SENIOR SECONDARY IMPROVEMENT PROGRAMME 2013

education
Department: Education
GAUTENG PROVINCE

GRADE 12

PHYSICAL SCIENCES

LEARNER HOMEWORK SOLUTIONS

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LEARNER HOMEWORK SOLUTIONS

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HOMEWORK SOLUTIONS : SESSION 8
TOPIC: CHEMICAL EQUILIBRIUM

QUESTION 1

1.1 The forward reaction is exothermic. ✓Thus, lowering the temperature favours the forward, exothermic reaction and the ammonia will now have a higher yield. ✓ However, the rate of reaction will be lowered and this will lead to the ammonia production being unprofitable. ✓ (3)

1.2.1

	NH_3	O_2	NO	H_2O
Initial concentration ($mol{\cdot}dm^{-3}$)	1	1	0	0
Change in concentration ($mol{\cdot}dm^{-3}$)	0,25	0,3125	0,25	0,375
Equilibrium concentration ($mol{\cdot}dm^{-3}$)	0,75✓	0,6875✓	0,25✓	0,375✓

$$K_c = \frac{[NO]^4[H_2O]^6}{[NH_3]^4[O_2]^5} \checkmark$$

$$= \frac{(0{,}25)^4(0{,}375)^6 \checkmark}{(0{,}75)^4(0{,}6875)^5 \checkmark}$$

$$= 2{,}2 \times 10^{-4} \quad \checkmark\checkmark$$ (9)

1.2.2 Low. ✓ The small equilibrium constant value indicates that the equilibrium lies towards the reactants side ✓ and that there are more reactant molecules in the reaction mixture at equilibrium, thus NO will have a low yield. ✓ (3)

[15]

QUESTION 2

	N_2	O_2	NO
Initial number of mole (mol)	7	2	0
Number of moles used/formed (mol)	0,2	0,2	0,4
Number of moles at equilibrium (mol)	6,8	1,8	0,4
Equilbrium concentration ($mol \cdot dm^{-3}$) c = n/V	3,4✓	0,9✓	0,2✓

$$K_c = \frac{[NO]^2}{[N_2][O_2]} \checkmark$$

$$= \frac{(0,2)^2}{(3,4)(0,9)} \checkmark$$

$$= 0,013 \checkmark$$

[6]

HOMEWORK SOLUTIONS: SESSION 9
TOPIC: ELECTROLYTIC AND GALVANIC CELLS

QUESTION 1

1.1.1 $Fe \rightarrow Fe^{2+} + 2e^-$ √√ (2)

1.1.2 Oxygen √ (1)

1.1.3 $E^\theta_{cell} = E^\theta_{cathode} - E^\theta_{anode}$ √

$= 0,4$ √ $- (-0,44)$√

$E^\theta_{cell} = 0,84$ V √

Because the emf is positive, the reaction is spontaneous. √ (5)

1.1.1 Mg is a stronger reducing agent √than Fe and will be oxidised √ (2)

Or Mg loses electrons more easily than Fe and becomes oxidised.

Or Fe is a weaker reducing agent than Mg and will not be oxidised.

1.2.2 Electrolytes in the soil √√or salts dissolved √in the moist soil. √ (2)

1.2.3 Mg is oxidised or becomes corroded or used up. √ (1)

1.2.4 $Mg \rightarrow Mg^{2+} + 2e^-$ √√ (2)

1.2.5 Any two:

- Paint√
- Electroplating√
- Oil or waterproofing
- Galvanising
- Plastic coating (2)

1.2.6 Advantage: ANY ONE:

- Plastic is cheaper√
- Does not rust

Disadvantage: Any one:

- Not degradable√
- Not as strong as iron (2)

[19]

HOMEWORK SOLUTIONS: SESSION 10

TOPIC: CONSOLIDATION EXERCISES ON MECHANICS AND MATTER AND MATERIALS

QUESTION 1

1.1 $W = hf$ ✓$= 6{,}63 \times 10^{-34} \times 9{,}4 \times 10^{14}$✓
$= 6{,}2 \times 10^{-19}$ J✓ (3)

1.2 $hf = W + E_K$ ✓

$6{,}63 \times 10^{-34}$ ✓ $\times 2{,}2 \times 10^{15}$✓ $= 6{,}2 \times 10^{-19} + E_K$✓

$E_K = 8{,}39 \times 10^{-19}$ J✓ (5)

1.3 $E_K = ½ mv^2$ ✓
$8{,}32 \times 10^{-19}$✓ $= ½ (9{,}1 \times 10^{-31}) v^2$ ✓ (m is the mass of an electron)

$v = 1{,}35 \times 10^6$ m·s^{-1} ✓ (4)

[12]

QUESTION 2

2.1 $W = hf$ ✓$= 6{,}63 \times 10^{-34} \times 4{,}47 \times 10^{15}$✓
$= 2{,}96 \times 10^{-19}$ J✓ (3)

2.2 $v = \lambda f$ ✓
3×10^8 ✓$= (234 \times 10^{-9})f$✓

$f = 1{,}3 \times 10^{15}$ Hz ✓

$hf = W + E_K$ ✓

$6{,}63 \times 10^{-34} \times 1{,}3 \times 10^{15}$ ✓$= 7{,}3 \times 10^{-19} + E_K$ ✓

$E_K = 1{,}32 \times 10^{-19}$ J✓ (8)

[11]

QUESTION 3

The longer wavelength of the star in comparison to the sun suggests red shift. ✓ This is the Doppler effect ✓in relation to light. As the star moves away from the earth, ✓the waves spread apart✓ so we detect a longer wavelength. ✓ **[5]**

HOMEWORK SOLUTIONS: SESSION 11
TOPIC: CONSOLIDATION EXERCISES ON SOUND, DOPPLER EFFECT AND LIGHT

QUESTION 1

1.1 The ability of a wave to bend / spread out (in wave fronts)✓ as they pass through a (small) aperture / opening OR around a (sharp) edge/ points /corners / barrier. ✓ (2)

1.2 1.2.1 Angle of / (Degree of) diffraction ✓ (1)

1.2.2 (Slit) width ✓ (1)

1.3 (Slit) 1 ✓

Slit 1 represents the most diffraction. ✓

OR

Diffraction /Angle / sin θ / θ is inversely proportional to slit width. ✓

OR

$\sin\theta \ \alpha \frac{1}{a}$ or $\theta \ \alpha \frac{1}{a}$ ✓

OR

Larger angle at which first minimum for slit 1 is obtained. ✓

OR

Smaller angle at which first minimum for slit 2 is obtained.✓ (2)

1.4

$$\sin\theta = \frac{m\lambda}{a} \checkmark$$

✓ ✓

$$\sin 5° = \frac{(1)(410\times10^{-9})}{a}$$

$\therefore$ a = 4,70 x 10^{-6} m ✓ (0,0000047 m / 4,7 μm) (4)

[10]

QUESTION 2

2.1 Every point on a wave front acts as a source of secondary wavelets ✓that spread out in all directions ✓with the same speed and the same frequency as the wave. (2)

2.2 As the wave passes through the slit, the slit acts as a source for secondary wavelets, ✓which moves out in all directions, ✓ including the area behind the slit. ✓ (3)

[5]

HOMEWORK SOLUTIONS : SESSION 12

TOPIC: CONSOLIDATION EXERCISES ON ORGANIC MOLECULES AND THEIR REACTIONS

QUESTION 1

1.1 Structural isomers are organic molecules that have the same molecular formulae but different structural formulae. ✓✓

1.2 All members of a homologous series obey the same general formula ,i.e. they have the same number of carbon and hydrogen atoms if it is a hydrocarbon, e.g., alkanes have a general formula of C_nH_{2n+2}. ✓✓

1.3 All the organic molecules in a homologous series have the same functional group, and they obey the same general formula. ✓✓

1.4 A functional group is a bond or an atom or a group of atoms that all the members of the homologous series have in common. ✓✓ **[8]**

QUESTION 2

2.1

```
       H    H    H    Cl   H
       |    |    |    |    |
   H — C —  C —  C —  C —  C — H
       |    |    |    |    |
       H    H    H    H    H
```

✓✓

2.2

```
       H    H    H    H
       |    |    |    |
   H — C —  C —  C —  C — Br
       |    |    |    |
       H    H  H-C-H  Br
                 |
                 H
```

✓✓

[4]

QUESTION 3

3.1 A and D ✓✓

3.2 A and B ✓✓

3.3 C ✓✓

3.4 E ✓✓ **[8]**

HOMEWORK SOLUTIONS: SESSION 13
TOPIC: CONSOLIDATION EXERCISES ON RATES, CHEMICAL EQUILIBRIUM AND ELECTROCHEMISTRY

QUESTION 1

1.1 silver√√ (2)

1.2 $Ni\ (s) \rightarrow Ni^{2+}\ (aq) + 2e^-$ √√ (2)

1.3 silver√√ (2)

1.4 $Ni(s)/Ni^{2+}(aq),\ 1\ mol\cdot dm^{-3}$ // $Ag^+\ (aq),\ 1\ mol\cdot dm^{-3}$ /Ag

√ √ √ (3)

1.5 $E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ √

$= 0,80$ √ $- (-0,25)$√

$E^{\theta}_{cell} = 1,05\ V$ √ (4)

[13]

QUESTION 2

2.1 C
2.2 D
2.3 B
2.4 D
2.5 C
2.6 D
2.7 C
2.8 B
2.9 C
2.10 C
2.11 B
2.12 C
2.13 A (13 x 2) **[26]**

HOMEWORK SOLUTIONS: SESSION 14

TOPIC 1: ELECTROSTATICS - GRADE 11 REVISION

QUESTION 1

1.1

$$F = \frac{kQ_1Q_2}{r^2} \checkmark = \frac{\left(9\times10^9\right)\left(4\times10^{-6}\right)\checkmark\left(6x10^{-6}\right)\checkmark}{(0.4)^2\checkmark} = 1.35\,\text{N} \checkmark$$

(4)

1.2 Four ✓ (1)

1.3 E (6μC) = kQ/r^2 ✓ ✓
= $(9 \times 10^9)(6 \times 10^{-6})/(0.,2)^2$ ✓

= $1,35 \times 10^6$ ✓ $N{\cdot}C^{-1}$ to the left.

E (4μC) = kQ/r^2
= $(9 \times 10^9)(4 \times 10^{-6})/(0.,6)^2$ ✓ ✓

= 1×10^6 $N{\cdot}C^{-1}$ to the right.

Take to the right as positive:

E_{net} = $-1,35 \times 10^6 + 1 \times 10^5$ = $-1,25 \times 10^6$ $N{\cdot}C^{-1}$
= $1,25 \times 10^6$ $N{\cdot}C^{-1}$ to the left ✓ (6)

1.4 New charge = $(+4x10\text{-}^{6}) + (-6x10^{-6})/2$ = -1×10^{-6} C ✓

U = kQ_1Q_2/r ✓
= $(9 \times 10^9)(-1 \times 10^{-6})^2$ ✓ /0,4 ✓
= $2,25 \times 10^{-2}$ J ✓ (5)

[16]

QUESTION 2

2.1 The current through a conductor is directly proportional to the potential difference across its ends at constant temperature. ✓✓ (2)

2.2 Equal ✓

<u>2 A divides equally at T</u> (and since $I_M = 1$ A it follows that $I_N = 1$ A) ✓

OR

$I \propto \frac{1}{R}$, $\therefore R_M = R_N$ (2)

2.3 emf = IR + Ir ✓ $\therefore$ 17 = 14 + Ir ✓ $\therefore$ Ir = 3 V

$r = \frac{V_{lost}}{I}$ ✓ $= \frac{3}{2}$ ✓ = 1,5 Ω ✓ (5)

2.4 $V_N = IR_N$ ✓ = (1)(2) ✓ = 2 V ✓ (3)

2.5 V_Y = 14 – 2 = 12 V ✓

$V_Y = IR_Y$ ✓ $\therefore$ 12 = (2)R_Y ✓

$\therefore R_Y = 6\ \Omega$ ✓ (4)

[16]

HOMEWORK SOLUTIONS: SESSION 15

TOPIC: ELECTRODYNAMICS - MOTORS AND GENERATORS AND ALTERNATING CURRENT

QUESTION 1

1.1 C
1.2 B
1.3 D
1.4 D
1.5 C

(5 x 2) **[10]**

QUESTION 2

2.1 There will be more current, more movement results. √ √ (2)

2.1.1 To stop the current briefly every 180º and to swop the directon of the current every 180º. √ (1)

2.1.2 To allow for free rotation of the coil. √ (1)

2.2 Yes. √ More current can be run through the coil. √ (Changing the number of coils or the strength of the magnets would be changing the actual structure of the motor.) (2)

2.3 A motor converts electrical energy into kinetic energy √ and a generator converts kinetic energy into electrical energy. √ In a motor the current needs to be provided and movement is created. In a generator the movement needs to be provided and a current is produced. (2)

2.4 More interaction of the magnetic field causes the conductor to have more current induced in it. √ So the faster the movement, the greater the current. √ (2)

[10]

QUESTION 3

3.1 $I = I_0 \sin\omega t$ √ √ or $I = I_0 \sin 2\pi f t$ (2)

3.2 $I_{RMS} = I_0 / \sqrt{2}$ √ √ (2)

3.3 $V_0 = \sqrt{2}\ V_{RMS}$ √ = 1,414 x 240 √ = 339,36V√ (3)

3.4 The average value of the current over the cycle is zero and no useful power is delivered. √ √ (2)

[9]