Question 7

For each of the following:
State whether the statement is true (T), or false (F), and explain your answer.

Statement	T / F	Explanation
a. In a gas at fixed pressure, temperature and volume all gas particles will move at the same velocity.		
b. The density of ice and water at 0°C and at atmospheric pressure is the same.		
c. In a redox reaction there is always an oxidation half reaction and a reduction half reaction.		
d. Mixing together solutions of two different salts will always result in the formation of a precipitate.		
e. Stoichiometric calculations are carried out using mole ratios of substances rather than mass ratios.		

1 + 1 + 1 + 1 + 1 = 5 marks

Total 5 marks

END OF SECTION B

END OF QUESTION AND ANSWER BOOK

CSE CENTRE FOR STRATEGIC EDUCATION
Leading educational thinking and practice

IARTV

STUDENT:	TEACHER:

CSE TEST – OCTOBER 2009

YEAR 11 – CHEMISTRY

Written test 2

Reading time: 15 minutes
Writing time: 1 hour 30 minutes

QUESTION AND ANSWER BOOK

Structure of book

Section	*Number of questions*	*Number of questions to be answered*	*Number of marks*	*Suggested times (minutes)*
A	20	20	20	30
B	7	7	55	60
			Total 75	90

- Students are permitted to bring into the test room: pens, pencils, highlighters, erasers, sharpeners, rulers, an approved graphics calculator (memory cleared) and/or one scientific calculator.
- Students are **NOT** permitted to bring into the test room: blank sheets of paper and/or white out liquid/tape.

Materials
- Question and answer book of 16 pages with an accompanying data sheet.
- Detachable answer sheet for multiple choice questions. You may remove this during reading time.

Instructions
- Write your **name** in the space provided above **and** on the multiple choice answer sheet.
- All written responses must be in English.

At the end of the test
- Place the answer sheet for multiple choice questions inside the front cover of this book.

Students are NOT permitted to bring mobile phones and/or other electronic communication devices into the test room.

c. State one reason why carbon dioxide cannot be successfully prepared using the method shown for oxygen.

1 mark

d. State how the following Principles of Green Chemistry can be applied to the preparation of substances in a school laboratory.

i. Preventing waste production.

ii. Consuming the minimum amount of energy.

iii. Minimising the possibility of accidents.

iv. Achieving maximum atom efficiency.

1 + 1 + 1 + 1 = 4 marks

Total 9 marks

d. What mass of nitrogen(IV) oxide occupies the same volume at SLC as the mass of NO produced in a?

2 marks

Total 9 marks

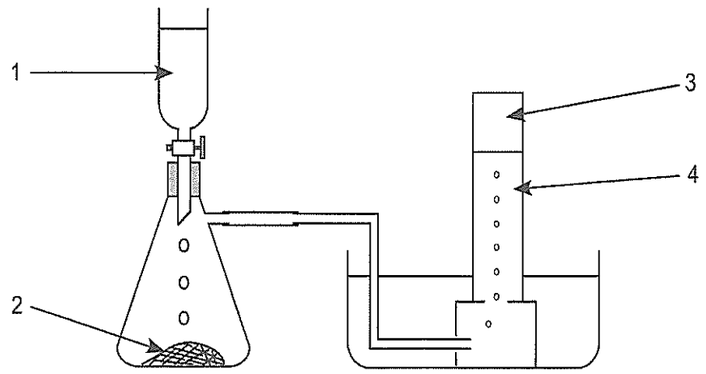
Question 6

a. Write balanced equations for suitable reactions for the laboratory preparation of oxygen and of carbon dioxide. State the reaction conditions.

Oxygen	
Carbon dioxide	

2 marks

b. The diagram shows one method for the laboratory preparation of oxygen.
Label the diagram as indicated by the numbers 1 – 4.



2 marks

SECTION A – Multiple choice questions

Instructions for Section A

Answer **all** questions in pencil on the answer sheet provided for multiple choice questions.

Choose the response that is **correct** or that **best answers** the question.

A correct answer scores 1, an incorrect answer scores 0. Marks will **not** be deducted for incorrect answers.

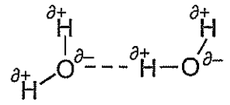
No marks will be given if more than one answer is completed for any question.

Question 1

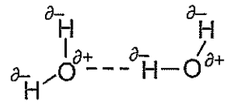
Which one of the following is the most accurate representation of the chemical bonding within and between water molecules? (Dispersion forces are not included.)

— indicates a covalent bond - - - indicates a hydrogen bond.

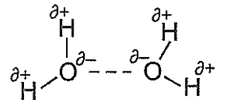
A.



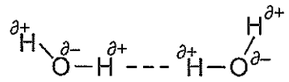
B.



C.



D.



Question 2

During which one of the following processes, that occur in the natural water cycle, is energy absorbed?

A. The temperature of liquid water decreases.

B. Tiny droplets of water coalesce to form larger drops.

C. Liquid water is converted to steam.

D. The temperature of ice falls below its freezing point.

Question 3

If the same amount of energy is absorbed by equal masses of water and of copper the

A. temperatures of both the water and the copper will increase by the same amount.

B. temperature of the water will increase more than the temperature of the copper.

C. temperature of the copper will increase more than the temperature of the water.

D. temperatures of both water and copper will remain constant but their volumes will increase.

Question 4

When the molecular compound ethanol, CH_3CH_2OH, is added to water, the ethanol

A. forms hydrogen bonds to water molecules and dissolves.

B. forms ions by reaction with water molecules and dissolves.

C. is immiscible with water and forms a separate layer.

D. dissociates into ions and dissolves.

Question 5

An aqueous solution of potassium chloride, KCl, contains 2.70 g of potassium ions per 500 mL of solution. The concentration of K^+ ions in this solution expressed as ppm (parts per million) and as molarity will be

A. 5.40×10^3 ppm and 0.138 M.

B. 2.70×10^3 ppm and 6.90×10^{-2} M.

C. 5.40 ppm and 0.138 M.

D. 2.70 ppm and 6.90×10^{-2} M.

Question 6

Addition of which one of the following reactants to a solution of sodium sulfate would result in the formation of a precipitate?

A. Potassium sulfate solution.

B. Copper(II) chloride solution.

C. Barium nitrate solution.

D. Ammonium carbonate solution.

Question 7

In which of the following reactions does a water molecule act as a base?

i. $HNO_{3(aq)} + H_2O_{(l)} \rightarrow H_3O^+_{(aq)} + NO_3^-{}_{(aq)}$

ii. $H_2O_{(l)} + H_2O_{(l)} \rightleftharpoons H_3O^+_{(aq)} + OH^-_{(aq)}$

iii. $PH_{3(aq)} + H_2O_{(l)} \rightleftharpoons PH_4^+{}_{(aq)} + OH^-_{(aq)}$

iv. $2\,H_2O_{(l)} + Ca_{(s)} \rightarrow Ca(OH)_{2(aq)} + H_{2(g)}$

A. i, ii and iv only.

B. iii only.

C. iii and iv only.

D. i and ii only.

c. Determine which reactant is in excess, and by what mass.

3 marks

Total 6 marks

Question 5

Copper reacts with excess 8.0 M nitric acid at SLC producing nitrogen(II) oxide gas according to the following equation.

$$3Cu_{(s)} + 8HNO_{3(aq)} \rightarrow 3Cu(NO_3)_{2(aq)} + 4H_2O_{(l)} + 2NO_{(g)}$$

a. What volume of NO gas is produced at SLC when 20.0 g of copper reacts with excess nitric acid?

3 marks

b. The volume of NO obtained increases by 20% as a result of a temperature increase. Calculate the temperature in °C which would cause this volume increase if the pressure remains the same.

3 marks

c. Write a balanced equation for the reaction of NO with oxygen gas to produce nitrogen(IV) oxide gas.

1 mark

ii. What is the pH of the solution at 25°C?

1 mark

d. Dilution of 5.0 mL of 0.50 M hydrochloric acid (HCl) is slowly carried out with 95 mL of water.
What is the pH of the diluted solution at 25°C?

2 marks

e. Why is it not possible to calculate the pH of oxalic acid directly from its molarity?

1 mark

Total 11 marks

Question 4

60 mL of a 2.5 M solution of lead(II) nitrate is mixed with 60 mL of a 2.0 M solution of potassium iodide and a precipitate of lead(II) iodide forms.

a. Write a balanced equation for the precipitation reaction.

1 mark

b. Calculate the amount in moles of each reactant.

2 marks

Question 8

The hydronium, H_3O^+, and hydroxide, OH^-, ion concentrations, in mol L^{-1}, of acid rain at 25°C with a pH of 5.8 are

A. $[H_3O^+] = 5.8$ and $[OH^-] = 8.2$.

B. $[H_3O^+] = 10^{-5.8}$ and $[OH^-] = 10^{-8.2}$.

C. $[H_3O^+] = 10^{5.8}$ and $[OH^-] = 10^{8.2}$.

D. $[H_3O^+] = 10^{-8.2}$ and $[OH^-] = 10^{-5.8}$.

Question 9

Metal X reacts spontaneously with metal Y in a displacement reaction as shown in the equation

$$X_{(s)} + Y^+_{(aq)} \rightarrow X^+_{(aq)} + Y_{(s)}$$

Which one of the following half equations represents the half reaction in which oxidation occurs?

A. $X_{(s)} + e^- \rightarrow X^+_{(aq)}$

B. $X_{(s)} \rightarrow X^+_{(aq)} + e^-$

C. $Y^+_{(aq)} \rightarrow Y_{(s)} + e^-$

D. $Y^+_{(aq)} + e^- \rightarrow Y_{(s)}$

Question 10

The following equation summarises the reactions causing the corrosion of iron. Which one of the following statements regarding corrosion is **incorrect**?

$$4Fe_{(s)} + 3O_{2(g)} + 2H_2O_{(l)} \rightarrow 2Fe_2O_3.H_2O_{(s)}$$

A. In the presence of water, iron atoms on the surface of the iron are oxidised by oxygen from air.

B. Oxygen is reduced at the anodic areas of the iron surface.

C. Electrons travel through the iron from anode to cathode.

D. Iron(II) hydroxide is formed during the corrosion process which is further oxidised to iron (III) hydroxide.

Question 11

What mass of silver is precipitated when 5.0 g of copper metal is added to an excess of silver nitrate solution according to the equation below?

$$Cu_{(s)} + 2AgNO_{3(aq)} \rightarrow Cu(NO_3)_{2(aq)} + 2Ag_{(s)}$$

A. 0.16 g

B. 8.5 g.

C. 10 g.

D. 17 g.

Question 12

The volume of 1.8 M lithium hydroxide solution required to exactly neutralise 100 mL of 0.75 M sulfuric acid is closest to

A. 27 mL.

B. 42 mL.

C. 83 mL.

D. 100 mL.

Question 13

The following equations represent some of the redox chemical reactions occurring in the Nitrogen Cycle.

$N_{2(g)} + O_{2(g)} \rightarrow 2NO_{(g)}$

$2NO_{2(g)} + H_2O_{(l)} \rightarrow HNO_{2(aq)} + HNO_{3(aq)}$

$2NH_4^+{}_{(aq)} + OH^-{}_{(aq)} \rightarrow NH_{3(g)} + H_2O_{(l)}$

$2NO_2^-{}_{(aq)} + O_{2(g)} \rightarrow 2NO_3^-{}_{(aq)}$

Two nitrogen containing species in which nitrogen has the same oxidation number are

A. HNO_2 and HNO_3.

B. NH_4^+ and N_2.

C. NH_3 and HNO_2.

D. NH_3 and NH_4^+.

Question 14

Which one of the following statements about ozone is **incorrect**?

A. Ozone, O_3, and oxygen, O_2, are allotropes of oxygen.

B. Ozone is able to absorb ultra violet radiation.

C. Ozone occurs only in the stratosphere.

D. Ozone is present in photochemical smog.

Question 15

Chemical species called free radicals are involved in the formation of photochemical smog. Examples are oxygen and hydroxyl free radicals.

A free radical is best described as an atom or molecular fragment which has

A. one more electron than it has protons.

B. one less electron than it has protons.

C. an incomplete outer electron shell.

D. an unpaired electron in its outer shell.

c. In the box on the diagram draw an arrow to indicate the direction of electron flow in the external circuit.

1 mark

d. The salt bridge consists of potassium nitrate solution. Into which half cell will potassium ions flow when the cell is operating?

_____

1 mark

e. Would you expect the mass loss from electrode Q to be the same as the mass increase of electrode R? Give a reason for your answer.

_____

_____

_____

_____

1 mark

Total 6 marks

Question 3

Oxalic acid, $H_2C_2O_4$, is a weak diprotic acid

a. Write balanced equations for the successive ionisation reactions of this acid.

_____

1 + 1 = 2 marks

b. Sulfuric acid, H_2SO_4, is a strong diprotic acid. If 0.50 M solutions of $H_2C_2O_4$ and H_2SO_4 are compared, which one would have

i. the higher concentration of H_3O^+ ions? _____

ii. the higher pH? _____

iii. the higher electrical conductivity? _____

3 marks

c. A solution of barium hydroxide has a concentration of 0.050 M

i. What are the H_3O^+ and OH^- ion concentrations in mol L^{-1} of this solution?

_____

_____

_____

_____

_____

2 marks

d. At 30°C, one mole of $Z(NO_3)_2$ will just dissolve in 543 g of water. Deduce the relative atomic mass of Z and name the element.

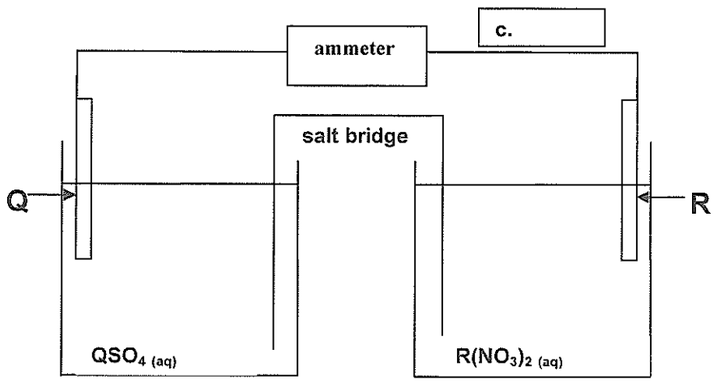
Name of Element:

3 marks

Total 9 marks

Question 2

A galvanic cell is set up as shown in the following diagram. Q and R are different metal elements which make up the electrodes, and each half cell contains an aqueous electrolyte as shown.



During operation of the galvanic cell it is found that electrode R increases in mass and electrode Q decreases in mass.

a. Write oxidation and reduction half equations for the reactions at the electrodes.

Half equation in which the **metal is oxidised**

Half equation in which the **metal is reduced**

1 + 1 = 2 marks

b. Write the overall cell reaction, including symbols of state.

1 mark

Question 16

A balloon is inflated until the air pressure inside it is 102.8 kPa.The air pressure outside the balloon is 101.3 kPa. If a hole is made in the balloon, when air movement has stopped the air pressure inside the balloon will be

A. 102.8 kPa.

B. 101.3 kPa.

C. 1.5 kPa.

D. 0 kPa.

Question 17

7.0 g of chlorine gas and 7.0 g of argon gas are placed in separate sealed containers which have the same volume and are maintained at the same temperature.

The two gas samples have

A. the same number of particles and exert the same pressure.

B. the same average particle velocity and exert different pressures.

C. different average kinetic energy and exert the same pressure.

D. the same average kinetic energy and exert different pressures.

Question 18

In which one of the following lists are all gases naturally occurring and Greenhouse gases?

A. H_2O, CH_4, CO_2.

B. CFCs, N_2O, CH_4.

C. SF_6, H_2O, CO_2.

D. PFCs, N_2O, SF_6.

Question 19

Ethyne (acetylene) burns in excess oxygen to produce carbon dioxide and water.

$$2C_2H_{2(g)} + 5O_{2(g)} \rightarrow 4CO_{2(g)} + 2H_2O_{(l)}$$

750 mL of ethyne is reacted completely in excess oxygen and the volume of gases produced is measured at various temperatures. Given that the sublimation temperature of carbon dioxide is –78°C, and the boiling temperature of water is 100°C, what volume of gases is produced when measured at the temperatures listed below?

	above 100°C	**at SLC**	**below –78°C**
A.	2250 mL	2250 mL	1500 mL
B.	1500 mL	750 mL	0 mL
C.	2250 mL	1500 mL	750 mL
D.	2250 mL	1500 mL	0 mL

Question 20

Rain water is naturally slightly acidic. The gas which is responsible for this **natural** acidity is

A. sulfur dioxide.

B. carbon dioxide.

C. nitrogen dioxide.

D. hydrogen sulphide.

END OF SECTION A

SECTION B – Short answer questions

Instructions for Section B

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

To obtain full marks for your responses you should

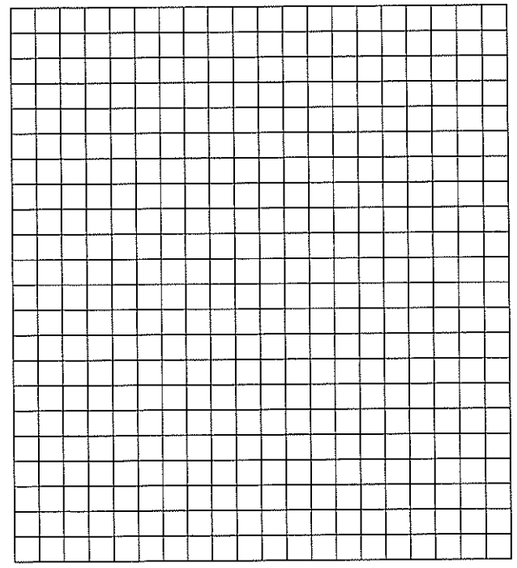
- give simplified answers with an appropriate number of significant figures to all numerical questions; unsimplified answers will not be given full marks.
- show all working in your answers to numerical questions. No credit will be given for an incorrect answer unless it is accompanied by details of the working.
- make sure chemical equations are balanced and that the formulas for individual substances include an indication of state; for example $H_2(g)$; NaCl(s)

Question 1

a. Use the information in the table to plot a solubility curve on the graph for a soluble salt whose formula is $Z(NO_3)_2$ where Z is a metal. 2 marks

Temperature °C	Solubility g/100g H_2O
10	43.0
20	52.0
30	61.0
50	79.0
70	97.0
80	106.0

Solubility (g/100g H_2O)



Temperature (°C)

Use the graph drawn in part **a.** to answer parts **b.**, **c.** and **d.** of this question.

b. What is the maximum mass of $Z(NO_3)_2$ that will dissolve in 100 g of water at 55°C? _____

1 mark

c. When a saturated solution of $Z(NO_3)_2$ dissolved in 90 g of water at 75°C cools to 20°C, what is the mass of solid which crystallises from solution?

_____

_____

_____

_____

_____

3 marks

1. Periodic table of the elements

Key: atomic number 79; symbol of element Au; relative atomic mass 197.0; name of element Gold

1 H 1.0 Hydrogen																	2 He 4.0 Helium
3 Li 6.9 Lithium	4 Be 9.0 Beryllium											5 B 10.8 Boron	6 C 12.0 Carbon	7 N 14.0 Nitrogen	8 O 16.0 Oxygen	9 F 19.0 Fluorine	10 Ne 20.1 Neon
11 Na 23.0 Sodium	12 Mg 24.3 Magnesium											13 Al 27.0 Aluminium	14 Si 28.1 Silicon	15 P 31.0 Phosphorus	16 S 32.1 Sulfur	17 Cl 35.5 Chlorine	18 Ar 39.9 Argon
19 K 39.1 Potassium	20 Ca 40.1 Calcium	21 Sc 44.9 Scandium	22 Ti 47.9 Titanium	23 V 50.9 Vanadium	24 Cr 52.0 Chromium	25 Mn 54.9 Manganese	26 Fe 55.9 Iron	27 Co 58.9 Cobalt	28 Ni 58.7 Nickel	29 Cu 63.6 Copper	30 Zn 65.4 Zinc	31 Ga 69.7 Gallium	32 Ge 72.6 Germanium	33 As 74.9 Arsenic	34 Se 79.0 Selenium	35 Br 79.9 Bromine	36 Kr 83.8 Krypton
37 Rb 85.5 Rubidium	38 Sr 87.6 Strontium	39 Y 88.9 Yttrium	40 Zr 91.2 Zirconium	41 Nb 92.9 Niobium	42 Mo 95.9 Molybdenum	43 Tc 98.1 Technetium	44 Ru 101.1 Ruthenium	45 Rh 102.9 Rhodium	46 Pd 106.4 Palladium	47 Ag 107.9 Silver	48 Cd 112.4 Cadmium	49 In 114.8 Indium	50 Sn 118.7 Tin	51 Sb 121.8 Antimony	52 Te 127.6 Tellurium	53 I 126.9 Iodine	54 Xe 131.3 Xenon
55 Cs 132.9 Caesium	56 Ba 137.3 Barium	57 La 138.9 Lanthanum	72 Hf 178.5 Hafnium	73 Ta 180.9 Tantalum	74 W 183.8 Tungsten	75 Re 186.2 Rhenium	76 Os 190.2 Osmium	77 Ir 192.2 Iridium	78 Pt 195.1 Platinum	79 Au 197.0 Gold	80 Hg 200.6 Mercury	81 Tl 204.4 Thallium	82 Pb 207.2 Lead	83 Bi 209.0 Bismuth	84 Po (209) Polonium	85 At (210) Astatine	86 Rn (222) Radon
87 Fr (223) Francium	88 Ra (226) Radium	89 Ac (227) Actinium	104 Rf (261) Rutherfordium	105 Db (262) Dubnium	106 Sg (266) Seaborgium	107 Bh (264) Bohrium	108 Hs (277) Hassium	109 Mt (268) Meitnerium	110 Ds (271) Darmstadtium	111 Rg (272) Roentgenium	112 Uub		114 Uuq		116 Uuh		118 Uuo

58 Ce 140.1 Cerium	59 Pr 140.9 Praseodymium	60 Nd 144.2 Neodymium	61 Pm (145) Promethium	62 Sm 150.3 Samarium	63 Eu 152.0 Europium	64 Gd 157.2 Gadolinium	65 Tb 158.9 Terbium	66 Dy 162.5 Dysprosium	67 Ho 164.9 Holmium	68 Er 167.3 Erbium	69 Tm 168.9 Thulium	70 Yb 173.0 Ytterbium	71 Lu 175.0 Lutetium
90 Th 232.0 Thorium	91 Pa 231.0 Protactinium	92 U 238.0 Uranium	93 Np (237.1) Neptunium	94 Pu (244) Plutonium	95 Am (243) Americium	96 Cm (247) Curium	97 Bk (247) Berkelium	98 Cf (251) Californium	99 Es (252) Einsteinium	100 Fm (257) Fermium	101 Md (258) Mendelevium	102 No (259) Nobelium	103 Lr (262) Lawrencium

CENTRE FOR STRATEGIC EDUCATION – YEAR 11 CHEMISTRY
Written Test 2 – October 2009

ANSWER SHEET

STUDENT NAME:

INSTRUCTIONS:

Use a **PENCIL** for **ALL** entries. For each question, shade the box which indicates your answer.
All answers must be completed like **THIS** example: A ■ C D
Marks will not be deducted for incorrect answers.
NO MARK will be given if more than **ONE** answer is completed for any question.
If you make a mistake, **ERASE** the incorrect answer – **DO NOT** cross it out.

ONE ANSWER PER LINE					ONE ANSWER PER LINE					ONE ANSWER PER LINE				
1	A	B	C	D	9	A	B	C	D	17	A	B	C	D
2	A	B	C	D	10	A	B	C	D	18	A	B	C	D
3	A	B	C	D	11	A	B	C	D	19	A	B	C	D
4	A	B	C	D	12	A	B	C	D	20	A	B	C	D
5	A	B	C	D	13	A	B	C	D					
6	A	B	C	D	14	A	B	C	D					
7	A	B	C	D	15	A	B	C	D					
8	A	B	C	D	16	A	B	C	D					

CSE CENTRE FOR STRATEGIC EDUCATION
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YEAR 11 – CHEMISTRY

Written test 2

DATA Sheet

Directions to students

This data sheet is for your reference.

You should remove it from the centrefold during reading time.

Any writing, notes, drawings or jottings you make on this data sheet will **not** be considered in the marking.

At the end of the test, make sure that you do **not** leave the data sheet in the centrefold of the question and answer book.

You may keep this data sheet.

Physical Constants

Molar volume at STP = 22.4 L mol^{-1}

Molar Volume at SLC = 24.5 L mol^{-1}

Ideal gas equation $pV = nRT$

R = 8.31 JK^{-1} mol^{-1}

0°C = 273 K

Avogadro constant = 6.02 x 10^{23} mol^{-1}

Specific heat capacity of copper = 0.39 Jg^{-1} $°C^{-1}$

Specific heat capacity of water = 4.2 Jg^{-1} $°C^{-1}$