

**GENERAL CERTIFICATE OF SECONDARY EDUCATION
TWENTY FIRST CENTURY SCIENCE
ADDITIONAL SCIENCE A**

A218/02

Unit 4: Ideas in Context
(Higher Tier)

**Thursday 4 June 2009
Morning**

Duration: 45 minutes

Candidates answer on the question paper
A calculator may be used for this paper

OCR Supplied Materials:

- Insert (inserted)

Other Materials Required:

- Pencil
- Ruler (cm/mm)




Candidate Forename		Candidate Surname	
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Centre Number						Candidate Number				
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INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is **40**.
- A list of physics equations is printed on page two.
- The Periodic Table is printed on the back page.
-  Where you see this icon you will be awarded a mark for the quality of written communication in your answer.
- This document consists of **12** pages. Any blank pages are indicated.

TWENTY FIRST CENTURY SCIENCE EQUATIONS

Useful Relationships

Explaining Motion

$$\text{speed} = \frac{\text{distance travelled}}{\text{time taken}}$$

$$\text{momentum} = \text{mass} \times \text{velocity}$$

$$\text{change of momentum} = \text{resultant force} \times \text{time for which it acts}$$

$$\text{work done by a force} = \text{force} \times \text{distance moved by the force}$$

$$\text{change in energy} = \text{work done}$$

$$\text{change in GPE} = \text{weight} \times \text{vertical height difference}$$

$$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times [\text{velocity}]^2$$

Electric Circuits

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

$$\frac{V_p}{V_s} = \frac{N_p}{N_s}$$

$$\text{energy transferred} = \text{power} \times \text{time}$$

$$\text{power} = \text{potential difference} \times \text{current}$$

$$\text{efficiency} = \frac{\text{energy usefully transferred}}{\text{total energy supplied}} \times 100\%$$

The Wave Model of Radiation

$$\text{wave speed} = \text{frequency} \times \text{wavelength}$$

PLEASE DO NOT WRITE ON THIS PAGE

Question 1 starts on page 4.

Answer **all** the questions.

This question is based on the article 'Acids in the body'.

1 (a) Look at the results of the student's investigation.

(i) What happens to the rate of the reaction when the concentration changes?

.....
 [1]

(ii) Use ideas about particles colliding to explain how changing the concentration affects the rate of reaction.

.....

 [2]

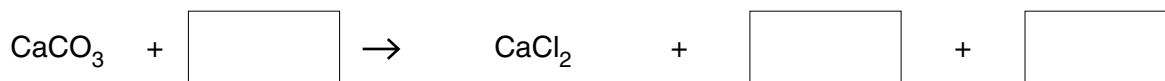
(iii) Why is it important to measure the **temperature** when the experiment is carried out?

.....
 [1]

(b) Eve carries out an experiment to investigate how carbonates react with acid. She adds some solid calcium carbonate to dilute hydrochloric acid in a beaker.

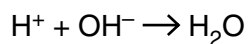
Complete the word and symbol equations for the reaction.

Balance the symbol equation.



[3]

- (c) The general equation for a neutralisation reaction is



Use the equation to describe what happens during a neutralisation reaction.

.....
 [2]

- (d) The table shows some information about some compounds used in medicines.

Complete the table to show the **two** missing formulae.

name of compound	formula	ions in compound	
		names	formula of ion
magnesium carbonate	MgCO ₃	magnesium ion carbonate ion	Mg ²⁺
sodium hydrogencarbonate	sodium ion hydrogencarbonate ion	Na ⁺ HCO ₃ ⁻

[2]

- (e) Calcium carbonate and sodium hydrogencarbonate are both used in medicines. Sodium hydrogencarbonate works much better than calcium carbonate at neutralising acids in the **blood**. Explain why.

.....
 [2]

[Total: 13]

This question is based on the article 'Help for patients with kidney failure'.

2 (a) During dialysis, **urea** passes out of the blood into the dialysis fluid by diffusion.

(i) Explain why urea diffuses out of the blood into the dialysis fluid.

In your answer you should write about

- what happens during diffusion
- the concentration of urea.



One mark will be for writing in sentences with correct spelling, punctuation and grammar.

.....

.....

.....

.....

..... [2+1]

(ii) How does a **partially permeable membrane** work?

.....

..... [2]

(iii) In a dialysis machine, the blood and the dialysis fluid flow in opposite directions.

How does this affect the diffusion of urea out of the blood?

.....

..... [1]

(b) Using the information provided, determine the percentage of the UK population likely to become patients with chronic kidney failure each year.

Show your calculations.

..... % [2]

(c) Why is it important to maintain balanced water levels in cells in the human body?

.....
.....
..... [2]

(d) Drinking alcohol affects the water balance in the human body.

What effect does alcohol have on the production of urine?

In your answer you should

- consider the volume and concentration of urine produced under these conditions
- describe how the production of ADH is affected by drinking alcohol.

.....
.....
.....
..... [3]

(e) The kidney is one of the organs in the human body involved in **homeostasis**.

What is homeostasis?

.....
..... [1]

[Total: 14]

This question is based on the article 'A time-line of scientific discoveries about light'.

3 (a) In 1817, Thomas Young showed that light is a transverse wave.

Describe the differences between a transverse wave and a longitudinal wave.

Your answer should include

- a labelled diagram of each type of wave
- the differences between them.

.....
.....
..... [3]

(b) In 1865, James Clerk Maxwell said that light was an electromagnetic wave.

State **two** ways in which electromagnetic waves are different from sound waves.

1
2 [1]

(c) In 1861, Maxwell took the first colour photograph. He used red, yellow and blue filters and then recombined the images.

Give **two** differences, other than colour, between red, yellow and blue light waves.

.....
..... [2]

- (d) In 1900, Max Planck suggested that light could be made up of packets of energy. These are now called photons.

In 1905, Albert Einstein showed that the intensity of a beam of light could be explained by thinking of light as a stream of photons.

Use ideas about light as a stream of photons to explain how light beams can have different intensities.

.....
..... [2]

- (e) Einstein also proposed a theory that the speed of light in a vacuum is constant. The speed of light is 300 000 000 m/s.

Calculate the frequency of an electromagnetic wave with a wavelength of 1.5 m.

frequency = unit [3]

- (f) Isaac Newton looked at the refraction of light through a prism. Refraction is caused by waves changing speed. Describe what happens to the wavelength **and** the frequency as a wave refracts.

.....
.....
..... [2]

[Total: 13]

END OF QUESTION PAPER

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The Periodic Table of the Elements

1	2	3	4	5	6	7	0	
7 Li lithium 3	9 Be beryllium 4	11 Na sodium 11	12 C carbon 6	13 Al aluminium 13	14 N nitrogen 7	15 O oxygen 8	16 F fluorine 9	17 Ne neon 10
19 K potassium 19	20 Ca calcium 20	23 Sc scandium 21	24 Ti titanium 22	25 V vanadium 23	26 Cr chromium 24	27 Mn manganese 25	28 Fe iron 26	29 Co cobalt 27
37 Rb rubidium 37	38 Sr strontium 38	39 Y yttrium 39	40 Zr zirconium 40	41 Nb niobium 41	42 Mo molybdenum 42	43 Tc technetium [98]	44 Ru ruthenium 44	45 Rh rhodium 45
55 Cs caesium 55	56 Ba barium 56	57 La* lanthanum 57	72 Hf hafnium 72	73 Ta tantalum 73	74 W tungsten 74	75 Re rhenium 75	76 Os osmium 76	77 Ir iridium 77
87 Fr francium 87	88 Ra radium 88	89 Ac* actinium 89	104 Rf rutherfordium 104	105 Db dubnium 105	106 Sg seaborgium 106	107 Bh bohrium 107	108 Hs hassium 108	109 Mt meitnerium 109
133 Cs caesium 55	137 Ba barium 56	139 La* lanthanum 57	178 Hf hafnium 72	181 Ta tantalum 73	184 W tungsten 74	186 Re rhenium 75	190 Os osmium 76	192 Ir iridium 77
199 K potassium 19	200 Ca calcium 20	201 Sc scandium 21	202 Ti titanium 22	203 V vanadium 23	204 Cr chromium 24	205 Mn manganese 25	206 Fe iron 26	207 Co cobalt 27
255 Rb rubidium 37	256 Sr strontium 38	257 Y yttrium 39	258 Zr zirconium 40	259 Nb niobium 41	260 Mo molybdenum 42	261 Tc technetium [98]	262 Ru ruthenium 44	263 Rh rhodium 45
311 Cs caesium 55	312 Ba barium 56	313 La* lanthanum 57	314 Hf hafnium 72	315 Ta tantalum 73	316 W tungsten 74	317 Re rhenium 75	318 Os osmium 76	319 Ir iridium 77
371 Fr francium 87	372 Ra radium 88	373 Ac* actinium 89	374 Rf rutherfordium 104	375 Db dubnium 105	376 Sg seaborgium 106	377 Bh bohrium 107	378 Hs hassium 108	379 Mt meitnerium 109
431 K potassium 19	432 Ca calcium 20	433 Sc scandium 21	434 Ti titanium 22	435 V vanadium 23	436 Cr chromium 24	437 Mn manganese 25	438 Fe iron 26	439 Co cobalt 27
487 Rb rubidium 37	488 Sr strontium 38	489 Y yttrium 39	490 Zr zirconium 40	491 Nb niobium 41	492 Mo molybdenum 42	493 Tc technetium [98]	494 Ru ruthenium 44	495 Rh rhodium 45
547 Cs caesium 55	548 Ba barium 56	549 La* lanthanum 57	550 Hf hafnium 72	551 Ta tantalum 73	552 W tungsten 74	553 Re rhenium 75	554 Os osmium 76	555 Ir iridium 77
607 Fr francium 87	608 Ra radium 88	609 Ac* actinium 89	610 Rf rutherfordium 104	611 Db dubnium 105	612 Sg seaborgium 106	613 Bh bohrium 107	614 Hs hassium 108	615 Mt meitnerium 109
667 K potassium 19	668 Ca calcium 20	669 Sc scandium 21	670 Ti titanium 22	671 V vanadium 23	672 Cr chromium 24	673 Mn manganese 25	674 Fe iron 26	675 Co cobalt 27
723 Rb rubidium 37	724 Sr strontium 38	725 Y yttrium 39	726 Zr zirconium 40	727 Nb niobium 41	728 Mo molybdenum 42	729 Tc technetium [98]	730 Ru ruthenium 44	731 Rh rhodium 45
787 Cs caesium 55	788 Ba barium 56	789 La* lanthanum 57	790 Hf hafnium 72	791 Ta tantalum 73	792 W tungsten 74	793 Re rhenium 75	794 Os osmium 76	795 Ir iridium 77
847 Fr francium 87	848 Ra radium 88	849 Ac* actinium 89	850 Rf rutherfordium 104	851 Db dubnium 105	852 Sg seaborgium 106	853 Bh bohrium 107	854 Hs hassium 108	855 Mt meitnerium 109
897 K potassium 19	898 Ca calcium 20	899 Sc scandium 21	900 Ti titanium 22	901 V vanadium 23	902 Cr chromium 24	903 Mn manganese 25	904 Fe iron 26	905 Co cobalt 27
953 Rb rubidium 37	954 Sr strontium 38	955 Y yttrium 39	956 Zr zirconium 40	957 Nb niobium 41	958 Mo molybdenum 42	959 Tc technetium [98]	960 Ru ruthenium 44	961 Rh rhodium 45
1013 Cs caesium 55	1014 Ba barium 56	1015 La* lanthanum 57	1016 Hf hafnium 72	1017 Ta tantalum 73	1018 W tungsten 74	1019 Re rhenium 75	1020 Os osmium 76	1021 Ir iridium 77
1073 Fr francium 87	1074 Ra radium 88	1075 Ac* actinium 89	1076 Rf rutherfordium 104	1077 Db dubnium 105	1078 Sg seaborgium 106	1079 Bh bohrium 107	1080 Hs hassium 108	1081 Mt meitnerium 109
1123 K potassium 19	1124 Ca calcium 20	1125 Sc scandium 21	1126 Ti titanium 22	1127 V vanadium 23	1128 Cr chromium 24	1129 Mn manganese 25	1130 Fe iron 26	1131 Co cobalt 27
1179 Rb rubidium 37	1180 Sr strontium 38	1181 Y yttrium 39	1182 Zr zirconium 40	1183 Nb niobium 41	1184 Mo molybdenum 42	1185 Tc technetium [98]	1186 Ru ruthenium 44	1187 Rh rhodium 45
1239 Cs caesium 55	1240 Ba barium 56	1241 La* lanthanum 57	1242 Hf hafnium 72	1243 Ta tantalum 73	1244 W tungsten 74	1245 Re rhenium 75	1246 Os osmium 76	1247 Ir iridium 77
1299 Fr francium 87	1300 Ra radium 88	1301 Ac* actinium 89	1302 Rf rutherfordium 104	1303 Db dubnium 105	1304 Sg seaborgium 106	1305 Bh bohrium 107	1306 Hs hassium 108	1307 Mt meitnerium 109
1359 K potassium 19	1360 Ca calcium 20	1361 Sc scandium 21	1362 Ti titanium 22	1363 V vanadium 23	1364 Cr chromium 24	1365 Mn manganese 25	1366 Fe iron 26	1367 Co cobalt 27
1415 Rb rubidium 37	1416 Sr strontium 38	1417 Y yttrium 39	1418 Zr zirconium 40	1419 Nb niobium 41	1420 Mo molybdenum 42	1421 Tc technetium [98]	1422 Ru ruthenium 44	1423 Rh rhodium 45
1471 Cs caesium 55	1472 Ba barium 56	1473 La* lanthanum 57	1474 Hf hafnium 72	1475 Ta tantalum 73	1476 W tungsten 74	1477 Re rhenium 75	1478 Os osmium 76	1479 Ir iridium 77
1531 Fr francium 87	1532 Ra radium 88	1533 Ac* actinium 89	1534 Rf rutherfordium 104	1535 Db dubnium 105	1536 Sg seaborgium 106	1537 Bh bohrium 107	1538 Hs hassium 108	1539 Mt meitnerium 109
1587 K potassium 19	1588 Ca calcium 20	1589 Sc scandium 21	1590 Ti titanium 22	1591 V vanadium 23	1592 Cr chromium 24	1593 Mn manganese 25	1594 Fe iron 26	1595 Co cobalt 27
1643 Rb rubidium 37	1644 Sr strontium 38	1645 Y yttrium 39	1646 Zr zirconium 40	1647 Nb niobium 41	1648 Mo molybdenum 42	1649 Tc technetium [98]	1650 Ru ruthenium 44	1651 Rh rhodium 45
1703 Cs caesium 55	1704 Ba barium 56	1705 La* lanthanum 57	1706 Hf hafnium 72	1707 Ta tantalum 73	1708 W tungsten 74	1709 Re rhenium 75	1710 Os osmium 76	1711 Ir iridium 77
1763 Fr francium 87	1764 Ra radium 88	1765 Ac* actinium 89	1766 Rf rutherfordium 104	1767 Db dubnium 105	1768 Sg seaborgium 106	1769 Bh bohrium 107	1770 Hs hassium 108	1771 Mt meitnerium 109
1819 K potassium 19	1820 Ca calcium 20	1821 Sc scandium 21	1822 Ti titanium 22	1823 V vanadium 23	1824 Cr chromium 24	1825 Mn manganese 25	1826 Fe iron 26	1827 Co cobalt 27
1875 Rb rubidium 37	1876 Sr strontium 38	1877 Y yttrium 39	1878 Zr zirconium 40	1879 Nb niobium 41	1880 Mo molybdenum 42	1881 Tc technetium [98]	1882 Ru ruthenium 44	1883 Rh rhodium 45
1931 Cs caesium 55	1932 Ba barium 56	1933 La* lanthanum 57	1934 Hf hafnium 72	1935 Ta tantalum 73	1936 W tungsten 74	1937 Re rhenium 75	1938 Os osmium 76	1939 Ir iridium 77
1991 Fr francium 87	1992 Ra radium 88	1993 Ac* actinium 89	1994 Rf rutherfordium 104	1995 Db dubnium 105	1996 Sg seaborgium 106	1997 Bh bohrium 107	1998 Hs hassium 108	1999 Mt meitnerium 109
2047 K potassium 19	2048 Ca calcium 20	2049 Sc scandium 21	2050 Ti titanium 22	2051 V vanadium 23	2052 Cr chromium 24	2053 Mn manganese 25	2054 Fe iron 26	2055 Co cobalt 27
2103 Rb rubidium 37	2104 Sr strontium 38	2105 Y yttrium 39	2106 Zr zirconium 40	2107 Nb niobium 41	2108 Mo molybdenum 42	2109 Tc technetium [98]	2110 Ru ruthenium 44	2111 Rh rhodium 45
2159 Cs caesium 55	2160 Ba barium 56	2161 La* lanthanum 57	2162 Hf hafnium 72	2163 Ta tantalum 73	2164 W tungsten 74	2165 Re rhenium 75	2166 Os osmium 76	2167 Ir iridium 77
2219 Fr francium 87	2220 Ra radium 88	2221 Ac* actinium 89	2222 Rf rutherfordium 104	2223 Db dubnium 105	2224 Sg seaborgium 106	2225 Bh bohrium 107	2226 Hs hassium 108	2227 Mt meitnerium 109
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2503 K potassium 19	2504 Ca calcium 20	2505 Sc scandium 21	2506 Ti titanium 22	2507 V vanadium 23	2508 Cr chromium 24	2509 Mn manganese 25	2510 Fe iron 26	2511 Co cobalt 27
2559 Rb rubidium 37	2560 Sr strontium 38	2561 Y yttrium 39	2562 Zr zirconium 40	2563 Nb niobium 41	2564 Mo molybdenum 42	2565 Tc technetium [98]	2566 Ru ruthenium 44	2567 Rh rhodium 45
2615 Cs caesium 55	2616 Ba barium 56	2617 La* lanthanum 57	2618 Hf hafnium 72	2619 Ta tantalum 73	2620 W tungsten 74	2621 Re rhenium 75	2622 Os osmium 76	2623 Ir iridium 77
2675 Fr francium 87	2676 Ra radium 88	2677 Ac* actinium 89	2678 Rf rutherfordium 104	2679 Db dubnium 105	2680 Sg seaborgium 106	2681 Bh bohrium 107	2682 Hs hassium 108	2683 Mt meitnerium 109
2731 K potassium 19	2732 Ca calcium 20	2733 Sc scandium 21						