

# **Cambridge International Examinations**

Cambridge International General Certificate of Secondary Education

CANDIDATE NAME					
CENTRE NUMBER			CANDIDATE NUMBER		

# 525565377

## **CO-ORDINATED SCIENCES**

0654/22

Paper 2 (Core) May/June 2016

2 hours

Candidates answer on the Question Paper.

No Additional Materials are required.

### **READ THESE INSTRUCTIONS FIRST**

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Answer all questions.

Electronic calculators may be used.

You may lose marks if you do not show your working or if you do not use appropriate units.

A copy of the Periodic Table is printed on page 32.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [ ] at the end of each question or part question.



1 A student adds dilute hydrochloric acid to four solids.

Fig. 1.1 shows the four experiments A, B, C and D.

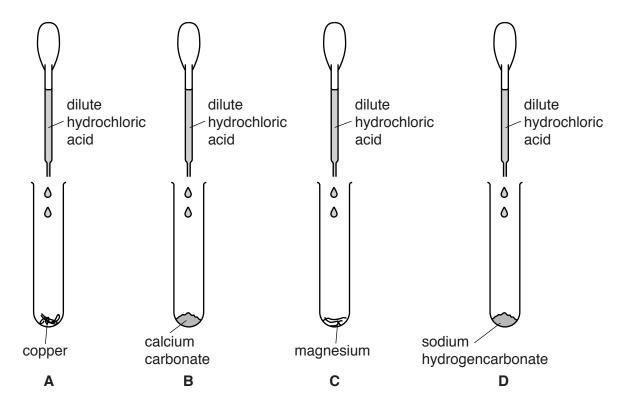


Fig. 1.1

(a) (i) In experiments B and D the same gas is released.

Name this gas and describe a test for it.	
name of gas	
test	
	 [2]

[2]

(ii) Name both products of the reaction in experiment C.

ı	
2	

(b) Table 1.1 shows temperature measurements the student makes during his investigation.

Table 1.1

experiment	temperature of substances before mixing/°C	temperature of the mixture after one minute/°C
Α	22	22
В	22	24
С	22	45
D	22	15

	(i)	Give the letter of the experiment that involves an exothermic reaction.	
		Explain your answer.	
		reaction	
		explanation	
			[1]
	(ii)	Explain the results for experiment A.	
			[2]
(c)	Nitr	ogen combines with oxygen to form nitrous oxide, N <sub>2</sub> O.	
	Nitr	ogen combines with magnesium to form magnesium nitride, Mg <sub>3</sub> N <sub>2</sub> .	
	Pre	dict the type of chemical bonding in nitrous oxide and magnesium nitride.	
	In e	ach case give a reason for your answer.	
	bon	ding in nitrous oxide	
	reas	son	
	bon	ding in magnesium nitride	
	reas	son	[4]

2 (a) Plants lose water by evaporation
--

(i)	Name the part of the plant from which most of this evaporation occurs.
	[1]
(ii)	State the term for the loss of water from a plant by evaporation.

**(b)** Fig. 2.1 shows the rate of water loss and the rate of water uptake for a plant over a period of one day.

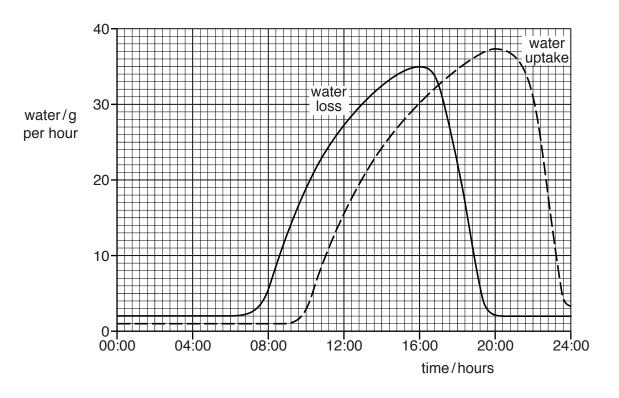


Fig. 2.1

(י)	For this day, state
	the time at which the rate of water loss is greatest,
	a time when the rate of water loss is the same as the rate of water uptake.

	(ii)	Describe the relationship between water loss and water uptake that is shown in Fig. 2.	1.
			[2]
(c)	Stat	te <b>one</b> way in which plants use water in	
	(i)	palisade mesophyll cells,	
			[1]
	(ii)	xylem vessels.	
			[1]

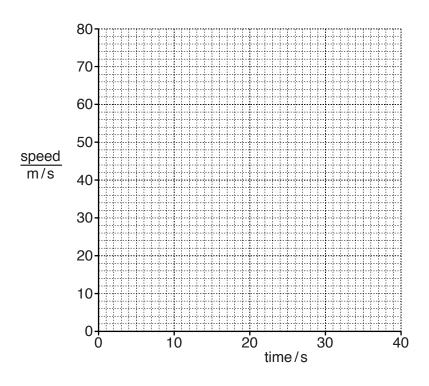
3 Fig. 3.1 shows an aircraft moving with constant acceleration from rest along a runway.



Fig. 3.1

(a) After 30 seconds the aircraft reaches a speed of 60 m/s.

On the grid below draw a speed/time graph to show the motion of the aircraft during this 30 second period.



[2]

(b) (i) Just after taking off, the aircraft continues to accelerate as it gains height.

State the term used to describe the energy gained by the aircraft.

.....[1]

(ii) State the term used to describe the energy contained in the aircraft's fuel.

.....[1]

(c) Fig. 3.2 shows a different aircraft moving at constant speed along the runway.

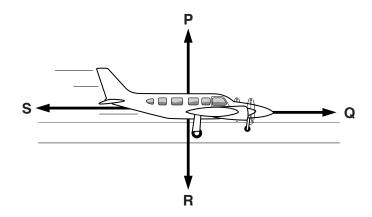


Fig. 3.2

Four forces P, Q, R and S are shown.

(i)	State which force from P, Q, R and S is	
	the weight of the aircraft,	
	the force exerted by the thrust of the engines.	[2]
(ii)	Compare the sizes of forces <b>Q</b> and <b>S</b> .	
		[1]

(d) Fig. 3.3 shows an aircraft being refuelled through a rubber pipe.

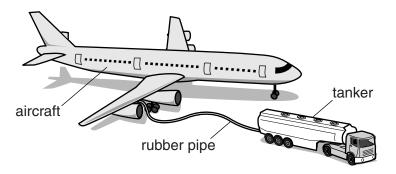


Fig. 3.3

As the fuel flows through the rubber pipe it becomes negatively charged.

Suggest, in terms of electrons, why the fuel becomes negatively charged.

4 Fig. 4.1 shows a hot-air balloon and a helium-filled airship.

The air in the balloon is heated by burning the hydrocarbon gas propane.

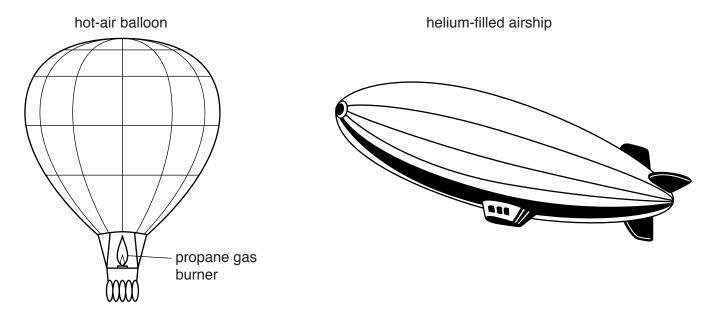


Fig. 4.1

(a)	(i)	State the percentages of nitrogen and oxygen in unpolluted air.	
		oxygen%	
		nitrogen%	[2]
	(ii)	The composition of the hot gas mixture inside the hot-air balloon is different from that the air outside.	of
		How is the air different? Explain your answer.	
			[2]

			9				
(b)	Pro	pane is obtained from a	fossil fuel.				
	(i)	Complete the sentences below using words or phrases chosen from the list.					
Each word or phrase may be used once, more than once or not at all.							
		catalytic cracking	compound	fractional distillation	gas		
		liquid	mixture	polymerisation	solid		
	Propane is obtained from petroleum by the process of						
		Propane has a chemica		is a			
		Petroleum does <b>not</b> ha	ve a chemical formul	a because it is a			
					[3]		
	(ii)	Propane is a saturated	hydrocarbon.				
		State the meaning of the	ne term <i>saturated hyd</i>	Irocarbon.			
					[2]		
(c)	Botl	h helium and hydrogen d	can be used to fill airs	ships.			
	Give peo		m is preferred to hydro	ogen for filling airships designe	d to transport		

5 Table 5.1 shows the area of deforestation in four different countries in a five year period.

Table 5.1

country	area of deforestation in five years/km²
F	28 000
G	9500
Н	1500
J	500

(a)	For the four countries combined, calculate the average area of deforestation per year during
	this five year period.

		average deforestation per year km <sup>2</sup>	[2]
(b)		tudent concluded that deforestation is more of a problem in country <b>F</b> than in country te <b>two</b> other pieces of information that are needed to make this comparison.	⁄ <b>G</b> .
	1		
	2		 [2]
(c)	(i)	Suggest <b>two</b> reasons why people might cut down a large number of trees.	
		2	
	(ii)	State <b>two</b> possible harmful effects of cutting down a large number of trees.	[2]
		2	
			[2]

(a) Fig. 6.1 shows an incomplete diagram of the electromagnetic spectrum. 6

radio waves		ultraviolet	gamma radiation
----------------	--	-------------	--------------------

		Fig. 6.1	
	(i)	Visible light is part of the electromagnetic spectrum.	
		On Fig. 6.1 write visible light in the correct position.	[1]
	(ii)	State the part of the electromagnetic spectrum shown in Fig. 6.1 which has the higher frequency.	ghest
			[1]
(b)	Gar	mma radiation is emitted from some unstable nuclei. Gamma radiation is ionising.	
	(i)	State what is meant by the term ionising radiation.	
			[1]
	(ii)	State <b>one</b> risk to humans of exposure to ionising radiation.	
			[1]
	(iii)	Alpha radiation is also emitted from some unstable nuclei.	
		State <b>two</b> differences between gamma radiation and alpha radiation.	
		1	
		2	
			[2]
			رک]

(c) Fig. 6.2 represents a wave.

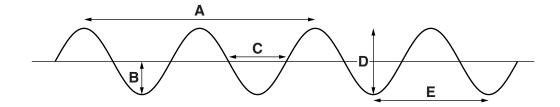


Fig. 6.2

State which measurement A, B, C, D or E is

- (ii) the wavelength of the wave. ...... [1]
- (d) Visible light is able to pass through an optical fibre by total internal reflection.

Fig. 6.3 shows a student's diagram of total internal reflection along an optical fibre. The diagram contains some errors.

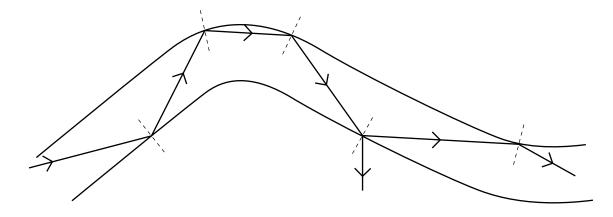


Fig. 6.3

On Fig. 6.3, circle **one** error the student has made in their diagram.

Describe the error you have identified.

[2]

**(e)** A converging lens is used to produce an image of a candle.

Fig. 6.4 shows the rays of light from the top of the candle passing through the lens and being focussed on the screen.

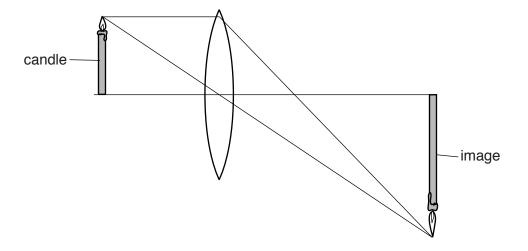


Fig. 6.4 (not to scale)

- (i) On Fig. 6.4, label with an **F**, the principal focus of the lens. [1]
- (ii) On Fig. 6.4, use a double headed arrow (← → ) to show the focal length of the lens. [1]

7	(a)	Define the term <i>homeostasis</i> .
		[2

**(b)** Fig. 7.1 shows a cross-section of the skin.

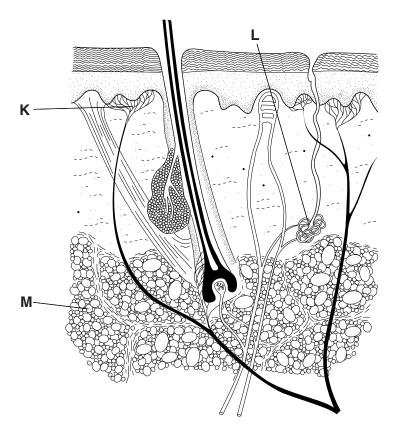


Fig. 7.1

(1)	name the structures labelled <b>k</b> and <b>L</b> .	
	K	
	L	[2]
(ii)	State what type of tissue is found at <b>M</b> .	
		.[1]

(iii) Use the words in the list to complete the sentences about temperature control.

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

arter	ioles	capillaries	insulation	muscles
	vasoconst	riction	vasodilation	veins
When a p	erson is too o	cold, the		near the surface of
their skin	contract. This	s is called		, and it results in
reduced b	lood flow thre	ough the		near the surface of
the skin.				

[3]

8 Fig. 8.1 shows a car.



		Fig. 8.1
(a)	The	car travels 70 km in 1.2 hours.
	Calc	culate the average speed of the car in km/h.
	Stat	e the formula you use and show your working.
	form	nula
	worl	king
		speed = km/h [2]
(b)	The	car is left outside on a hot, sunny day.
	(i)	State the method of energy transfer by which energy travels from the Sun to the Earth.
		[1]
	(ii)	The air in the tyres of the car also gets hot.
		Explain, in terms of particles, why the pressure of the air in the tyres increases as the air gets hot.
		[2]

(c)		a very cold morning there is ice on the windscreen of the car. The ice disappears as the emperature increases above the melting point of the ice.
	Stat	te what is meant by the term <i>melting point</i> .
		[2]
(-J\		
(d)		wheels of some cars are made from an alloy of aluminium. Steel can also be used to be the wheels.
	_	gest a simple way for the owner to test whether a wheel from the car is made from ninium or steel. Explain your answer.
		[1]
(e)	The	engine in the car is noisy.
		driver can hear the sound from the engine because the frequency of the sound is within human audible frequency range.
	(i)	State the audible frequency range for a normal adult human.
		from
	(ii)	The driver notices that the sound from the engine is very loud and has a high pitch.
		Describe the frequency of this sound.
		[1]

9	(a)	(i)	Explain the meaning of the following statements about the element lead.	
			The proton number of lead is 82.	
			The nucleon number of a lead atom is 207.	
			[2	 2]
		(ii)	Another atom of lead has a nucleon number of 208.	
			State the term used for atoms of an element that have different nucleon numbers.	
				1]
	(b)	Fia.	9.1 shows the apparatus and materials a teacher assembles for the electrolysis of lea	ad
	(-)		mide.	
			d.c. power	
			supply  (-) (+)	
			crucible	
			lead bromide powder	
			Fig. 9.1	

(ii) When the teacher closes the switch in his circuit, electrolysis does not occur.

Describe what the teacher must do so that the electrolysis does occur.

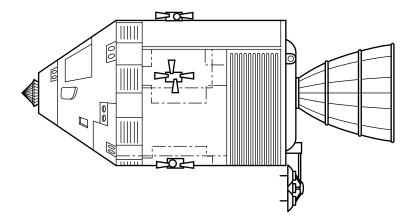
[1]

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(i) On Fig. 9.1, label the cathode.

(iii)	Name the gas that would be produced during this electrolysis and state the colour of this gas.
	name of gas
	colour of gas[2]
	. 9.2 shows the apparatus and materials used to investigate the reaction between lithium water.
	pH meter  pH  gas given off  water  lithium hydroxide dissolves
	Fig. 9.2
The LiC	e reaction between lithium and water produces a gas and a solution of lithium hydroxide,
(i)	Suggest and explain the reading of the pH meter at the end of the reaction.
	pH reading
	explanation
	[2]
/ii\	Name the gas that is given off during the reaction

(iii) Lithium hydroxide is used in space vehicles to remove the carbon dioxide produced by the astronauts.



Construct the word equation for this reaction.

Gaseous carbon dioxide reacts with lithium hydroxide to produce lithium carbonate. Water is also produced in the reaction.

 +	 <b>→</b>	 +	

[1]

Please turn over for Question 10.

(a)	State what is meant by the term recessive allele.										
(b)	Fig. 10.1 shows the inheritance of cystic fibrosis in a family.										
	grandparents P Q										
	parents S										
	offspring										
	key = normal male										
	= male with CF										
	= normal female										
	= female with CF										
	Fig. 10.1										
	Using the symbols $\bf N$ (allele for normal) and $\bf n$ (allele for CF), state <b>all</b> the possible geno of the people labelled $\bf P$ , $\bf Q$ and $\bf R$ .										
	P										
	Q										
	R										

(c)	The	e person labelled <b>S</b> has a normal phenotype.	
	(i)	State what is meant by the term <i>phenotype</i> .	
			.[1].
	(ii)	Person <b>S</b> is heterozygous. Explain what this means.	
			[1]

- 11 Sulfur is a yellow, crystalline solid that is often found uncombined in the Earth's crust.
  - (a) Fig. 11.1 shows the arrangement of atoms in sulfur crystals.

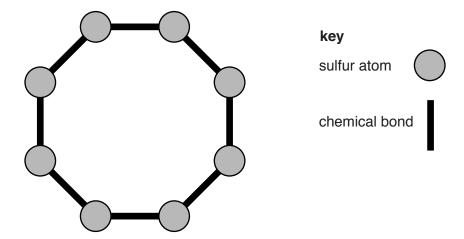


Fig. 11.1

(i)	State the word used for a small group of atoms that are chemically bonded.	
		[1]
(ii)	State the chemical formula of the structure shown in Fig. 11.1.	
		[1]

**(b)** Fig. 11.2 shows the apparatus and materials used by a teacher to demonstrate the formation of sulfur dioxide by burning sulfur in air.

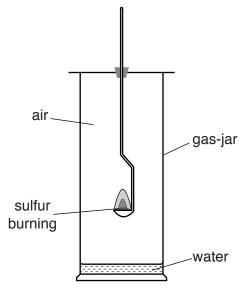


	Fig. 11.2
(i)	When sulfur burns it is oxidised.
	Explain why sulfur is said to be oxidised in this reaction.
	[1]
(ii)	Some sulfur dioxide dissolves and reacts with the water in the bottom of the gas-jar to form an aqueous solution.
	Predict and explain the colour of full-range indicator (Universal Indicator) when added to this aqueous solution.
	colour
	explanation
	[2]
(iii)	Sulfur compounds occur naturally in petroleum.  These are removed before petroleum products, such as gasoline, are used as fuel.
	State and explain, in terms of the effects on the environment, why sulfur compounds are removed from petroleum.

- 12 A torch contains four cells, a filament lamp and a switch connected in series.
  - (a) (i) Draw a circuit diagram for the torch using electrical circuit symbols.

[3]

- (ii) A voltmeter is used to check the potential difference (voltage) across the lamp.
  - The symbol for the voltmeter is —(V)—

Using the symbol for a voltmeter, draw the voltmeter connected in the correct position in the circuit you have drawn in **(a)(i)**. [1]

**(b)** The current in the filament lamp and the potential difference (voltage) across the lamp are measured.

Fig. 12.1 shows the current/potential difference graph for the lamp.

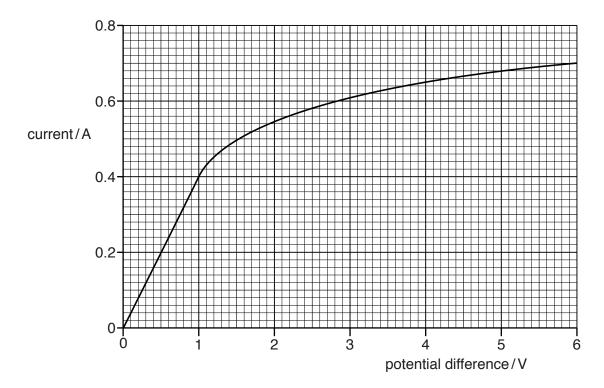


Fig. 12.1

		potential difference across the lamp.
		[1]
	(ii)	Use the graph in Fig. 12.1 to find the current through the lamp when the potentia difference across the lamp is 6V.
		current = A [1]
(c)	Two	lamps, one of resistance $4\Omega$ and one of resistance $12\Omega$ , are connected in series.
	Cal	culate the total resistance of these two lamps in series.
	Sta	te the formula you use and show your working.
	forn	nula
	wor	king
		resistance = $\Omega$ [2]

		20
13	(a)	A piece of tissue from a plant root is tested for reducing sugar.
		Outline how this test is done and state the result of the test if reducing sugar is present.
		[3
	(b)	Fig. 13.1 shows a root cell from a piece of tissue.
		Fig. 13.1
		(i) For this root cell, name
		a structure that contains chromosomes,
		a structure that would <b>not</b> be present in an animal cell,
		a structure that is <b>not</b> present, but which <b>would</b> be present in a palisade cell.
		[3
		(ii) An animal eats this root. State which structure in the plant cell contributes fibre to the animal's diet.

(iii)	State how fibre is important in the diet of the animal.
	[1]

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The Periodic Table of Elements

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	>	. 1	<u> </u>	hel 4	-	Z	ne Z	7	⋖	arg 4	rö		Ary Ap	4	× _	xer 13	ď	<u>~</u>	rac			
					6	ш	fluorine 19	17	Cl	chlorine 35.5	35	Ā	bromine 80	53	н	iodine 127	85	¥	astatine			
	>				80	0	oxygen 16	16	ഗ	sulfur 32	34	Se	selenium 79	52	<u>e</u>	tellurium 128	84	Ро	polonium	116	_	livermorium –
	>				7	z	nitrogen 14	15	۵	phosphorus 31	33	As	arsenic 75	51	Sb	antimony 122	83	<u>.</u>	bismuth 209			
	≥				9	O	carbon 12	14	Si	silicon 28	32	Ge	germanium 73	50	Sn	tin 119	82	Ъ	lead 207	114	Εl	flerovium -
	≡				2	М	boron 11	13	Ρl	aluminium 27	31	Ga	gallium 70	49	In	indium 115	81	1L	thallium 204			
											30	Zu	zinc 65	48	g	cadmium 112	80	Hg	mercury 201	112	ű	copernicium
											29	J.	copper 64	47	Ag	silver 108	79	Au	gold 197	111	Rg	roentgenium -
dn											28	Z	nickel 59	46	Pd	palladium 106	78	귙	platinum 195	110	Ds	darmstadtium -
Group											27	ပိ	cobalt 59	45	뫈	rhodium 103	77	'n	iridium 192	109	Ħ	meitnerium -
		_	I	hydrogen 1							26	Ь	iron 56	44	Ru	ruthenium 101	9/	SO	osmium 190	108	Hs	hassium
					J						25	Mn	manganese 55	43	ပ	technetium -	75	Re	rhenium 186	107	뮵	bohrium -
						loc	SS				24	ပ်	chromium 52	42	Мо	molybdenum 96	74	>	tungsten 184	106	Sg	seaborgium -
				Key	atomic number	atomic symbo	name relative atomic mass				23	>	vanadium 51	41	qN	niobium 93	73	Та	tantalum 181	105	op O	dubnium
						ato	rela				22	F	titanium 48	40	Zr	zirconium 91	72	Ξ	hafnium 178	104	¥	rutherfordium -
											21	လွ	scandium 45	39	>	yttrium 89	57-71	lanthanoids		89–103	actinoids	
	=				4	Be	beryllium 9	12	Mg	magnesium 24	20	Ca	calcium 40	38	Š	strontium 88	56	Ba	barium 137	88	Ra	radium
	-				3	<u>'</u>	lithium 7	1	Na	sodium 23	19	¥	potassium 39	37	Rb	rubidium 85	55	S	caesium 133	87	ъ	francium

Lu Lu	lutetium 175	103	۲	lawrencium	ı
70 Yb	ytterbium 173	102	8	nobelium	ı
e9 Tm	thulium 169	101	Md	mendelevium	ı
88 <u>F</u>	erbium 167	100	Fm	fermium	ı
67 H0	holmium 165	66	Es	einsteinium	ı
e6 Dy	dysprosium 163	86	Ç	californium	1
65 Tb	terbium 159	97	ă	berkelium	ı
64 Gd	gadolinium 157	96	Cm	curium	ı
63 Eu	europium 152	92	Am	americium	ı
62 Sm	samarium 150	94	Pu	plutonium	ı
61 Pm	promethium —	93	Ν	neptunium	ı
99 <b>P</b> X	neodymium 144	92	$\supset$	uranium	238
59 <b>Pr</b>	praseodymium 141	91	Ра	protactinium	731
S8 Ce	cerium 140	06	┖	thorium	737
57 <b>La</b>	lanthanum 139	68	Ac	actinium	ı

lanthanoids

actinoids

The volume of one mole of any gas is  $24\,dm^3$  at room temperature and pressure (r.t.p.)

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