**Factors that affect the rate of reaction Worksheet**

**Answer Key**

2

1. Recork the bottle.

Reduce the concentration of O2.

2. Remove the air from the bottle with the aid of a pump and a cork.

Reduce the concentration of O2.

3. Place the bottle in a refrigerator uncorked.

Reduce the temperature of the wine

4. Transfer the wine to a bottle with a smaller diameter and leave it uncorked.

Reduce the surface area of the wine in contact with the air.

3

By using the paper and kindling the surface area is increased.

4

Factors :

1. Increase in the amounts of water vapour and carbon dioxide

2. Increase in the temperature

Consequences :

If the green plants grow more rapidly they will reduce the amount of carbon dioxide and reduce the green-house effect.

5

B

6

The speed at which milk becomes sour increases with an increase in temperature.

or

Any other equivalent answer.

7

D

8

C

9

1 and 4 only

10

C

11

The situation in which the beaker on the right produces the more rapid reaction is : the fourth.

12

D

13

D

14

B

15

A

16

Example of an appropriate procedure

1. Number of moles of Na2O2 which reacted

1 mole → 78 g

x → 15.6 g

Answer : x = 0.2 mol

2. Average rate *v*(m) of reaction in mol /s

*v*(m) = 

*v*(m) = 

*v*(m) = 0.02 mol/s

Answer : The average rate of reaction of sodium peroxide was 0.02 mol/s.

17

B

18

C

19

D

**Factors Affecting the Rate of Reaction**

2

"If the bottle is opened then the wine must be drunk." This maxim is based on the fact that when wine is exposed to air, it oxidizes and the flavour deteriorates. Explain how each of the four procedures below would reduce the rate of the oxidation of the wine.

1. Recork the bottle.

2. Remove the air from the bottle with the aid of a pump and a cork.

3. Place the bottle in a refrigerator uncorked.

4. Transfer the wine to a bottle with a smaller diameter and leave it uncorked.

3

When you light a fire you use paper and kindling wood rather than trying to light a log with a match.

Use the collision theory to explain why.

4

Read the article below :

|  |
| --- |
| **THE GREEN-HOUSE EFFECT**  Scientists will not risk trying to predict the consequences of the green-house effect, because of the many factors that must be considered. Computer simulations predict that there will be a warming of the Earth of 3°C during the next century. This does not appear to be much of a change, but even a few degrees difference can have an enormous impact on the planet.  However, these predictions depend on the amount of gas that is produced. A global warming of 3°C is predicted on the assumption that CO2 and the other green-house gases continue to be produced at the same rate.  It is a fact that plants need carbon dioxide. Chlorophyll carries out photo synthesis according to the following equation: water vapour + carbon dioxide + energy → sugar + oxygen. In this way plants convert carbon dioxide into various sugars and this promotes their growth particularly in warm climates. |

Based on this article, give two factors that influence the rate of growth of green plants and explain the consequences that this rapid growth of green plants will have on the greenhouse effect.

5

You are interested in comparing the rate of some chemical reactions that occur in nature.

In each of the following pairs, which reaction will have the slowest rate?

1. a) The formation of coal in the earth.

b) The formation of water vapour during a forest fire.

2. a) The burning of a cigarette in air.

b) The burning of a cigarette in pure oxygen gas.

3. a) The combustion of a match.

b) The combustion of sugars in the human body.

|  |  |  |  |
| --- | --- | --- | --- |
| A) | 1a, 2b and 3a | C) | 1b, 2a and 3b |
| B) | 1a, 2a and 3b | D) | 1b, 2b and 3a |

6

The following data were obtained from an experiment in which milk was soured.

|  |  |
| --- | --- |
| **SOUR MILK** | |
| Temperature  (°C) | Time  (days) |
| 1  3  8  12  15  22 | 20  12  4  2  1  0.5 |

Example : It took 20 days for milk at a temperature of 1°C to sour.

What conclusion can be drawn from this experiment?

7

The automobile engine (internal combustion engine) is powered by gasoline and air.

** → **

Among the factors proposed below, which does **NOT** modify the rate of combustion of gasoline?

|  |  |
| --- | --- |
| A) | Vary the quantity of O2 present in the air. |
| B) | Vary the nature of gasoline used. |
| C) | Vary the pressure of O2. |
| D) | Vary the quantity of CO2 in the exhaust gases. |

9

The wine (CH3CH2OH = alcohol) inside a bottle oxidizes in contact with air (O2) to be transformed into vinegar (CH3COOH). The equation can be represented by :

** → **

Which of the following changes would increase the rate of the oxidation of wine?

1. Increase the surface area in contact with air (O2).

2. Decrease the air pressure.

3. Place the bottle in the refrigerator.

4. Add the catalyst MnO2 to the wine.

10

Eric wants to measure the rate of combustion of a candle. His results are recorded in the table below.

|  |  |  |
| --- | --- | --- |
|  | **Before combustion** | **After combustion** |
| Mass of candle (g) | 165.5 | 162.0 |
| Time (h:min:s) | 13:42:00 | 13:47:00 |

The equation is : **C25H52(s) + 38 O2(g) → 25 CO2(g) + 26 H2O(g)**

Four students calculate the rate of this combustion reaction using Eric's results.

|  |  |
| --- | --- |
| **Student** | **Result** |
| Pauline | 2.0 × 10−3 mol/min of C25H52 consumed |
| Peter | 1.0 × 10−3 mol/min of C25H52 consumed |
| Jacqueline | 3.5 g/min of C25H52 consumed |
| Andie | 7.0 × 10−1g/min of C25H52 consumed |

Which students have correctly calculated the rate of this combustion reaction?

|  |  |  |  |
| --- | --- | --- | --- |
| A) | Peter and Jacqueline | C) | Pauline and Andie |
| B) | Peter and Andie | D) | Pauline and Jacqueline |

11

To compare the rates of reaction, you put 100g of calcium carbonate, CaCO3(s), into eight solutions of hydrochloric acid HCl(aq). You group them in pairs as shown in the four situations below :



In which situation (1, 2, 3 or 4) will the beaker on the right react more rapidly than the beaker on the left?

12

Curves 1 and 2 on the graph below represent energy pathways for the same chemical reaction. The reaction rate is faster for pathway number 2.

**Chemical Reaction**



Which factor is most probably responsible for the pathway in curve 2?

|  |  |
| --- | --- |
| A) | Increase in temperature |
| B) | Increase in contacting surface area |
| C) | Decrease is concentration of reactants |
| D) | Presence of a catalyst |

13

Match the process on the left with the factors on the right.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| PROCESSES | | | | FACTORS INFLUENCING  THE RATE OF REACTION | |
| 1. Preserving food in a controlled environment  2. Freezing sea-food  3. Mixing two substances to produce certain fast-setting glues (ex. *epoxy*).  4. Lighting a fire with wood chips | | | | a. Atmospheric Pressure  b. Temperature  c. Concentration of reactants  d. Surface area contact  e. Catalyst | |
| A) | 1a, 2b, 3d and 4e | C) | 1b, 2e, 3c and 4d | |
| B) | 1a, 2e, 3c and 4b | D) | 1c, 2b, 3e and 4d | |

14

In the fire triangle, three components must be present for combustion to occur. What are the three components?

|  |  |
| --- | --- |
| A) | Solid, liquid, gas |
| B) | Fuel, oxygen, heat |
| C) | Hydrocarbons, heat, gas |
| D) | Fuel, hydrocarbons, heat |

15

The graph below represents a chemical reaction which occurred at first without a catalyst and then occurred a second time with a catalyst.



What are respectively, in kilojoules, the heat of reaction (Δ*H*) and the activation energy (*E*a) of the reaction with a catalyst?

|  |  |  |  |
| --- | --- | --- | --- |
| A) | -1 000 kJ and 500 kJ | C) | 1 000 kJ and 500 kJ |
| B) | -1 000 kJ and 2 000 kJ | D) | 1 000 kJ and 2 000 kJ |

16

In the presence of water, 15.6 g of sodium peroxide, Na2O2(s), forms sodium hydroxide, NaOH(aq), and releases oxygen gas, O2(g).

The reaction is represented by the following equation :

**2 Na2O2(s) + 2 H2O (*l*) → 4 NaOH(aq) + O2(g)**

Knowing that the reaction lasts 10 seconds, what is the average reaction rate of the sodium peroxide in moles per second?

17

Which of the following factors always affect the rate of a chemical reaction?

1. The nature of the reactants

2. The surface area of the reactants

3. The pressure

4. The concentration of the reactants

|  |  |  |  |
| --- | --- | --- | --- |
| A) | 1, 2 and 3 | C) | 1, 3 and 4 |
| B) | 1, 2 and 4 | D) | 2, 3 and 4 |

18

During an experiment to determine the rate of a chemical reaction, you increase the temperature of the system and notice an increase in the reaction rate.

Which of the following best explains this increase in the reaction rate?

|  |  |
| --- | --- |
| A) | An increase in temperature increases the number of molecular collisions. |
| B) | An increase in temperature decreases the activation energy barrier. |
| C) | An increase in temperature increases the number of effective molecular collisions. |
| D) | An increase in temperature increases the heat of reaction. |

19

Consider the following experiment.

1) 4 g of Mg ribbon are reacted in 100 mL HCl (1 mol/L).

2) 4 g of Mg powder are reacted in 10 mL HCl (1 mol/L).

Which reaction will be faster as a result of what factor(s)?

|  |  |
| --- | --- |
| A) | Reaction 1 as a result of the surface area of contact between reactants and the amount of acid |
| B) | Reaction 1 as a result of the amount of acid |
| C) | Reaction 2 as a result of the surface area of contact between reactants and the amount of acid |
| D) | Reaction 2 as a result of the surface area of contact between the reactants |