SMART EXAM RESOURCES
SUBJECT: CHEMISTRY
TOPIC:STOICHIOMETRY
SET-3-QP-MS

EMPIRICAL FORMULA

1 Many organic compounds contain carbon, hydrogen and oxygen only.

(a) An organic compound **V** has the following composition by mass.

C, 48.65%; H, 8.11%; O, 43.24%

Calculate the empirical formula of compound **V**.

empirical formula = ... [3]

(b) Compound **W** has the empirical formula CH_4O and a relative molecular mass of 32.

Calculate the molecular formula of compound **W**.

molecular formula = ... [1]

MARK SCHEME:

(a)	48.65 / 12 8.11 / 1 43.24 / 16 (1) **OR evaluation** 4.05 8.11 2.7(0) divide all by smallest **OR** 1.5 : 3 : 1 **OR** 6 : 3 : 2 (1) $C_3H_6O_2$ (1) **ALLOW** symbols in any order	**3**
(b)	(M_r of CH_4O = 32) CH_4O (1)	**1**

2 Ester **Y** has the following composition by mass:

C, 58.82%; H, 9.80%; O, 31.37%.

Calculate the empirical formula of ester **Y**.

empirical formula = ... [3]

MARK SCHEME:

	C 58.82 / 12 H 9.80 / 1 O 31.37 / 16 **OR** 4.90:9.80:1.96 (1) 2.5:5:1 **OR** 5:10:2 (1) $C_5H_{10}O_2$(1)	**3**

3 Ester **Y** has the following composition by mass:

C, 48.65%; H, 8.11%; O, 43.24%.

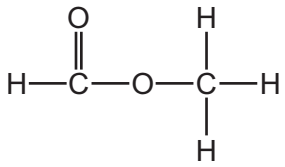
Calculate the empirical formula of ester **Y**.

empirical formula = ... [3]

MARK SCHEME:

	C 48.65 / 12 H 8.11 / 1 O 43.24 / 16 **OR** 4.05:8.11:2.70 (1) fractions shown dividing all by smallest **OR** 1.5:3:1 **OR** 3:6:2 (1) $C_3H_6O_2$ (1)	**3**

4 Ester **Y** has the structure shown.



(a) (i) Name ester **Y**.

..... [1]

(ii) Deduce the empirical formula of ester **Y**.

..... [1]

MARK SCHEME:

Question	Answer	Marks
(a)(i)	methyl methanoate	1
(a)(ii)	CH_2O	1

5 a Phosphorus oxychloride has the formula $POCl_3$.

Phosphorus oxychloride is the only product of the reaction between phosphorus(V) chloride, PCl_5, and phosphorus(V) oxide, P_4O_{10}.

Write a chemical equation for the reaction between phosphorus(V) chloride and phosphorus(V) oxide.

..... [2]

b Compound **X** has the following composition by mass.

H, 3.66%; P, 37.80%; O, 58.54%

Calculate the empirical formula of compound **X**.

empirical formula = ... [2]

c Compound **Y** has the empirical formula H_3PO_4 and a relative molecular mass of 98.

Deduce the molecular formula of compound **Y**.

molecular formula = ... [1]

MARK SCHEME:

(a)	P_4O_{10} + 6PCl_5 → 10$POCl_3$ **M1** all formula correct and on the correct sides of the arrow (1) **M2** equation fully correct (1)	**2**
(b)	**M1** H 3.66 / 1 P 37.80 / 31 O 58.54 / 16 **OR** H = 3.66 P = 1.22 O = 3.66 **OR** H:P:O 3:1:3 (1) **M2** H_3PO_3 (1)	**2**
(c)	H_3PO_4 (1)	**1**

6 Many organic compounds contain carbon, hydrogen and oxygen only.

(a) An organic compound **R** has the following composition by mass.

C, 69.77%; H, 11.63%; O, 18.60%

Calculate the empirical formula of compound **R**.

empirical formula = ... [2]

(b) Compound **S** has the empirical formula CH_2O and a relative molecular mass of 60.

Calculate the molecular formula of compound **S**.

molecular formula = ... [2]

MARK SCHEME:

(a)	11.63 / 1 69.77 / 12 18.6 /16 **Or evaluation** 11.63 5.81 1.16 **Or ratio** 10 : 5 : 1 (1) $C_5H_{10}O$ (1)	**2**
(b)	(M_r of CH_2O =) 30 (1) $C_2H_4O_2$ (1)	**2**