James Ruse Agricultural High School

**Chemistry Assessment
Task 1   Term 4   2007**

Theory

Chemistry

General Instructions

- Reading Time   5 minutes
- Working Time   45 minutes
- Write using black or blue pen
- Draw diagrams using pencil
- Board approved calculators may be used.
- A data sheet and a Periodic Table are provided at the back of the paper.
- Write your Student Number at the top of this page

Total Marks   37

Part A

Multiple Choice: 10 marks
Attempt Questions 1-10
Allow about 10 minutes for this part   **Total Marks 10**

Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

Sample: 2 + 4 =   (A) 2   (B) 6   (C) 8   (D) 9

A ◯   B ●   C ◯   D ◯

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

A ●   B ✖   C ◯   D ◯

If you change your mind and have crossed out what you consider to be the correct answer, then indicate the correct answer by writing the word *correct* and drawing an arrow as follows.
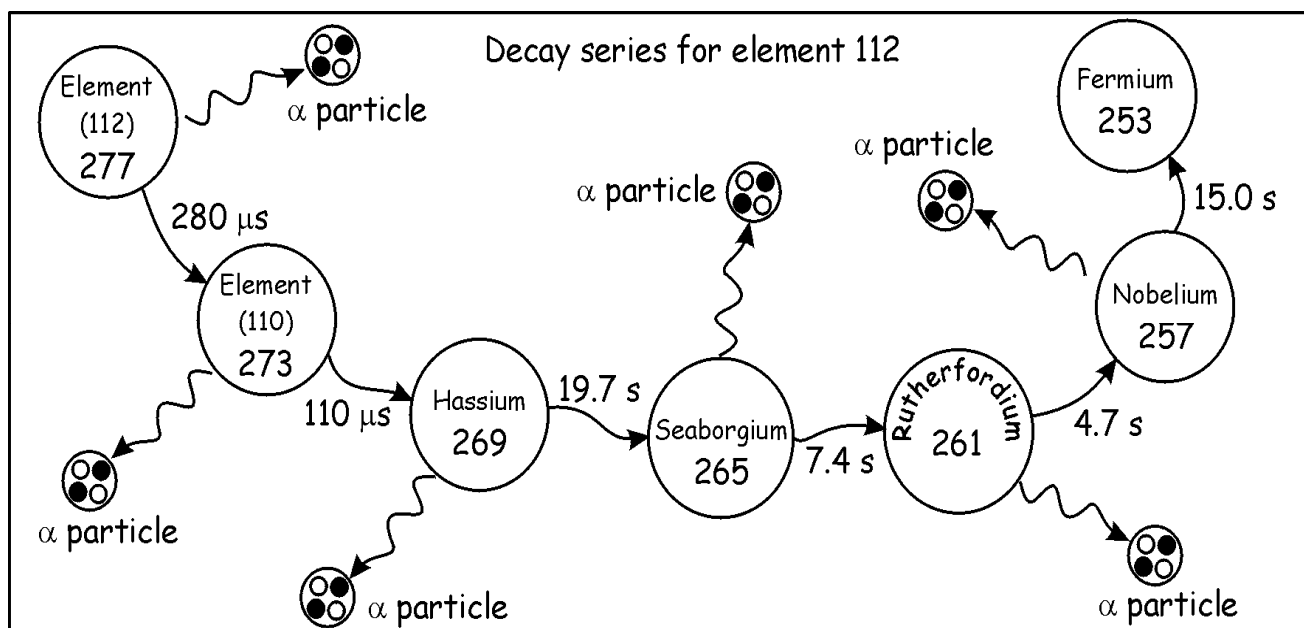
A ✖   B ✖   C ◯   D ◯

▸ **Mark your answers for Questions 1 – 10 in the Answer Box on page 6**

1.   Gold exists in 35 isotopic forms. Stable isotopes of gold have a neutron to proton ratio of 1.5 to1.

Which of these gold isotopes is stable?

(A)   Au–171
(B)   Au–205
(C)   Au–184
(D)   Au–197
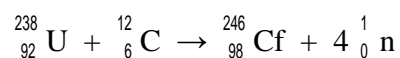

2.   The diagram shows the progressive decay of element 112.

How long does it take an atom of element 112 to decay into an atom of fermium–253?

(A)   15.0 seconds
(B)   27.1 seconds
(C)   46.8 seconds
(D)   436.8 seconds

3.   Which addition polymer is used to make a disposable plastic shopping bag?

(A)   cellulose
(B)   polyethylene
(C)   polystyrene
(D)   polyvinylchloride

4.   Californium–246 is prepared by bombarding a target of uranium–238 with carbon.

$$^{238}_{92} U + ^{12}_{6} C \rightarrow ^{246}_{98} Cf + 4 ^{1}_{0} n$$

Where must the bombardment occur?

(A)   A catalytic cracker
(B)   A cloud chamber
(C)   A nuclear reactor
(D)   A particle accelerator

5.   The reaction sequence below shows how a monomer can be derived from cellulose in order to build a polymer

Cellulose ⟶ | X | ⟶ | Y | ⟶ | Z | ⟶ Polymer

Identify X, Y and Z.

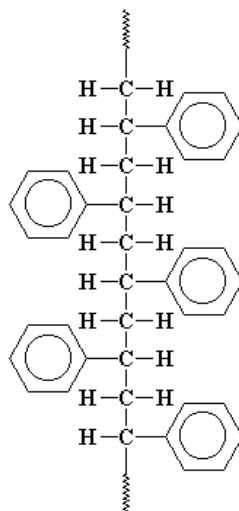|	X	Y	Z
(A)	Glucose	Ethene	ethanol
(B)	Ethanol	Glucose	ethene
(C)	Glucose	Ethanol	ethene
(D)	Ethene	Ethanol	glucose

6.   What is the major component of biomass?

(A)   cellulose
(B)   crude oil
(C)   ethylene
(D)   glucose

7.   What are two examples of biopolymers?

(A)   cellulose, glucose
(B)   starch, cellulose
(C)   ethanol, ethylene
(D)   petroleum, natural gas

8.   A section of a polymer is represented by the following structural formula.

     What is the systematic name of the monomer that forms this polymer?

     (A)   benzene
     (B)   ethylbenzene
     (C)   phenylbenzene
     (D)   phenylethene

9.   What name is given for the chemical process that involves the breaking of large carbon compounds found in petroleum into molecules such as propene?

     (A)   catalysis
     (B)   cracking
     (C)   distillation
     (D)   fractional distillation

10. What is the oxidation state of iodine in $NaIO_4$?

     (A)   - 1
     (B)   +3
     (C)   +4
     (D)   +7

Part A Answer grid for multiple choice questions.

1.   A O   B O   C O   D O

2.   A O   B O   C O   D O

3.   A O   B O   C O   D O

4.   A O   B O   C O   D O

5.   A O   B O   C O   D O

6.   A O   B O   C O   D O

7.   A O   B O   C O   D O

8.   A O   B O   C O   D O

9.   A O   B O   C O   D O

10. A O   B O   C O   D O

Part B. Extended Response Questions:
Allow about 35 minutes for this part.
Question 11   (4 marks)

Describe a chemical procedure that can be used to distinguish between cyclohexane and cyclohexene. Include observations and relevant equation(s).

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Question 12   (3 marks)

Using an example, outline the steps in the formation of an addition polymer.

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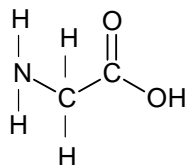
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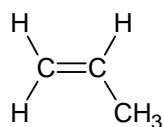
Question 13   **(5 marks)**

(a)   Draw the structure of a section of an addition polymer and a condensation polymer that can be made from the monomers below. Include 3 monomer units for each polymer.   **(4 marks)**

    Monomers:

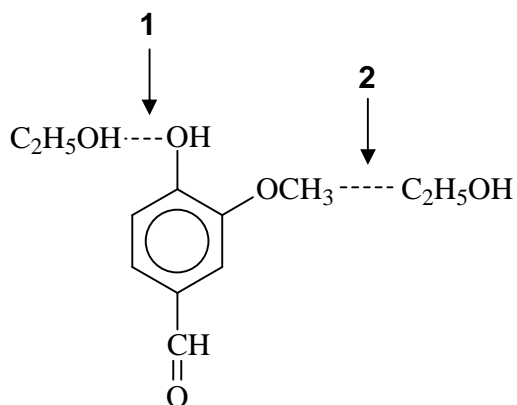   **an amino acid**   **an alkene**

Addition

Condensation

(b)   What is the name of the addition polymer?   **(1 mark)**

………………………………………………………………………………

Question 14   **(2 marks)**

A major use of ethanol is as a solvent in the perfume industry. Vanillin (an extract from vanilla) is component of *Vanilla Sky* perfume. The diagram below shows ethanol molecules dissolving vanillin.

Identify the intermolecular forces and the type (polar or non-polar) of solvent behaviour acting at locations 1 & 2.

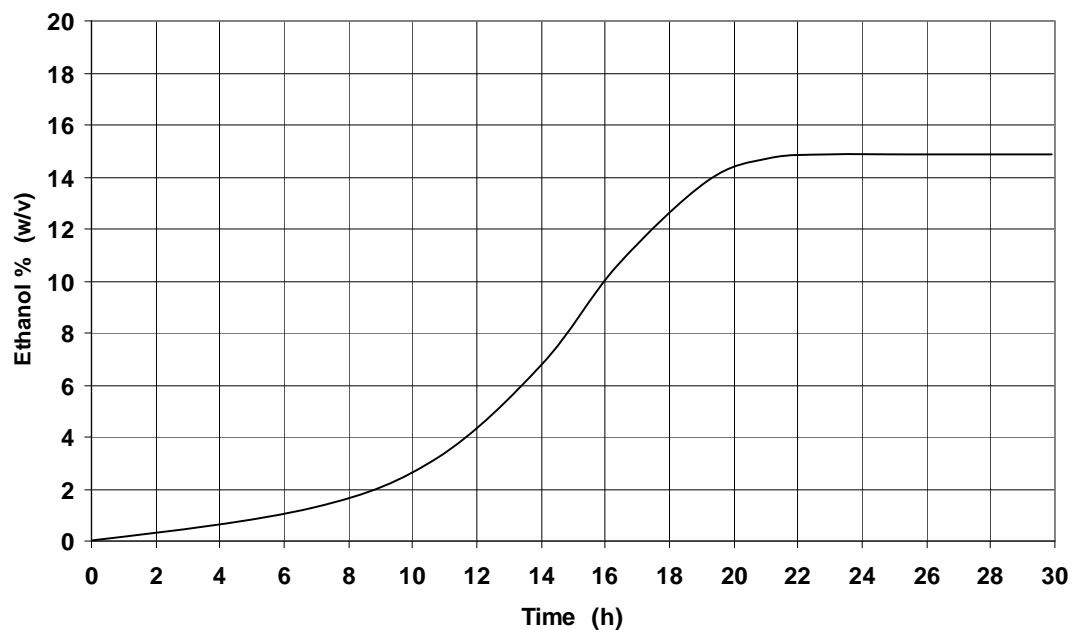Location 1   **(1 mark)**

……………………………………………………………………………………

Location 2   **(1 mark)**

……………………………………………………………………………………

Question 15 (4 marks)

Ethan is conducting research on the effect of temperature on the fermentation of glucose.
The graph shows the production of ethanol at a constant temperature of 25°C.

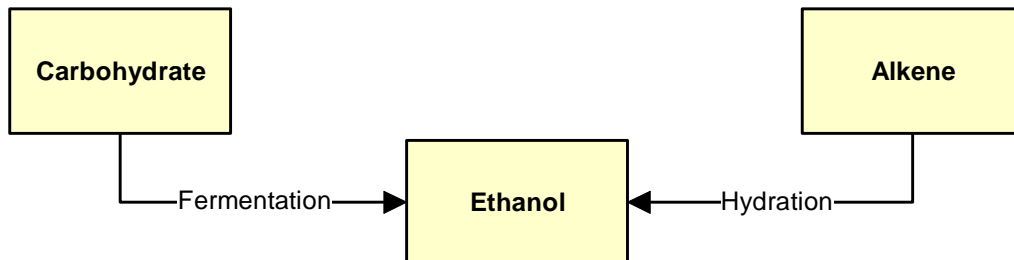(a) Calculate the concentration of the ethanol (mol L^{-1}) at 16 hours. **(2 marks)**

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(b) Draw another curve on the graph above, showing the relative production of ethanol
     if the fermentation had been performed for 30 hours at 35°C instead of 25°C. **(2 marks)**

Question 16   **(5 marks)**

Ethanol is globally produced on a large-scale by two main processes as shown on the flow chart.

(a)   Write balanced chemical equations for the two processes including reaction conditions.

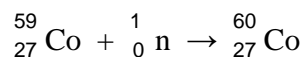   **(3 marks)**

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(b)   Australia has a high potential for expanded ethanol production by fermentation.
Identify two advantages and two disadvantages of ethanol as a fuel.   **(2 marks)**

Advantages	Disadvantages

Question 17   **(4 marks)**

Cobalt–60 is a radioisotope used in medicine and industry and is prepared by a simple nuclear reaction.

$$^{59}_{27}\text{Co} + {^1_0}\text{n} \rightarrow {^{60}_{27}}\text{Co}$$

(a)   Where does this process takes place?.   **(1 mark)**

………………………………………………………………………………………….

(b)   All radioisotopes must be used with extreme caution.

    (i)   Outline the danger associated with radioisotopes.   **(2 marks)**

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(c)   (ii)   Identify an instrument which can be used to detect the danger.   **(1 mark)**

………………………………………………………………………………………….

End of Test 🔔

Student Number…………………

Mark …………………………..

James Ruse Agricultural High School

**Chemistry Assessment
Task 1   Term 4   2007**

Theory

ANSWERS and MARKING SCHEMEs

Chemistry

General Instructions

- Reading Time   5 minutes
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Part A

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A ○   B ●   C ○   D ○

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correct

A ✖   B ✖   C ○   D ○

‣ **Mark your answers for Questions 1 – 10 in the Answer Box on page 6**

1. Gold exists in 35 isotopic forms. Stable isotopes of gold have a neutron to proton ratio of 1.5 to 1.
   Which of these gold isotopes is stable?

   (A) Au–171
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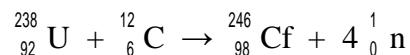   **(D) Au–197**

2. The diagram shows the progressive decay of element 112.

Decay series for element 112

How long does it take an atom of element 112 to decay into an atom of fermium–253?

   (A) 15.0 seconds
   (B) 27.1 seconds
   (C) 46.8 seconds
   (D) 436.8 seconds

3. Which addition polymer is used to make a disposable plastic shopping bag?

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   (B) polyethylene
   (C) polystyrene
   (D) polyvinylchloride

4. Californium–246 is prepared by bombarding a target of uranium–238 with carbon.

$$^{238}_{92}\text{U} + ^{12}_{6}\text{C} \rightarrow ^{246}_{98}\text{Cf} + 4\,^{1}_{0}\text{n}$$

Where must the bombardment occur?

(A)   A catalytic cracker
(B)   A cloud chamber
(C)   A nuclear reactor
(D)   A particle accelerator

5. The reaction sequence below shows how a monomer can be derived from cellulose in order to build a polymer

Cellulose ⟶ $\boxed{\text{X}}$ ⟶ $\boxed{\text{Y}}$ ⟶ $\boxed{\text{Z}}$ ⟶ Polymer

Identify X, Y and Z.

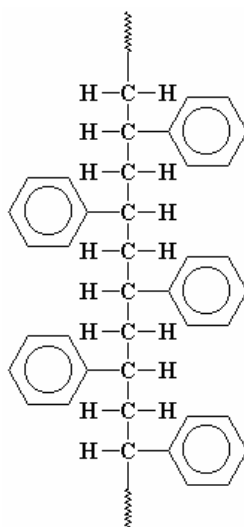|	*X*	*Y*	*Z*
(A)	Glucose	Ethene	ethanol
(B)	Ethanol	Glucose	ethene
(C)	**Glucose**	**Ethanol**	**ethene**
(D)	Ethene	Ethanol	glucose

6.   What is the major component of biomass?

(A)   cellulose
(B)   crude oil
(C)   ethylene
(D)   glucose

7.   What are two examples of biopolymers?

(A)   cellulose, glucose
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(A) benzene
(B) ethylbenzene
(C) phenylbenzene
(D) phenylethene

9. What name is given for the chemical process that involves the breaking of large carbon compounds found in petroleum into molecules such as propene?

(A) catalysis
(B) cracking
(C) distillation
(D) fractional distillation

10. What is the oxidation state of iodine in $NaIO_4$?

(A) 1 -
(B) 3 +
(C) 4 +
(D) 7 +

…………………………

Part A Answer grid for multiple choice questions.   **Total …………/ 10**

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1.   A O   B O   C O   D ●

2.   A O   B O   C ●   D O

3.   A O   B ●   C O   D O

4.   A O   B O   C O   D ●

5.   A O   B O   C ●   D O

6.   A ●   B O   C O   D O

7.   A O   B ●   C O   D O

8.   A O   B O   C O   D ●

9.   A O   B ●   C O   D O

10.   A O   B O   C O   D ●

Part B : Extended Response Questions
Allow about 35 minutes for this part.

Question 11   **(4 marks)**

Describe a chemical procedure that can be used to distinguish between cyclohexane and cyclohexene. Include observations and relevant equation(s).

Possible Answer:

Add equal amounts of cyclohexane and cyclohexene to test tubes; place these in a dark cupboard. Add bromine water. The cyclohexene will react with the bromine water causing it to change from a red/brown colour to colourless (decolourise bromine water). The cyclohexane will not react with the bromine water leaving it a red/brown colour.
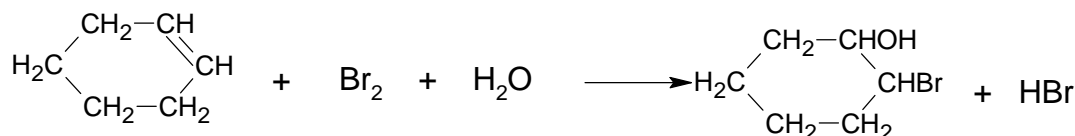
Marking Scheme

Criteria	Marks
Description of two expected sets of results (observations*) + stating the use of bromine water + writing a balanced equation	*4*
Description of two expected sets of results (observations*) + stating the use of bromine water	*3*
Description of one expected set of results (observations*) + stating the use of bromine water	*2*
Stating the use of bromine water	*1*

Note: *observations must describe the relevant colour change observed.

Question 12   (3 marks)

Using an example, outline the steps in the formation of an addition polymer.

Marking Schemes

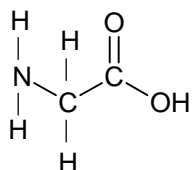| Criteria	Marks
Description of how a monomer can be activated (initiation) + stating the name of an addition polymer + description of the propagation process	*3*
Description of how a monomer can be activated (initiation) + stating the name of an addition polymer	*2*
Stating the name of an addition polymer	*1*

Possible Answer:

Initiation: radical (or catalyst) is mixed with monomer (ethene). This activates the ethene (breaking the double bond), which then reacts with another ethene (propagation). The process is repeated until a terminator ceases the polyethylene chain growth.
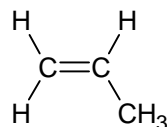
Question 13   **(4 marks)**

(a)   Draw the structure of a section of an addition polymer and a condensation polymer that can be made from the monomers below. Include 3 monomer units for each polymer.   **(4 marks)**

Monomers:
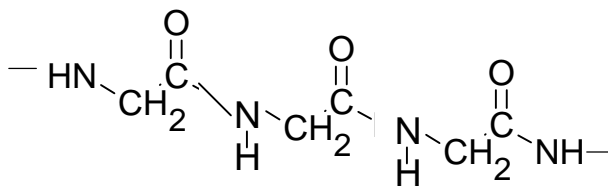
an amino acid   **an alkene**

Addition
Condensation

(b)   What is the name of the addition polymer? **(1 mark)**

………………………………………………………………………………………………………..

Possible Answer :   **Outcomes: H12, H13, H14**

polyglycine
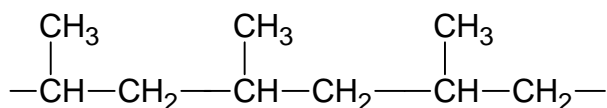
polypropylene

Marking Guidelines

Criteria	Mark
correct structure for addition polymer	1
correct structure for condensation polymer	1
3 monomer units for each polymer	2

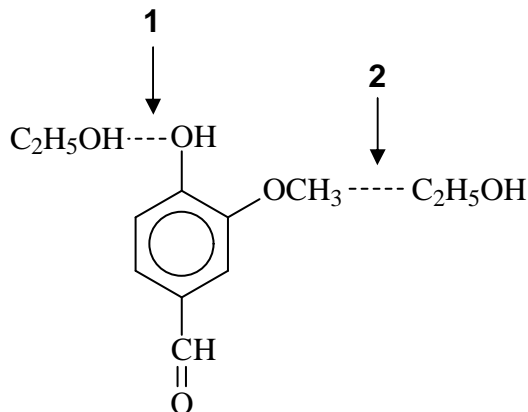(b)   What is the name of the addition polymer? **(1 mark)**

Answer: *(polypropene or polypropylene)*
Marking Guidelines

Criteria	Mark
correct name	1

Question 14   (2 marks)

A major use of ethanol is as a solvent in the perfume industry. Vanillin (an extract from vanilla) is component of *Vanilla Sky* perfume. The diagram below shows ethanol molecules dissolving vanillin.

Identify the intermolecular forces and the type (polar or non-polar) of solvent behaviour acting at locations 1 & 2.

Location 1

…………………………………………………………………………………………………….
Location 2

……………………………………………………………………………………………………
ANSWER

At location 1, ethanol is acting as a <u>polar</u> solvent dissolving vanillin by forming a <u>hydrogen bond</u> or <u>dipole–dipole force</u>.   (1 mark)

At location 2, ethanol is acting as a <u>non–polar</u> solvent dissolving vanillin with a <u>dispersion force</u>. (1 mark)
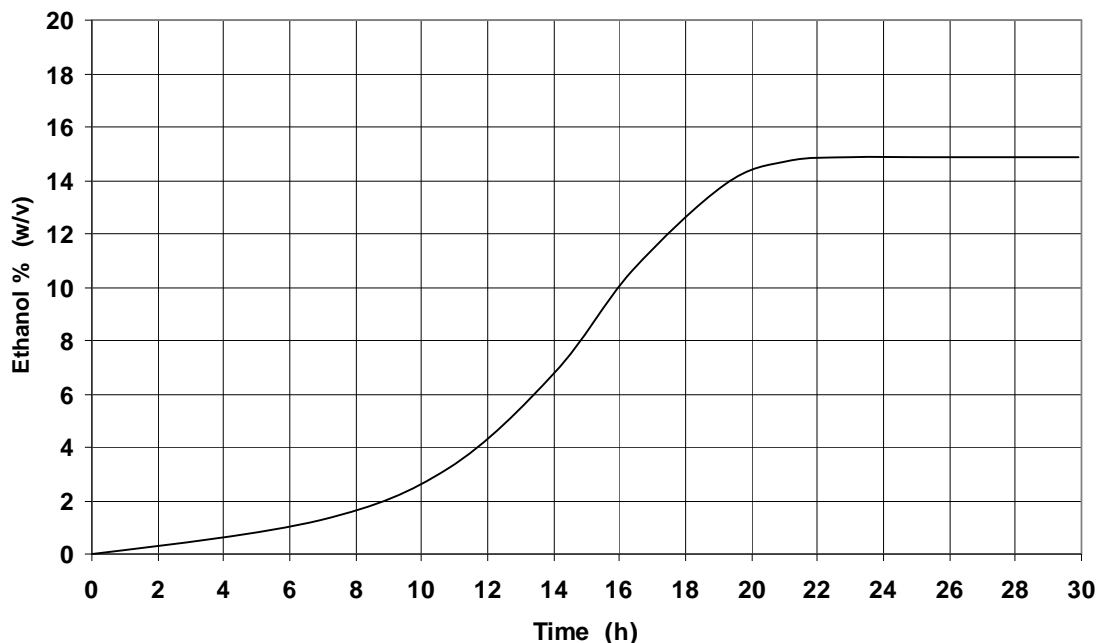
Outcomes assessed: H6

MARKING GUIDELINES

Criteria	Marks
• Identifies intermolecular forces at both locations • Identifies type of solvent behaviour at both locations	2
• Identifies intermolecular forces at both locations OR • Identifies type of solvent behaviour at both locations OR • Identifies intermolecular force and type of solvent behaviour at one location	1

Question 15   (4 marks)

Ethan is conducting research on the effect of temperature on the fermentation of glucose.
The graph shows the production of ethanol at a constant temperature of 25°C.

(a)   Calculate the concentration of the ethanol (mol L $^{-1}$) at 16 hours.   **(2 marks)**

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At 16 hours, [ethanol] = 10% (w/v) = 10 g/100 mL   (1 mark)

cV = m/M; c = m/M/V = 10 g/46.068 g mol $^{-1}$/0.100 L = 2.2 mol L $^{-1}$ (1 mark)

Outcomes assessed: H10
MARKING GUIDELINES

Criteria	Marks
• Correctly calculates the concentration of ethanol	2
• Shows one correct step in the calculation	1

(b)   Draw another curve on the graph above, showing the relative production of ethanol
if the fermentation had been performed for 30 hours at 35°C instead of 25°C.   **(2 marks)**
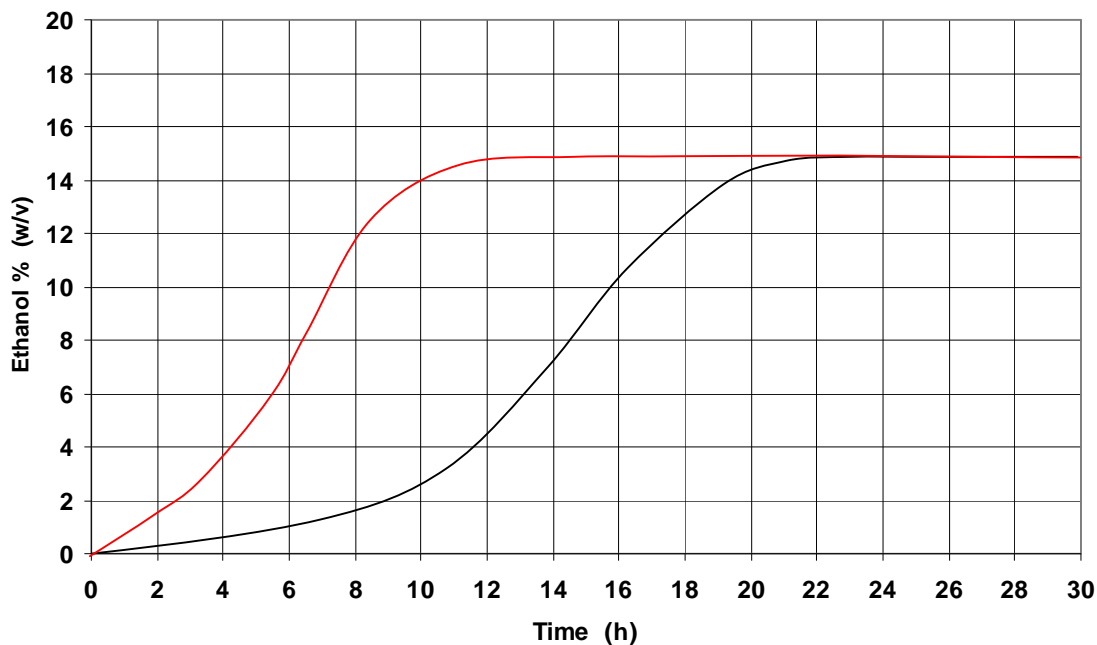
Curve with a steeper initial slope (faster fermentation due to more favourable conditions).
(1 mark)
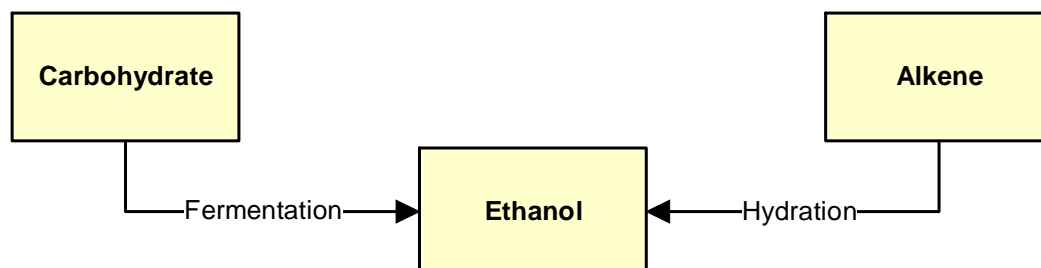
Curve plateaus at 15% ethanol where yeast die.   (1 mark)

Outcomes assessed: H8, H13

MARKING GUIDELINES

Criteria	Marks
• Correctly draws the curve	2
• Draws a curve with a steeper gradient OR • Draws a curve with the same plateau	1

Question 16   (5 marks)

Ethanol is globally produced on a large-scale by two main processes as shown on the flow chart.

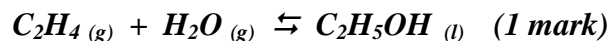(a)   Write balanced chemical equations for the two processes including reaction conditions.

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(2 marks)

$C_6H_{12}O_6\ _{(aq)} \rightarrow 2C_2H_5OH\ _{(aq)} + 2CO_2\ _{(g)}$ *(1 mark)*

$C_2H_4\ _{(g)} + H_2O\ _{(g)} \rightleftharpoons C_2H_5OH\ _{(l)}$ *(1 mark)*

Conditions – yeast (fermentation), dil. H_2SO_4 (hydration)   (1 mark for both)

Question 16 (a)
Outcomes assessed: H8, H9

MARKING GUIDELINES

Criteria	Marks
• Writes two correctly balanced chemical equations and represents ethanol as C_2H_5OH • Identifies the reaction conditions for both reactions	3
• Writes two correctly balanced chemical equations and represents ethanol as C_2H_5OH	2
• Writes one correctly balanced chemical equation and represents ethanol as C_2H_5OH OR • Identifies the reaction conditions for both reactions	1

(b)   Australia has a high potential for expanded ethanol production by fermentation.
        Identify two advantages and two disadvantages of ethanol as a fuel.   **(2 marks)**

Advantages	*Disadvantages*

Possible Answer

| *Advantages*	*Disadvantages*
• *Ethanol is a renewable resource* • *Ethanol reduces dependence on oil* • *Ethanol is cleaner burning* • *Ethanol has lower greenhouse potential*	• *Ethanol produces less energy than petrol* • *Ethanol production would require huge tracts of land which could impact on food production* • *Ethanol is more costly to produce*

Outcomes assessed: H3, H5

MARKING GUIDELINES

Criteria	Marks
• Identifies two advantages of ethanol as a fuel • Identifies two disadvantages of ethanol as a fuel	2
• Identifies two advantages of ethanol as a fuel OR • Identifies two disadvantages of ethanol as a fuel OR • Identifies one advantage and one disadvantage of ethanol as a fuel	1

Question 17　(4 marks)

Cobalt–60 is a radioisotope used in medicine and industry and is prepared by a simple nuclear reaction…

$$^{59}_{27}\text{Co} + ^{1}_{0}\text{n} \rightarrow ^{60}_{27}\text{Co}$$
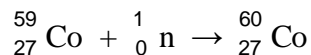
(a)　　Where does this process takes place?.　　　　　　　　　　　　　　**(1 mark)**

………………………………………………………………………………………….

　　　　　　Nuclear reactor

Outcomes assessed: H6

MARKING GUIDELINES

Criteria	Marks
• Identifies the process taking place in a nuclear reactor	1

(b)　　All radioisotopes must be used with extreme caution.

　　　　(i)　Outline the danger associated with radioisotopes.　　　　**(2 marks)**

…………………………………………………………………………………………

…………………………………………………………………………………………

Outcomes assessed: H4

MARKING GUIDELINES

Criteria	Marks
• Identifies radiation or radioactivity as a danger • Identifies a specific harmful effect of radiation or radioactivity	2
• Identifies radiation or radioactivity as a danger OR • Identifies a specific harmful effect of radiation or radioactivity	1

Radiation/radioactivity (1 mark) causes damage/death to living cells (1 mark).

(c)   (ii)   Identify an instrument which can be used to detect the danger.   **(1 mark)**

……
        Geiger counter
Outcomes assessed: H4

MARKING GUIDELINES

Criteria	Marks
• Identifies an instrument used to detect radiation or radioactivity	1