(Question 8 continued)

<table>
<tr>
<td>8.</td>
<td>d</td>
<td></td>
<td>
<table>
<tr><th>Preventative treatments</th><th>Curative treatments</th></tr>
<tr><td colspan="2">may have side effects ✓</td></tr>
<tr><td colspan="2">same aim to improve health ✓</td></tr>
<tr><td colspan="2">both based on scientific understanding/science ✓</td></tr>
<tr><td colspan="2">may influence life style ✓</td></tr>
<tr><td>maintains health/prevents disease</td><td>cures the disease ✓</td></tr>
<tr><td>reduces health costs</td><td>costs to health system/society may be higher ✓</td></tr>
<tr><td>reduces the spread/incidence of the disease</td><td>does not reduce the spread/incidence of the disease ✓</td></tr>
<tr><td>before infection</td><td>after infection ✓</td></tr>
</table>
</td>
<td>Each row is [1] mark.
Need to have one comparison and one difference for [2] marks.
Need both parts in a row for [1] mark.</td>
<td>2 max</td>
</tr>
</table>

Section B

Question			Answers	Notes	Total
9.	**a**		attraction to/gravity/pull of Earth/like the moon ✓ they do not fall to Earth because of curvature of Earth's surface/Earth is a sphere ✓ **«**Newton's Law of gravitation states that**»** attraction between two masses/attraction between mass of satellite and mass of the Earth/centripetal force ✓ Newton's first law/inertia ✓		**2 max**
9.	**b**		takes 24 hours to complete one orbit at this altitude ***OR*** appears stationary ✓ follows the rotation of the Earth ***OR*** satellite is located at the same point above the Earth all the time ✓ that height/altitude is the only one that gives the required speed ✓ send signals from one country to another "in real time" ✓ allows a large area to be covered ***OR*** $\frac{1}{3}$ of Earth's surface covered ✓		**2 max**

(continued…)

(Question 9 continued)

9.	**c**		transmits signals **«**consistently**»** to the same place ✓ fixed antennae on Earth/no need for antennae to track satellite ✓ signals reach a large area on Earth/signals have a big footprint ✓		**2 max**
9.	**d**		weather satellites ✓ telephone ✓ internet ***OR*** digital radio ✓ monitoring/listening to communications ✓	*Accept any other correct answer.*	**2 max**
9.	**e**		large costs/waste of money ***OR*** better use for the money ✓ spying on individuals/companies/governments ✓ spy cameras can take detailed photos ✓ satellites can eavesdrop on telephone/internet communications ✓ satellites pass over airspace of other/many countries' space ✓ broadcasting TV/radio to countries without permission ✓ who is responsible for Space junk/thousands of disused satellites/bits of satellites orbiting about that can cause danger to human piloted spacecraft ✓ pollution/**«**rocket**»** launch emissions ✓		**3 max**

(continued…)

(Question 9 continued)

9.	**f**		***Impact:*** light produced from electricity/electricity produced mainly from fossil fuels ***OR*** electricity production causes pollution ✓ release CO_2 which is a greenhouse gas/contributes to global warming/climate change ✓ **«**waste**»** heat produced ✓ light pollution ***OR*** stars cannot be seen ✓ impact on ecosystems/nocturnal animals/populations ✓ ***Reducing impact:*** regulations **«**national governments/international**»** on power use and time ✓ reduce use of electricity by using more efficient bulbs/LEDs/turn lights off ✓ use renewable sources of energy such as wind/solar/geothermal so less fossil fuels burned ✓	*Award **[2 max]** unless both parts addressed.*	**3 max**

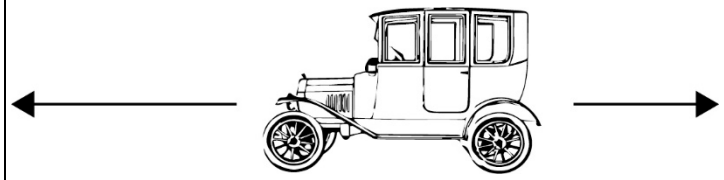
Question			Answers	Notes	Total
10	**a**		«optical» telescope ✓ diffraction grating/spectrometer ✓		**2**
10	**b**		a spectrum is like a finger print/barcode ***OR*** **«**the spectrum from the star**»** is a mixture of different elements ✓ the spectrum from the star is compared with the spectra from known elements on Earth ✓ overlapping spectra identify the element ✓		**2 max**
10	**c**		hydrogen and helium ✓		**1**
10	**d**		moving away from the Earth ✓ universe is expanding ✓ red shift is different in size for all four spectra indicating they are all travelling at different speeds/velocities ***OR*** the furthest ones are travelling the fastest ✓		**3 max**

Question			Answers	Notes	Total
11	a		prevents «some» infectious diseases ***OR*** cures bacterial diseases ✓ less feed required/promotes growth ✓ less time for full growth saves money ✓ buildup of antibiotic resistance in bacteria ✓ antibiotic enters human food chain ✓		**3 max**
11	b		less reliance/demand on animal products ***OR*** more reliance/demand on vegetables ✓ some animal feedstuff may be eaten directly by humans ✓ more «varied» vegetarian products available ✓ less water/land used for meat production/more water/land available ✓ transfer of land use not always possible ✓ change from meat to vegetable production ✓ eat lower on food chain/more efficiently ✓ more food available ✓ technology developments for more «artificial» meat-like products ✓		**3 max**

(continued…)

(Question 11 continued)

Question			Answers	Notes	Total
11	**c**		large amount wasted «20%-30%» ✓ food lost during planting/harvesting/storage/transport ✓ food wasted at retail/consumption stage ✓ more efficient food system would reduce losses and increase total food available ✓ poverty and not enough food in some places ***OR*** poor distribution ✓		**2 max**

<table>
<tr><th colspan="3">Question</th><th>Answers</th><th>Notes</th><th>Total</th></tr>
<tr><td>12</td><td>a</td><td></td><td>forces both horizontal and opposite ✓
the forward arrow is longer than the backwards arrow ✓
  </td><td></td><td>2</td></tr>
<tr><td>12</td><td>b</td><td></td><td>reduce drag/air flow ✓
increase streamlining/make more aerodynamic ✓</td><td></td><td>1 max</td></tr>
<tr><td>12</td><td>c</td><td></td><td>
<table>
<tr><th>Internal combustion</th><th>All-electric</th></tr>
<tr><td colspan="2">heats up atmosphere/pollution ✓</td></tr>
<tr><td>burns fossil fuel that emits CO_2 contributing to enhanced global warming</td><td>CO_2 emissions depend on whether electricity is produced from fossil fuels, renewable sources or a mixture ✓</td></tr>
<tr><td>harmful chemical emissions</td><td>no chemical emissions from car itself ✓</td></tr>
<tr><td>noisy</td><td>less noise ✓</td></tr>
<tr><td>highly polluting</td><td>less total pollution «in production and use» ✓</td></tr>
</table>
</td><td>Each row is [1] mark.

Need to include one comparison and one difference to get [2] marks.

Need both parts in a row for [1] mark.</td><td>2 max</td></tr>
</table>

(continued…)

(Question 12 continued)

Question			Answers	Notes	Total
12	**d**	**i**	energy from fossil fuels used to build the factory/CO_2 emissions ✓ energy from fossil fuels used to build the solar cells/CO_2 emissions ✓ water usage/waste ✓ displaces wild life ✓;		**1 max**
12	**d**	**ii**	energy from fossil fuels used to transport the batteries/materials to build the batteries ✓ energy from fossil fuels to mine for and refine lithium ✓ lithium-ion batteries difficult to dispose safely «because lithium is toxic/flammable» ✓		**1 max**
12	**e**		use electric cars powered from renewable sources ✓ use hydrogen fuel cell car ✓ make internal combustion engine more efficient/less emissions ✓ ban internal combustion engine ✓ use car less/use a bike/walk ✓ share own car/use taxis/rent a car/car sharing schemes/public transport ✓ work at home/teleworking ***OR*** live closer to work ✓ speed limits ***OR*** drive slower ✓ open windows instead of air conditioning ✓		**3 max**