

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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**Thursday 14 May 2020**

Morning (Time: 2 hours)

Paper Reference **4CH1/1CR 4SD0/1CR**

**Chemistry**

**Unit: 4CH1**

**Science (Double Award) 4SD0**

**Paper: 1CR**

**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.*
- Show all the steps in any calculations and state the units.
- 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 110.
- 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.
- Write your answers neatly and in good English.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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# 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> aluminium 13	14 <b>N</b> nitrogen 7	15 <b>O</b> oxygen 8	16 <b>F</b> fluorine 9	17 <b>Ne</b> neon 10
19 <b>K</b> potassium 19	20 <b>Ca</b> calcium 20	23 <b>Na</b> sodium 11	24 <b>Mg</b> magnesium 12	27 <b>Co</b> cobalt 27	28 <b>Ni</b> nickel 28	29 <b>Cu</b> copper 29	30 <b>Zn</b> zinc 30	35 <b>Br</b> bromine 35
37 <b>Rb</b> rubidium 37	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
55 <b>Cs</b> caesium 55	56 <b>Ba</b> barium 56	57 <b>La*</b> lanthanum 57	58 <b>Ce</b> cerium 58	59 <b>Pr</b> praseodymium 59	60 <b>Nd</b> neodymium 60	61 <b>Pm</b> promethium 61	62 <b>Sm</b> samarium 62	63 <b>Eu</b> europium 63
87 <b>Fr</b> francium 87	88 <b>Ra</b> radium 88	89 <b>Ac*</b> actinium 89	90 <b>Th</b> thorium 90	91 <b>Pa</b> protactinium 91	92 <b>U</b> uranium 92	93 <b>Np</b> neptunium 93	94 <b>Pu</b> plutonium 94	95 <b>Am</b> americium 95
133 <b>Cs</b> caesium 133	137 <b>Ba</b> barium 137	138 <b>La*</b> lanthanum 138	139 <b>Ce</b> cerium 139	140 <b>Pr</b> praseodymium 140	141 <b>Nd</b> neodymium 141	142 <b>Pm</b> promethium 142	143 <b>Sm</b> samarium 143	144 <b>Eu</b> europium 144
151 <b>Lu*</b> lutetium 151	152 <b>Hf</b> hafnium 152	153 <b>Ta</b> tantalum 153	154 <b>W</b> tungsten 154	155 <b>Re</b> rhenium 155	156 <b>Os</b> osmium 156	157 <b>Ir</b> iridium 157	158 <b>Pt</b> platinum 158	159 <b>Au</b> gold 159
165 <b>Ho*</b> holmium 165	167 <b>Tm</b> thulium 167	168 <b>Yb</b> ytterbium 168	169 <b>Lu*</b> lutetium 169	170 <b>Hf</b> hafnium 170	171 <b>Ta</b> tantalum 171	172 <b>W</b> tungsten 172	173 <b>Re</b> rhenium 173	174 <b>Os</b> osmium 174
181 <b>Er*</b> erbium 181	182 <b>Tm</b> thulium 182	183 <b>Yb</b> ytterbium 183	184 <b>Lu*</b> lutetium 184	185 <b>Hf</b> hafnium 185	186 <b>Ta</b> tantalum 186	187 <b>W</b> tungsten 187	188 <b>Re</b> rhenium 188	189 <b>Os</b> osmium 189
197 <b>Ir</b> iridium 197	198 <b>Pt</b> platinum 198	199 <b>Au</b> gold 199	200 <b>Hg</b> mercury 200	201 <b>Tl</b> thallium 201	202 <b>Pb</b> lead 202	203 <b>Bi</b> bismuth 203	204 <b>Po</b> polonium 204	205 <b>At</b> astatine 205
209 <b>Tl</b> thallium 209	210 <b>Pb</b> lead 210	211 <b>Bi</b> bismuth 211	212 <b>Po</b> polonium 212	213 <b>At</b> astatine 213	214 <b>Rn</b> radon 214	215 <b>Fr</b> francium 215	216 <b>Ra</b> radium 216	217 <b>Ac</b> actinium 217
223 <b>Fr</b> francium 223	226 <b>Ra</b> radium 226	227 <b>Ac*</b> actinium 227	228 <b>Th</b> thorium 228	232 <b>U</b> uranium 232	238 <b>U</b> uranium 238	244 <b>Pu</b> plutonium 244	254 <b>Am</b> americium 254	262 <b>Cf</b> californium 262
254 <b>Am</b> americium 254	262 <b>Cf</b> californium 262	267 <b>Bk</b> berkelium 267	271 <b>Hf</b> hafnium 271	272 <b>Ta</b> tantalum 272	277 <b>W</b> tungsten 277	281 <b>Re</b> rhenium 281	286 <b>Os</b> osmium 286	291 <b>Ir</b> iridium 291
287 <b>La*</b> lanthanum 287	288 <b>Ce</b> cerium 288	289 <b>Pr</b> praseodymium 289	290 <b>Nd</b> neodymium 290	291 <b>Pm</b> promethium 291	292 <b>Sm</b> samarium 292	293 <b>Eu</b> europium 293	294 <b>Gd</b> gadolinium 294	295 <b>Tm</b> thulium 295
297 <b>Lu*</b> lutetium 297	298 <b>Hf</b> hafnium 298	299 <b>Ta</b> tantalum 299	300 <b>W</b> tungsten 300	301 <b>Re</b> rhenium 301	302 <b>Os</b> osmium 302	303 <b>Ir</b> iridium 303	304 <b>Pt</b> platinum 304	305 <b>Au</b> gold 305
307 <b>La*</b> lanthanum 307	308 <b>Ce</b> cerium 308	309 <b>Pr</b> praseodymium 309	310 <b>Nd</b> neodymium 310	311 <b>Pm</b> promethium 311	312 <b>Sm</b> samarium 312	313 <b>Eu</b> europium 313	314 <b>Gd</b> gadolinium 314	315 <b>Tm</b> thulium 315
317 <b>Lu*</b> lutetium 317	318 <b>Hf</b> hafnium 318	319 <b>Ta</b> tantalum 319	320 <b>W</b> tungsten 320	321 <b>Re</b> rhenium 321	322 <b>Os</b> osmium 322	323 <b>Ir</b> iridium 323	324 <b>Pt</b> platinum 324	325 <b>Au</b> gold 325
327 <b>La*</b> lanthanum 327	328 <b>Ce</b> cerium 328	329 <b>Pr</b> praseodymium 329	330 <b>Nd</b> neodymium 330	331 <b>Pm</b> promethium 331	332 <b>Sm</b> samarium 332	333 <b>Eu</b> europium 333	334 <b>Gd</b> gadolinium 334	335 <b>Tm</b> thulium 335
337 <b>Lu*</b> lutetium 337	338 <b>Hf</b> hafnium 338	339 <b>Ta</b> tantalum 339	340 <b>W</b> tungsten 340	341 <b>Re</b> rhenium 341	342 <b>Os</b> osmium 342	343 <b>Ir</b> iridium 343	344 <b>Pt</b> platinum 344	345 <b>Au</b> gold 345
347 <b>La*</b> lanthanum 347	348 <b>Ce</b> cerium 348	349 <b>Pr</b> praseodymium 349	350 <b>Nd</b> neodymium 350	351 <b>Pm</b> promethium 351	352 <b>Sm</b> samarium 352	353 <b>Eu</b> europium 353	354 <b>Gd</b> gadolinium 354	355 <b>Tm</b> thulium 355
357 <b>Lu*</b> lutetium 357	358 <b>Hf</b> hafnium 358	359 <b>Ta</b> tantalum 359	360 <b>W</b> tungsten 360	361 <b>Re</b> rhenium 361	362 <b>Os</b> osmium 362	363 <b>Ir</b> iridium 363	364 <b>Pt</b> platinum 364	365 <b>Au</b> gold 365
367 <b>La*</b> lanthanum 367	368 <b>Ce</b> cerium 368	369 <b>Pr</b> praseodymium 369	370 <b>Nd</b> neodymium 370	371 <b>Pm</b> promethium 371	372 <b>Sm</b> samarium 372	373 <b>Eu</b> europium 373	374 <b>Gd</b> gadolinium 374	375 <b>Tm</b> thulium 375
377 <b>Lu*</b> lutetium 377	378 <b>Hf</b> hafnium 378	379 <b>Ta</b> tantalum 379	380 <b>W</b> tungsten 380	381 <b>Re</b> rhenium 381	382 <b>Os</b> osmium 382	383 <b>Ir</b> iridium 383	384 <b>Pt</b> platinum 384	385 <b>Au</b> gold 385
387 <b>La*</b> lanthanum 387	388 <b>Ce</b> cerium 388	389 <b>Pr</b> praseodymium 389	390 <b>Nd</b> neodymium 390	391 <b>Pm</b> promethium 391	392 <b>Sm</b> samarium 392	393 <b>Eu</b> europium 393	394 <b>Gd</b> gadolinium 394	395 <b>Tm</b> thulium 395
397 <b>Lu*</b> lutetium 397	398 <b>Hf</b> hafnium 398	399 <b>Ta</b> tantalum 399	400 <b>W</b> tungsten 400	401 <b>Re</b> rhenium 401	402 <b>Os</b> osmium 402	403 <b>Ir</b> iridium 403	404 <b>Pt</b> platinum 404	405 <b>Au</b> gold 405
407 <b>La*</b> lanthanum 407	408 <b>Ce</b> cerium 408	409 <b>Pr</b> praseodymium 409	410 <b>Nd</b> neodymium 410	411 <b>Pm</b> promethium 411	412 <b>Sm</b> samarium 412	413 <b>Eu</b> europium 413	414 <b>Gd</b> gadolinium 414	415 <b>Tm</b> thulium 415
417 <b>Lu*</b> lutetium 417	418 <b>Hf</b> hafnium 418	419 <b>Ta</b> tantalum 419	420 <b>W</b> tungsten 420	421 <b>Re</b> rhenium 421	422 <b>Os</b> osmium 422	423 <b>Ir</b> iridium 423	424 <b>Pt</b> platinum 424	425 <b>Au</b> gold 425
427 <b>La*</b> lanthanum 427	428 <b>Ce</b> cerium 428	429 <b>Pr</b> praseodymium 429	430 <b>Nd</b> neodymium 430	431 <b>Pm</b> promethium 431	432 <b>Sm</b> samarium 432	433 <b>Eu</b> europium 433	434 <b>Gd</b> gadolinium 434	435 <b>Tm</b> thulium 435
437 <b>Lu*</b> lutetium 437	438 <b>Hf</b> hafnium 438	439 <b>Ta</b> tantalum 439	440 <b>W</b> tungsten 440	441 <b>Re</b> rhenium 441	442 <b>Os</b> osmium 442	443 <b>Ir</b> iridium 443	444 <b>Pt</b> platinum 444	445 <b>Au</b> gold 445
447 <b>La*</b> lanthanum 447	448 <b>Ce</b> cerium 448	449 <b>Pr</b> praseodymium 449	450 <b>Nd</b> neodymium 450	451 <b>Pm</b> promethium 451	452 <b>Sm</b> samarium 452	453 <b>Eu</b> europium 453	454 <b>Gd</b> gadolinium 454	455 <b>Tm</b> thulium 455
457 <b>Lu*</b> lutetium 457	458 <b>Hf</b> hafnium 458	459 <b>Ta</b> tantalum 459	460 <b>W</b> tungsten 460	461 <b>Re</b> rhenium 461	462 <b>Os</b> osmium 462	463 <b>Ir</b> iridium 463	464 <b>Pt</b> platinum 464	465 <b>Au</b> gold 465
467 <b>La*</b> lanthanum 467	468 <b>Ce</b> cerium 468	469 <b>Pr</b> praseodymium 469	470 <b>Nd</b> neodymium 470	471 <b>Pm</b> promethium 471	472 <b>Sm</b> samarium 472	473 <b>Eu</b> europium 473	474 <b>Gd</b> gadolinium 474	475 <b>Tm</b> thulium 475
477 <b>Lu*</b> lutetium 477	478 <b>Hf</b> hafnium 478	479 <b>Ta</b> tantalum 479	480 <b>W</b> tungsten 480	481 <b>Re</b> rhenium 481	482 <b>Os</b> osmium 482	483 <b>Ir</b> iridium 483	484 <b>Pt</b> platinum 484	485 <b>Au</b> gold 485
487 <b>La*</b> lanthanum 487	488 <b>Ce</b> cerium 488	489 <b>Pr</b> praseodymium 489	490 <b>Nd</b> neodymium 490	491 <b>Pm</b> promethium 491	492 <b>Sm</b> samarium 492	493 <b>Eu</b> europium 493	494 <b>Gd</b> gadolinium 494	495 <b>Tm</b> thulium 495
497 <b>Lu*</b> lutetium 497	498 <b>Hf</b> hafnium 498	499 <b>Ta</b> tantalum 499	500 <b>W</b> tungsten 500	501 <b>Re</b> rhenium 501	502 <b>Os</b> osmium 502	503 <b>Ir</b> iridium 503	504 <b>Pt</b> platinum 504	505 <b>Au</b> gold 505
507 <b>La*</b> lanthanum 507	508 <b>Ce</b> cerium 508	509 <b>Pr</b> praseodymium 509	510 <b>Nd</b> neodymium 510	511 <b>Pm</b> promethium 511	512 <b>Sm</b> samarium 512	513 <b>Eu</b> europium 513	514 <b>Gd</b> gadolinium 514	515 <b>Tm</b> thulium 515
517 <b>Lu*</b> lutetium 517	518 <b>Hf</b> hafnium 518	519 <b>Ta</b> tantalum 519	520 <b>W</b> tungsten 520	521 <b>Re</b> rhenium 521	522 <b>Os</b> osmium 522	523 <b>Ir</b> iridium 523	524 <b>Pt</b> platinum 524	525 <b>Au</b> gold 525
527 <b>La*</b> lanthanum 527	528 <b>Ce</b> cerium 528	529 <b>Pr</b> praseodymium 529	530 <b>Nd</b> neodymium 530	531 <b>Pm</b> promethium 531	532 <b>Sm</b> samarium 532	533 <b>Eu</b> europium 533	534 <b>Gd</b> gadolinium 534	535 <b>Tm</b> thulium 535
537 <b>Lu*</b> lutetium 537	538 <b>Hf</b> hafnium 538	539 <b>Ta</b> tantalum 539	540 <b>W</b> tungsten 540	541 <b>Re</b> rhenium 541	542 <b>Os</b> osmium 542	543 <b>Ir</b> iridium 543	544 <b>Pt</b> platinum 544	545 <b>Au</b> gold 545
547 <b>La*</b> lanthanum 547	548 <b>Ce</b> cerium 548	549 <b>Pr</b> praseodymium 549	550 <b>Nd</b> neodymium 550	551 <b>Pm</b> promethium 551	552 <b>Sm</b> samarium 552	553 <b>Eu</b> europium 553	554 <b>Gd</b> gadolinium 554	555 <b>Tm</b> thulium 555
557 <b>Lu*</b> lutetium 557	558 <b>Hf</b> hafnium 558	559 <b>Ta</b> tantalum 559	560 <b>W</b> tungsten 560	561 <b>Re</b> rhenium 561	562 <b>Os</b> osmium 562	563 <b>Ir</b> iridium 563	564 <b>Pt</b> platinum 564	565 <b>Au</b> gold 565
567 <b>La*</b> lanthanum 567	568 <b>Ce</b> cerium 568	569 <b>Pr</b> praseodymium 569	570 <b>Nd</b> neodymium 570	571 <b>Pm</b> promethium 571	572 <b>Sm</b> samarium 572	573 <b>Eu</b> europium 573	574 <b>Gd</b> gadolinium 574	575 <b>Tm</b> thulium 575
577 <b>Lu*</b> lutetium 577	578 <b>Hf</b> hafnium 578	579 <b>Ta</b> tantalum 579	580 <b>W</b> tungsten 580	581 <b>Re</b> rhenium 581	582 <b>Os</b> osmium 582	583 <b>Ir</b> iridium 583	584 <b>Pt</b> platinum 584	585 <b>Au</b> gold 585
587 <b>La*</b> lanthanum 587	588 <b>Ce</b> cerium 588	589 <b>Pr</b> praseodymium 589	590 <b>Nd</b> neodymium 590	591 <b>Pm</b> promethium 591	592 <b>Sm</b> samarium 592	593 <b>Eu</b> europium 593	594 <b>Gd</b> gadolinium 594	595 <b>Tm</b> thulium 595
597 <b>Lu*</b> lutetium 597	598 <b>Hf</b> hafnium 598	599 <b>Ta</b> tantalum 599	600 <b>W</b> tungsten 600	601 <b>Re</b> rhenium 601	602 <b>Os</b> osmium 602	603 <b>Ir</b> iridium 603	604 <b>Pt</b> platinum 604	605 <b>Au</b> gold 605
607 <b>La*</b> lanthanum 607	608 <b>Ce</b> cerium 608	609 <b>Pr</b> praseodymium 609	610 <b>Nd</b> neodymium 610	611 <b>Pm</b> promethium 611	612 <b>Sm</b> samarium 612	613 <b>Eu</b> europium 613	614 <b>Gd</b> gadolinium 614	615 <b>Tm</b> thulium 615
617 <b>Lu*</b> lutetium 617	618 <b>Hf</b> hafnium 618	619 <b>Ta</b> tantalum 619	620 <b>W</b> tungsten 620	621 <b>Re</b> rhenium 621	622 <b>Os</b> osmium 622	623 <b>Ir</b> iridium 623	624 <b>Pt</b> platinum 624	625 <b>Au</b> gold 625
627 <b>La*</b> lanthanum 627	628 <b>Ce</b> cerium 628	629 <b>Pr</b> praseodymium 629	630 <b>Nd</b> neodymium 630	631 <b>Pm</b> promethium 631	632 <b>Sm</b> samarium 632	633 <b>Eu</b> europium 633	634 <b>Gd</b> gadolinium 634	635 <b>Tm</b> thulium 635
637 <b>Lu*</b> lutetium 637	638 <b>Hf</b> hafnium 638	639 <b>Ta</b> tantalum 639	640 <b>W</b> tungsten 640	641 <b>Re</b> rhenium 641	642 <b>Os</b> osmium 642	643 <b>Ir</b> iridium 643	644 <b>Pt</b> platinum 644	645 <b>Au</b> gold 645
647 <b>La*</b> lanthanum 647	648 <b>Ce</b> cerium 648	649 <b>Pr</b> praseodymium 649	650 <b>Nd</b> neodymium 650	651 <b>Pm</b> promethium 651	652 <b>Sm</b> samarium 652	653 <b>Eu</b> europium 653	654 <b>Gd</b> gadolinium 654	655 <b>Tm</b> thulium 655
657 <b>Lu*</b> lutetium 657								

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**Answer ALL questions.**

1 (a) The box gives some methods used in the separation of mixtures.

chromatography	crystallisation	evaporation
filtration	fractional distillation	simple distillation

Use words from the box to answer these questions.

(i) Identify the method used to obtain pure water from sea water. (1)

(ii) Identify the method used to separate the dyes in a food colouring. (1)

(iii) Identify the method used to obtain ethanol from a mixture of ethanol and water. (1)

(b) Complete the sentences by writing a suitable word in each blank space. (3)

When salt is added to water and stirred until no more will ..... , a saturated solution forms.

The salt is the .....

The water is the .....

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



2 The diagram shows the positions of some elements in the Periodic Table.

1	2											3	4	5	6	7	0
																	He
																F	
Na																Cl	
K																Br	

(a) Use symbols from this table to answer these questions.

Each symbol may be used once, more than once or not at all.

(i) Give the symbol of a metal.

(1)

(ii) Give the symbol of a noble gas.

(1)

(iii) Give the symbol of a liquid at room temperature.

(1)

(iv) Give the symbols of the two elements in Period 3

(1)

..... and .....

(b) Deduce the electronic configuration of Na

(1)

**(Total for Question 2 = 5 marks)**



3 This question is about alkenes and alkanes.

(a) Complete the table by giving the missing information about the alkene with the molecular formula  $C_3H_6$

(4)

<b>Molecular formula</b>	$C_3H_6$
<b>Name</b>	
<b>Empirical formula</b>	
<b>General formula</b>	
<b>Displayed formula</b>	

(b) Alkenes are unsaturated compounds.

(i) State what is meant by the term **unsaturated**.

(1)

.....

.....

(ii) Describe a test to show that a compound is unsaturated.

(2)

.....

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(c) When the alkane methane reacts with chlorine, the products are chloromethane ( $\text{CH}_3\text{Cl}$ ) and hydrogen chloride gas.

(i) Give a chemical equation for this reaction. (1)

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(ii) What is the name of this type of reaction? (1)

- A addition
- B decomposition
- C neutralisation
- D substitution

(iii) State the condition needed for this reaction to occur. (1)

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(d) When ethane reacts with chlorine, one of the products of the reaction has the formula  $C_2H_4Cl_2$

There are two isomers with this formula.

(i) State what is meant by the term **isomers**. (2)

.....

.....

.....

.....

(ii) Draw the displayed formulae of the two isomers with the formula  $C_2H_4Cl_2$  (2)

isomer 1	isomer 2

(Total for Question 3 = 14 marks)



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- 4 A solution of hydrogen peroxide decomposes when a catalyst of manganese(IV) oxide is added.

The products of the reaction are water and oxygen.

- (a) Complete the chemical equation for this reaction.

(1)



- (b) Give a test for oxygen.

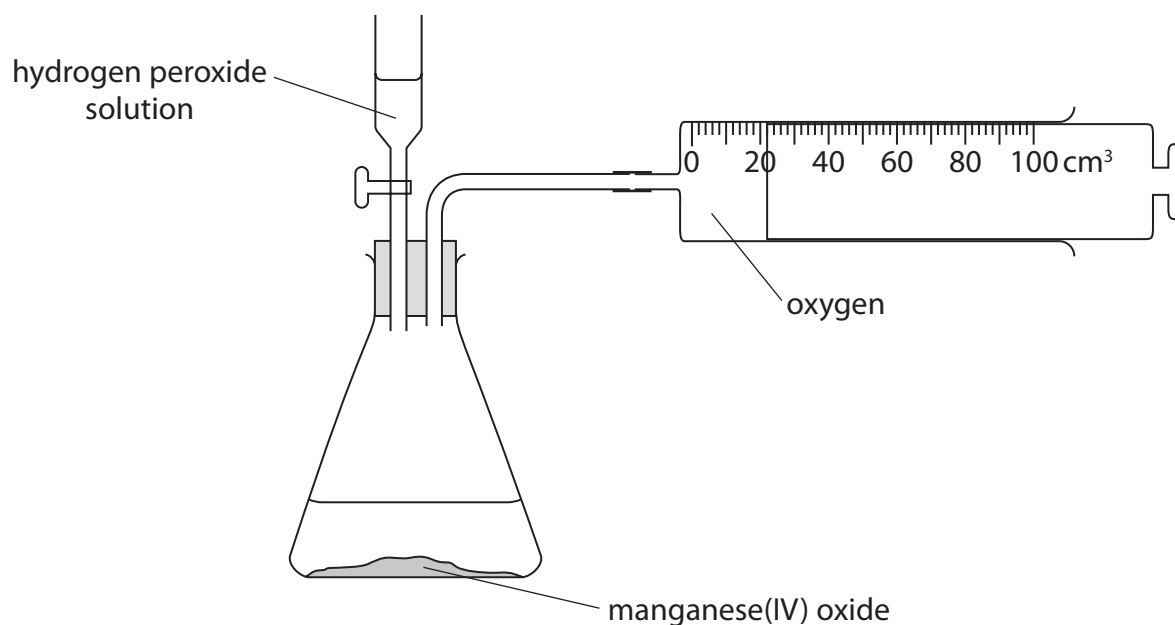
(1)

- (c) State the reason for adding a catalyst.

(1)

- (d) A student investigates how changing the concentration of the hydrogen peroxide solution affects the rate of this reaction.

She uses this apparatus.

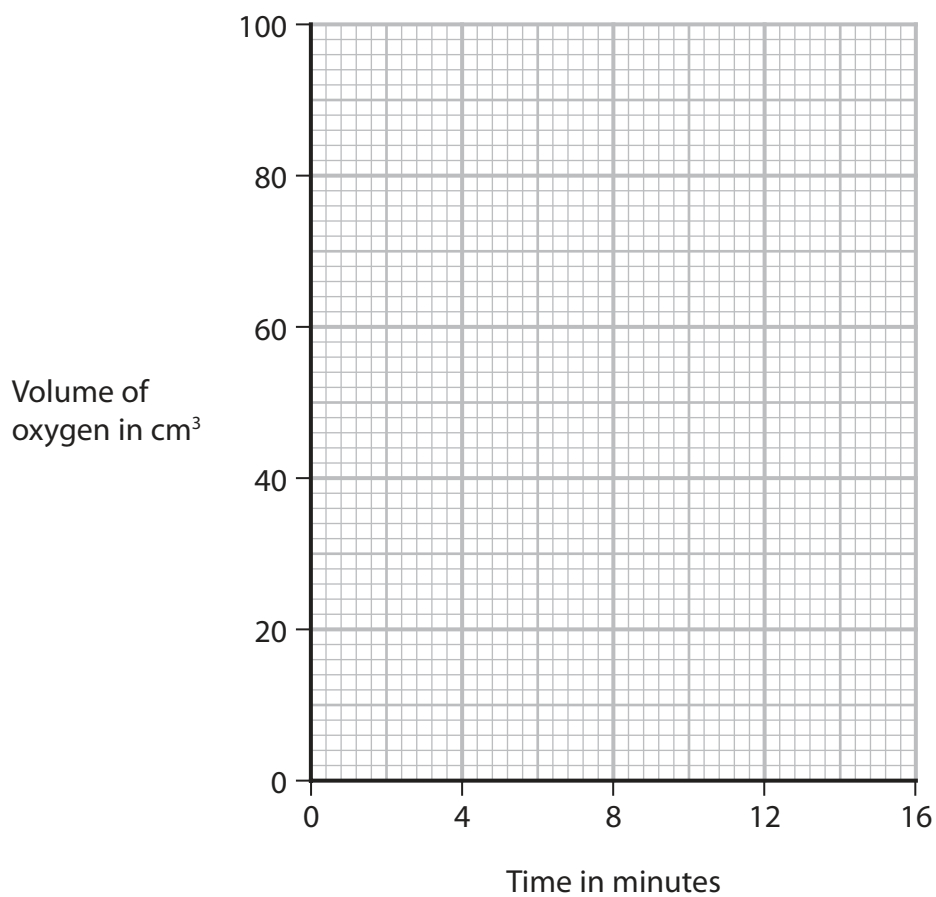


The student records the volume of oxygen that collects every 2 minutes for 16 minutes.

The table shows her results.

Time in minutes	0	2	4	6	8	10	12	14	16
Volume of oxygen in cm <sup>3</sup>	0	22	38	50	55	69	76	80	80

- (i) Plot the student's results on the grid. (1)
- (ii) Draw a circle on the grid around the anomalous result. (1)
- (iii) Draw a curve of best fit through the points, ignoring the anomalous result. (1)



(iv) Suggest a mistake that the student might have made to cause the anomalous result.

(1)

.....

.....

.....

(v) Determine the volume of oxygen collected during the first 3 minutes.

Show on your graph how you obtain your answer.

(2)

volume of oxygen = ..... cm<sup>3</sup>

(e) The student repeats the experiment using hydrogen peroxide solution of half the concentration of the original solution.

She keeps the volume of the hydrogen peroxide solution and all other conditions the same.

(i) Draw on the grid the curve you would expect the student to obtain.

(2)

(ii) Explain how using hydrogen peroxide solution of half the concentration affects the rate of the reaction.

Refer to particle collision theory in your answer.

(3)

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**(Total for Question 4 = 14 marks)**

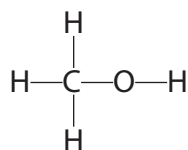
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- 5 (a) The diagram shows the displayed formula of the organic compound methanol, CH<sub>3</sub>OH



- (i) Determine the number of atoms in one molecule of methanol. (1)

- (ii) State why methanol is not a hydrocarbon. (1)

- (b) The atoms in methanol are held together by covalent bonds.

- (i) State what is meant by the term **covalent bond**. (2)

- (ii) Draw a dot-and-cross diagram to show the bonding in a molecule of methanol.  
Show only the outer electrons of each atom. (2)



(c) Another organic compound has the percentage composition by mass

$$C = 38.7\% \quad H = 9.7\% \quad O = 51.6\%$$

(i) Calculate the empirical formula of this compound.

(3)

empirical formula = .....

(ii) The relative molecular mass ( $M_r$ ) of the compound is 62

Determine the molecular formula of the compound.

(2)

molecular formula = .....

**(Total for Question 5 = 11 marks)**

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6 This question is about elements in Group 7 of the Periodic Table and their compounds.

(a) (i) Give the name of this group of elements. (1)

.....

(ii) State the colour of chlorine gas. (1)

.....

(iii) Give a test for chlorine gas. (2)

.....

.....

.....

.....

(b) Give a test to show that a solution contains iodide ions. (3)

test .....

.....

.....

.....

result .....

.....

.....

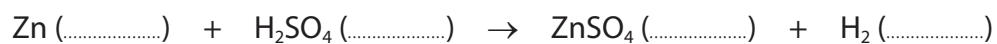
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7 A student uses the reaction between zinc and dilute sulfuric acid to prepare some zinc sulfate crystals.

- (a) (i) Complete the equation for this reaction by giving the correct state symbols. (1)



- (ii) State what would be observed during this reaction. (1)

.....

.....

(b) The student adds excess zinc to a beaker of dilute sulfuric acid.

- (i) Explain why it is necessary to add excess zinc. (2)

.....

.....

.....

- (ii) Draw a diagram of the apparatus the student should use to remove the unreacted zinc and collect the zinc sulfate solution. (2)





(c) The student obtains a pure, dry sample of zinc sulfate crystals.

The formula of zinc sulfate crystals is  $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$

(i) Calculate the relative molecular mass ( $M_r$ ) of zinc sulfate crystals.

(2)

$M_r = \dots\dots\dots$

(ii) The student uses 0.0200 mol of dilute sulfuric acid in her preparation.

Show that the maximum mass of zinc sulfate crystals that the student could obtain is about 6 g.

(2)

(iii) The student obtains a mass of 4.28 g of zinc sulfate crystals.

Calculate the percentage yield of the zinc sulfate crystals.

Give your answer to three significant figures.

(3)

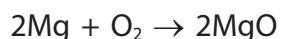
percentage yield =  $\dots\dots\dots$  %

**(Total for Question 7 = 13 marks)**



- 8 (a) A piece of magnesium ribbon is ignited and placed in a gas jar of oxygen.

The equation for the reaction is



- (i) Give two observations that would be made in this reaction.

(2)

1.....

.....

2.....

.....

- (ii) State why this is an oxidation reaction.

(1)

.....

.....

- (b) A second piece of magnesium ribbon is ignited and placed in a gas jar of carbon dioxide.

A very exothermic reaction occurs, forming magnesium oxide and carbon.

- (i) State what is meant by the term **exothermic**.

(1)

.....

.....

- (ii) Give the chemical equation for this reaction.

(1)

.....

- (iii) A fire starts in a warehouse where magnesium is stored.

Suggest why it would **not** be suitable to use a carbon dioxide fire extinguisher to put out this fire.

(1)

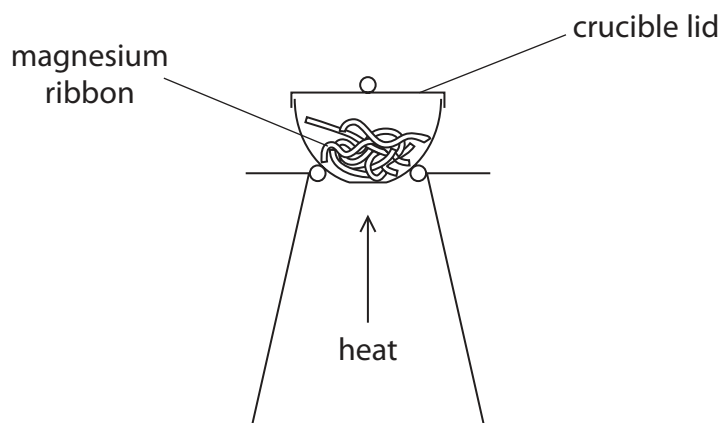
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- (c) A student uses this apparatus to find the mass of magnesium oxide that forms when a known mass of magnesium is heated.



This is his method.

- find the mass of the crucible and lid
- place some magnesium ribbon in the crucible
- find the mass of the crucible, lid and magnesium
- heat the crucible with the lid on for a few minutes
- find the mass of the crucible, lid and magnesium oxide

Using this method, the mass of magnesium oxide formed is less than expected.

Explain two changes that the student should make to his method to obtain a mass of magnesium oxide closer to the expected mass.

(4)

1 .....

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.....

.....

2 .....

.....

.....

.....

(Total for Question 8 = 10 marks)



9 This question is about some compounds of the elements in Group 4 of the Periodic Table.

(a) When carbon dioxide dissolves in water, a weak acid forms.

(i) Which of these could be the pH of this weak acid?

(1)

- A 1
- B 5
- C 7
- D 9

(ii) Which of these is a correct statement about acids?

(1)

- A acids contain  $\text{OH}^-$  ions
- B acids are electron donors
- C acids are proton acceptors
- D acids are proton donors

(b) When lead(II) carbonate is heated, lead(II) oxide and carbon dioxide form.

(i) Give the name of this type of reaction.

(1)

(ii) Complete the equation for this reaction.

(1)



- (c) Silicon dioxide,  $\text{SiO}_2$ , and silicon(IV) chloride,  $\text{SiCl}_4$ , are both covalently bonded compounds.

The table shows the melting and boiling points of these two compounds, and the physical state of silicon dioxide at room temperature.

Compound	Melting point in $^{\circ}\text{C}$	Boiling point in $^{\circ}\text{C}$	Physical state at room temperature
$\text{SiO}_2$	1710	2230	solid
$\text{SiCl}_4$	-69	58	

- (i) Complete the table by giving the physical state of silicon(IV) chloride at room temperature. (1)
- (ii) Explain, in terms of structure and bonding, why silicon dioxide has a much higher melting point than silicon(IV) chloride. (6)

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(Total for Question 9 = 11 marks)



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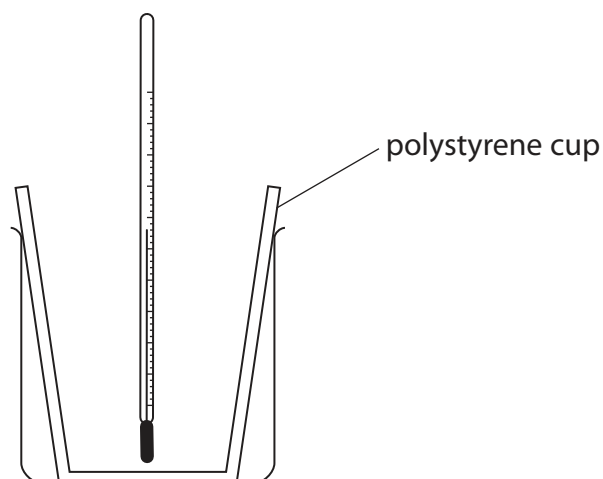
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- 10 A student uses this apparatus to investigate the reaction between potassium hydroxide solution and dilute hydrochloric acid.



This is her method.

- pour  $25\text{ cm}^3$  of potassium hydroxide solution into a polystyrene cup and record the temperature of the solution
- pour  $25\text{ cm}^3$  of dilute hydrochloric acid into a measuring cylinder and record the temperature of the acid
- add the acid to the polystyrene cup and stir the mixture
- record the highest temperature reached

- (a) (i) Give a word equation for the reaction between potassium hydroxide and hydrochloric acid.

(1)

- (ii) Explain why the student needs to stir the mixture.

(2)



(b) The table gives the temperatures of the solutions before the student mixes them.

potassium hydroxide solution	17.8 °C
dilute hydrochloric acid	18.4 °C

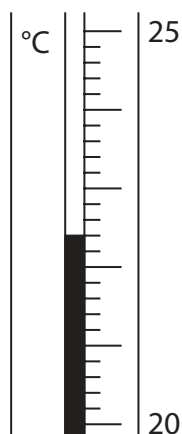
Calculate the mean (average) temperature of the two solutions.

(2)

mean temperature = ..... °C

(c) The student repeats the experiment on a different day, using 25 cm<sup>3</sup> of potassium hydroxide solution and 25 cm<sup>3</sup> of dilute hydrochloric acid.

The thermometer shows the highest temperature reached at the **end** of the experiment.



(i) Complete the table by giving the missing information.

Give both temperatures to the nearest 0.1 °C.

(2)

mean temperature at start in °C	
temperature at end in °C	
temperature rise in °C	5.2





(ii) Show that the heat energy change,  $Q$ , in the student's experiment is about 1100 J.

[for the mixture,  $c = 4.2 \text{ J/g/}^\circ\text{C}$ ]

[mass of  $1.0 \text{ cm}^3$  of mixture = 1.0 g]

(3)

(iii) The student uses 0.020 mol of potassium hydroxide in his experiment.

Calculate the enthalpy change ( $\Delta H$ ) in kJ/mol, for 1.0 mol of potassium hydroxide.

Include a sign in your answer.

(3)

$\Delta H = \dots\dots\dots$  kJ/mol

**(Total for Question 10 = 13 marks)**

**TOTAL FOR PAPER = 110 MARKS**

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