Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

CHEMISTRY **0620/21**

Paper 2 **May/June 2015**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name in the spaces at the top of this page.
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.
A copy of the Periodic Table is printed on page 16.
You may lose marks if you do not show your working or if you do not use appropriate units.

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.

The syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 1/Level 2 Certificate.

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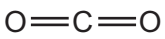
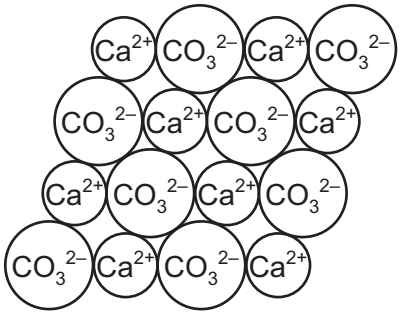
CAMBRIDGE International Examinations

1 The structures of six substances containing carbon are shown below.

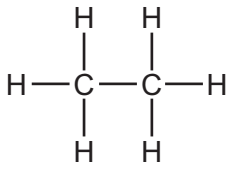
A



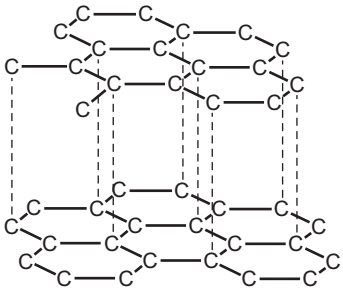
B



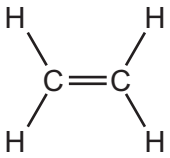
C



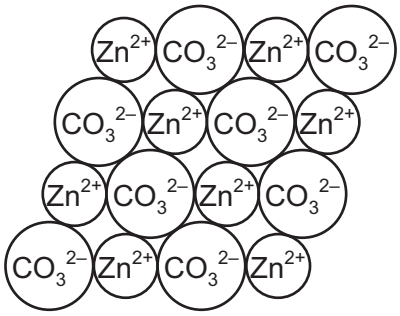
D



E



F



Answer the following questions about these substances.
Each substance may be used once, more than once or not at all.

View solution

(a) Which substance, **A**, **B**, **C**, **D**, **E** or **F**,

(i) is an element, ... [1]

(ii) is a saturated hydrocarbon, ... [1]

(iii) is added to the blast furnace to help in the extraction of iron, ... [1]

(iv) has a giant covalent structure, ... [1]

(v) is a product of respiration, ... [1]

(vi) contains a metal ion with 20 protons? ..... [1]

(b) Complete the word equation for the thermal decomposition of substance **B**.

View solution

..... $\xrightarrow{\text{heat}}$ calcium oxide + ...

[2]

(c) Describe a test for substance **A**.

View solution

test .....

result .....

[2]

[Total: 10]

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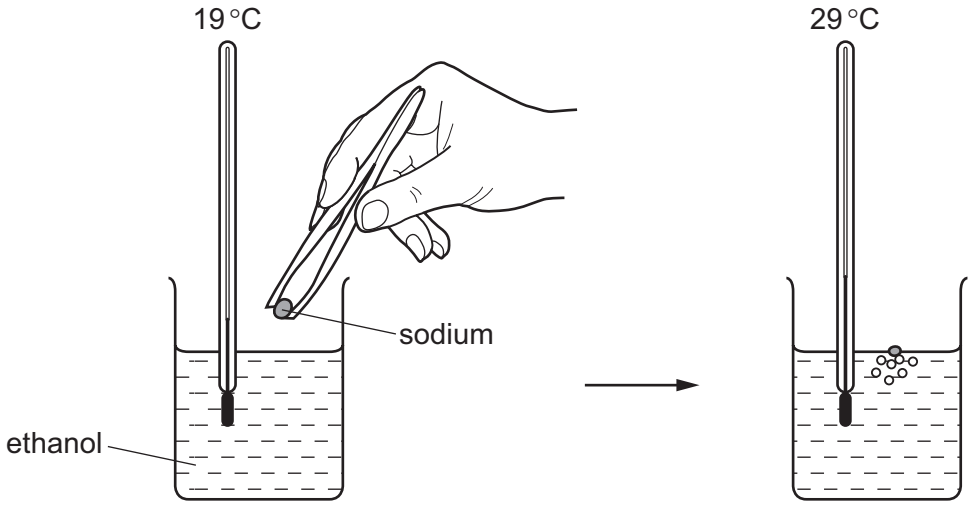
2 A small piece of sodium is added to some ethanol. The temperature was measured before and after the sodium was added.



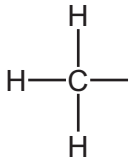
(a) Explain how this experiment shows that the reaction is exothermic.

View solution

..... [1]

(b) Complete the structure of ethanol to show all atoms and bonds.

View solution



[1]

(c) Ethanol can be made by the reaction of steam with ethene.

View solution

(i) Write the word equation for this reaction.

..... [1]

View solution

(ii) What conditions are needed for this reaction?
Tick **two** boxes.

enzyme catalyst	☐
high temperature (300 °C)	☐
low temperature (10 °C)	☐
phosphoric acid catalyst	☐
presence of light	☐

[2]

View solution

(iii) What will be observed when ethene is bubbled through aqueous bromine?

..... [1]

View solution

(d) Ethanol can also be made by fermentation.
The fermentation mixture contains solids as well as an aqueous solution of ethanol.

Suggest how the ethanol can be purified from this fermentation mixture.

.....

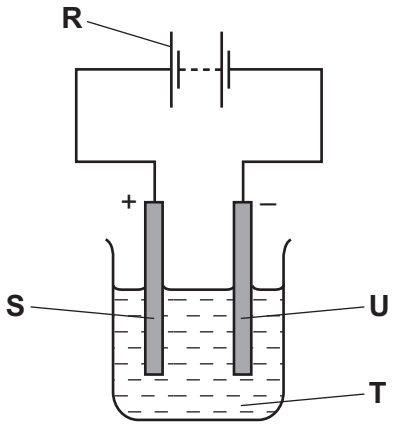
.....

.....

..... [3]

[Total: 9]

3 The diagram shows the apparatus used for the electrolysis of molten sodium bromide.



(a) (i) What does the term *electrolysis* mean?

View solution

.....

..... [1]

(ii) Which letter, **R**, **S**, **T** or **U**, in the diagram above represents the cathode?

View solution

..... [1]

(b) Complete the word equation for the electrolysis of molten sodium bromide.

View solution

sodium bromide → ..... + ...

[2]

(c) A solution of sodium bromide in water is neutral.

View solution

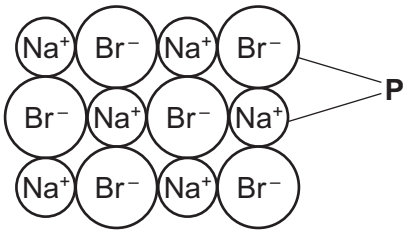
Which **one** of the following pH values is neutral?
Put a ring around the correct answer.

pH 0 pH 6 pH 7 pH 10 pH 14

[1]

(d) The diagram below shows the arrangement of the particles in sodium bromide at room temperature.

View solution



(i) Give the name of the type of particles, **P**, present in sodium bromide.

..... [1]

(ii) What is the state of sodium bromide at room temperature?
Use the information in the diagram to explain your answer.

View solution

.....

.....

..... [2]

(e) Sodium bromide can be made by heating sodium in bromine vapour.

View solution

Complete the balanced symbol equation for this reaction.

..... Na + ... $\rightarrow$ 2NaBr

[2]

(f) Bromine has two naturally-occurring isotopes.

View solution

What is the meaning of the term *isotope*?

.....

..... [1]

[Total: 11]

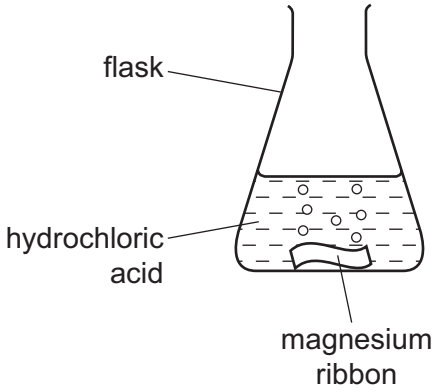
4 A student investigated the reaction of magnesium with dilute hydrochloric acid.

$$Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$$

She measured the volume of gas given off at various times during the reaction.

(a) Complete the diagram of the apparatus she would use to measure the volume of the gas given off.
Label the apparatus.

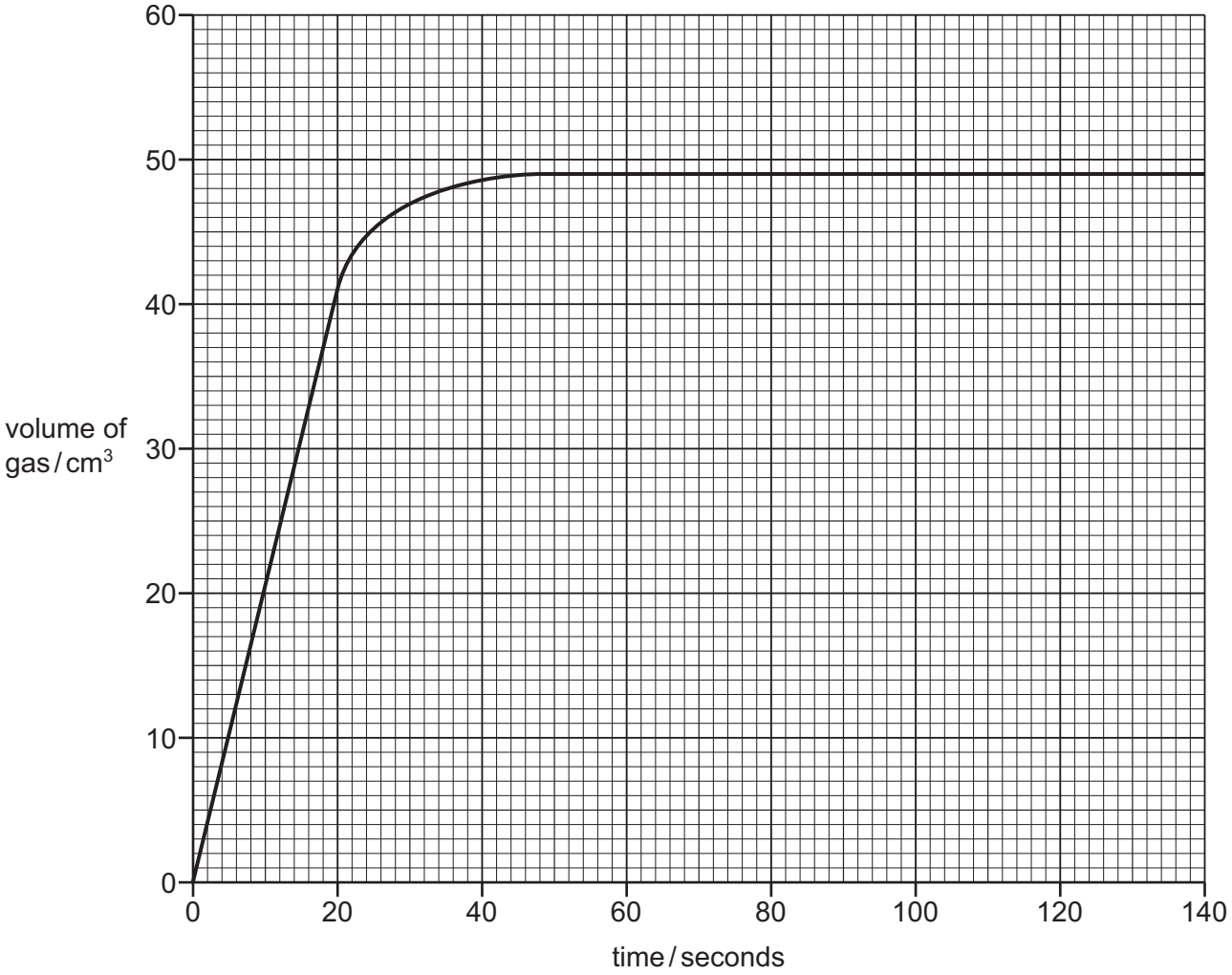
View solution



[3]

(b) The student carried out the reaction at 25 °C using magnesium ribbon.
Her results are shown below.

View solution



(i) How long does it take for the reaction to stop?

..... seconds [1]

(ii) What is the volume of hydrogen made after 20 seconds?

..... cm^3 [1]

(iii) On the grid above, draw a line to show how the volume of gas changes when the experiment is carried out at 15 °C and all other conditions remain the same. [2]

(iv) The student repeated the experiment using magnesium powder. All other conditions remain the same.

How does the rate of reaction with magnesium powder compare with the rate of reaction with magnesium ribbon?

..... [1]

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(c) (i) Draw a diagram to show the electron arrangement in a molecule of hydrogen.

View solution

[1]

(ii) What type of bonding is present in a hydrogen molecule?

View solution

..... [1]

(d) Magnesium chloride is a salt.
Magnesium sulfate is also a salt.

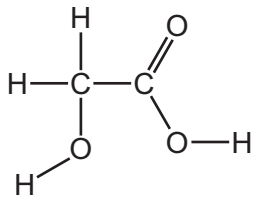
View solution

Give the name of two **compounds** which react together to form magnesium sulfate.

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

[Total: 12]

5 The structure of glycolic acid is shown below.



View solution

(a) On the structure above, put a ring around the carboxylic acid functional group. [1]

(b) Glycolic acid is prepared by heating a mixture of methanal, carbon monoxide and water with a sulfuric acid catalyst.

View solution

(i) The formula of methanal is HCHO.

Calculate the relative molecular mass of methanal.

[1]

(ii) What is the function of the catalyst? View solution

..... [1]

(iii) State **one** adverse effect of carbon monoxide on humans. View solution

..... [1]

(c) Glycolic acid can also be prepared by the reduction of oxalic acid.

View solution

(i) What does the term *reduction* mean?

..... [1]

(ii) Give the name of the reducing agent in the following reaction.

View solution

$$2CuO(s) + C(s) \xrightarrow{\text{heat}} 2Cu(s) + CO_2(g)$$

name of reducing agent ..... [1]

(d) Glycolic acid is found in unripe grapes.
Grape skins contain a number of different coloured pigments.

View solution

Describe how you could obtain a solution of these pigments from grape skins.

.....

.....

.....

..... [3]

(e) Glycolic acid can undergo polymerisation.
Ethene can also undergo polymerisation.
The equation for the polymerisation of ethene is shown below.

View solution

$$\text{ethene} \xrightarrow[\text{high temperature}]{\text{catalyst}} \text{poly(ethene)}$$

Give the name of the monomer in this equation.

..... [1]

(f) Long chain alkanes can be cracked to produce shorter chain alkanes and alkenes.

View solution

(i) What conditions are needed for cracking?

.....

..... [2]

(ii) Complete the equation for the cracking of hexadecane, $C_{16}H_{34}$, to form octane, C_8H_{18}, and ethene only.

$$C_{16}H_{34} \rightarrow C_8H_{18} + \ldots\ldots C_2H_4$$

[1]

[Total: 13]

View solution

6 The table shows some physical properties of the metals, **A**, **B**, **C** and **D**.

metal	electrical conductivity	density in g / cm^3	boiling point / °C	hardness
A	fairly good	8.64	765	hard
B	good	0.97	883	soft
C	good	7.14	907	hard
D	good	0.86	760	soft

(a) (i) Which **two** metals in the table are Group I metals?
Give a reason for your answer.

View solution

.....

..... [2]

(ii) None of the metals **A**, **B**, **C** or **D** are transition elements.

View solution

Give **two** properties of transition elements or their compounds that make them different from metals **A**, **B**, **C** and **D**.

.....

..... [2]

(iii) Cobalt is a transition element.
When it is heated very strongly in steam, hydrogen is given off.

View solution

Complete the symbol equation for this reaction.

..... $Co(s)$ + $4H_2O(g)$ → $Co_3O_4(s)$ + ... $H_2(g)$

[2]

(iv) Iron is also a transition element.

View solution

Describe how iron is converted to steel.
In your answer, refer to basic oxides and oxygen.

.....

.....

.....

..... [3]

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(b) When lithium reacts with water it moves about on the surface of the water, bubbles are seen and the lithium disappears slowly.

Predict how the reaction of potassium with water compares with the reaction of lithium with water.

View solution

In your answer, include

- any differences in observations,
- the names of the products formed when lithium and potassium react with water.

.....

.....

.....

.....

.....

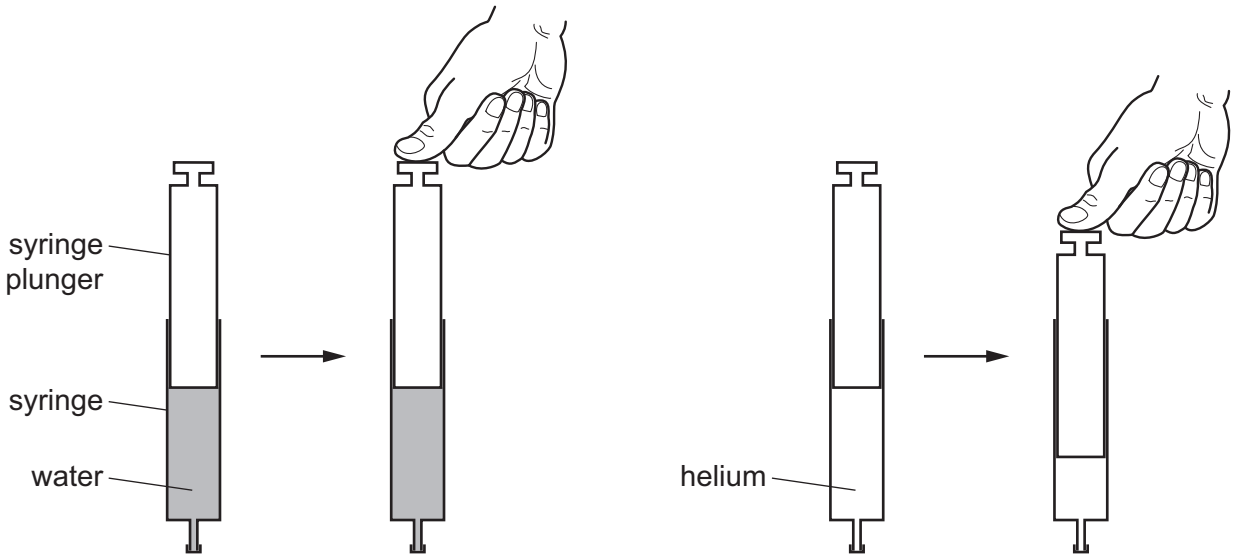
.....

..... [5]

[Total: 14]

7 **(a)** A student took two identical syringes.
He filled one with water and the other with helium gas and sealed the end of both syringes.
He then pushed the syringe plungers with equal force.
The diagram shows what happened.

View solution



Describe and explain these results using ideas about particles in liquids and gases.

.....

.....

.....

.....

.....

.....

..... [4]

(b) The table shows some properties of the Group 0 elements helium, neon, argon and krypton.

View solution

element	electron arrangement	density of the liquefied gas in g / cm^3	melting point / °C	boiling point / °C
helium	2	0.15	–272	–269
neon		1.20	–248	–245
argon	2,8,8	1.40	–189	–186
krypton	2,8,18,8	2.15	–157	–152

(i) Describe how the density of the liquefied noble gases changes down Group 0.

..... [1]

(ii) Deduce the electron arrangement of neon.

View solution

..... [1]

(iii) What is the state of argon at –188 °C?

View solution

..... [1]

(iv) Which element in the table has the highest melting point?

View solution

..... [1]

(c) The table below shows the number of electrons, protons and neutrons in some isotopes of helium, argon and neon.

View solution

Complete the table.

element	number of electrons	number of protons	number of neutrons
$^{3}_{2}$He	2	2	.....
$^{38}_{18}$Ar	.....	18	20
.....	10	10	11

[3]

[Total: 11]

DATA SHEET
The Periodic Table of the Elements

Group																		
I	II										III	IV	V	VI	VII	0
					1 H Hydrogen 1											4 He Helium 2
7 Li Lithium 3	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 Sodium 11	24 Mg Magnesium 12										27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	64 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
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	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
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57 *	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	Po Polonium 84	At Astatine 85	Rn Radon 86
Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89 †																

*58-71 Lanthanoid series	140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
†90-103 Actinoid series	232 Th Thorium 90	231 Pa Protactinium 91	238 U Uranium 92	Np Neptunium 93	Pu Plutonium 94	Am Americium 95	Cm Curium 96	Bk Berkelium 97	Cf Californium 98	Es Einsteinium 99	Fm Fermium 100	Md Mendelevium 101	No Nobelium 102	Lr Lawrencium 103

Key: a = relative atomic mass; X = atomic symbol; b = proton (atomic) number

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

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