Write your name here

Surname	Other names

Centre Number | Candidate Number

Edexcel GCE

Chemistry

Advanced

Unit 6B: Chemistry Laboratory Skills II Alternative

Wednesday 15 May 2013 – Morning
Time: 1 hour 15 minutes

Paper Reference
6CH08/01

Candidates may use a calculator.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

Information

- The total mark for this paper is 50.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- You will be assessed on your ability to organise and present information, ideas, descriptions and arguments clearly and logically, including your use of grammar, punctuation and spelling.
- A Periodic Table is printed on the back cover of this paper.

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

P41653A

10/5/6/7/7/

P 4 1 6 5 3 A 0 1 1 6

PEARSON

Answer ALL the questions. Write your answers in the spaces provided.

1 (a) Compound **Z** is a crystalline solid that contains a nickel cation and one type of anion. Complete the table below.

	Test	Observation	Inference
(i)	Add dilute sulfuric acid to compound **Z**	Bubbles of a colourless gas are released. The gas turns limewater milky and a ..... coloured solution is formed **(1)**	Name of gas released is ..... Formula of anion in **Z** is ..... Formula of the complex ion formed is $[Ni(H_2O)_6]^{2+}(aq)$ **(2)**
(ii)	Add concentrated hydrochloric acid to the solution containing $[Ni(H_2O)_6]^{2+}$ ions	Yellow-brown solution forms	Formula of the complex ion formed is ..... **(1)**
(iii)	Add a few drops of dilute aqueous ammonia to the solution containing $[Ni(H_2O)_6]^{2+}$ ions	Green precipitate forms	Formula of the precipitate formed is ..... **(1)**
(iv)	Add excess dilute aqueous ammonia to the solution containing $[Ni(H_2O)_6]^{2+}$ ions until no further change is observed	.... **(1)**	Formula of the complex ion formed is $[Ni(NH_3)_6]^{2+}$

(b) A 10.0 cm^3 sample of a solution containing $[Ni(H_2O)_6]^{2+}$ ions was titrated with a solution of concentration 0.010 mol dm^{-3} with respect to the ligand $EDTA^{4-}$ ions. The equation for the reaction is

$$[Ni(H_2O)_6]^{2+} + EDTA^{4-} \rightarrow [Ni(EDTA)]^{2-} + 6H_2O$$

(i) The mean titre of the solution containing $EDTA^{4-}$ ions was 24.20 cm^3. Use this information, and the equation above, to calculate the concentration in mol dm^{-3} of the solution containing $[Ni(H_2O)_6]^{2+}$ ions.

(2)

(ii) Assuming the total error in the measurement of the mean titre is ±0.10 cm^3, calculate the percentage error in this titre.

(1)

(iii) A similar solution, containing the same concentration of $[Ni(H_2O)_6]^{2+}$ ions, also contained a small amount of an impurity, copper(II) sulfate.

Suggest what effect this impurity would have on the titre. Justify your answer.

(2)

.....

.....

.....

.....

(Total for Question 1 = 11 marks)

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2 A colourless liquid, compound **X**, was extracted from raspberries. **X** has the molecular formula $C_{10}H_{12}O_2$ and contains a benzene ring.

(a) What would you expect to see if a sample of compound **X** was burned in air?

(1)

.....

.....

(b) A series of tests was carried out on compound **X**. In each test, state what you can deduce about the structure of compound **X** from the results described.

(i) **X** forms a white precipitate with aqueous bromine solution.

(1)

.....

.....

(ii) **X** forms an orange precipitate with 2,4-dinitrophenylhydrazine.

(1)

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.....

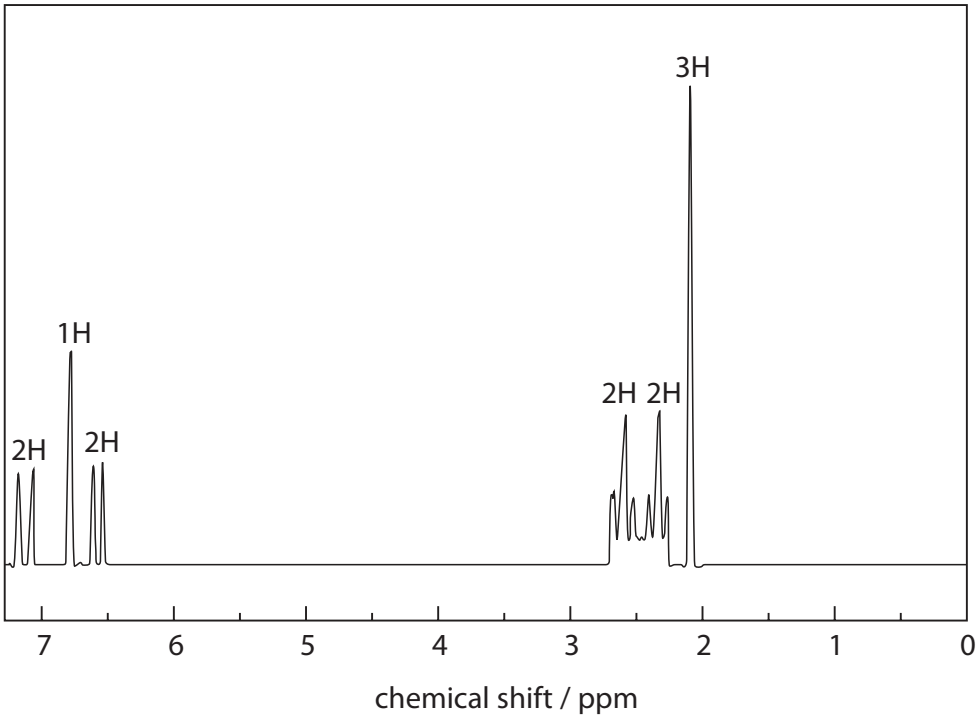
(iii) Fehling's (or Benedict's) solution remains blue when warmed with compound **X**.

(1)

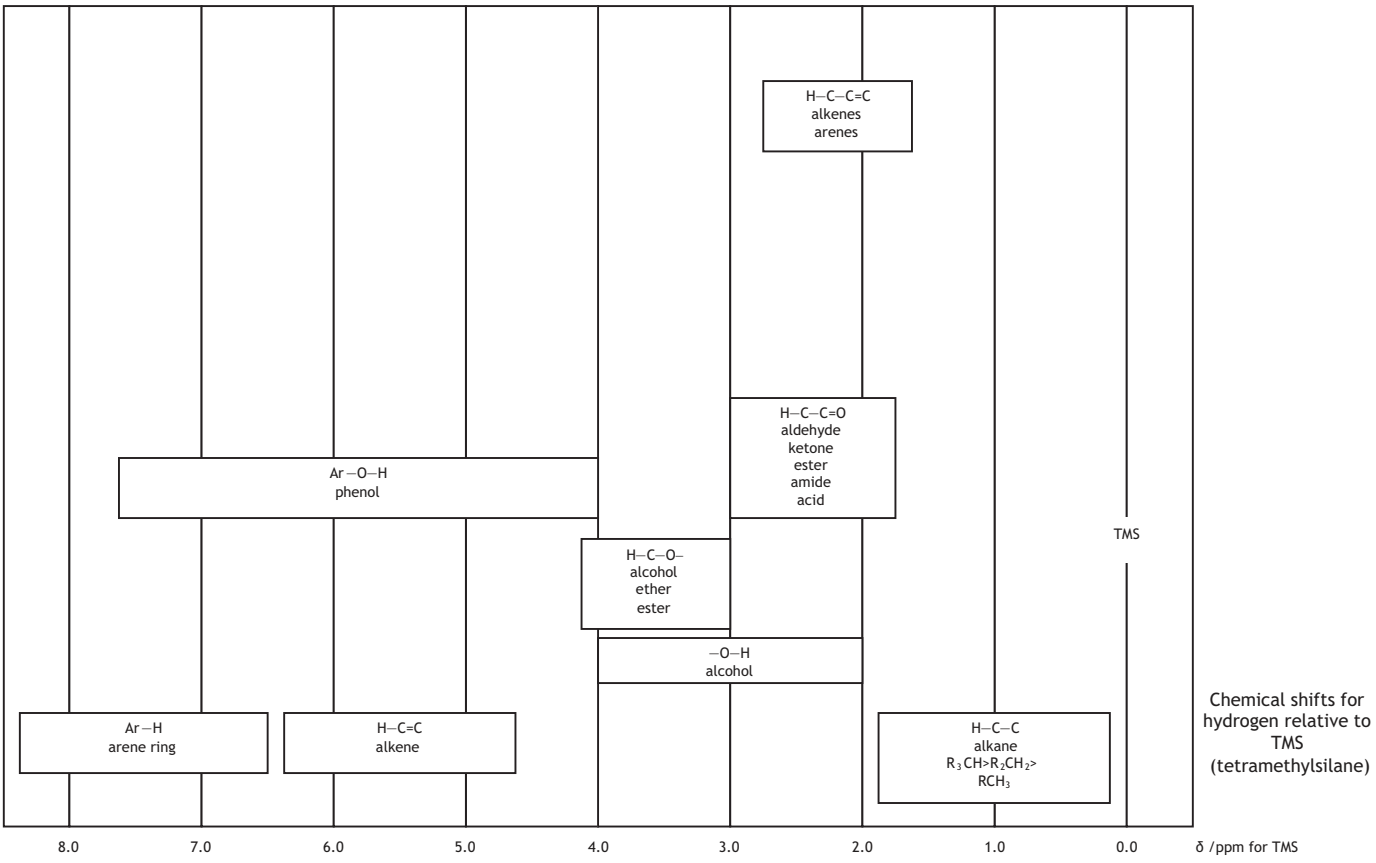
.....

.....

(c) The high resolution proton nmr spectrum of compound **X** is shown below. This spectrum shows that there are six different proton environments in the molecule of **X**. The relative number of hydrogen atoms in each environment is indicated on the spectrum. Use this spectrum, the data below and your answers to (a) and (b) to help answer the questions that follow.



Nuclear Magnetic Resonance

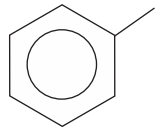


(i) Which hydrogen atoms in compound **X** are most likely to have caused the peaks at 6.5 ppm and 7.2 ppm?

(1)

.....

(ii) Compound **X** has a side chain containing four carbon atoms attached to the benzene ring. Show all the atoms on this side chain and label each hydrogen environment on the side chain with its splitting pattern.



(3)

.....

.....

.....

.....

.....

.....

(iii) Suggest the structural formula of **X**.

(1)

(d) Compound **X** can be extracted from raspberries by steam distillation. Draw a labelled diagram of the apparatus you could use to carry out this steam distillation.

(3)

(Total for Question 2 = 12 marks)

3 Glucose can be oxidized using acidified potassium manganate(VII). The kinetics of the reaction can be studied using the procedure outlined below.

1. Measured volumes of glucose solution, sulfuric acid and water were added to a conical flask.
2. A measured volume of potassium manganate(VII) solution was added to the flask. The mixture was gently swirled and a stopwatch started.
3. The time taken for the mixture in the flask to change colour was recorded and the initial rate of the reaction was then calculated.
4. The experiment was repeated using different volumes of the solutions.

The results of the experiments are shown in the table below.

Experiment	Glucose / cm^3	Sulfuric acid / cm^3	Potassium manganate(VII) / cm^3	Water / cm^3	Initial rate / mol dm^{-3} s^{-1}
A	20.0	20.0	10.0	0.0	1.0×10^{-5}
B	20.0	20.0	5.0	5.0	5.0×10^{-6}
C	10.0	20.0	10.0	10.0	9.8×10^{-6}
D	10.0	10.0	10.0	20.0	4.9×10^{-6}

(a) (i) Which piece of equipment should be used to measure out the volumes used in each experiment? Justify your choice.

(2)

(ii) What colour change would you see in step 3?

(2)

From ..... to .....

(iii) Explain why water was added to the flask in experiments B, C and D.

(1)

.....

.....

(iv) Suggest a technique that could be used to continuously monitor the change in concentration of potassium manganate(VII) during the reaction.

(1)

.....

.....

(v) State the order with respect to glucose, sulfuric acid and potassium manganate(VII) and hence write the rate equation for the reaction.

(3)

(b) Experiment A was repeated at different temperatures and the time taken for the potassium manganate(VII) to change colour was recorded. The results were processed to find values of 1/temperature and ln (rate constant) and these are shown in the table below.

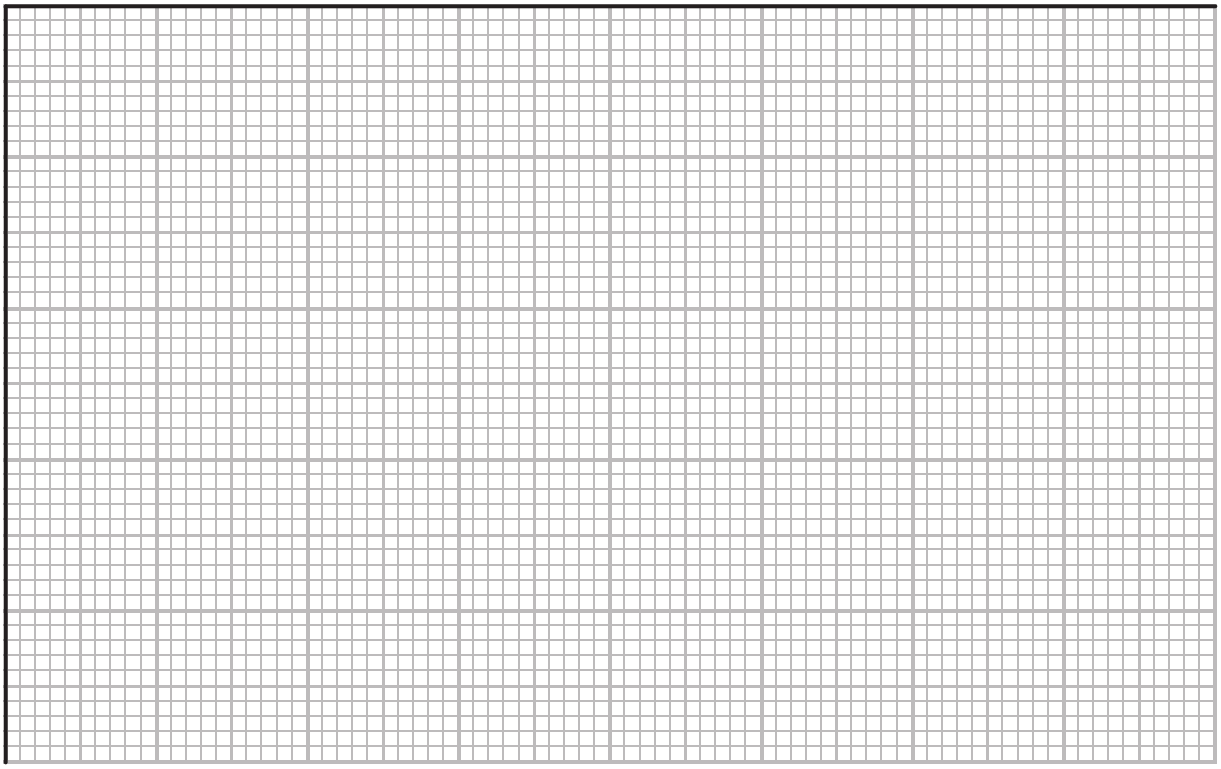
Experiment	1 / temperature / K^{-1}	ln (rate constant)
E	3.00×10^{-3}	–1.60
F	3.10×10^{-3}	–2.60
G	3.21×10^{-3}	–3.75
H	3.35×10^{-3}	–5.20

(i) Plot a graph of ln (rate constant) against 1 / temperature on the axes below.

(3)

1 / temperature / K^{-1}

ln (rate constant)



(ii) Calculate the gradient of the graph.

(1)

(iii) Use your answer to (ii) and the relationship below to calculate the activation energy, E_a, for this reaction. Include a sign and units in your answer.

$$\text{Gradient} = \frac{-E_a}{R}$$

$R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$

(2)

(Total for Question 3 = 15 marks)

4 The procedure outlined below can be used to extract caffeine from tea.

1. Add 25 g of tea, 10 g of calcium carbonate and 250 cm^3 of water to a large beaker.
2. Gently boil the mixture for 15 minutes.
3. While the mixture is still warm, filter using suction filtration.
4. Transfer the filtrate to a separating funnel and separate the caffeine from the aqueous mixture using solvent extraction, with dichloromethane as the solvent.
5. Dry the extract.
6. Remove the solvent.

[Density of dichloromethane = 1.32 g cm^{-3}]

(a) (i) Outline how to carry out the solvent extraction in **step 4**, to obtain a solution of caffeine dissolved in dichloromethane.

(3)

(ii) How would you dry the extract in **step 5**? Include the name of a suitable drying agent in your answer.

(2)

(b) (i) The solvent dichloromethane is harmful and can enter the body through inhalation and skin absorption. Suggest a possible way to minimise each of these risks when using dichloromethane.

(2)

Inhalation .....

Skin absorption .....

(ii) Suggest a suitable way to remove the solvent in **step 6**.

(1)

(c) The extraction can also be carried out using liquid carbon dioxide. Suggest an advantage of using this rather than dichloromethane.

(1)

(d) A student carrying out this extraction obtained 85 mg of caffeine. Calculate the percentage by mass of caffeine obtained from the sample of tea used.

(2)

(e) Caffeine obtained in this way is often a pale green solid, due to impurities. State the name of another technique you could use to further purify the caffeine.

(1)

.....

.....

(Total for Question 4 = 12 marks)

TOTAL FOR PAPER = 50 MARKS

The Periodic Table of Elements

Key

relative atomic mass **atomic symbol** name atomic (proton) number

1 (1)	2 (2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	3 (13)	4 (14)	5 (15)	6 (16)	7 (17)	0 (8) (18)
							1.0 **H** hydrogen 1										4.0 **He** helium 2
6.9 **Li** lithium 3	9.0 **Be** beryllium 4											10.8 **B** boron 5	12.0 **C** carbon 6	14.0 **N** nitrogen 7	16.0 **O** oxygen 8	19.0 **F** fluorine 9	20.2 **Ne** neon 10
23.0 **Na** sodium 11	24.3 **Mg** magnesium 12											27.0 **Al** aluminium 13	28.1 **Si** silicon 14	31.0 **P** phosphorus 15	32.1 **S** sulfur 16	35.5 **Cl** chlorine 17	39.9 **Ar** argon 18
39.1 **K** potassium 19	40.1 **Ca** calcium 20	45.0 **Sc** scandium 21	47.9 **Ti** titanium 22	50.9 **V** vanadium 23	52.0 **Cr** chromium 24	54.9 **Mn** manganese 25	55.8 **Fe** iron 26	58.9 **Co** cobalt 27	58.7 **Ni** nickel 28	63.5 **Cu** copper 29	65.4 **Zn** zinc 30	69.7 **Ga** gallium 31	72.6 **Ge** germanium 32	74.9 **As** arsenic 33	79.0 **Se** selenium 34	79.9 **Br** bromine 35	83.8 **Kr** krypton 36
85.5 **Rb** rubidium 37	87.6 **Sr** strontium 38	88.9 **Y** yttrium 39	91.2 **Zr** zirconium 40	92.9 **Nb** niobium 41	95.9 **Mo** molybdenum 42	[98] **Tc** technetium 43	101.1 **Ru** ruthenium 44	102.9 **Rh** rhodium 45	106.4 **Pd** palladium 46	107.9 **Ag** silver 47	112.4 **Cd** cadmium 48	114.8 **In** indium 49	118.7 **Sn** tin 50	121.8 **Sb** antimony 51	127.6 **Te** tellurium 52	126.9 **I** iodine 53	131.3 **Xe** xenon 54
132.9 **Cs** caesium 55	137.3 **Ba** barium 56	138.9 **La*** lanthanum 57	178.5 **Hf** hafnium 72	180.9 **Ta** tantalum 73	183.8 **W** tungsten 74	186.2 **Re** rhenium 75	190.2 **Os** osmium 76	192.2 **Ir** iridium 77	195.1 **Pt** platinum 78	197.0 **Au** gold 79	200.6 **Hg** mercury 80	204.4 **Tl** thallium 81	207.2 **Pb** lead 82	209.0 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111							

Elements with atomic numbers 112-116 have been reported but not fully authenticated

* Lanthanide series	140 **Ce** cerium 58	141 **Pr** praseodymium 59	144 **Nd** neodymium 60	[147] **Pm** promethium 61	150 **Sm** samarium 62	152 **Eu** europium 63	157 **Gd** gadolinium 64	159 **Tb** terbium 65	163 **Dy** dysprosium 66	165 **Ho** holmium 67	167 **Er** erbium 68	169 **Tm** thulium 69	173 **Yb** ytterbium 70	175 **Lu** lutetium 71
* Actinide series	232 **Th** thorium 90	[231] **Pa** protactinium 91	238 **U** uranium 92	[237] **Np** neptunium 93	[242] **Pu** plutonium 94	[243] **Am** americium 95	[247] **Cm** curium 96	[245] **Bk** berkelium 97	[251] **Cf** californium 98	[254] **Es** einsteinium 99	[253] **Fm** fermium 100	[256] **Md** mendelevium 101	[254] **No** nobelium 102	[257] **Lr** lawrencium 103