Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson BTEC Level 3 Nationals Certificate

Centre Number | | | | | | |

Learner Registration Number | | | | | | | | |

Wednesday 15 January 2020

Morning (Time: 40 minutes) | Paper Reference **31617H/1C**

Applied Science / Forensic and Criminal Investigation

Unit 1: Principles and Applications of Science I

Chemistry

SECTION B: PERIODICITY AND PROPERTIES OF ELEMENTS

You must have:
A calculator and a 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 learner registration number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

Information

- The exam comprises three papers worth 30 marks each.
  Section A: Structure and functions of cells and tissues (Biology).
  Section B: Periodicity and properties of elements (Chemistry).
  Section C: Waves in communication (Physics).
- The total mark for this exam is 90.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- The periodic table of elements can be found at the back of this paper.

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.

Turn over ▶

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1/1/1/1/1/

P 6 3 9 4 2 A 0 1 1 2

Pearson

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

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 ☒.

1 Figure 1 shows a molecule of the covalent compound tetrachloromethane.

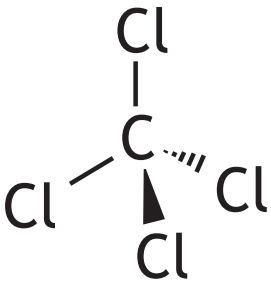

Figure 1

(a) Identify the reason why the molecule in Figure 1 has a tetrahedral shape.

(1)

☒ **A** Each chlorine atom forms four single bonds.

☒ **B** The carbon atom forms four single bonds.

☒ **C** The carbon atom forms two double bonds.

☒ **D** The molecule has four atoms.

(b) Complete the dot and cross diagram, in Figure 2, for tetrachloromethane, CCl_4.

Show outer electrons only.

(2)

Cl

Cl C Cl

Cl

Figure 2

(c) CCl_4 is a liquid at room temperature.

There are intermolecular forces between the molecules.

Name the intermolecular force between the CCl_4 molecules.

(1)

.....

(d) A sample of chlorine contains 80% chlorine-35 and 20% chlorine-37.

Calculate the relative atomic mass of this sample of chlorine.

Show your working.

(2)

relative atomic mass = ...

(Total for Question 1 = 6 marks)

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2 Magnesium sulfate is an ionic compound.

(a) Describe the structure of an ionic compound.

(2)

.....

.....

.....

.....

(b) Magnesium reacts with sulfuric acid to form magnesium sulfate and hydrogen.

Complete the equation for this reaction.

(2)

..... + ... → $MgSO_4$ + H_2

(c) (i) A learner is given 6.02 g of magnesium sulfate.

Calculate the number of moles of magnesium sulfate.

(relative formula mass of $MgSO_4$ = 120.4)

(1)

number of moles = ...

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(ii) The learner dissolves the magnesium sulfate in distilled water to make 500 cm^3 of solution.

Calculate, using your answer to (c)(i), the molar concentration of this magnesium sulfate solution.

If you did not get an answer for (c)(i), use the value 0.04 for the number of moles.

Show your working.

(3)

molar concentration = ... mol dm^{-3}

(Total for Question 2 = 8 marks)

3 Fluorine, chlorine, bromine and iodine are the first four elements in group 7 (the halogens).

(a) Identify the halogen with the lowest first ionisation energy.

(1)

☒ **A** bromine

☒ **B** chlorine

☒ **C** fluorine

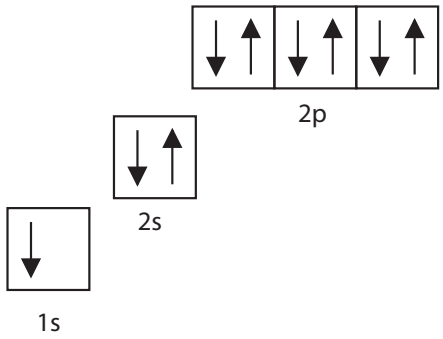
☒ **D** iodine

(b) The halogens all have similar chemical properties because of their electronic configuration.

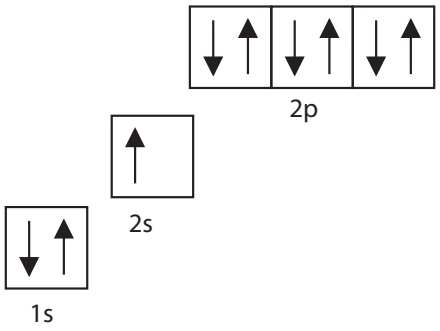
(i) Identify the correct electronic configuration for an atom of fluorine.

(1)

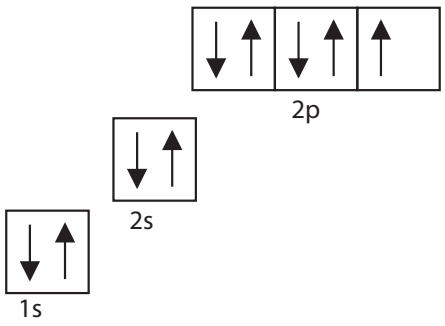
A



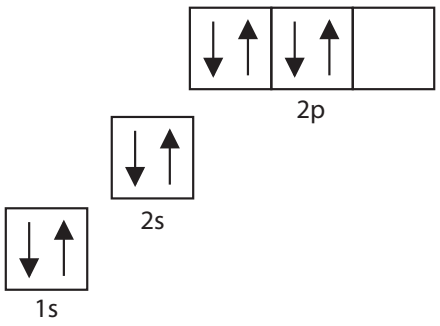
B



C



D



☒ **A**

☒ **B**

☒ **C**

☒ **D**

(ii) Fluorine atoms can react to become fluoride ions.

Electron affinity is one way of measuring how easily a fluorine atom becomes a fluoride ion.

Identify the correct word in each sentence to complete Paragraph 1.

Underline the words you have chosen.

(2)

The first electron affinity is the energy released

when one mole of fluorine atoms [gains / loses / shares] one mole of electrons.

For the electron affinity to happen,

the atoms must be in the [gas / liquid / solid] state.

Paragraph 1

(iii) The electronegativity of the halogens changes down group 7.

Explain how electronegativity changes down group 7.

(3)

(c) A displacement reaction is when a more reactive element displaces a less reactive element from a compound.

In a displacement experiment, different halogens were added to different sodium halide solutions.

Table 1 shows the results of the displacement experiment.

A tick (✓) shows when a displacement reaction occurred.

A cross (✗) shows when no displacement reaction occurred.

		sodium halide solution		
		sodium bromide	**sodium chloride**	**sodium iodide**
halogen	**bromine**	✗	✗	✓
	chlorine	✓	✗	✓
	iodine	✗	✗	✗

Table 1

Identify and justify, using the results from Table 1, the order of reactivity of the **three** halogens.

(3)

Order of reactivity

Most reactive halogen .....

.....

Least reactive halogen .....

Justification.....

.....

.....

.....

(Total for Question 3 = 10 marks)

4 Table 2 shows two substances, **X** and **Y**, and their ability to conduct electricity when in different states.

substance	state	ability to conduct electricity
X	solid	good
	liquid	good
Y	solid	poor
	liquid	good

Table 2

Explain, using the information in Table 2, which substance is ionic and which substance is metallic.

(6)

(Total for Question 4 = 6 marks)

TOTAL FOR SECTION B = 30 MARKS

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The Periodic Table of Elements

1	2											3	4	5	6	7	0 (8) (18)
							1.0 H hydrogen 1										4.0 He helium 2
(1)	(2)		Key									(13)	(14)	(15)	(16)	(17)	
6.9 Li lithium 3	9.0 Be beryllium 4		relative atomic mass atomic symbol name atomic (proton) number									10.8 B boron 5	12.0 C carbon 6	14.0 N nitrogen 7	16.0 O oxygen 8	19.0 F fluorine 9	20.2 Ne neon 10
23.0 Na sodium 11	24.3 Mg magnesium 12	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	27.0 Al aluminium 13	28.1 Si silicon 14	31.0 P phosphorus 15	32.1 S sulfur 16	35.5 Cl chlorine 17	39.9 Ar argon 18
39.1 K potassium 19	40.1 Ca calcium 20	45.0 Sc scandium 21	47.9 Ti titanium 22	50.9 V vanadium 23	52.0 Cr chromium 24	54.9 Mn manganese 25	55.8 Fe iron 26	58.9 Co cobalt 27	58.7 Ni nickel 28	63.5 Cu copper 29	65.4 Zn zinc 30	69.7 Ga gallium 31	72.6 Ge germanium 32	74.9 As arsenic 33	79.0 Se selenium 34	79.9 Br bromine 35	83.8 Kr krypton 36
85.5 Rb rubidium 37	87.6 Sr strontium 38	88.9 Y yttrium 39	91.2 Zr zirconium 40	92.9 Nb niobium 41	95.9 Mo molybdenum 42	[98] Tc technetium 43	101.1 Ru ruthenium 44	102.9 Rh rhodium 45	106.4 Pd palladium 46	107.9 Ag silver 47	112.4 Cd cadmium 48	114.8 In indium 49	118.7 Sn tin 50	121.8 Sb antimony 51	127.6 Te tellurium 52	126.9 I iodine 53	131.3 Xe xenon 54
132.9 Cs caesium 55	137.3 Ba barium 56	138.9 La* lanthanum 57	178.5 Hf hafnium 72	180.9 Ta tantalum 73	183.8 W tungsten 74	186.2 Re rhenium 75	190.2 Os osmium 76	192.2 Ir iridium 77	195.1 Pt platinum 78	197.0 Au gold 79	200.6 Hg mercury 80	204.4 Tl thallium 81	207.2 Pb lead 82	209.0 Bi bismuth 83	[209] Po polonium 84	[210] At astatine 85	[222] Rn radon 86
[223] Fr francium 87	[226] Ra radium 88	[227] Ac* actinium 89	[261] Rf rutherfordium 104	[262] Db dubnium 105	[266] Sg seaborgium 106	[264] Bh bohrium 107	[277] Hs hassium 108	[268] Mt meitnerium 109	[271] Ds darmstadtium 110	[272] Rg roentgenium 111							

Elements with atomic numbers 112-116 have been reported but not fully authenticated

* Lanthanide series

* Actinide series

140 Ce cerium 58	141 Pr praseodymium 59	144 Nd neodymium 60	[147] Pm promethium 61	150 Sm samarium 62	152 Eu europium 63	157 Gd gadolinium 64	159 Tb terbium 65	163 Dy dysprosium 66	165 Ho holmium 67	167 Er erbium 68	169 Tm thulium 69	173 Yb ytterbium 70	175 Lu lutetium 71
232 Th thorium 90	[231] Pa protactinium 91	238 U uranium 92	[237] Np neptunium 93	[242] Pu plutonium 94	[243] Am americium 95	[247] Cm curium 96	[245] Bk berkelium 97	[251] Cf californium 98	[254] Es einsteinium 99	[253] Fm fermium 100	[256] Md mendelevium 101	[254] No nobelium 102	[257] Lr lawrencium 103