

Please check the examination details below before entering your candidate information

Candidate surname

Other names

**Pearson Edexcel  
International GCSE (9–1)**

Centre Number

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Candidate Number

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**Time** 1 hour 15 minutes

**Paper  
reference**

**4CH1/2C**

**Chemistry  
PAPER 2C**

**You must have:**  
Calculator, ruler

Total Marks

## Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided  
– *there may be more space than you need.*
- Some questions must be answered with a cross in a box . If you change your mind about an answer, put a line through the box  and then mark your new answer with a cross .

## Information

- The total mark for this paper is 70.
- The marks for **each** question are shown in brackets  
– *use this as a guide as to how much time to spend on each question.*

## Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.
- Good luck with your examination.

Turn over ►

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Pearson

# The Periodic Table of the Elements

1	2	3	4	5	6	7	0																																																																																																																																																																																																																																																																																																																																																																																																																														
7 <b>Li</b> lithium 3	9 <b>Be</b> beryllium 4	11 <b>Na</b> sodium 11	12 <b>C</b> carbon 6	13 <b>Al</b> aluminum 13	14 <b>N</b> nitrogen 7	15 <b>P</b> phosphorus 15	16 <b>O</b> oxygen 8	17 <b>F</b> fluorine 9	18 <b>Ne</b> neon 10																																																																																																																																																																																																																																																																																																																																																																																																																												
19 <b>K</b> potassium 19	20 <b>Ca</b> calcium 20	23 <b>Sc</b> scandium 21	24 <b>Ti</b> titanium 22	25 <b>V</b> vanadium 23	26 <b>Cr</b> chromium 24	27 <b>Mn</b> manganese 25	28 <b>Fe</b> iron 26	29 <b>Co</b> cobalt 27	30 <b>Ni</b> nickel 28	31 <b>Cu</b> copper 29	32 <b>Zn</b> zinc 30	33 <b>Ga</b> gallium 31	34 <b>Ge</b> germanium 32	35 <b>As</b> arsenic 33	36 <b>Se</b> selenium 34	37 <b>Br</b> bromine 35	38 <b>Sr</b> strontium 38	39 <b>Y</b> yttrium 39	40 <b>Zr</b> zirconium 40	41 <b>Nb</b> niobium 41	42 <b>Mo</b> molybdenum 42	43 <b>Tc</b> technetium 43	44 <b>Ru</b> ruthenium 44	45 <b>Rh</b> rhodium 45	46 <b>Pd</b> palladium 46	47 <b>Ag</b> silver 47	48 <b>Cd</b> cadmium 48	49 <b>In</b> indium 49	50 <b>Sn</b> tin 50	51 <b>Sb</b> antimony 51	52 <b>Te</b> tellurium 52	53 <b>I</b> iodine 53	54 <b>Xe</b> xenon 54																																																																																																																																																																																																																																																																																																																																																																																																				
55 <b>Cs</b> caesium 55	56 <b>Ba</b> barium 56	57 <b>La*</b> lanthanum 57	58 <b>Hf</b> hafnium 72	59 <b>Ta</b> tantalum 73	60 <b>W</b> tungsten 74	61 <b>Re</b> rhenium 75	62 <b>Os</b> osmium 76	63 <b>Ir</b> iridium 77	64 <b>Pt</b> platinum 78	65 <b>Au</b> gold 79	66 <b>Hg</b> mercury 80	67 <b>Tl</b> thallium 81	68 <b>Pb</b> lead 82	69 <b>Bi</b> bismuth 83	70 <b>Po</b> polonium 84	71 <b>At</b> astatine 85	72 <b>Rn</b> radon 86	73 <b>Fr</b> francium 87	74 <b>Ra</b> radium 88	75 <b>Ac*</b> actinium 89	76 <b>Rf</b> rutherfordium 104	77 <b>Db</b> dubnium 105	78 <b>Sg</b> seaborgium 106	79 <b>Bh</b> bohrium 107	80 <b>Hs</b> hassium 108	81 <b>Mt</b> meitnerium 109	82 <b>Ds</b> darmstadtium 110	83 <b>Rg</b> roentgenium 111	84 <b>U</b> uranium 92	85 <b>Np</b> neptunium 93	86 <b>Pu</b> plutonium 94	87 <b>Am</b> americium 95	88 <b>Cm</b> curium 96	89 <b>Bk</b> berkelium 97	90 <b>Cf</b> californium 98	91 <b>Es</b> einsteinium 99	92 <b>Fm</b> fermium 100	93 <b>Mn</b> mendelevium 101	94 <b>Lr</b> lawrencium 103	95 <b>Rf</b> rutherfordium 104	96 <b>Db</b> dubnium 105	97 <b>Sg</b> seaborgium 106	98 <b>Bh</b> bohrium 107	99 <b>Hs</b> hassium 108	100 <b>Mt</b> meitnerium 109	101 <b>Ds</b> darmstadtium 110	102 <b>Rg</b> roentgenium 111	103 <b>U</b> uranium 92	104 <b>Np</b> neptunium 93	105 <b>Pu</b> plutonium 94	106 <b>Am</b> americium 95	107 <b>Cm</b> curium 96	108 <b>Bk</b> berkelium 97	109 <b>Cf</b> californium 98	110 <b>Es</b> einsteinium 99	111 <b>Fm</b> fermium 100	112 <b>Mn</b> mendelevium 101	113 <b>Lr</b> lawrencium 103	114 <b>Rf</b> rutherfordium 104	115 <b>Db</b> dubnium 105	116 <b>Sg</b> seaborgium 106	117 <b>Bh</b> bohrium 107	118 <b>Hs</b> hassium 108	119 <b>Mt</b> meitnerium 109	120 <b>Ds</b> darmstadtium 110	121 <b>Rg</b> roentgenium 111	122 <b>U</b> uranium 92	123 <b>Np</b> neptunium 93	124 <b>Pu</b> plutonium 94	125 <b>Am</b> americium 95	126 <b>Cm</b> curium 96	127 <b>Bk</b> berkelium 97	128 <b>Cf</b> californium 98	129 <b>Es</b> einsteinium 99	130 <b>Fm</b> fermium 100	131 <b>Mn</b> mendelevium 101	132 <b>Lr</b> lawrencium 103	133 <b>Rf</b> rutherfordium 104	134 <b>Db</b> dubnium 105	135 <b>Sg</b> seaborgium 106	136 <b>Bh</b> bohrium 107	137 <b>Hs</b> hassium 108	138 <b>Mt</b> meitnerium 109	139 <b>Ds</b> darmstadtium 110	140 <b>Rg</b> roentgenium 111	141 <b>U</b> uranium 92	142 <b>Np</b> neptunium 93	143 <b>Pu</b> plutonium 94	144 <b>Am</b> americium 95	145 <b>Cm</b> curium 96	146 <b>Bk</b> berkelium 97	147 <b>Cf</b> californium 98	148 <b>Es</b> einsteinium 99	149 <b>Fm</b> fermium 100	150 <b>Mn</b> mendelevium 101	151 <b>Lr</b> lawrencium 103	152 <b>Rf</b> rutherfordium 104	153 <b>Db</b> dubnium 105	154 <b>Sg</b> seaborgium 106	155 <b>Bh</b> bohrium 107	156 <b>Hs</b> hassium 108	157 <b>Mt</b> meitnerium 109	158 <b>Ds</b> darmstadtium 110	159 <b>Rg</b> roentgenium 111	160 <b>U</b> uranium 92	161 <b>Np</b> neptunium 93	162 <b>Pu</b> plutonium 94	163 <b>Am</b> americium 95	164 <b>Cm</b> curium 96	165 <b>Bk</b> berkelium 97	166 <b>Cf</b> californium 98	167 <b>Es</b> einsteinium 99	168 <b>Fm</b> fermium 100	169 <b>Mn</b> mendelevium 101	170 <b>Lr</b> lawrencium 103	171 <b>Rf</b> rutherfordium 104	172 <b>Db</b> dubnium 105	173 <b>Sg</b> seaborgium 106	174 <b>Bh</b> bohrium 107	175 <b>Hs</b> hassium 108	176 <b>Mt</b> meitnerium 109	177 <b>Ds</b> darmstadtium 110	178 <b>Rg</b> roentgenium 111	179 <b>U</b> uranium 92	180 <b>Np</b> neptunium 93	181 <b>Pu</b> plutonium 94	182 <b>Am</b> americium 95	183 <b>Cm</b> curium 96	184 <b>Bk</b> berkelium 97	185 <b>Cf</b> californium 98	186 <b>Es</b> einsteinium 99	187 <b>Fm</b> fermium 100	188 <b>Mn</b> mendelevium 101	189 <b>Lr</b> lawrencium 103	190 <b>Rf</b> rutherfordium 104	191 <b>Db</b> dubnium 105	192 <b>Sg</b> seaborgium 106	193 <b>Bh</b> bohrium 107	194 <b>Hs</b> hassium 108	195 <b>Mt</b> meitnerium 109	196 <b>Ds</b> darmstadtium 110	197 <b>Rg</b> roentgenium 111	198 <b>U</b> uranium 92	199 <b>Np</b> neptunium 93	200 <b>Pu</b> plutonium 94	201 <b>Am</b> americium 95	202 <b>Cm</b> curium 96	203 <b>Bk</b> berkelium 97	204 <b>Cf</b> californium 98	205 <b>Es</b> einsteinium 99	206 <b>Fm</b> fermium 100	207 <b>Mn</b> mendelevium 101	208 <b>Lr</b> lawrencium 103	209 <b>Rf</b> rutherfordium 104	210 <b>Db</b> dubnium 105	211 <b>Sg</b> seaborgium 106	212 <b>Bh</b> bohrium 107	213 <b>Hs</b> hassium 108	214 <b>Mt</b> meitnerium 109	215 <b>Ds</b> darmstadtium 110	216 <b>Rg</b> roentgenium 111	217 <b>U</b> uranium 92	218 <b>Np</b> neptunium 93	219 <b>Pu</b> plutonium 94	220 <b>Am</b> americium 95	221 <b>Cm</b> curium 96	222 <b>Bk</b> berkelium 97	223 <b>Cf</b> californium 98	224 <b>Es</b> einsteinium 99	225 <b>Fm</b> fermium 100	226 <b>Mn</b> mendelevium 101	227 <b>Lr</b> lawrencium 103	228 <b>Rf</b> rutherfordium 104	229 <b>Db</b> dubnium 105	230 <b>Sg</b> seaborgium 106	231 <b>Bh</b> bohrium 107	232 <b>Hs</b> hassium 108	233 <b>Mt</b> meitnerium 109	234 <b>Ds</b> darmstadtium 110	235 <b>Rg</b> roentgenium 111	236 <b>U</b> uranium 92	237 <b>Np</b> neptunium 93	238 <b>Pu</b> plutonium 94	239 <b>Am</b> americium 95	240 <b>Cm</b> curium 96	241 <b>Bk</b> berkelium 97	242 <b>Cf</b> californium 98	243 <b>Es</b> einsteinium 99	244 <b>Fm</b> fermium 100	245 <b>Mn</b> mendelevium 101	246 <b>Lr</b> lawrencium 103	247 <b>Rf</b> rutherfordium 104	248 <b>Db</b> dubnium 105	249 <b>Sg</b> seaborgium 106	250 <b>Bh</b> bohrium 107	251 <b>Hs</b> hassium 108	252 <b>Mt</b> meitnerium 109	253 <b>Ds</b> darmstadtium 110	254 <b>Rg</b> roentgenium 111	255 <b>U</b> uranium 92	256 <b>Np</b> neptunium 93	257 <b>Pu</b> plutonium 94	258 <b>Am</b> americium 95	259 <b>Cm</b> curium 96	260 <b>Bk</b> berkelium 97	261 <b>Cf</b> californium 98	262 <b>Es</b> einsteinium 99	263 <b>Fm</b> fermium 100	264 <b>Mn</b> mendelevium 101	265 <b>Lr</b> lawrencium 103	266 <b>Rf</b> rutherfordium 104	267 <b>Db</b> dubnium 105	268 <b>Sg</b> seaborgium 106	269 <b>Bh</b> bohrium 107	270 <b>Hs</b> hassium 108	271 <b>Mt</b> meitnerium 109	272 <b>Ds</b> darmstadtium 110	273 <b>Rg</b> roentgenium 111	274 <b>U</b> uranium 92	275 <b>Np</b> neptunium 93	276 <b>Pu</b> plutonium 94	277 <b>Am</b> americium 95	278 <b>Cm</b> curium 96	279 <b>Bk</b> berkelium 97	280 <b>Cf</b> californium 98	281 <b>Es</b> einsteinium 99	282 <b>Fm</b> fermium 100	283 <b>Mn</b> mendelevium 101	284 <b>Lr</b> lawrencium 103	285 <b>Rf</b> rutherfordium 104	286 <b>Db</b> dubnium 105	287 <b>Sg</b> seaborgium 106	288 <b>Bh</b> bohrium 107	289 <b>Hs</b> hassium 108	290 <b>Mt</b> meitnerium 109	291 <b>Ds</b> darmstadtium 110	292 <b>Rg</b> roentgenium 111	293 <b>U</b> uranium 92	294 <b>Np</b> neptunium 93	295 <b>Pu</b> plutonium 94	296 <b>Am</b> americium 95	297 <b>Cm</b> curium 96	298 <b>Bk</b> berkelium 97	299 <b>Cf</b> californium 98	300 <b>Es</b> einsteinium 99	301 <b>Fm</b> fermium 100	302 <b>Mn</b> mendelevium 101	303 <b>Lr</b> lawrencium 103	304 <b>Rf</b> rutherfordium 104	305 <b>Db</b> dubnium 105	306 <b>Sg</b> seaborgium 106	307 <b>Bh</b> bohrium 107	308 <b>Hs</b> hassium 108	309 <b>Mt</b> meitnerium 109	310 <b>Ds</b> darmstadtium 110	311 <b>Rg</b> roentgenium 111	312 <b>U</b> uranium 92	313 <b>Np</b> neptunium 93	314 <b>Pu</b> plutonium 94	315 <b>Am</b> americium 95	316 <b>Cm</b> curium 96	317 <b>Bk</b> berkelium 97	318 <b>Cf</b> californium 98	319 <b>Es</b> einsteinium 99	320 <b>Fm</b> fermium 100	321 <b>Mn</b> mendelevium 101	322 <b>Lr</b> lawrencium 103	323 <b>Rf</b> rutherfordium 104	324 <b>Db</b> dubnium 105	325 <b>Sg</b> seaborgium 106	326 <b>Bh</b> bohrium 107	327 <b>Hs</b> hassium 108	328 <b>Mt</b> meitnerium 109	329 <b>Ds</b> darmstadtium 110	330 <b>Rg</b> roentgenium 111	331 <b>U</b> uranium 92	332 <b>Np</b> neptunium 93	333 <b>Pu</b> plutonium 94	334 <b>Am</b> americium 95	335 <b>Cm</b> curium 96	336 <b>Bk</b> berkelium 97	337 <b>Cf</b> californium 98	338 <b>Es</b> einsteinium 99	339 <b>Fm</b> fermium 100	340 <b>Mn</b> mendelevium 101	341 <b>Lr</b> lawrencium 103	342 <b>Rf</b> rutherfordium 104	343 <b>Db</b> dubnium 105	344 <b>Sg</b> seaborgium 106	345 <b>Bh</b> bohrium 107	346 <b>Hs</b> hassium 108	347 <b>Mt</b> meitnerium 109	348 <b>Ds</b> darmstadtium 110	349 <b>Rg</b> roentgenium 111	350 <b>U</b> uranium 92	351 <b>Np</b> neptunium 93	352 <b>Pu</b> plutonium 94	353 <b>Am</b> americium 95	354 <b>Cm</b> curium 96	355 <b>Bk</b> berkelium 97	356 <b>Cf</b> californium 98	357 <b>Es</b> einsteinium 99	358 <b>Fm</b> fermium 100	359 <b>Mn</b> mendelevium 101	360 <b>Lr</b> lawrencium 103	361 <b>Rf</b> rutherfordium 104	362 <b>Db</b> dubnium 105	363 <b>Sg</b> seaborgium 106	364 <b>Bh</b> bohrium 107	365 <b>Hs</b> hassium 108	366 <b>Mt</b> meitnerium 109	367 <b>Ds</b> darmstadtium 110	368 <b>Rg</b> roentgenium 111	369 <b>U</b> uranium 92	370 <b>Np</b> neptunium 93	371 <b>Pu</b> plutonium 94	372 <b>Am</b> americium 95	373 <b>Cm</b> curium 96	374 <b>Bk</b> berkelium 97	375 <b>Cf</b> californium 98	376 <b>Es</b> einsteinium 99	377 <b>Fm</b> fermium 100	378 <b>Mn</b> mendelevium 101	379 <b>Lr</b> lawrencium 103	380 <b>Rf</b> rutherfordium 104	381 <b>Db</b> dubnium 105	382 <b>Sg</b> seaborgium 106	383 <b>Bh</b> bohrium 107	384 <b>Hs</b> hassium 108	385 <b>Mt</b> meitnerium 109	386 <b>Ds</b> darmstadtium 110	387 <b>Rg</b> roentgenium 111	388 <b>U</b> uranium 92	389 <b>Np</b> neptunium 93	390 <b>Pu</b> plutonium 94	391 <b>Am</b> americium 95	392 <b>Cm</b> curium 96	393 <b>Bk</b> berkelium 97	394 <b>Cf</b> californium 98	395 <b>Es</b> einsteinium 99	396 <b>Fm</b> fermium 100	397 <b>Mn</b> mendelevium 101	398 <b>Lr</b> lawrencium 103	399 <b>Rf</b> rutherfordium 104	400 <b>Db</b> dubnium 105	401 <b>Sg</b> seaborgium 106	402 <b>Bh</b> bohrium 107	403 <b>Hs</b> hassium 108	404 <b>Mt</b> meitnerium 109	405 <b>Ds</b> darmstadtium 110	406 <b>Rg</b> roentgenium 111	407 <b>U</b> uranium 92	408 <b>Np</b> neptunium 93	409 <b>Pu</b> plutonium 94	410 <b>Am</b> americium 95	411 <b>Cm</b> curium 96	412 <b>Bk</b> berkelium 97	413 <b>Cf</b> californium 98	414 <b>Es</b> einsteinium 99	415 <b>Fm</b> fermium 100	416 <b>Mn</b> mendelevium 101	417 <b>Lr</b> lawrencium 103	418 <b>Rf</b> rutherfordium 104	419 <b>Db</b> dubnium 105	420 <b>Sg</b> seaborgium 106	421 <b>Bh</b> bohrium 107	422 <b>Hs</b> hassium 108	423 <b>Mt</b> meitnerium 109	424 <b>Ds</b> darmstadtium 110	425 <b>Rg</b> roentgenium 111	426 <b>U</b> uranium 92	427 <b>Np</b> neptunium 93	428 <b>Pu</b> plutonium 94	429 <b>Am</b> americium 95	430 <b>Cm</b> curium 96	431 <b>Bk</b> berkelium 97	432 <b>Cf</b> californium 98	433 <b>Es</b> einsteinium 99	434 <b>Fm</b> fermium 100	435 <b>Mn</b> mendelevium 101	436 <b>Lr</b> lawrencium 103	437 <b>Rf</b> rutherfordium 104	438 <b>Db</b> dubnium 105	439 <b>Sg</b> seaborgium 106	440 <b>Bh</b> bohrium 107	441 <b>Hs</b> hassium 108	442 <b>Mt</b> meitnerium 109	443 <b>Ds</b> darmstadtium 110	444 <b>Rg</b> roentgenium 111	445 <b>U</b> uranium 92	446 <b>Np</b> neptunium 93	447 <b>Pu</b> plutonium 94	448 <b>Am</b> americium 95	449 <b>Cm</b> curium 96	450 <b>Bk</b> berkelium 97	451 <b>Cf</b> californium 98	452 <b>Es</b> einsteinium 99	453 <b>Fm</b> fermium 100	454 <b>Mn</b> mendelevium 101	455 <b>Lr</b> lawrencium 103	456 <b>Rf</b> rutherfordium 104	457 <b>Db</b> dubnium 105	458 <b>Sg</b> seaborgium 106	459 <b>Bh</b> bohrium 107	460 <b>Hs</b> hassium 108	461 <b>Mt</b> meitnerium 109	462 <b>Ds</b> darmstadtium 110	463 <b>Rg</b> roentgenium 111	464 <b>U</b> uranium 92	465 <b>Np</b> neptunium 93	466 <b>Pu</b> plutonium 94	467 <b>Am</b> americium 95	468 <b>Cm</b> curium 96	469 <b>Bk</b> berkelium 97	470 <b>Cf</b> californium 98	471 <b>Es</b> einsteinium 99	472 <b>Fm</b> fermium 100	473 <b>Mn</b> mendelevium 101	474 <b>Lr</b> lawrencium 103	475 <b>Rf</b> rutherfordium 104	476 <b>Db</b> dubnium 105

**Answer ALL questions. Write your answers in the spaces provided.**

**1** Use the Periodic Table to help you answer this question.

(a) (i) Name the element with atomic number 14 (1)

(ii) Name the element with a relative atomic mass of 11 (1)

(iii) Name the element in Group 2 and Period 3 (1)

(b) (i) Determine the number of neutrons in a phosphorus atom with mass number 31 (1)

(ii) State the electronic configuration of an aluminium atom. (1)

(iii) State why neon is unreactive. (1)

**(Total for Question 1 = 6 marks)**

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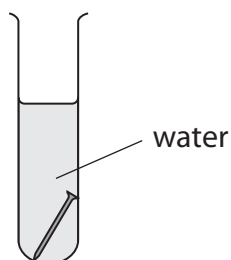
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2 A student investigates the rusting of iron.

(a) She places an iron nail in a test tube of water and leaves it for several days.



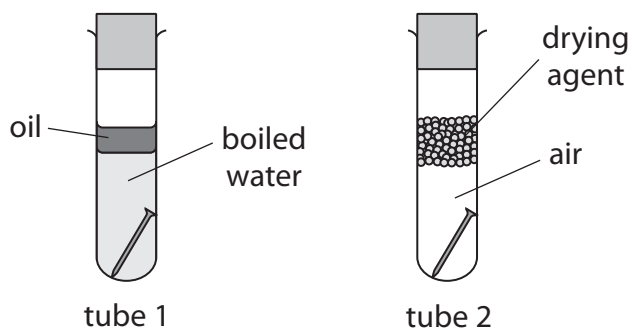
(i) Predict the appearance of the iron nail after several days.

(1)

(ii) Name the main compound in rust.

(1)

(b) The student then sets up two more test tubes containing iron nails.



Explain why the iron nail in tube 1 and the iron nail in tube 2 do not rust.

(4)

tube 1.....

tube 2.....

(Total for Question 2 = 6 marks)



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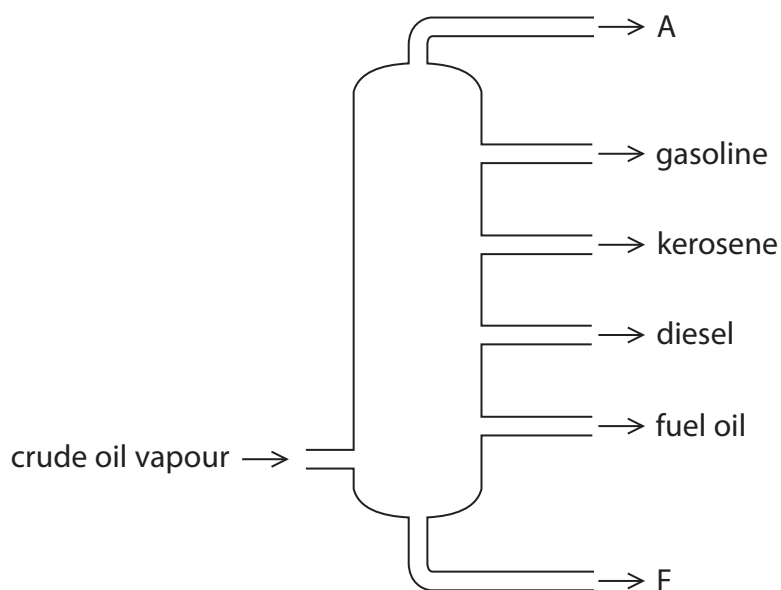
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3 The diagram shows the industrial equipment used to separate crude oil into fractions.



(a) (i) Give the name of the industrial equipment.

(1)

(ii) Give one use of the fuel oil fraction.

(1)

(iii) Give the names of fraction A and fraction F.

(2)

fraction A.....

fraction F.....



- (b) One compound in the gasoline fraction is the alkane octane ( $C_8H_{18}$ ) and one compound in the kerosene fraction is the alkane dodecane ( $C_{12}H_{26}$ )

These two alkanes are covalently bonded and have simple molecular structures.

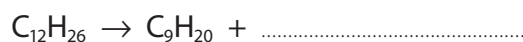
- (i) Give the general formula for the alkanes. (1)

- (ii) Explain, in terms of their structures, why  $C_{12}H_{26}$  has a higher boiling point than  $C_8H_{18}$ . (3)

- (c) Catalytic cracking can be used to convert the alkane  $C_{12}H_{26}$  into more useful products.

- (i) Give the name of the catalyst used for catalytic cracking. (1)

- (ii) Complete the equation for this cracking reaction. (1)



**(Total for Question 3 = 10 marks)**

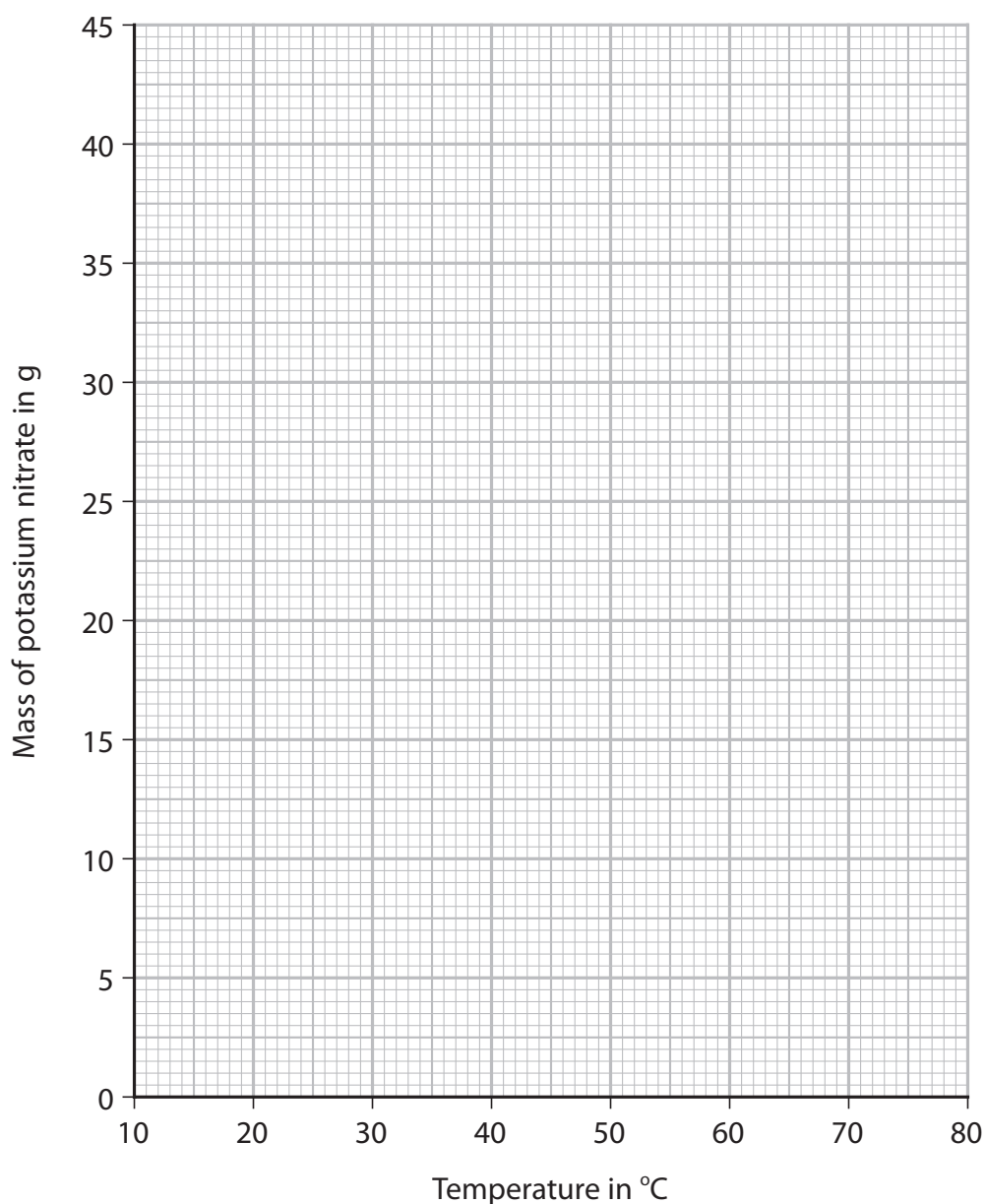


- 4 A student investigates the solubility of potassium nitrate in water. She measures the masses of potassium nitrate that dissolve in  $25 \text{ cm}^3$  of water at different temperatures.

The table shows the student's results. One of the results is anomalous.

Temperature in $^{\circ}\text{C}$	10	20	30	40	50	60	70
Mass of potassium nitrate in g	8.0	10.0	12.5	16.0	17.5	26.5	34.0

- (a) (i) Plot the results on the grid. (1)
- (ii) Draw a circle around the anomalous result. (1)
- (iii) Ignoring the anomalous result, draw a curve of best fit. (1)





(b) Suggest **two** possible mistakes that could have caused the anomalous result. (2)

1 .....

.....

2 .....

.....

(c) Use your graph to find the maximum mass of potassium nitrate that dissolves in 25 cm<sup>3</sup> of water at 75 °C.

Show on your graph how you obtained your answer. (2)

mass = ..... g

(d) Use your graph to calculate the solubility of potassium nitrate in g per 100 g of water at 25 °C.

[1.0 cm<sup>3</sup> of water has a mass of 1.0 g] (2)

solubility = ..... g per 100 g of water

**(Total for Question 4 = 9 marks)**

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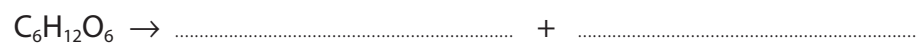


(ii) The word equation for the fermentation process is



Complete the chemical equation for this reaction.

(1)



**(Total for Question 5 = 14 marks)**

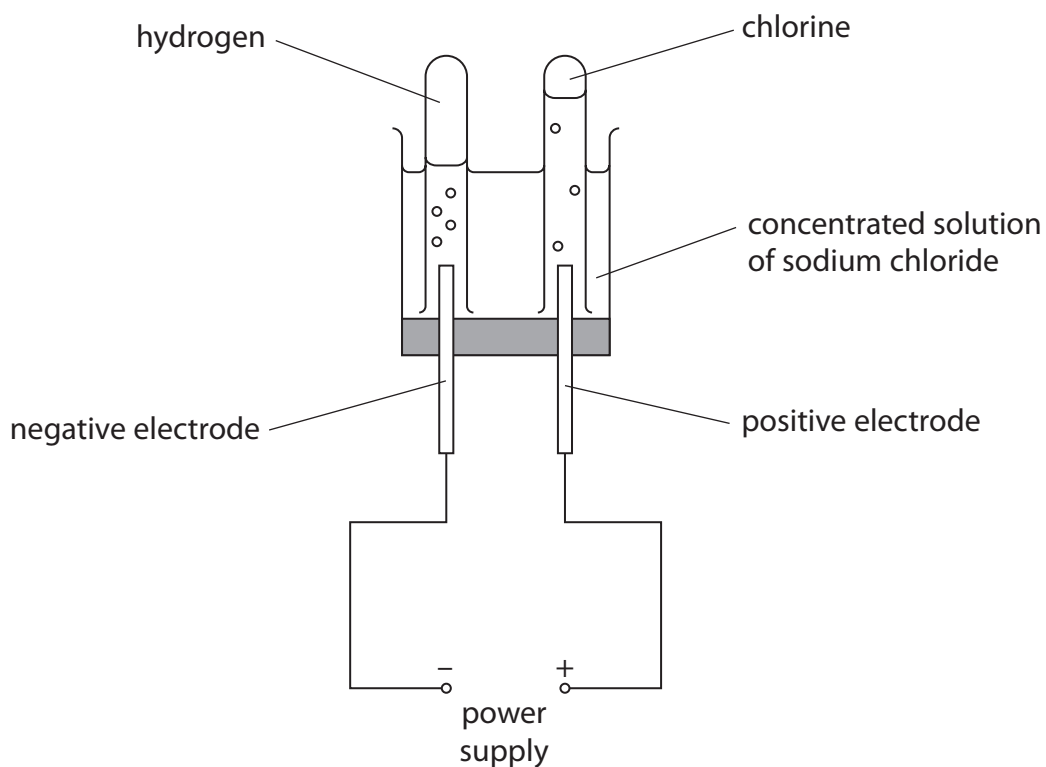
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6 The diagram shows how hydrogen gas and chlorine gas can be prepared in the laboratory by electrolysis of a concentrated solution of sodium chloride.



(a) (i) Give a test for hydrogen gas.

(1)

.....

(ii) Give a test for chlorine gas.

(2)

.....

.....

.....

.....

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(b) The ionic half-equation for the formation of chlorine at the positive electrode is



(i) State why this reaction is an oxidation reaction. (1)

.....

.....

(ii) Give the ionic half-equation for the formation of hydrogen at the negative electrode. (1)

.....

.....

(iii) State why it is safer to do this electrolysis in a fume cupboard. (1)

.....

.....

(iv) Suggest why the volume of chlorine collected during this electrolysis is less than the volume of hydrogen collected. (1)

.....

.....

.....



- (c) In the chemical industry, chlorine can be produced by the electrolysis of molten sodium chloride.

The overall equation for this reaction is



- (i) Explain why sodium chloride needs to be molten rather than solid for electrolysis to occur.

(2)

.....

.....

.....

.....

.....

.....

- (ii) Calculate the maximum volume, in  $\text{dm}^3$ , of chlorine gas at rtp that can be obtained from 23.4 tonnes of molten sodium chloride.

[1 tonne =  $10^6$  g]

[ $M_r$  of NaCl = 58.5]

[molar volume of chlorine at rtp =  $24 \text{ dm}^3$ ]

Give your answer in standard form.

(4)

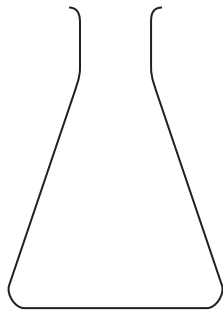
volume = .....  $\text{dm}^3$

**(Total for Question 6 = 13 marks)**

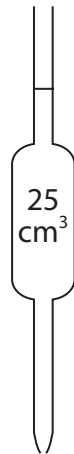




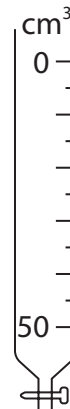
- 7 A student does a titration to find the concentration of a solution of phosphoric acid. He uses these pieces of apparatus X, Y and Z in his titration.



X



Y



Z

Diagrams are not to scale.

- (a) Give the names of X, Y and Z.

(3)

X .....

Y .....

Z .....

- (b) What is the colour of phenolphthalein in phosphoric acid?

(1)

- A blue
- B colourless
- C pink
- D red



- (c) The student titrates  $25.0\text{ cm}^3$  of phosphoric acid with a solution of sodium hydroxide (NaOH).

Table 1 shows the student's results.

titration number	1	2	3	4
volume of NaOH added in $\text{cm}^3$	30.35	30.25	30.00	30.30
concordant results				

**Table 1**

Concordant results are those within  $0.20\text{ cm}^3$  of each other.

- (i) Add ticks ( $\checkmark$ ) to table 1 to show the concordant results. (1)
- (ii) Use your ticked results to calculate the mean (average) volume of NaOH added. (2)

mean volume = .....  $\text{cm}^3$

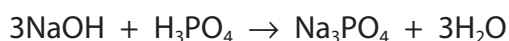


(d) Table 2 shows the titration results of another student.

volume of phosphoric acid used in cm <sup>3</sup>	25.0
concentration of sodium hydroxide solution in mol/dm <sup>3</sup>	0.525
mean volume of sodium hydroxide added in cm <sup>3</sup>	30.40

**Table 2**

The equation for the reaction is



- (i) Calculate the amount, in moles, of NaOH in 30.40 cm<sup>3</sup> of sodium hydroxide solution. (2)

amount = ..... mol

- (ii) Calculate the amount, in moles, of H<sub>3</sub>PO<sub>4</sub> in 25.0 cm<sup>3</sup> of phosphoric acid. (1)

amount = ..... mol

- (iii) Calculate the concentration, in mol/dm<sup>3</sup>, of the phosphoric acid. (2)

concentration = ..... mol/dm<sup>3</sup>

**(Total for Question 7 = 12 marks)**

**TOTAL FOR PAPER = 70 MARKS**

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