REDSPOT

IGCSE

(Syllabus 0620)

CHEMISTRY

Paper 2 (Extended) - All Variants

(Topical)

period	2019 to 2024
contents	June & November, Paper 2 (P21, P22 & P23) With Answers
form	Topic By Topic
compiled for	IGCSE

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TOPIC 2.2

Atomic Structure and Isotopes

1. Which statement about an atom of fluorine, $^{19}_{9}F$, is correct?

A It contains more protons than neutrons.

B It contains a total of 28 protons, neutrons and electrons.

C Its isotopes contain different numbers of protons.

D Its nucleus contains 9 neutrons.

[June 2019/P21/Q4]

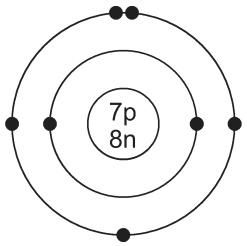
2. What is an isotope of $^{31}_{15}E$?

A $^{31}_{14}E$ **B** $^{33}_{15}E$ **C** $^{31}_{16}E$ **D** $^{33}_{16}E$

[June 2019/P22/Q4]

3. The structure of an atom is shown.

Which element is the atom an isotope of?



key
● = electron
n = neutron
p = proton

A nitrogen **B** oxygen

C phosphorus **D** titanium

[June 2019/P23/Q4]

4. An isotope of chromium is represented by $^{52}_{24}Cr$.

Which statement about an atom of this isotope of chromium is correct?

A It contains 24 electrons.

B It contains 24 neutrons.

C It contains 28 protons.

D It contains 52 neutrons.

[Nov 2019/P21/Q5]

5. Element X has two isotopes, $^{12}_{6}X$ and $^{14}_{6}X$.

Which statement about these isotopes is correct?

A They have different chemical properties because they have different numbers of neutrons.

B They have the same chemical properties because they have the same number of outer shell electrons.

C They have the same nucleon number because the sum of the number of protons and electrons is the same.

D They have different positions in the Periodic Table because they have different numbers of neutrons.

[Nov 2019/P21/Q6]

6. The numbers of protons, neutrons and electrons present in the atoms P, Q, R and S are shown.

atom	number of protons	number of neutrons	number of electrons
P	4	5	4
Q	5	6	5
R	6	6	6
S	6	7	6

Which atoms are isotopes of the same element?

A P and Q only **B** Q and R only **C** R and S only **D** P and S only

[Nov 2019/P23/Q5]

7. Carbon has three isotopes, ^{12}C, ^{13}C and ^{14}C.

Why do all three isotopes have the same chemical properties?

A They all have the same atomic mass.

B They all have the same number of electrons in their outer shell.

C They all have the same number of electron shells.

D They all have the same number of nucleons.

[Nov 2019/P23/Q6]

8. The atomic number and nucleon number of a potassium atom are shown.

	potassium atom
atomic number	19
nucleon number	39

How many protons, neutrons and electrons are in a potassium ion, K^+?

	protons	neutrons	electrons
A	19	20	18
B	19	20	20
C	20	19	18
D	20	19	19

[June 2020/P21/Q4]

9. Which statement explains why methane has a lower boiling point than water?

A Methane has weaker covalent bonds than water.

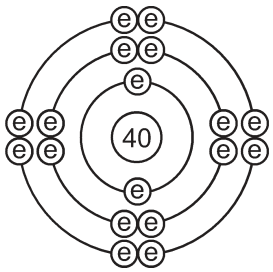
B Methane has weaker attractive forces than water.

C Methane molecules are heavier than water molecules.

D Methane molecules have more bonds than water molecules.

[June 2020/P21/Q7]

10. The diagram shows the electronic structure of a particle with a nucleon number (mass number) of 40.



The table shows the suggestions that three students, 1, 2 and 3, made to identify the particle.

	student		
	1	2	3
particle	Ar	C*l*	Ca^{2+}

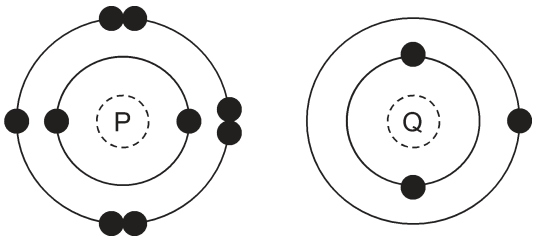
Which students are correct?

A 1 and 2 only **B** 1 and 3 only

C 2 and 3 only **D** 1, 2 and 3

[June 2020/P22/Q4]

11. The electronic structures of two atoms, P and Q, are shown.



P and Q combine together to form a compound.

What is the type of bonding in the compound and what is the formula of the compound?

	type of bonding	formula
A	ionic	PQ
B	ionic	PQ_2
C	covalent	PQ_2
D	covalent	PQ

[June 2020/P21/P22/P23/Q5]

12. The atomic structure of four particles are shown.

	electrons	protons	neutrons
P	18	17	18
Q	18	17	20
R	17	17	18
S	17	17	20

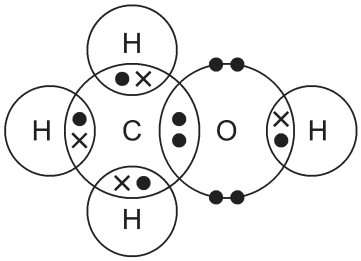
Which particles have the same chemical properties?

A P and R only **B** P and S **C** P, Q and R **D** R and S

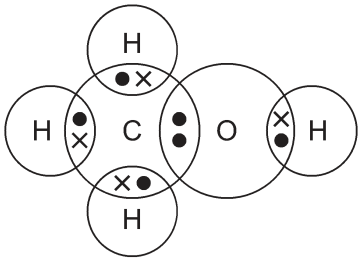
[Nov 2020/P21/Q5]

13. Which diagram shows the outer shell electron arrangement in a molecule of methanol, CH_3OH?

A



B



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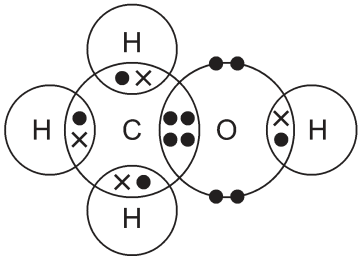
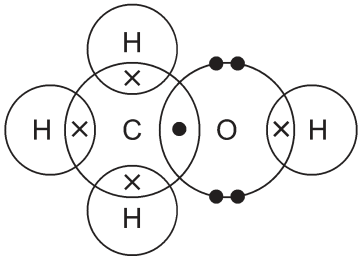


D



[Nov 2020/P21/Q7]

14. Which statement about isotopes is correct?

A They have different proton numbers.

B They have different chemical properties.

C They have the same nucleon number.

D They have the same number of electrons in their outer shell.

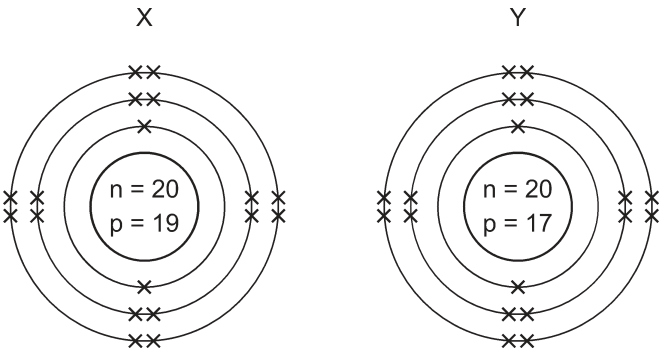
[Nov 2020/P22/Q3]

15. Which row identifies compounds that contain single covalent bonds only, double covalent bonds only or both single and double covalent bonds?

	single covalent bonds only	double covalent bonds only	both single and double covalent bonds
A	C_2H_4	CH_3OH	CO_2
B	CH_3OH	C_2H_4	CO_2
C	CH_3OH	CO_2	C_2H_4
D	CO_2	C_2H_4	CH_3OH

[Nov 2020/P22/Q7]

16. The arrangements of the electrons in two ions formed from elements X and Y are shown.



Which equation represents the reaction between elements X and Y?

A $X_2 + 2Y \rightarrow 2X^+ + 2Y^-$

B $X_2 + 2Y \rightarrow 2X^- + 2Y^+$

C $2X + Y_2 \rightarrow 2X^+ + 2Y^-$

D $2X + Y_2 \rightarrow 2X^- + 2Y^+$

[Nov 2020/P21/P22/P23/Q6]

17. Some information about particles P, Q, R and S is shown.

	nucleon number	number of neutrons	number of electrons
P	12	6	6
Q	24	12	10
R	16	8	10
S	14	8	6

Which two particles are isotopes of the same element?

A P and Q **B** P and S **C** Q and R **D** R and S

[June 2021/P22/Q8]

18. Element X has 7 protons.

Element Y has 8 more protons than X.

Which statement about element Y is correct?

A Y has more electron shells than X.

B Y has more electrons in its outer shell than X.

C Y is in a different group of the Periodic Table from X.

D Y is in the same period of the Periodic Table as X.

[June 2021/P21/P22/P23/Q4]

19. A covalent molecule Q contains only six shared electrons.

What is Q?

A ammonia, NH_3 **B** chlorine, Cl_2 **C** methane, CH_4 **D** water, H_2O

[June 2021/P21/P22/P23/Q5]

20. Which statement about isotopes of the same element is correct?

A They have different numbers of electrons. **B** They have different numbers of neutrons.

C They have different numbers of protons. **D** They have the same mass number.

[June 2021/P23/Q7]

21. How many protons, neutrons and electrons are there in one atom of the isotope $^{27}_{13}Al$?

	protons	neutrons	electrons
A	13	13	13
B	13	14	13
C	14	13	13
D	14	14	13

[Nov 2021/P22/Q4]

22. The nucleus of a particular atom consists of nineteen particles.
Nine of them are positively charged and ten of them are uncharged.
Which statement about this nucleus is correct?

A The nucleus has a nucleon number of nine.
B The nucleus has a nucleon number of ten.
C The nucleus has a proton number of nine.
D The nucleus has a proton number of ten.

[Nov 2021/P23/Q4]

23. Which diagram shows the outer electron arrangement in a molecule of carbon dioxide?

A **B** **C** **D**

[Nov 2021/P23/Q8]

24. The numbers of protons and neutrons and the electronic structures of four particles, W, X, Y and Z, are shown.

	number of protons	number of neutrons	electronic structure
W	8	8	2,8
X	8	10	2,6
Y	8	8	2,6
Z	10	8	2,8

Which particles have the same chemical properties?

A W and Y **B** W and Z **C** X and Y **D** X and Z

[June 2022/P21/Q3]

TOPIC 2.2

Answer Keys

1. B	2. B	3. A	4. A	5. B	6. C
7. B	8. A	9. B	10. B	11. A	12. D
13. A	14. D	15. C	16. C	17. B	18. A
19. A	20. B	21. B	22. C	23. A	24. C
25. D	26. A	27. C	28. A	29. D	30. C
31. B	32. D	33. B	34. A	35. D	36. D
37. B	38. A	39. D	40. B	41. A	42. C
43. B	44. C	45. C	46. C	47. C	48. C
49. B	50. B	51. B			

TOPIC 5

Chemical Energetics

Exothermic and Endothermic reactions

1. Nitrogen reacts with hydrogen to produce ammonia.

$$N_2 + 3H_2 \rightarrow 2NH_3$$

The reaction is exothermic. The bond energies are shown in the table.

bond	bond energy in kJ / mol
N≡N	945
H–H	436
N–H	390

What is the energy change for this reaction?

A –1473 kJ / mol **B** –87 kJ / mol **C** 87 kJ / mol **D** 1473 kJ / mol

[June 2019/P21/Q12]

2. Two elements, X and Y, react together to form a covalent molecule as shown.
The reaction is exothermic.

$$X_2(g) + Y_2(g) \rightarrow 2XY(g)$$

The bond energies are shown in the table.

bond	bond energy in kJ / mol
X–X	436
Y–Y	242
X–Y	431

What is the energy change for the reaction?

A +184 kJ / mol **B** –184 kJ / mol **C** +247 kJ / mol **D** –247 kJ / mol

[June 2019/P22/Q12]

3. Which statements about endothermic reactions are correct?

1 The energy of the products is greater than the energy of the reactants.
2 The energy of the reactants is greater than the energy of the products.
3 The temperature of the surroundings increases during the reaction.
4 The temperature of the surroundings decreases during the reaction.

A 1 and 3 only **B** 1 and 4 only **C** 2 and 3 only **D** 2 and 4 only

[Nov 2019/P21/Q13]

4. The temperature of the water in two beakers, X and Y, is measured as 21.5 °C.

5 g of sodium chloride is dissolved in the water in beaker X. The temperature changes to 18.0 °C.

5 g of calcium oxide is dissolved in the water in beaker Y. The temperature changes to 29.4 °C.

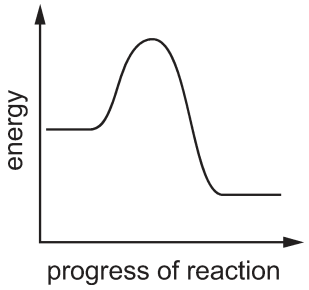
Which types of process are occurring in beakers X and Y?

	X	Y
A	endothermic	endothermic
B	endothermic	exothermic
C	exothermic	endothermic
D	exothermic	exothermic

[Nov 2019/P22/Q13]

5. An energy level diagram for a reaction is shown.

Which statement and explanation about this reaction are correct?



	statement	explanation
A	the reaction is endothermic	the products have more energy than the reactants
B	the reaction is endothermic	the products have less energy than the reactants
C	the reaction is exothermic	the products have more energy than the reactants
D	the reaction is exothermic	the products have less energy than the reactants

[Nov 2019/P23/Q13]

6. The equation for the complete combustion of methane gas is shown.

$$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$$

Bond energies are shown.

bond	bond energy in kJ / mol
C–H	412
H–O	463
C=O	743
O=O	498

What is the overall energy change, in kJ / mol, for the above reaction?

A –1192 **B** –694 **C** +694 **D** +1192

[June 2020/P21/Q12]

7. Sodium nitrate is added to water in a beaker and stirred until it dissolves.

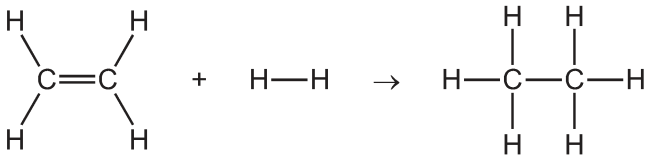
At the end of the experiment, the beaker feels cold.

Which row describes the reaction?

	temperature of solution	type of reaction
A	decreases	endothermic
B	decreases	exothermic
C	increases	endothermic
D	increases	exothermic

[Nov 2020/P21/Q15]

8. Ethene reacts with hydrogen to form ethane.



The bond energies are shown in the table.

bond	bond energy in kJ / mol
C–C	+350
C–H	+410
H–H	+436
C=C	+614

What is the energy change for the reaction?

A –290 kJ / mol **B** –120 kJ / mol

C +120 kJ / mol **D** +290 kJ / mol

[Nov 2020/P21/Q17]

9. A sign displayed in a flour mill is shown.

Which statement explains why there is a danger of explosion in a flour mill?

A Flour burns very quickly because it is a fine powder.

B Flour is a catalyst for combustion.

C Flour mills get hot and speed up the rate of combustion.

D The combustion of flour is exothermic.

[Nov 2020/P21/Q18]

10. The combustion of methane is exothermic.

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

Which statement about this reaction is correct?

A The energy needed to break the bonds in methane and oxygen is greater than the energy released in making new bonds in carbon dioxide and water.

B The energy needed to break the bonds in methane and oxygen is less than the energy released in making new bonds in carbon dioxide and water.

C The energy released in breaking bonds in methane and oxygen is greater than the energy needed to make new bonds in carbon dioxide and water.

D The energy released in breaking bonds in methane and oxygen is less than the energy needed to make new bonds in carbon dioxide and water.

[Nov 2020/P22/Q14]

11. Nitrogen, N_2, and hydrogen, H_2, can be converted into ammonia, NH_3, using a catalyst.

What is the purpose of the catalyst?

A to increase the amount of ammonia produced

B to increase the rate of reaction

C to reduce the amount of reactants needed

D to reduce the rate of reaction

[Nov 2020/P22/Q17]

12. Which substance does **not** require oxygen in order to produce energy?

A coal

B hydrogen

C natural gas

D ^{235}U

[Nov 2020/P23/Q14]
Repeat [Nov 2020/P21/P22/Q16]

13. Ethanol is used as a fuel.

ethanol + oxygen → carbon dioxide + water

Which statements are correct?

1 The reaction is endothermic.
2 The products have more energy than the reactants.
3 The oxygen for this reaction comes from the air.
4 The temperature of the reaction mixture rises during this reaction.

A 1 and 2

B 1 and 3

C 2 and 4

D 3 and 4

[Nov 2020/P23/Q15]

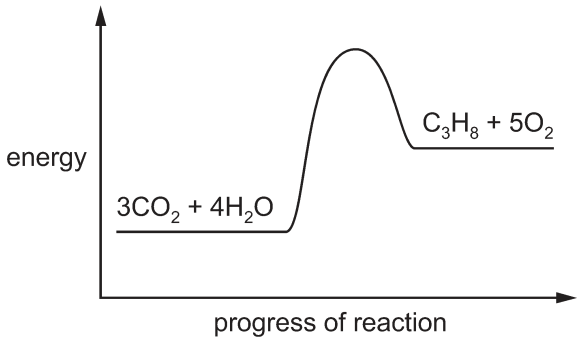
14. The complete combustion of propane is exothermic.

The equation for this reaction is shown.

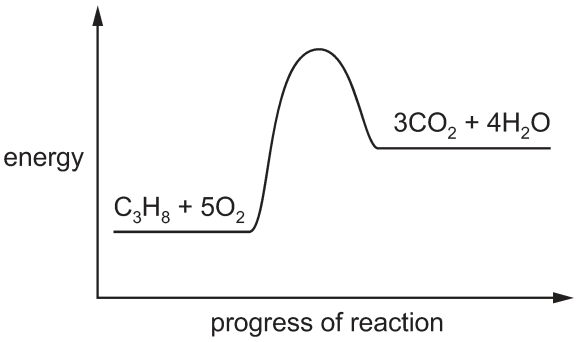
$$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$$

Which energy level diagram represents the complete combustion of propane?

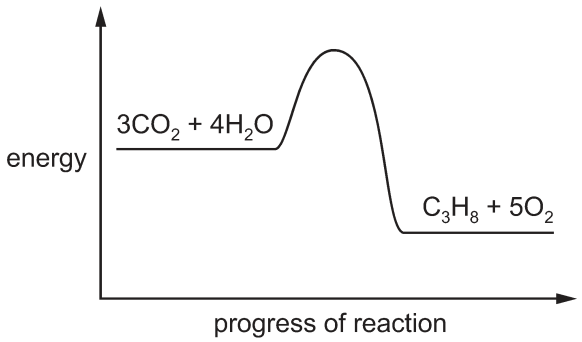
A



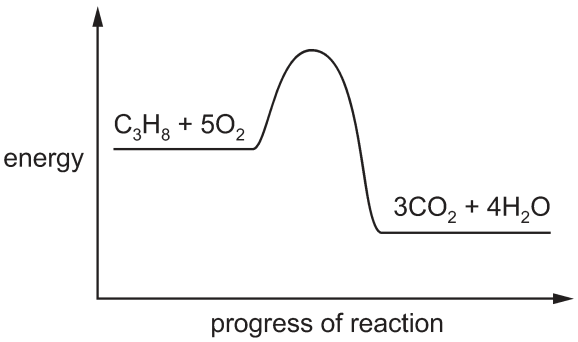
B



C

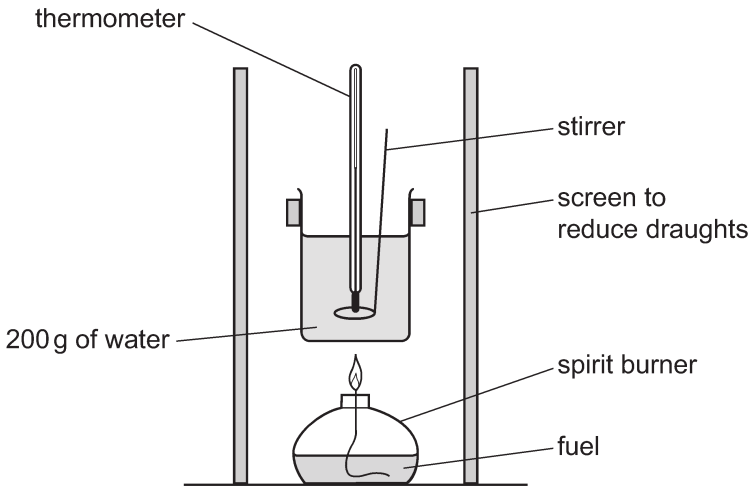


D



[June 2021/P21/Q12]

15. Four different fuels are used to heat a beaker of water, for the same amount of time, using the apparatus shown.



The initial temperature of the water and the temperature after heating by the fuel are recorded.

Which fuel releases the most heat energy?

	initial temperature / °C	temperature after heating / °C
A	17	46
B	24	52
C	26	61
D	30	62

[June 2021/P22/Q12]

16. The equation shows the reaction between hydrogen and oxygen.

$$2\,H-H + O=O \rightarrow 2\,H-O-H$$

The bond energies are shown.

	bond energy in kJ / mol
H–H	436
O=O	495
O–H	463

Which row shows the energy change and the type of reaction?

	energy change in kJ / mol	type of reaction
A	441	exothermic
B	441	endothermic
C	485	exothermic
D	485	endothermic

[June 2021/P22/Q20]

17. The equation for the decomposition of hydrogen iodide is shown.

$$2HI \rightarrow H_2 + I_2$$

Some bond energies are shown.

bond	bond energy in kJ / mol
H–H	440
I–I	150
H–I	300

What is the energy change for the reaction?

A –290 kJ / mol **B** –10 kJ / mol **C** +10 kJ / mol **D** +290 kJ / mol

[June 2021/P23/Q17]

TOPIC 5

Answer Keys

1. B	2. B	3. B	4. B	5. D	6. B
7. A	8. B	9. A	10. B	11. B	12. D
13. D	14. D	15. C	16. C	17. C	18. B
19. B	20. D	21. B	22. C	23. B	24. C
25. B	26. A	27. A	28. A	29. B	30. B
31. C	32. D	33. A	34. A	35. B	36. B
37. C	38. A	39. C	40. A	41. C	42. C
43. A	44. B	45. D	46. A	47. C	