higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

PHYSICAL SCIENCE
(Second Paper)
NQF LEVEL 3

(10021003)

23 November 2018 (X-Paper)
09:00–12:00

Nonprogrammable calculators may be used.

This question paper consists of 9 pages, 1 data sheet and 1 periodic table.

NCV

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TIME: 3 HOURS
MARKS: 150

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions.
2. Read ALL the questions carefully.
3. Number the answers according to the numbering system used in this question paper.
4. Write your EXAMINATION NUMBER and the EXAM CENTRE NUMBER in the space provided in the ANSWER BOOK.
5. Show formulae and substitutions in ALL calculations.
6. Accurately approximate ALL final answers to TWO decimal places.
7. Write neatly and legibly.

NCV

SECTION A

QUESTION 1

Give ONE term for each of the following descriptions. Write only the term next to the question number (1.1–1.5) in the ANSWER BOOK.

1.1 Theory that explains the behaviour of ideal gases

1.2 Tendency of a substance to be drawn out to a considerable length without breaking

1.3 Chemical mist formed by water vapour, dust and other pollutants

1.4 Amount of energy absorbed or released when 1 kg of a substance changes phase at a constant temperature

1.5 Minimum energy that must be supplied to reactants to start a chemical reaction

(5 × 1) **[5]**

QUESTION 2

Choose a term from COLUMN B that matches a description in COLUMN A. Write only the letter (A–I) next to the question number (2.1–2.5) in the ANSWER BOOK.

COLUMN A		COLUMN B	
2.1	Type of dipole-dipole intermolecular forces	A	mole
		B	London forces
2.2	Temporary intermediate product formed during a reaction	C	22,4 dm^3
2.3	Extent to which a substance is deformed when it is subjected to stress	D	strain
		E	activation energy
2.4	Molar volume of gases	F	activation complex
2.5	Amount of a substance that has the same number of particles as there are atoms in 12 grams of carbon	G	hydrogen bonds
		H	24,2 dm^3
		I	elastic limit

(5 × 1) **[5]**

QUESTION 3

Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'True' or 'False' next to the question number (3.1–3.5) in the ANSWER BOOK.

3.1 Covalent bonding occurs between nonmetallic atoms when electrons are shared.

3.2 An alkali is a basic oxide that is insoluble in water.

3.3 Carbon dioxide is highly poisonous because it combines with the haemoglobin in blood more readily than oxygen.

3.4 Equal volumes of all gases at the same temperature and pressure contain the same number of molecules.

3.5 Carbon dioxide is an industrial emission from factories that burn fossil fuels.

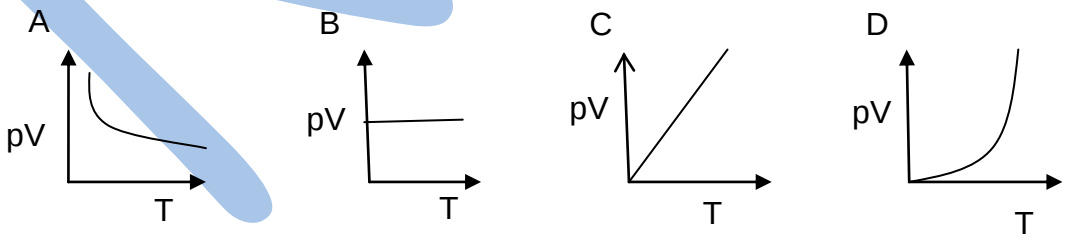
(5 × 2) **[10]**

QUESTION 4

Various options are given as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (4.1–4.5) in the ANSWER BOOK.

4.1 A certain mass of ideal gas is heated and the corresponding changes in pressure (p), volume (V) and temperature (T) are recorded.

Which ONE of the following graphs shows the correct relationship between p, V and T:



4.2 The oxidation number of chromium in potassium dichromate:

A +6
B +12
C -14
D +14

4.3 Which ONE of the following metals is least reactive with water:

A K
B Li
C Na
D Mg

4.4 The volume of a gas is V when its pressure is P.

What will the volume of the gas be, if its pressure changes to 4P?

A 0,5 V
B 0,25 V
C 4 V
D 8 V

4.5 During a displacement reaction between potassium iodide and chlorine, xylene was added to the mixture.

Xylene changed the colour to purple because of ...

A I^-.
B Cl^-.
C I_2.
D Cl_2.

(5 × 3) **[15]**

TOTAL SECTION A: 35

SECTION B

QUESTION 5

5.1 In an experiment to investigate Charles's law, a balloon is inflated with air and placed in ice water and boiling water.

5.1.1 Use the kinetic molecular theory to explain the behaviour of the gas particles when the balloon is placed in hot water. (3)

5.1.2 State Charles's law. (3)

5.1.3 Suppose the temperature of the ice water is 3 °C and the volume of the balloon is 2,57 dm^3.

What will the volume of the gas be if the temperature of the boiling water is 112 °C? (5)

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5.2 A gas cylinder contains oxygen gas at 77 °C.

Calculate the mass of oxygen present when the pressure is 145,25 kPa. (6)

5.3 Consider the following elements:

Oxygen and sulphur

5.3.1 What do the atoms of these elements have in common? (2)

5.3.2 Sulphur bonds with hydrogen.

Which type of bond will be formed? (2)

5.3.3 Distinguish which is more polar between an *S-H bond* and an *O-H bond*. (2)

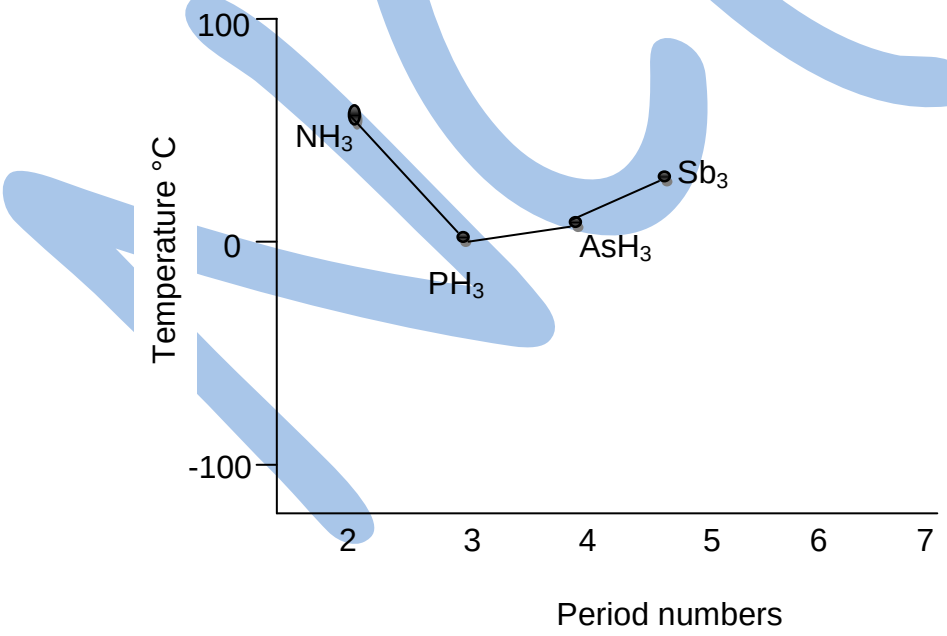
5.3.4 Use Lewis notation to represent the hydrogen sulphide molecule. (3)

5.3.5 What is the shape of the hydrogen sulphide molecule? (2)

[28]

QUESTION 6

6.1 The boiling points of the hydrides of Group 5 are shown below:



6.1.1 Define the term *electronegativity*. (2)

6.1.2 Explain why NH_3 has the highest boiling point of the hydrides of Group 5. (4)

6.1.3 What is the shape of an ammonia molecule? (2)

6.1.4 Calculate the oxidation number of nitrogen in ammonia. (2)

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6.2 6.2.1 Explain in terms of the kinetic theory why solids expand when heated. (3)

6.2.2 A cadmium rod measures 40 cm at 20 °C and 40,096 cm at 100 °C.

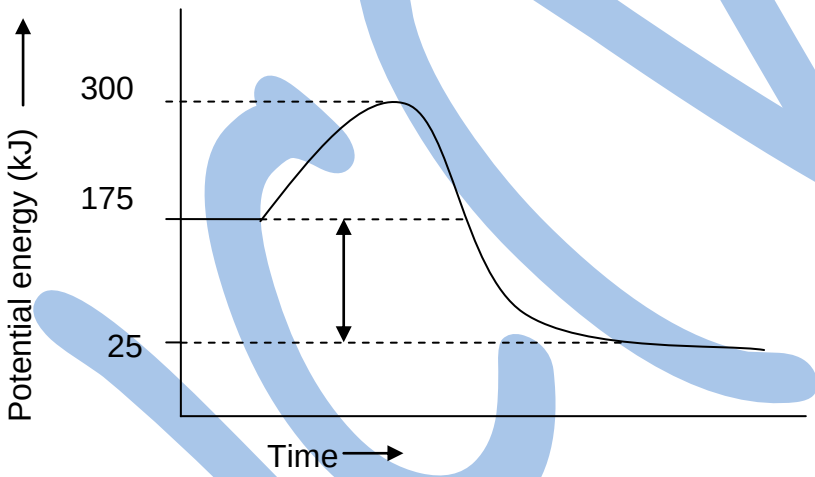
Find the coefficient of linear expansion of cadmium. (5)

6.2.3 Distinguish between *latent heat of fusion* and *latent heat of vaporisation*. (2 + 2) (4)

[22]

QUESTION 7

7.1 The graph below represents the energy changes that take place during a reaction between hydrogen and fluorine to form hydrogen fluoride.



7.1.1 Write a balanced equation for the reaction. (3)

7.1.2 Is the reaction endothermic or exothermic? Give a reason for the answer. (2)

7.1.3 What is the energy of the reactants? (1)

7.1.4 What is the energy of the products? (1)

7.1.5 Calculate ΔH for the above reaction. (2)

7.1.6 Calculate the activation energy (Ea) of the reaction. (2)

7.1.7 What is the energy of the activated complex? (1)

7.1.8 Classify the reaction as decomposition, displacement or combination. Explain the answer. (2)

7.1.9 Use the balanced equation in QUESTION 7.1.1 to show that mass is conserved. (4)

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7.2 Give the names of each of the following compounds:

7.2.1 $NH_4C\ell$

7.2.2 $Ba(NO_3)_2$

7.2.3 Na_2CO_3

(3 × 2) (6)
[24]

QUESTION 8

8.1 Complete and balance each of the following reactions:

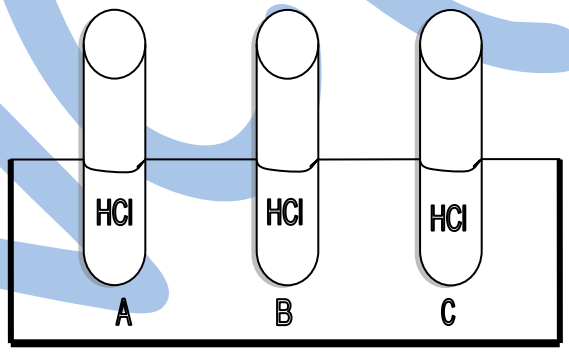
8.1.1 $A\ell(s) + H_2SO_4(aq) \rightarrow$

8.1.2 $CH_4(g) + O_2(g) \rightarrow$

8.1.3 $AgNO_3(aq) + NaC\ell(aq) \rightarrow$

(3 × 2) (6)

8.2 In the following experiment students were investigating the reactivity of three metals with hydrochloric acid. Zinc metal was placed in test tube A, magnesium in B and copper in C.



8.2.1 Give the observation for test tube A. (2)

8.2.2 Write a balanced equation for the reaction that takes place in test tube B. (3)

8.2.3 Write the reactivity series for the THREE metals, starting from the most reactive to the least reactive. (3)

8.2.4 Describe ONE method that can be used to identify the gas. (2)

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8.3 Consider the following reactions:

A. Potassium chlorate $\xrightarrow{\text{heat}}$ potassium chloride + oxygen

B. $Li + O_2 \longrightarrow Li_2O$

C $K_2O + H_2O \longrightarrow$

8.3.1 Which type of reaction is:

(a) Reaction A

(b) Reaction B (2 × 1) (2)

8.3.2 What type of product is Li_2O? Acidic or basic? (1)

8.3.3 Write the formula of the product of reaction C. (2)

8.3.4 Write reaction A in symbols and balance it. (3)

[24]

QUESTION 9

9.1 Give TWO industrial uses of each of the following:

9.1.1 Oxygen

9.1.2 Nitrogen

9.1.3 H_2

(3 × 2) (6)

9.2 Industries are expected to put measures in place to prevent and control emission and pollutants.

State THREE measures used by industries to prevent emission. (3)

9.3 Give a reason why each of the following gases is considered hazardous:

9.3.1 Carbon monoxide

9.3.2 Chlorine

(2 × 2) (4)

9.4 Chlorofluorocarbons are the main source of pollutants that are depleting the ozone layer in the upper atmosphere.

9.4.1 Name TWO sources of chlorofluorocarbons. (2)

9.4.2 What is the function of the ozone layer? (2)

[17]

TOTAL SECTION B: 115
GRAND TOTAL: 150

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DATA SHEET

TABLE 1: PHYSICAL CONSTANTS

NAME	SYMBOL	VALUE
Avogadro's constant	N_A	$6{,}02 \times 10^{23}\ mol^{-1}$
Molar gas volume at STP	V_m	$22{,}4\ dm^3.mol^{-1}$
Standard pressure	p^θ	$1{,}013 \times 10^5\ Pa$
Standard temperature	T^θ	273 K
Charge on electron	e	$-1{,}6 \times 10^{-19}\ C$
Molar gas constant	R	$8{,}31\ J.K^{-1}.mol^{-1}$

TABLE 2: FORMULAE

$\frac{p_1V_1}{T_1} = \frac{p_2V_2}{T_2}$	$pV = nRT$
$n = \frac{m}{M}$	$\Delta L = \alpha L_0 \Delta T$
$c = \frac{m}{MV}$	$\frac{n_a}{n_b} = \frac{c_aV_a}{c_bV_b}$
$c = \frac{n}{V}$	$\frac{n_s}{n_b} = \frac{c_sV_s}{c_bV_b}$

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PERIODIC TABLE

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