



Oxford Cambridge and RSA

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Thursday 18 May 2017 – Morning

**GCSE TWENTY FIRST CENTURY SCIENCE
CHEMISTRY A/SCIENCE A**

A171/01 Modules C1 C2 C3 (Foundation Tier)



Candidates answer on the Question Paper.
A calculator may be used for this paper.

OCR supplied materials:

None

Other materials required:

- Pencil
- Ruler (cm/mm)

Duration: 1 hour



Candidate forename					Candidate surname				
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Centre number						Candidate number			
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INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the barcodes.

INFORMATION FOR CANDIDATES

- The quality of written communication is assessed in questions marked with a pencil (✍).
- The Periodic Table is printed on the back page.
- 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 **60**.
- This document consists of **20** pages. Any blank pages are indicated.

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1 The exhaust gases of cars contain pollutants.
One of the pollutants is nitrogen monoxide.

(a) Put a **ring** around the correct words in each line to describe how nitrogen monoxide is formed in cars.

Nitrogen monoxide forms when nitrogen from the **air / petrol**

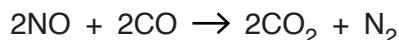
combines with **oxygen / carbon dioxide / water** from the air

at a **high / low** temperature inside the engine. [2]

(b) Cars are fitted with catalytic converters.

A reaction in the catalytic converter converts the nitrogen monoxide into a harmless gas.

This is the equation for the reaction.



Which statement about the reaction is **true**?

Put a tick (✓) in the box next to the correct answer.

Nitrogen monoxide is oxidised to form nitrogen dioxide.

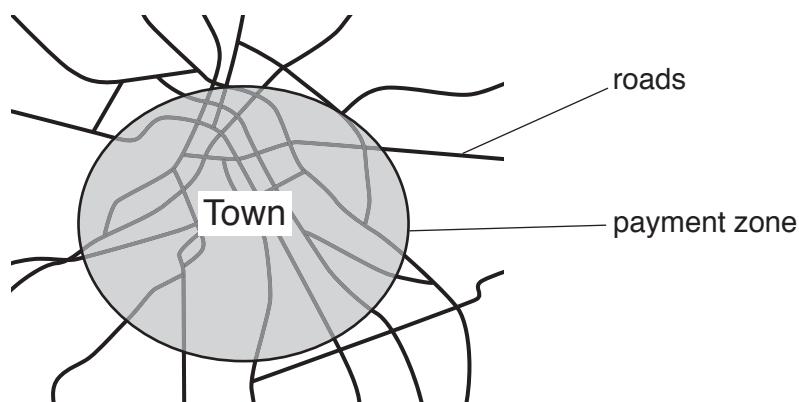
Nitrogen monoxide is reduced to form nitrogen dioxide.

Nitrogen monoxide is oxidised to form nitrogen.

Nitrogen monoxide is reduced to form nitrogen.

[1]

(c) A town council wanted to reduce the amount of air pollutants in a town. The council decided to introduce a payment zone for cars.



(i) Why did the council think that a payment for cars to enter the town would improve air quality in the town?

.....

.....

.....

[2]

(ii) Alex works for the town council.

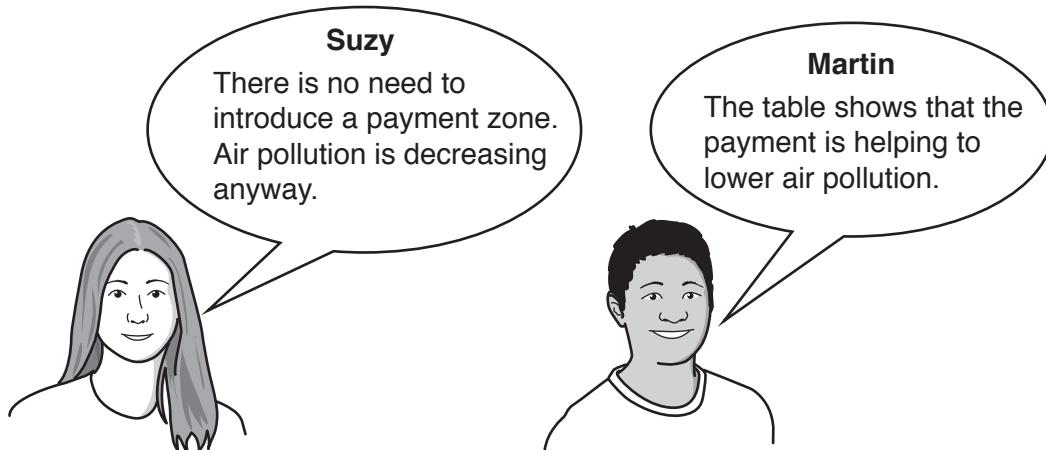
Alex measured the amount of pollutants in the air inside the payment zone and outside the payment zone.

He recorded data every day for a year before the payment was introduced and every day for a year afterwards.

The table shows Alex's data.

Site	Pollutant	Daily mean amount before the payment was introduced in $\mu\text{g}/\text{m}^3$	Daily mean amount after the payment was introduced in $\mu\text{g}/\text{m}^3$	Percentage change in %
Outside the payment zone	nitrogen oxides	560	476	-15
	carbon monoxide	25	22	-12
Inside the payment zone	nitrogen oxides	600	480	-20
	carbon monoxide	30	24	-20

Suzy and Martin talk about the data in the table.



Explain how the data in the table supports the ideas of both Suzy and Martin.

.....
.....
.....

[3]

[Total: 8]

2 Sulfur dioxide is an air pollutant which is formed when fossil fuels are burned in power stations and in motor vehicles.

(a) How does the sulfur dioxide form?

Put a tick (✓) in the box next to the correct answer.

Sulfur in the fuel burns.

Sulfur reacts with nitrogen in the air.

Sulfur dioxide is added to fossil fuels to help them burn.

Incomplete combustion of carbon compounds in the fuel.

[1]

(b) Sulfur dioxide is damaging to the environment because it causes acid rain.

Complete the following sentence which describes how acid rain is formed.
Choose from the following words.

chlorine

nitrogen

oxygen

sulfur

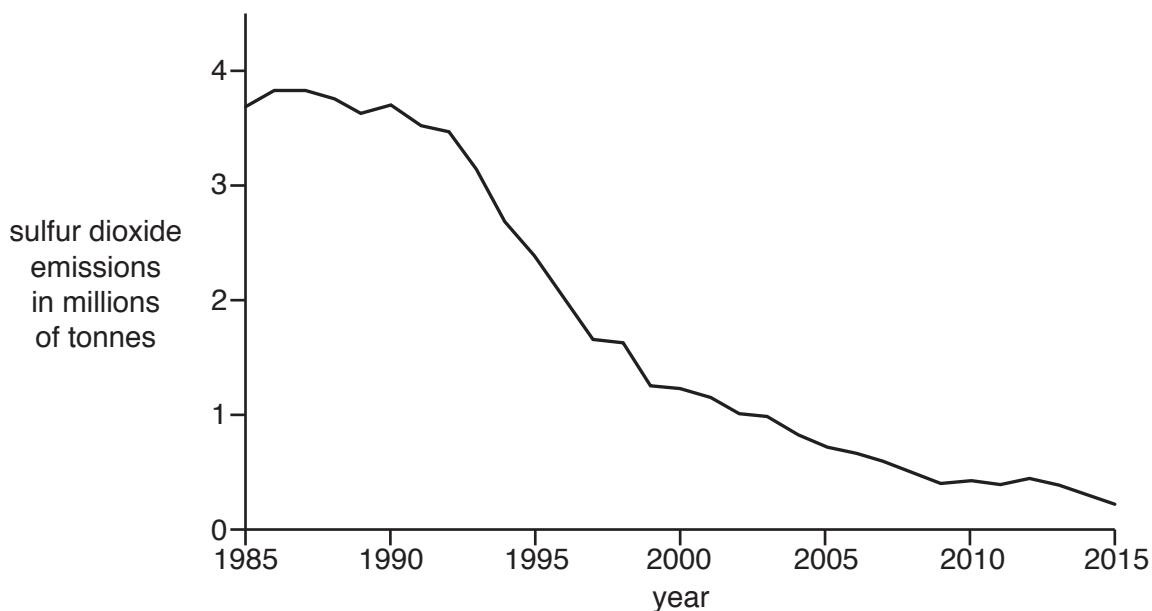
water

Acid rain is formed when sulfur dioxide reacts with

and

[2]

(c) The graph shows the amount of sulfur dioxide put into the air in the UK from 1985 to 2015.



Describe how the sulfur dioxide emissions have changed from 1985 to 2015 and suggest reasons for the change.



The quality of written communication will be assessed in your answer.

[6]

[Total: 9]

3 The amounts of gases in the Earth's atmosphere have changed since the atmosphere first formed.

(a) Complete the following statements about the atmosphere and how it has changed. Choose from the following words.

argon

carbon dioxide

nitrogen

oxygen

water

(i) When the Earth's atmosphere first formed, it contained mainly water vapour and

.....

[1]

(ii) After plants appeared, photosynthesis produced more

[1]

(iii) The Earth's atmosphere now contains approximately:

21% oxygen

78%

1%

[2]

[Total: 4]

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4 Crude oil contains hydrocarbons.

The table shows information about some of the hydrocarbons in crude oil.

Hydrocarbon	Number of carbons in one molecule	Properties			
		Melting point in °C	Boiling point in °C	State at 25 °C	Density in g/cm ³
Methane	1	−182	−161	gas	0.42
Ethane	2	−183	−89	0.55
Propane	3	−188	−42	gas	0.50
Butane	4	−135	0	gas	0.58
Pentane	5	−130	36	liquid	0.63
Octane	8	−57	126	liquid	0.70
Undecane	11	−26	196	liquid	0.74
Dodecane	12	−10	216	0.75
Eicosane	20	37	344	solid	0.79

(a) Predict the states at room temperature for **ethane** and **dodecane**.

Write your answers in the table.

[2]

(b) Larger hydrocarbon molecules contain more carbon atoms.

Use the information in the table and your own knowledge to describe how the properties change as the molecules increase in size.



The quality of written communication will be assessed in your answer.

. [6]

[Total: 8]

5 Nanoparticles are very small particles.

(a) Which statements about nanoparticles are **true** and which are **false**?

Put a tick (✓) in one box in each row.

	True	False
Nanoparticles can be used to make sports equipment stronger.		
Nanoparticles can occur naturally.		
Nanoparticles have the same properties as larger particles.		
Nanoparticles are about the same size as molecules.		

[2]

(b) Doctors use stitches to hold together large cuts so that they can heal properly.

Doctor Khalique is considering buying a new type of material to use for stitches.

He needs to choose between a material that contains silver nanoparticles and a material that does not.

(i) Doctor Khalique thinks that there are advantages of using the material that contains nanoparticles instead of the material that does not.

Give **one** advantage of using the material with silver nanoparticles for stitches.

.....
.....

[1]

(ii) Doctor Khalique has some concerns about using a material that contains nanoparticles on patients.

Give **one** reason against using nanoparticles.

.....
.....

[1]

(iii) Doctor Khalique decides to buy the new material with nanoparticles.

Use the ideas of risk and benefit to justify his decision.

.....
.....

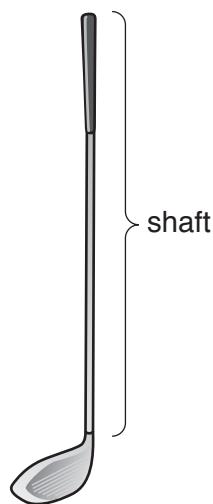
[1]

[Total: 5]

13

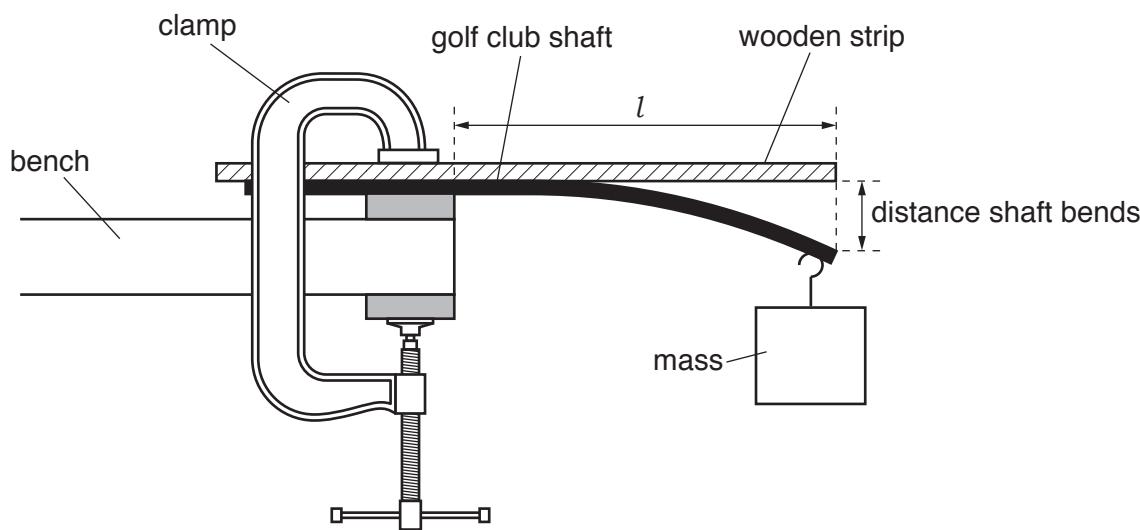
6 Chris works for a company that makes golf clubs.

The flexibility of the shaft of the golf club is important.



Golf clubs are given a Flex Rating as a measure of the flexibility of the shaft.

Chris measures the flexibility of a shaft using the following apparatus.



He measures the distance that the shaft bends when the mass is added.

Chris tests several different shafts.

(a) In each test, Chris controls the length of the shaft.
Explain how and why he does this.

.....

.....

.....

.....

[2]

14

(b) Chris tests the flexibility of a golf club shaft.

He repeats his measurements five times for the same shaft.

(i) How can Chris judge whether his measurements are repeatable?

.....
.....

[1]

These are his results.

Distance shaft bends in mm				
Test 1	Test 2	Test 3	Test 4	Test 5
86	89	87	88	87

(ii) Calculate the mean value for the distance the shaft bends.

$$\text{mean} = \dots \text{ mm} \quad [2]$$

(iii) The Flex Rating for the shaft is given by the following formula.

$$\text{Flex Rating} = \frac{10000}{3 \times \text{distance shaft bends in mm}}$$

The company wants a shaft which has a Flex Rating of between 38 and 39.

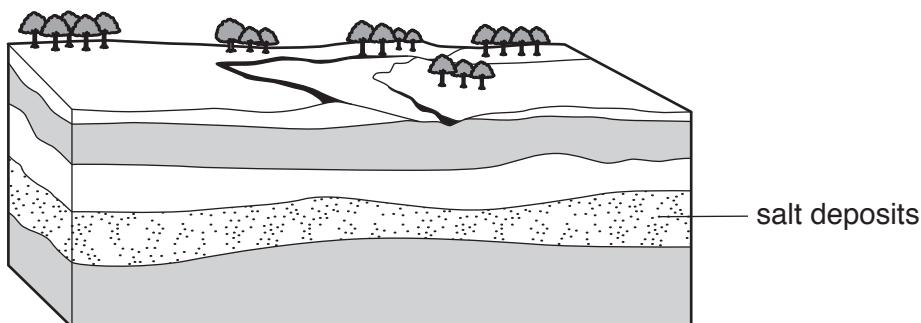
Use the formula to explain if this shaft is suitable.

.....
.....
.....

[3]

[Total: 8]

7 There are large underground salt deposits between layers of rocks in the north west of England.



(a) Geologists have looked at the rocks in some of the layers. They found evidence that the rocks were formed under the sea.

(i) Which **two** pieces of evidence show that the rocks were formed under the sea?

Put a tick (✓) in the boxes next to the correct answers.

The rock is black.

The rock has ripples on its surface.

The rock contains fossils of trees.

The rock contains pieces of shell.

The rock is hard.

[2]

(ii) The rocks were formed in a hot climate.

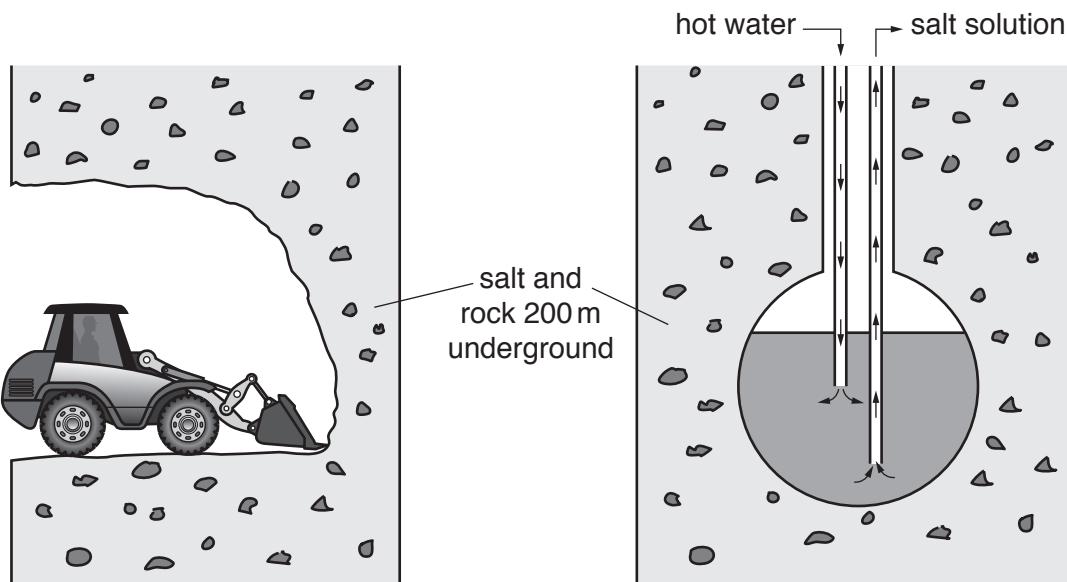
Explain how rocks formed in a hot climate are found in the north west of England which has a much cooler climate.

.....
.....

[1]

(b) A company wants to extract the salt from underground and use it for making chemicals. Salt used for making chemicals needs to have a high purity.

The salt deposits are 200 m underground.
Salt can be extracted by two methods.

**Method 1**

Salt mixed with rocks is dug out from underground and brought up to the surface.

Method 2

Water is heated and pumped into the salt and rock. Salt dissolves and salt solution is pumped back to the surface.

Compare the advantages and disadvantages of each method and explain which would be the best method to extract salt for making chemicals.



The quality of written communication will be assessed in your answer.

[6]

. [6]

[Total: 9]

8 Before the 19th century, people made alkalis from natural raw materials.

(a) These statements are about making and using alkalis before the 19th century.

Which statements are **true** and which are **false**?

Put a tick (✓) in one box in each row.

Statement	True	False
Alkalies were made from burnt wood and urine.		
Alkalies were made from acids.		
Alkalies were used to make soaps and dyes.		
Alkalies were used as food flavourings.		

[2]

(b) In the 19th century a large scale method for making alkalis was developed. The new method produced large amounts of a toxic gas.

In 1874, Henry Deacon invented a new reaction which used up the toxic gas.

This is the equation for the reaction.



Henry Deacon had this to say about his new reaction.



Is what Deacon says correct?

Use the equation to explain your answer.

.....

.....

.....

.....

[3]

9 PVC is a polymer used to make clothing.



(a) PVC contains carbon and hydrogen.

Place a (ring) around the other element present in PVC.

oxygen

nitrogen

chlorine

copper

phosphorus

[1]

(b) Plasticisers are added to the PVC polymer to make it more suitable for clothing.

How does adding a plasticiser change the properties of a polymer?

Put a tick (✓) in the box next to the correct answer.

The plasticiser makes the polymer stronger.

The plasticiser makes the polymer stiffer.

The plasticiser makes the polymer more flexible.

The plasticiser removes the colour from the polymer.

[1]

(c) Over time, plasticisers leach out slowly from the polymer.

Explain why this causes problems if a polymer with plasticisers is used for making water bottles.

.....
.....
.....

[2]

[Total: 4]

END OF QUESTION PAPER

The Periodic Table of the Elements

		Key																																																																		
1	2	relative atomic mass atomic symbol name atomic (proton) number																																																																		
7	Li	9	Be	beryllium	4	45	Sc	scandium	21	48	Ti	titanium	22	51	Cr	chromium	24	52	Mn	manganese	25	55	Fe	iron	26	56	Co	cobalt	27	59	Ni	nickel	28	63.5	Cu	copper	29	65	Zn	zinc	30	70	Ga	gallium	31	73	Ge	germanium	32	75	As	arsenic	33	79	Se	selenium	34	80	Br	bromine	35	84	Kr	krypton	36			
23	Na	24	Mg	magnesium	12	40	Ca	calcium	20	89	Y	yttrium	39	91	Nb	niobium	41	93	Mo	molybdenum	42	[98] Tc	technetium	43	101	Ru	ruthenium	44	103	Rh	rhodium	45	106	Pd	palladium	46	108	Ag	silver	47	112	Cd	cadmium	48	115	In	indium	49	119	Sn	tin	50	122	Sb	antimony	51	128	Te	tellurium	52	127	I	iodine	53	131	Xe	xenon	54

1	2	3	4	5	6	7	0	4	He	helium	2																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
7	Li	9	Be	beryllium	4	11	B	boron	5	12	C	carbon	6	14	N	nitrogen	7	16	O	oxygen	8	19	F	fluorine	9	20	Ne	neon	10																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
23	Na	24	Mg	magnesium	12	27	Al	aluminum	13	28	Si	silicon	14	31	P	phosphorus	15	32	S	sulfur	16	35.5	Cl	chlorine	17	40	Ar	argon	18																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
39	K	40	Ca	calcium	20	85	Rb	rubidium	37	88	Sr	strontium	38	137	Cs	caesium	55	139	La*	lanthanum	57	178	Hf	hafnium	72	181	Ta	tantalum	73	184	W	tungsten	74	190	Os	osmium	76	192	Ir	iridium	77	195	Pt	platinum	78	197	Au	gold	79	201	Hg	mercury	80	204	Tl	thallium	81	207	Pb	lead	82	209	Bi	bismuth	83	[209]	Po	polonium	84	[210]	At	astatine	85	[222]	Rn	radon	86																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
19	potassium	21	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	8010	8011	8012	8013	8014	8015	8016	8017	8018	8019	8020	8021	8022	8023	8024	8025	8026	8027	8028	8029	8030	8031	8032	8033	8034	8035	8036	8037	8038	8039	8040	8041	8042	8043	8044	8045	8046	8047	8048	8049	8050	8051	8052	8053	8054	8055	8056	8057	8058	8059	8060	8061	8062	8063	8064	8065	8066	8067	8068	8069	8070	8071	8072	8073	8074	8075	8076	8077	8078	8079	8080	8081	8082	8083	8084	8085	8086	8087	8088	8089	8090	8091	8092	8093	8094	8095	8096	8097	8098	8099	80100	80101	80102	80103	80104	80105	80106	80107	80108	80109	80110	80111	80112	80113	80114	80115	80116	80117	80118	80119	80120	80121	80122	80123	80124	80125	80126	80127	80128	80129	80130	80131	80132	80133	80134	80135	80136	80137	80138	80139	80140	80141	80142	80143	80144	80145	80146	80147	80148	80149	80150	80151	80152	80153	80154	80155	80156	80157	80158	80159	80160	80161	80162	80163	80164	80165	80166	80167	80168	80169	80170	80171	80172	80173	80174	80175	80176	80177	80178	80179	80180	80181	80182	80183	80184	80185	80186	80187	80188	80189	80190	80191	80192	80193	80194	80195	80196	80197	80198	80199	80200	80201	80202	80203	80204	80205	80206	80207	80208	80209	80210	80211	80212	80213	80214	80215	80216	80217	80218	80219	80220	80221	80222	80223	80224	80225	80226	80227	80228	80229	80230	80231	80232	80233	80234	80235	80236