

# NATIONAL

# SENIOR CERTIFICATE

**GRADE 12**

**PHYSICAL SCIENCES P2 MEMORANDUM**

**MAY/JUNE 2017**

**MARKS: 150**

**This question paper consists of 9 pages.**

**QUESTION 1**

* 1. C 🗸🗸 (2)

1.2 A 🗸🗸 (2)

1.3 D 🗸🗸 (2)

1.4 B 🗸🗸 (2)

1.5 C 🗸🗸 (2)

1.6 D 🗸🗸 (2)

1.7 B 🗸🗸 (2)

1.8 A 🗸🗸 (2)

1.9 D 🗸🗸 (2)

1.10 C 🗸🗸 (2)

 **[20]**

**QUESTION 2**

2.1

 2.1.1 D or F 🗸 (1)

 2.1.2 E 🗸 (1)

2.2

 2.2.1 2,4-dimethylhex-1-ene (**Accept** 2,4-dimethyl-1-hexene) 🗸🗸🗸 (3)

|  |  |  |  |
| --- | --- | --- | --- |
|  H |  |  | H |
|  | C | C |  |
|  |  |  |  |
|  H |  |  | H |

 2.2.2

 🗸🗸 (2)

2.3

 2.3.1 CnH2n+2 🗸 🗸 (2)

 2.3.2 CO2 and H2O🗸🗸 (2)

2.4

 2.4.1 🗸🗸

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | H | Cℓ | H |  |
|  |  |  |  |  |
| H | C | C | C | H |
|   |  |  |  |  |
|   | H | H | H |  |

2-chloropropane 🗸🗸 (4)

 2.4.2 Positional 🗸(isomer). (1)

 **[20]**

**QUESTION 3**

3.1

 3.1.1 Heat. 🗸 (1)

 3.1.2 Elimination/ Dehydrohalogenation. 🗸 (1)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | H | H |  | H | H |  |
|  |  |  |  |  |  |  |
|   |  |  |  |  |  |  |
| H | C | C | C | C | C | H |
|   |  |  |  |  |  |  |
|   |  |  |  |  |  |  |
|   | H |  | H | H | H |  |

 3.1.3 🗸🗸 (2)

 3.1.4 Water or dilute sodium hydroxide. 🗸 (1)

 3.1.5 Substitution/Hydrolysis. 🗸 (1)

 3.1.6 Elimination/Dehydration. 🗸 (1)

3.2

 3.2.1 Esterification 🗸 (1)

 3.2.2 Ethyl ethanoate 🗸🗸 (2)

**Marking Criteria: (1 mark each)**

* Formula
* Correct substitution
* Use of molar relationship
* Calculation of mass of ethanol
* Calculation of % purity

3.3 M( C3H6O2) = 74

 n = $\frac{m}{Mr}$ 🗸 = $\frac{80,64}{74}$ 🗸 = 1,09 moℓ

 1,09 moℓ ester was delivered by 1,09 mol ethanol.🗸

 M(CH4O) = 32

 1,09 x 32 = 34,87 g 🗸

 % purity: $\frac{34,87}{70}$ x 100 = 49,82 % 🗸 (5)

 **[15]**

**QUESTION 4**

4.1 The temperature at which the vapour pressure equals atmospheric (external)

 pressure. 🗸🗸 (2)

4.2 What is the relationship between the functional group (type of homologous

 series or compound) and the boiling point of a substance. 🗸🗸 (2)

4.3

 4.3.1 Type of functional group/ type of homologous series/compound. 🗸 (1)

 4.3.2 Boiling point. 🗸 (1)

4.4 Act as a controlled variable that will not have an effect on the boiling points

 of those compounds. 🗸🗸 (2)

4.5

* Between molecules of pentan-1-ol (A) there are weak London forces and

 strong hydrogen bonds. 🗸

* Between molecules of butanoic acid(C) there are very strong hydrogen bonds🗸

 as it has two sites of hydrogen bonding 🗸in addition to the weak London forces.

More energy is required to overcome the intermolecular forces in C than

 in A. 🗸 (4)

 **[12]**

**QUESTION 5**

5.1 The amount of heat/energy released or absorbed in a reaction. 🗸🗸

 OR

 The net change of chemical potential energy of the system. (2)

5.2 Positive🗸

 The energy of the products is greater than that of the reactants. 🗸 (2)

5.3

Progress of the reaction

Potential energy (kJ)

CH4(g) + 2O2(g) Ea

 ∆H

CO2 + 2H2O

**Marking criteria**

Labelled axes🗸

Shape of graph🗸

Position of reactants🗸

Position of products🗸

ΔH🗸

Activation energy🗸

 (6)

 **[10]**

**QUESTION 6**

6.1 -Particles with Ek $\geq $ EA collide effectively. 🗸

 -Number of effective collisions per unit time. 🗸

 - Particles must have correct orientation. (2)

6.2 The catalyst provides an alternative pathway/route for the reaction, 🗸

 with lower activation energy. 🗸 More molecules/particles have enough

 energy, 🗸and more effective collisions occur, 🗸 increasing the rate of  the

 reaction. (4)

6.3

Number of particles

✓✓

Energy

New activation energy

 (2)

 **[08]**

**QUESTION 7**

7.1 - Increase the temperature of HCℓ. 🗸

 - Add a catalyst. 🗸 (2)

 OR

 - Increase the concentration of HCℓ.

 - Increase the state of division of CuCO3.

7.2 (300g-200g) =100g🗸🗸 (2)

7.3 CO2(g) forms and escapes from the beaker. 🗸🗸 (2)

7.4 Yes. 🗸

 - At 40 s. 🗸

 - The mass of the beaker with contents remains constant at 200g

 after 40 s. 🗸

 - No further CO2 has formed and escaped. 🗸 (4)

7.5 average reaction rate = - 🗸

 = -  🗸

 = 2,5 g.s-1 🗸 (3)

7.6 **Mass vs Time**

300

2800

260

**Mass (g)**

**A**

240

220

**B**

200

0

10

20

30

40

**Time (s)**

**Marking criteria**

Labelled axes🗸

Shape of graphs🗸

Points on curve A🗸

Curve B, lower gradient/slope🗸

Curve A, steeper gradient/slope🗸

Activation energy🗸

(5)

 **[22]**

**QUESTION 8**

8.1

 8.1.1 A system that is isolated from the environment. 🗸🗸 (2)

 8.1.2 Exothermic. 🗸

 **(-ve)**

 ΔH is negative/ energy is released. 🗸 (2)

8.2

 8.2.1 Greater than/Greater at t1 than at t2. 🗸

 Larger/ Steeper gradient/slope. 🗸 (2)

 **OR**

 Smaller at t2 than at t1.

 Smaller/Less steep gradient/slope.

 8.2.2 **Calculation using number of moles:**

 **Option 1**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | HCℓ | O2 | H2O | Cℓ 2 |
| Initial quantity(mol) | 1 | 0,3🗸 | 0 | 0 |
| Change(mol) | -0,8 | -0,2 | +0,4 | +0,4 |
| Quantity at equilibrium(mol) | 0,2🗸 | 0,1🗸 | 0,4 | 0,4🗸 |
| Equilibruim concentration(mol.dm-3) | $$\frac{0,2}{5}$$= 0,04 | $$\frac{0,1}{5}$$=0,02 | $$\frac{0,4}{5}$$=0,08 | $$\frac{0,4}{5}$$=0,08 |

 Ratio🗸

 Divide by 5🗸

 Kc = [H2O]2 [Cℓ 2]2

Wrong Kc expression Max 6/9

 [HCℓ]4[O2] 🗸

No Kc expression Max 8/9

 = (0,08)2 (0,08)2

 (0,04)4(0,02) 🗸

 = 800 🗸 (9)

 **OR**

 **Calculations using concentration:**

 **OPTION 2**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | HCℓ | O2 | H2O | Cℓ 2 |
| Initial concentration(mol.dm-3) | $$\frac{1}{5}$$= 0,2 | $$\frac{0,3}{5}$$= 0,06🗸 | 0 | 0 |
| Change(mol.dm-3) | -0,16 | -0,04 | +0,08 | +0,08 |
| Equilibruim concentration(mol.dm-3) | = 0,04🗸 | =0,02🗸 | =0,08 | =0,08🗸 |

Divide by 5🗸

 Ratio🗸

 Kc = [H2O]2 [Cℓ 2]2

Wrong Kc expression Max 6/9

 [HCℓ]4[O2] 🗸

No Kc expression Max 8/9

 = (0,08)2 (0,08)2

 (0,04)4(0,02) 🗸

 = 800 🗸

8.3 -Remains the same. 🗸

 **(-ve)**

 -Equilibrium position shifts towards direction of less moles of gas. 🗸

 -Forward reaction is thus favoured. 🗸 (3)

8.4

 8.4.1 Decreases 🗸 (1)

 8.4.2 Remains the same (1)

 8.4.3 Decreases 🗸 (1)

 **[22]**

**QUESTION 9**

9.1

 9.1.1 A substance that ionises completely/fully in water.🗸🗸 (2)

 9.1.2 Water. 🗸 (1)

 9.1.3 Basic. 🗸 (1)

 CO32-(aq) + H2O(ℓ) 🗸 → HCO3-(aq) + OH-(aq) 🗸 bal🗸 (3)

9.2

 9.2.1 A. 🗸 (1)

 9.2.2 a) Stays the same. (1)

 b) Increases.

 9.2.3

|  |  |
| --- | --- |
| **OPTION 1**pH = - log [H+] 🗸4,2🗸 = - log [H+][H+] = 6,31 x 10-5 mol·dm-3🗸 [OH-][H+] = 10-14[OH-](6,31 x 10-5) = 10-14🗸 [OH-] = 1,58x 10-10 mol·dm-3🗸 | **OPTION 2**pH + pOH = 14🗸4,2🗸 + pOH = 14 pOH = 9,8🗸 pOH = -log[OH-] 9,8 = -log[OH-]🗸 [OH-] = 1,58 x 10-10 🗸 |

 (5)

9.3

 9.3.1 Ampholyte. 🗸🗸 (2)

 9.3.2 H2CO3 🗸🗸 (2)

9.4

 = 🗸

 🗸🗸🗸

  = 20cm3🗸 (5)

 **[23]**

 **GRAND TOTAL: 150**