Name:		Index Number:		Class:	

DUNMAN HIGH SCHOOL
Preliminary Examinations 2018
Year 6

H2 CHEMISTRY

9729/04

Paper 4 Practical

28 August 2018
2 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

1 Write your **name**, **index number** and **class** on this cover page.
2 Give details of the practical shift and laboratory where appropriate, in the boxes provided.
3 Write in dark blue or black pen.
4 You may use an HB pencil for any diagrams or graphs.
5 Do not use staples, paper clips, glue or correction fluid.
6 **You are to start with Question 1 FIRST.**
7 Protective eye goggles and gloves must be worn at ALL TIMES.

Answer **ALL** questions in the spaces provided on the Question Paper.

The use of an approved scientific calculator is expected, where appropriate. You may lose marks if you do not show your working or if you do not use appropriate units.

Qualitative Analysis Notes are printed on pages 17 and 18.

The number of marks is given in brackets, [ ], at the end of each question or part question.

Shift
Laboratory

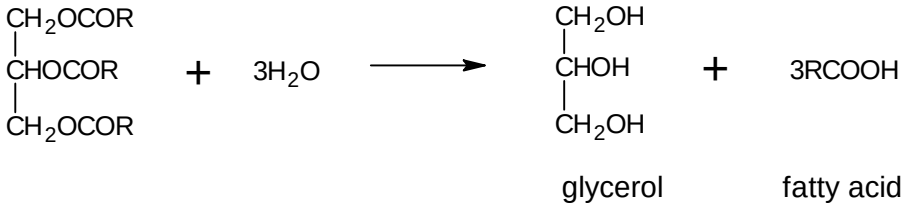
For Examiner's Use	
Question No.	**Marks**
1	/14
2	/13
3	/28
Total	/55

[Turn over

Answer **all** questions in the spaces provided.

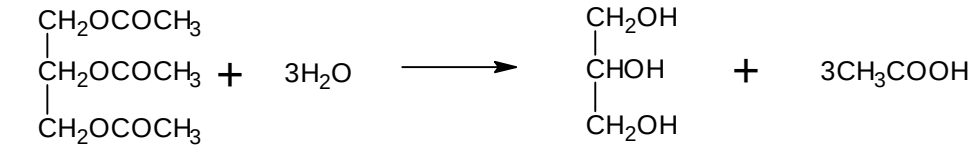
1 Investigation of reaction kinetics between triacetin and lipase

Lipase is an enzyme that breaks down, hydrolyses, the lipids present in animal fats and vegetable oils. It does so by hydrolysing ester bonds. A general reaction scheme for this process is shown below; the size of the R group and its level of saturation will depend on the lipid used.



Olive oil is often used as a substrate in testing for lipase, with the oleic acid released being titrated with sodium hydroxide solution. Oleic acid, $C_{17}H_{33}COOH$, is a mono–unsaturated fatty acid.

In this experiment, glycerol triethanoate (triacetin) is used as the substrate. Lipase breaks this substrate down into glycerol and ethanoic acid as shown below.



glycerol triethanoate
(triacetin)

The ethanoic acid produced lowers the pH of the solution. This change can be detected by using a suitable acid–base indicator, bromocresol purple which changes from purple at high pH value to yellow at lower pH value. Sodium carbonate is added to the triacetin to ensure that the pH is high enough at the start of the experiment. Only after the sodium carbonate has all reacted with the liberated ethanoic acid will the ethanoic acid concentration rise and the pH value decreases. The reaction time is measured from the initial point of mixing the solutions until the end–point of the indicator is reached.

The following reagents are provided for this experiment.

FA 1 is triacetin
FA 2 is 0.5% sodium carbonate solution
FA 3 is 8% lipase solution
FA 4 is bromocresol purple solution

Procedure

1. To a test-tube, add 2 drops of **FA 2** followed by 1 drop of **FA 4**.

2. Using a dropper, add 5 drops of **FA 1** to the test tube.

3. Using a 250 cm^3 beaker, collect 200 cm^3 of warm water from the dispenser.

4. **Swirl the bottle** containing **FA 3** before using a syringe to transfer 0.20 cm^3 of **FA 3** into the test tube. Start the stopwatch immediately and place the test tube into the warm water bath.

5. **Shake the test tube continuously**. This is necessary to ensure that **FA 1** and **FA 3** are continually mixed.

6. Record the reaction time, ***t*** (in seconds) when the mixture turns yellow. This will be a gradual process.

7. Repeat steps 1 – 6 for four other test tubes, using different volumes of **FA 3** as shown in the table below.

Test Tube	Volume of **FA 3** / cm^3
1	0.20
2	0.40
3	0.60
4	0.80
5	1.00

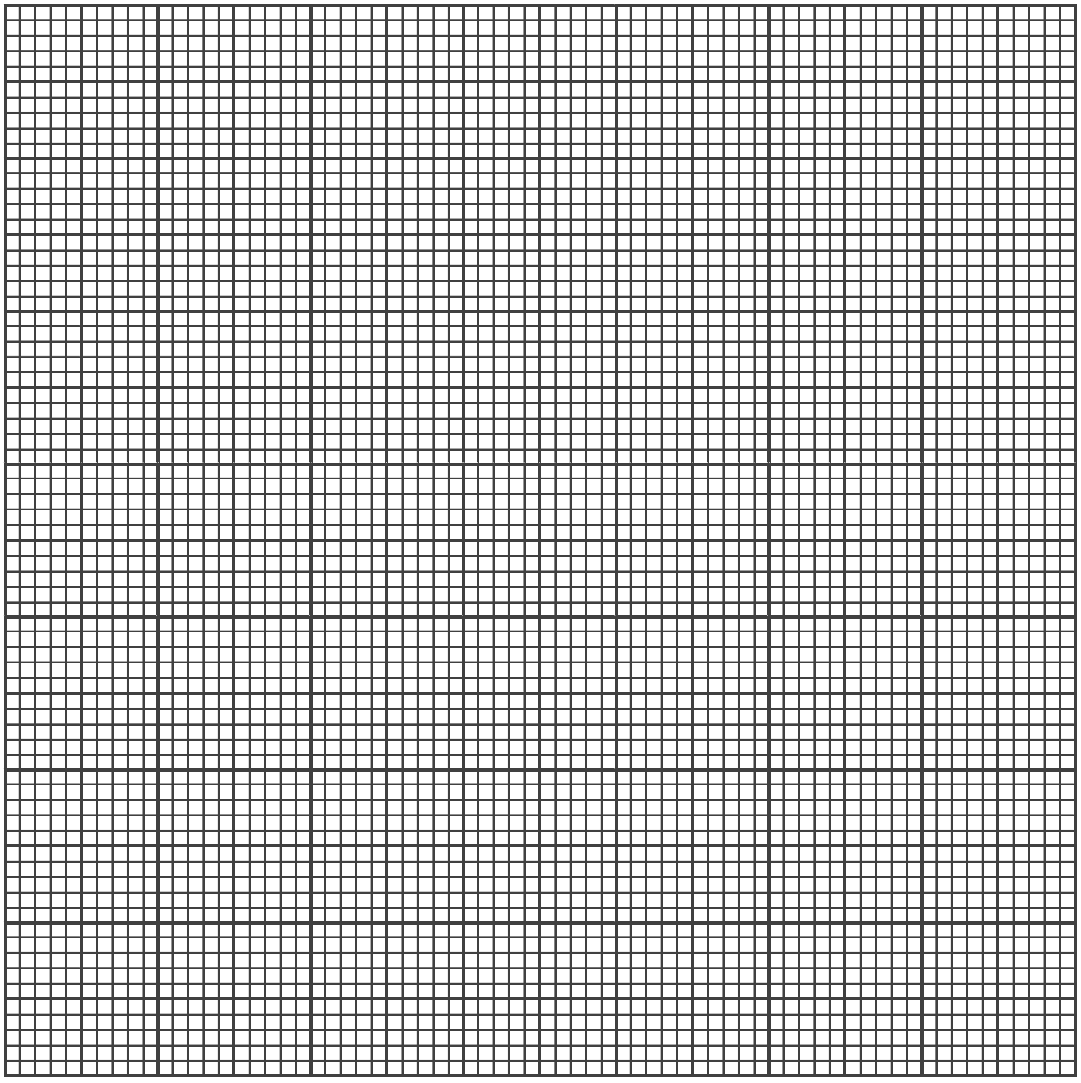
8. Calculate the value of reaction rate, $\frac{\mathbf{1}}{\boldsymbol{t}}$, for each experiment.

(a) Results:

(i)

[4]

(ii) Plot the reaction rate, $\frac{\mathbf{1}}{\boldsymbol{t}}$, against the volume of **FA 3** used.



[3]

(iii) By considering the graph in **(a)(ii)**, deduce the order of reaction with respect to lipase, **FA 3**. Explain your deduction.

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……[3]

(iv) The **weighted reaction time** can be obtained by multiplying the appropriate conversion factor to the reaction time, ***t*** (in seconds).

Test Tube	Conversion factor	Weighted reaction time / s
1	0.20	
2	0.40	
3	0.60	
4	0.80	
5	1.00	

Based on your deduction in **(a)(iii)**, sketch the expected graph of **weighted reaction time, in seconds,** against the volume of **FA 3** used. Explain your sketch.

[1]

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……[1]

(b) Explain how the volumes of **FA 1**, **FA 2** and **FA 3** should change in the procedure in order to investigate the relationship between substrate concentration and the rate of reaction. You are **not** required to give exact figures.

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……[2]

[Total: 14]

2 Planning

An ideal gas is a theoretical idea – a gas in which there are no attractive forces between the molecules, and in which the molecules take up no space. The ideal gas law is usually stated as $pV = nRT$, where

- p is the pressure
- V is the volume
- n is the number of moles
- T is the temperature in K

of the gas, and

- R is the ideal gas constant.

The value of R is determined experimentally by measuring the other variables in the equation, and solving mathematically to get the value of the constant. R is the same for all gases – provided the gas has ideal behaviour.

In this experiment you will determine the ideal gas constant using H_2 gas. The H_2 will be generated using the reaction between magnesium and hydrochloric acid.

$$Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$$

You may assume you are provided with:

- a two-necked round bottom flask,
- a rubber tubing,
- a water tub,
- 0.1 mol dm^{-3} hydrochloric acid,
- thermometer,
- barometer (instrument used to measure pressure),
- one piece of magnesium ribbon strip of about 0.06 g,
- apparatus normally found in a school laboratory

(a) Your plan should contain the following:

- the procedure that you would follow and the measurements that you would take
- a tabulation of the experimental data to be collected
- the reactants and conditions that you would use
- the mass of magnesium that you would use and the volume of hydrochloric acid that you would measure. Assume that the molar volume of gas under experimental conditions is 24.0 dm^3 mol^{-1}.
  [A_r: Mg, 24.3]

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……………………………………………………………………………………………[7]

(b) State two basic assumptions of an ideal gas.

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……[2]

(c) Real gases do not obey the ideal gas law exactly. Sketch a **fully labelled** graph representing the deviation from ideality for one mole of each of the following gases.

- ideal gas
- H_2 gas
- CH_4 gas

[4]

[Total: 13]

3 Investigation of chemical reactions of electrolytes

You are provided with the following.
FA 5 is sodium chloride solution
FA 6 and **FA 9** are aqueous electrolytes, each containing one cation and one anion.

(a) Electrolysis of FA 5

1. Set up the apparatus and circuit as shown in Fig. 3.1.

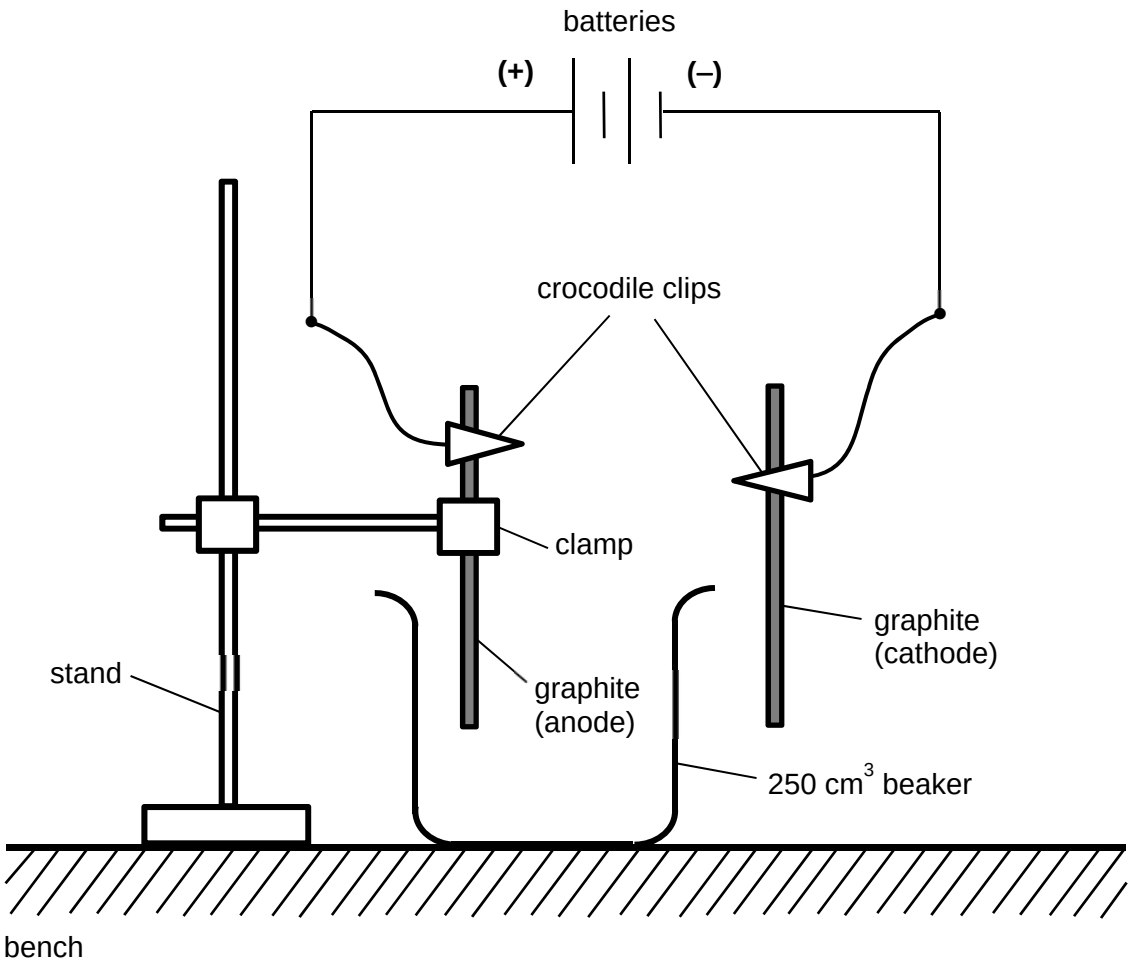

Fig 3.1

2. Transfer about 200 cm^3 of **FA 5** into the glass beaker.
3. Ensure that the graphite (anode) is partially submerged in **FA 5** by adjusting the height of the clamp.
4. Immerse one end of the graphite (cathode) in **FA 5** for a few minutes and record your observations in Table 3.1. You do **not** need to collect and test any gases evolved.

Table 3.1

electrolyte	observations at the electrodes
FA 5	anode:
	cathode:

[1]

5. Perform the tests described in Table 3.2, and record your observations in the table.

Table 3.2

tests		observations
1.	Add one drop of Universal Indicator solution to **FA 5** near the **cathode**.	
2.	Place a piece of moist blue litmus paper near the **anode**. Observe until no further change is seen.	

[2]

6. Remove both electrodes from **FA 5** and rinse them thoroughly with deionised water.

Consider your observations in Table 3.2.

(i) Explain, with the aid of an equation, the observations made in test 1 in Table 3.2.

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……..[2]

(ii) With reference to the data below, suggest an explanation for your observations in test 2 in Table 3.2, in terms of *E* values.

electrode reaction	$E^{\ominus}$ / V
$Cl_2 + 2e^- \rightleftharpoons 2Cl^-$	+1.36
$O_2 + 4H^+ + 4e^- \rightleftharpoons 2H_2O$	+1.23

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……[3]

(b) (i) Qualitative analysis of FA 6

FA 7 is a solution of potassium sodium tartrate tetrahydrate in sodium hydroxide.
FA 8 is an organic compound with only one functional group.

Perform the tests described in Table 3.3, and record your observations in the table. You do **not** need to test and identify any gases evolved. If there is no observable change, write **no observable change**.

Table 3.3

tests		observations
1.	To 1 cm depth of **FA 6** in a test-tube, add aqueous ammonia dropwise, with shaking, until no further change is seen.	
2.	To 1 cm depth of **FA 6** in a test-tube, add an equal volume of **FA 7**. Add 1 cm depth of **FA 8** and shake the mixture thoroughly. Warm the mixture in a water bath. Observe the mixture until no further changes are seen.	

[4]

Identify the cation present in **FA 6** and the functional group present in **FA 8**.

Cation present in **FA 6**: ……[1]

Functional group present in **FA 8**: ……[1]

(ii) Electrolysis of FA 6

1. Repeat steps **1** to **3** of the procedure in **3(a)** using **FA 6**.
2. Immerse one end of the graphite (cathode) in **FA 6** for a few minutes until it is coated with a **thin layer of solid** and record your observations in Table 3.4. You do **not** need to identify any gases evolved.
3. Remove the graphite (cathode) from **FA 6** and rinse it with deionised water.
4. Retain the graphite (cathode) for further tests in **(b)(iii)**.

Table 3.4

electrolyte	observations at the electrodes
FA 6	anode:
	cathode:

[1]

(iii) Investigation of some chemical reactions involving the solid deposited

Perform the tests described in Table 3.5, and record your observations in the table. Test and identify any gases evolved. If there is no observable change, write **no observable change**.

Table 3.5

tests		observations
1.	Put the graphite (cathode) from **(b)(ii)** in a boiling tube. **Carry out the following steps in the fume hood.** Cautiously add 2 cm depth of **concentrated hydrochloric acid** to the boiling tube and shake the mixture thoroughly to dissolve, as much as possible, the solid coated on the electrode. Add an equal volume of **FA 6** to the boiling tube.	
Decant the solution into another boiling tube and retain it for tests 2 and 3.		
2.	Put about 2 cm depth of the solution from test 1 into a test-tube. Add an equal volume of potassium iodide and shake the mixture thoroughly. Filter the mixture.	
3.	Put about 2 cm depth of the solution from test 1 into a test-tube. Add 1 cm depth of deionised water to the test-tube. Then add a small piece of aluminium foil and shake the mixture thoroughly. Observe the mixture until no further changes are seen.	

[6]

(c) Consider your observations in Table 3.5.

(i) Explain the colour changes you observed in test 1 in Table 3.5, in terms of the ions present in the solutions.

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……..[2]

(ii) State the role of potassium iodide in test 2 in Table 3.5. Explain your answer in terms of oxidation state changes.

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……..[1]

(d) Identification of ions present in FA 9

(i) Perform the tests described in Table 3.6, and record your observations in the table. Test and identify any gases evolved. If there is no observable change, write **no observable change**.

Table 3.6

tests		observations
1.	Test the **FA 9** solution using Universal Indicator paper.	
2.	To 2 cm depth of **FA 9** in a test-tube, add barium nitrate dropwise, with shaking, until no further change is seen.	

[2]

(ii) Suggest the identity of **FA 9**. Describe one chemical test using a reagent from the Qualitative Analysis Notes provided to confirm the identity of the **cation** in **FA 9**.

Identity of **FA 9**: ……..[1]

Chemical test: ……

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……..

……..[1]

[Total: 28]

Qualitative Analysis Notes

[ppt. = precipitate]

(a) Reactions of aqueous cations

cation	***reaction with***	
	NaOH(aq)	NH_3(aq)
aluminium, Al^{3+}(aq)	white ppt. soluble in excess	white ppt. insoluble in excess
ammonium, NH_4^+ (aq)	ammonia produced on heating	–
barium, Ba^{2+}(aq)	no ppt. (if reagents are pure)	no ppt.
calcium, Ca^{2+}(aq)	white. ppt. with high [Ca^{2+}(aq)]	no ppt.
chromium(III), Cr^{3+}(aq)	grey-green ppt. soluble in excess giving dark green solution	grey-green ppt. insoluble in excess
copper(II), Cu^{2+}(aq)	pale blue ppt. insoluble in excess	blue ppt. soluble in excess giving dark blue solution
iron(II), Fe^{2+}(aq)	green ppt., turning brown on contact with air insoluble in excess	green ppt., turning brown on contact with air insoluble in excess
iron(III), Fe^{3+}(aq)	red-brown ppt. insoluble in excess	red-brown ppt. insoluble in excess
magnesium, Mg^{2+}(aq)	white ppt. insoluble in excess	white ppt. insoluble in excess
manganese(II), Mn^{2+}(aq)	off-white ppt., rapidly turning brown on contact with air insoluble in excess	off-white ppt., rapidly turning brown on contact with air insoluble in excess
zinc, Zn^{2+}(aq)	white ppt. soluble in excess	white ppt. soluble in excess

(b) Reactions of anions

ion	*reaction*
carbonate, CO_3^{2-}	CO_2 liberated by dilute acids
chloride, Cl^-(aq)	gives white ppt. with Ag^+(aq) (soluble in NH_3(aq))
bromide, Br^-(aq)	gives pale cream ppt. with Ag^+(aq) (partially soluble in NH_3(aq))
iodide, I^-(aq)	gives yellow ppt. with Ag^+(aq) (insoluble in NH_3(aq))
nitrate, NO_3^- (aq)	NH_3 liberated on heating with OH^-(aq) and Al foil
nitrite, NO_2^- (aq)	NH_3 liberated on heating with OH^-(aq) and Al foil; NO liberated by dilute acids (colourless NO $\rightarrow$ (pale) brown NO_2 in air)
sulfate, SO_4^{2-} (aq)	gives white ppt. with Ba^{2+}(aq) (insoluble in excess dilute strong acids)
sulfite, SO_3^{2-} (aq)	SO_2 liberated with dilute acids; gives white ppt. with Ba^{2+}(aq) (soluble in dilute strong acids)

(c) Tests for gases

gas	*test and test result*
ammonia, NH_3	turns damp red litmus paper blue
carbon dioxide, CO_2	gives a white ppt. with limewater (ppt. dissolves with excess CO_2)
chlorine, Cl_2	bleaches damp litmus paper
hydrogen, H_2	“pops” with a lighted splint
oxygen, O_2	relights a glowing splint
sulfur dioxide, SO_2	turns aqueous acidified potassium manganate(VII) from purple to colourless

(d) Colour of halogens

halogen	*colour of element*	*colour in aqueous solution*	*colour in hexane*
chlorine, Cl_2	greenish yellow gas	pale yellow	pale yellow
bromine, Br_2	reddish brown gas / liquid	orange	orange-red
iodine, I_2	black solid / purple gas	brown	purple

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