education

MPUMALANGA PROVINCE

REPUBLIC OF SOUTH AFRICA

FURTHER EDUCATION AND TRAINING

GRADE 12

PHYSICAL SCIENCES TOPIC TEST

TOPIC: ACIDS AND BASES

30 MAY 2025 (Proposed date)

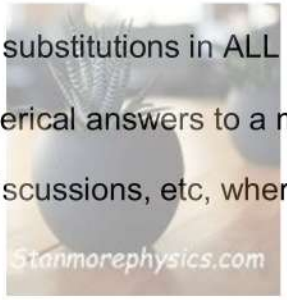
MARKS: 30

TIME: 36 minutes

This question paper consists of 5 and 1 data sheet

INSTRUCTIONS AND INFORMATION

1. Write your name in the appropriate space on the ANSWER BOOK.
2. This question paper consists of THREE questions. Answer ALL the questions in the ANSWER BOOK.
3. Start EACH Question on a NEW page in the ANSWER BOOK.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Leave one line between two sub questions, for example between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable calculator.
7. You may use appropriate mathematical instruments.
8. You are advised to use the attached DATA SHEET.
9. Show ALL formulae and substitutions in ALL calculations.
10. Round off your final numerical answers to a minimum of TWO decimal places.
11. Give brief motivations, discussions, etc, where required.
12. Write neatly and legibly.



QUESTION 1: MULTIPLE–CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write only the letter (A–D) next to the question number (1.1 to 1.2) in the ANSWER BOOK, eg. 1.3E

1.1 Consider the acid-base reactions below.

P: $NH_3(aq) + H_3PO_4(aq) + \rightleftharpoons NH_4^+(aq) + H_2PO_4^-(aq)$

Q: $H_2PO_4^-(aq) + H_2O(\ell) \rightleftharpoons HPO_4^{2-}(aq) + H_30^+(aq)$

A substance that act as an ampholyte in these two reactions is….

A H_2O

B $H_2PO_4^-$

C NH_4^+

D H_30^+ (2)

1.2 During a titration, Bromothymol blue is chosen as the most suitable indicator. Which one of the following acid-base pair is used in this titration?

	ACID	BASE
A	Oxalic acid	Sodium hydroxide
B	Hydrochloric acid	Ammonia
C	Sulphuric acid	Sodium hydroxide
D	Nitric acid	Ammonia

(2)
[4]

QUESTION 2

2.1 Sulphuric acid, H_2SO_4, is a strong acid and ionises in two steps, which are represented by the following incomplete equations.

$$H_2SO_4(aq) + H_2O(\ell) \rightleftharpoons \mathbf{X}(aq) + H_3O^+(aq)$$

$$HSO_4^-(aq) + H_2O(\ell) \rightleftharpoons \mathbf{Y}(aq) + H_3O^+(aq)$$

2.1.1 Define the term *strong acid*. (2)

For Compound **X**, write down:

2.1.2 It's NAME or FORMULA (1)

2.1.3 The NAME or FORMULA of its conjugate acid. (1)

2.1.4 The NAME or FORMULA of its conjugate base. (1)

2.1.5 The nature of compound **Y**. Choose from ACIDIC, BASIC or NEUTRAL. (1)

2.1.6 Use Lowry-Brønsted theory to explain the answer to question 2.1.5 (1)

2.2 A dilute sulphuric acid, H_2SO_4, solution has a concentration of 0.2 $mol.dm^{-3}$. This acid is prepared by adding 10 cm^3 of concentrated H_2SO_4 acid sample to 490cm^3 of distilled water.

2.2.1 Calculate the concentration of the concentrated H_2SO_4 acid sample. (3)

The diluted H_2SO_4 acid is reacted with ammonia solution, according to the following balanced equation:

$$H_2SO_4\ (aq) + NH_3(aq) \rightarrow (NH_4)_2SO_4(aq)$$

Some $NH_4)_2SO_4(aq)$ formed is dissolved in water in the test tube.

2.2.2 Is the PH of the solution in the test tube ACIDIC,NEUTRAL or BASIC? (1)

2.2.3 Write down a balanced ionic equation to explain t the answer to QUESTION 2.2.2 (2)

[13]

QUESTION 3

3.1 Consider the following acid-base reactions.

A: $HX(aq) + H_2O(\ell) \rightleftharpoons X^-(aq) + H_3O^+(aq)$ Ka = $1x10^2$

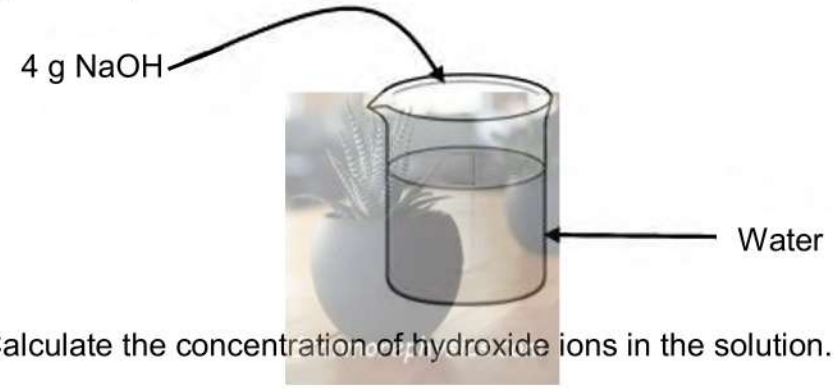
B: $HNO_3(aq) + NH_3(aq) \rightleftharpoons NH_4^+(aq) + NO_3^-(aq)$ Ka = $1x10^3$

3.1.1 Which acid HNO_3 or HX has a lower PH? (1)

3.1.2 From reactions **A** and **B** identify the reaction that illustrates Arrhenius theory (1)

3.1.3 From reactions **A,** write down the FORMULS or NAME of the weakest acid. (1)

3.2 sodium hydroxide solution, NaOH(aq), is prepared in a beaker by dissolving 4 g of sodium hydroxide pellets in water to make a $500cm^3$ solution.



3.2.1 Calculate the concentration of hydroxide ions in the solution. (3)

3.2.2 During a titration, 25 cm^3 of a sulphuric acid, $H_2SO_4(aq)$ solution neutralises 12,5 cm^3 of sodium hydroxide solution according to the following balanced chemical equation.

$H_2SO_4(aq) + 2NaOH(aq) \rightarrow (NH_4)_2SO_4(aq) + H_2O(\ell)$

Calculate the PH of sulphuric acid solution. (7)

[13]

TOTAL:30

DATA FOR PHYSICAL SCIENCES GRADE 12

PAPER 2 (CHEMISTRY)

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ or $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$

BLE 3: THE PERIODIC TABLE OF ELEMENTS

KEY

Atomic number

Electronegativity → 29 / 1,9 / Cu / 63,5 ← Symbol

Relative atomic mass (approximately)

I	II	III	IV	V	VI	VII	0
1 2,1 H 1							2 He 4
3 1,0 Li 7	4 1,5 Be 9	5 2,0 B 11	6 2,5 C 12	7 3,0 N 14	8 3,5 O 16	9 4,0 F 19	10 Ne 20
11 0,9 Na 23	12 1,2 Mg 24	13 1,5 Aℓ 27	14 1,8 Si 28	15 2,1 P 31	16 2,5 S 32	17 3,0 Cℓ 35,5	18 Ar 40
19 0,8 K 39	20 1,0 Ca 40	21 1,3 Sc 45	22 1,5 Ti 48	23 1,6 V 51	24 1,6 Cr 52	25 1,5 Mn 55	26 1,8 Fe 56	27 1,8 Co 59	28 1,8 Ni 59	29 1,9 Cu 63,5	30 1,6 Zn 65	31 1,6 Ga 70	32 1,8 Ge 73	33 2,0 As 75	34 2,4 Se 79	35 2,8 Br 80	36 Kr 84
37 0,8 Rb 86	38 1,0 Sr 88	39 1,2 Y 89	40 1,4 Zr 91	41 Nb 92	42 1,8 Mo 96	43 1,9 Tc	44 2,2 Ru 101	45 2,2 Rh 103	46 2,2 Pd 106	47 1,9 Ag 108	48 1,7 Cd 112	49 1,7 In 115	50 1,8 Sn 119	51 1,9 Sb 122	52 2,1 Te 128	53 2,5 I 127	54 Xe 131
55 0,7 Cs 133	56 0,9 Ba 137	57 La 139	72 1,6 Hf 179	73 Ta 181	74 W 184	75 Re 186	76 Os 190	77 Ir 192	78 Pt 195	79 Au 197	80 Hg 201	81 1,8 Tℓ 204	82 1,8 Pb 207	83 1,9 Bi 209	84 2,0 Po	85 2,5 At	86 Rn
87 0,7 Fr	88 0,9 Ra 226	89 Ac															

58 Ce 140	59 Pr 141	60 Nd 144	61 Pm	62 Sm 150	63 Eu 152	64 Gd 157	65 Tb 159	66 Dy 163	67 Ho 165	68 Er 167	69 Tm 169	70 Yb 173	71 Lu 175
90 Th 232	91 Pa	92 U 238	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

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Marking guidelines

MARKS: 30

These marking guidelines consist of 3 pages

QUESTION 1

1.1 B✓✓ (2)

1.3 C✓✓ (2)
[4]

QUESTION 2

2.1.1 Acid that ionises completely in water to form a high concentration of H_3O^+ ions.✓✓ (2)

2.1.2 Hydrogen sulphate ion/HSO_4^-✓ (1)

2.1.3 Sulphuric acid/H_2SO_4✓ (1)

2.1.4 SO_4^{2-}✓ (1)

2.1.5 BASIC✓ (1)

2.1.6 It is a Proton acceptor✓ (1)

2.2.1 n(concentrated) = n(dilute)
CV = CV✓
C(0,01) = (0,2)(0,5)✓
$C_{(conc)}$ = 10 mol.dm^{-3}✓ (3)

2.2.2 ACIDIC✓ (1)

2.2.3 $NH_4^+(aq) + H_2O(\ell)$✓ → $NH_3(aq) + H_3O^+(aq)$✓ **(Ignore the phases)** (2)
[13]

QUESTION 3

3.1.1 HNO_3✓ (1)

3.1.2 **A**✓ (1)

3.1.3 H_3O^+✓ (1)

3.2.1 **OPTION 1**

$C_{(NaOH)} = \frac{m}{MV}$ ✓

$C_{(NaOH)} = \frac{4}{(40)(0,5)}$ ✓

$C_{(NaOH)} = 0,2 \text{ mol.dm}^{-3}$

$C_{(OH^-)} = 0,2 \text{ mol.dm}^{-3}$ ✓

OPTION 2

$n_{(NaOH)} = \frac{m}{M}$

$n_{(NaOH)} = \frac{4}{40} = 0,1 \text{ mol}$

$C_{(NaOH)} = \frac{n}{v}$ ✓

$C_{(NaOH)} = \frac{0,1}{0,5}$ ✓

$C_{(NaOH)} = 0,2 \text{ mol.dm}^{-3}$

$C_{(OH^-)} = 0,2 \text{ mol.dm}^{-3}$ ✓ (3)

3.2.2

OPTION 1	**OPTION 2**
$\frac{CaVa}{CbVb} = \frac{na}{nb}$ ✓ $\frac{Ca(25)}{(0,2)(12,5)}$ ✓ $= \frac{1}{2}$ ✓ Ca = 0,05 mol.dm^{-3} $[H_3O^+] = 2\ (0,05)$ ✓ pH = -log $[H_3O^+]$ ✓ pH= -log (0,1) ✓ pH = 1 ✓	$n_b = C_bV_b$ $n_b = (0,2)(0,0125)$ ✓ $n_b = 0,0025$ mol na = $\frac{1}{2}$ x 0,0025 ✓ = 0,00125 $Ca = \frac{na}{Va}$ $Ca = \frac{0,00125}{0,025}$ ✓ Ca = 0,05 mol.dm^{-3} $[H_3O^+] = 2\ (0,05)$ ✓ pH = -log $[H_3O^+]$ ✓ pH= -log (0,1) ✓ pH = 1 ✓

(7)

[13]

TOTAL:30