Junior Summer Work

1. [Maximum mark: 1]

Metal M reacts with 16.0 g of sulfur to produce 26.0 g of the compound MS_2. What is the relative atomic mass of M?

A. 5

B. 10

C. 20

D. 40 [1]

2. [Maximum mark: 1]

64 g of methane and 96 g of oxygen are reacted according to the equation.

$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$

What would be found in the reaction vessel at completion of the reaction?

A. $CO_2(g)$ and $H_2O(l)$ only

B. $O_2(g)$, $CO_2(g)$ and $H_2O(l)$ only

C. $CH_4(g)$, $CO_2(g)$ and $H_2O(l)$ only

D. $CH_4(g)$, $O_2(g)$, $CO_2(g)$ and $H_2O(l)$ [1]

3. [Maximum mark: 1]

Ammonia reacts with oxygen to produce nitrogen (II) oxide and water.

$$\_\_\_ NH_3(g) + \_\_\_ O_2(g) \rightarrow \_\_\_ NO(g) + \_\_\_ H_2O(l)$$

What is the NH_3:O_2 ratio in the balanced equation?

A. 2:5

B. 4:5

C. 1:1

D. 2:1 [1]

4. [Maximum mark: 1]

Gallium (A_r = 69.72) consists of two stable isotopes, Ga-69 and Ga-71.

What is the relative abundance of Ga-71?

A. 36 %

B. 40 %

C. 60 %

D. 64 % [1]

5. [Maximum mark: 1]

Which electron configuration represents a d-block element in the ground state?

A. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^1$

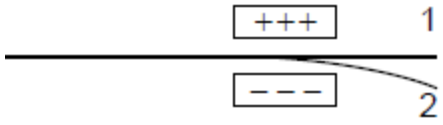
B. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^{10}$

C. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^9$

D. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^{10} 4p^1$ [1]

6. [Maximum mark: 1]

A beam containing two different kinds of particles is passed through oppositely charged plates with the results shown in the diagram.



What conclusion can be drawn from this observation?

A. Particle 1 has a larger mass than particle 2.

B. Particle 2 has a larger mass than particle 1.

C. Particle 1 is positively charged.

D. Particle 2 is positively charged. [1]

7. [Maximum mark: 1]

Which factor generally increases when first ionization energy increases?

A. Atomic radius

B. Electronegativity

C. Metallic character

D. Nuclear charge [1]

8. [Maximum mark: 1]

The periodic table provided shows 118 elements. Which group of elements would a new element with atomic number 119 be most similar to?

A. Alkali metals

B. Halogens

C. Lanthanoids and actinoids

D. Noble gases [1]

9. [Maximum mark: 1]

The formula for praseodymium phosphate is $PrPO_4$. What is the formula for praseodymium oxide?

A. Pr_2O

B. PrO

C. Pr_2O_3

D. PrO_2 [1]

10. [Maximum mark: 1]

Which reactions release heat?

I. $C(s) + O_2(g) \rightarrow CO_2(g)$

II. $Na^+(g) + e^- \rightarrow Na(g)$

III. $NH_3(g) \rightarrow NH_3(l)$

A. I and II only

B. I and III only

C. II and III only

D. I, II and III [1]

11. [Maximum mark: 1]

Which expression represents the calculation used to obtain the $\Delta H^{\ominus}$ value for the conversion of oxygen to one mole of ozone (O_3)?

		$\Delta H^{\ominus}$, kJ
Eqn (i)	$2CO_2 \rightarrow 2CO + O_2$	+566
Eqn (ii)	$3CO + O_3 \rightarrow 3CO_2$	–992

A. $-566 - 922$

B. $-566 + 992$

C. $1.5 \times (-566) + 992$

D. $1.5 \times (-566) - 992$ [1]

12. [Maximum mark: 1]

Ammonia reacts with oxygen to produce nitrogen (II) oxide and water.

$$\_\_\_ NH_3(g) + \_\_\_ O_2(g) \rightarrow \_\_\_ NO(g) + \_\_\_ H_2O(l)$$

What is the NH_3:O_2 ratio in the balanced equation?

A. 2:5

B. 4:5

C. 1:1

D. 2:1 [1]

13. [Maximum mark: 1]

Metal M reacts with 16.0 g of sulfur to produce 26.0 g of the compound MS_2. What is the relative atomic mass of M?

A. 5

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C. 20

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14. [Maximum mark: 1]

64 g of methane and 96 g of oxygen are reacted according to the equation.

$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$

What would be found in the reaction vessel at completion of the reaction?

A. $CO_2(g)$ and $H_2O(l)$ only

B. $O_2(g)$, $CO_2(g)$ and $H_2O(l)$ only

C. $CH_4(g)$, $CO_2(g)$ and $H_2O(l)$ only

D. $CH_4(g)$, $O_2(g)$, $CO_2(g)$ and $H_2O(l)$ [1]

15. [Maximum mark: 1]

Gallium ($A_r = 69.72$) consists of two stable isotopes, Ga-69 and Ga-71.

What is the relative abundance of Ga-71?

A. 36 %

B. 40 %

C. 60 %

D. 64 % [1]

16. [Maximum mark: 1]

The first three ionization energies for two elements, X and Y, are:

	Ionization energies ($kJ\,mol^{-1}$)		
	First	**Second**	**Third**
X	900	1757	14 849
Y	1086	2350	4620

Which pair of elements represent X and Y, respectively?

A. Lithium and beryllium

B. Lithium and carbon

C. Beryllium and carbon

D. Helium and beryllium [1]

17. [Maximum mark: 1]

Which group of elements have the most similar atomic radii?

A. Li, Be, B, C

B. Fe, Co, Ni, Cu

C. K, Ca, Br, Kr

D. Ne, Ar, Kr, Xe [1]

18. [Maximum mark: 1]

Which aqueous solutions would have a different wavelength of maximum absorbance from 0.10 mol dm^{-3} $FeSO_4$?

I. 0.01 mol dm^{-3} $FeSO_4$

II. 0.10 mol dm^{-3} $Fe_2(SO_4)_3$

III. 0.10 mol dm^{-3} $FeSCN^{2+}$

A. I and II only

B. I and III only

C. II and III only

D. I, II and III [1]

19. [Maximum mark: 1]

Which reactions release heat?

I. $C(s) + O_2(g) \rightarrow CO_2(g)$

II. $Na^+(g) + e^- \rightarrow Na(g)$

III. $NH_3(g) \rightarrow NH_3(l)$

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20. [Maximum mark: 1]

Which expression represents the calculation used to obtain the $\Delta H^{\ominus}$ value for the conversion of oxygen to one mole of ozone (O_3)?

		$\Delta H^{\ominus}$, kJ
Eqn (i)	$2CO_2 \rightarrow 2CO + O_2$	+566
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A. −566 − 922

B. −566 + 992

C. 1.5 × (−566) + 992

D. 1.5 × (−566) − 992 [1]

21. [Maximum mark: 1]

Which information does the molecular formula provide?

A. The simplest ratio of atoms in a molecule

B. The actual numbers of atoms in a molecule

C. The number of molecules in one mole

D. The types of bonds in a molecule [1]

22. [Maximum mark: 1]

A student heated a known mass of zinc powder in an open crucible until there was no further mass change and recorded the final mass.

What would the student be able to derive from this data?

I. Percentage composition of zinc oxide
II. Empirical formula of zinc oxide
III. Molecular formula of zinc oxide

A. I and II only

B. I and III only

C. II and III only

D. I, II and III [1]

23. [Maximum mark: 1]

What is the molar mass of a gas according to the following experimental data?

Mass of gas	40.0 g
Volume	220 cm3
Temperature	17 °C
Pressure	98 kPa

Ideal gas constant = 8.31 J K^{-1} mol^{-1}

PV = nRT

A. $\frac{40.0 \times 8.31 \times 290}{98 \times 0.220}$

B. $\frac{98 \times 0.220}{40.0 \times 8.31 \times 290}$

C. $\frac{40.0 \times 8.31 \times 17}{98 \times 0.220}$

D. $\frac{98 \times 0.220}{40.0 \times 8.31 \times 17}$ [1]

24. [Maximum mark: 1]

Which information does the molecular formula provide?

A. The simplest ratio of atoms in a molecule

B. The actual numbers of atoms in a molecule

C. The number of molecules in one mole

D. The types of bonds in a molecule [1]

25. [Maximum mark: 1]

A student heated a known mass of zinc powder in an open crucible until there was no further mass change and recorded the final mass.

What would the student be able to derive from this data?

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II. Empirical formula of zinc oxide
III. Molecular formula of zinc oxide

A. I and II only

B. I and III only

C. II and III only

D. I, II and III [1]

26. [Maximum mark: 1]

What is the molar mass of a gas according to the following experimental data?

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Volume	220 cm3
Temperature	17 °C
Pressure	98 kPa

Ideal gas constant = 8.31 J K^{-1} mol^{-1}

PV = nRT

A. $\frac{40.0 \times 8.31 \times 290}{98 \times 0.220}$

B. $\frac{98 \times 0.220}{40.0 \times 8.31 \times 290}$

C. $\frac{40.0 \times 8.31 \times 17}{98 \times 0.220}$

D. $\frac{98 \times 0.220}{40.0 \times 8.31 \times 17}$ [1]

27. [Maximum mark: 1]

What is the enthalpy change of the reaction, in kJ?

$2C\,(graphite) + O_2\,(g) \rightarrow 2CO\,(g)$

Substance	$\Delta H^{\ominus}_{combustion}$ / kJ mol^{-1}
C (graphite)	−394
CO (g)	−283

A. −394 − 283

B. 2(−394) + 2(−283)

C. −394 + 283

D. 2(−394) + 2(283)

[1]

28. [Maximum mark: 1]

What is the coefficient of HCl (aq) when the equation is balanced using the smallest possible whole numbers?

$$\_\_CuO\,(s) + \_\_HCl\,(aq) \rightarrow \_\_CuCl_2\,(aq) + \_\_H_2O\,(l)$$

A. 1

B. 2

C. 3

D. 4

[1]

29. [Maximum mark: 1]

What is the enthalpy change of reaction for the following equation?

$C_2H_4\,(g) + H_2\,(g) \rightarrow C_2H_6\,(g)$

$C_2H_4\,(g) + 3O_2\,(g) \rightarrow 2CO_2\,(g) + 2H_2O\,(l) \quad \Delta H = x$

$C_2H_6\,(g) + \frac{7}{2}O_2\,(g) \rightarrow 2CO_2\,(g) + 3H_2O\,(l) \quad \Delta H = y$

$H_2\,(g) + \frac{1}{2}O_2\,(g) \rightarrow H_2O\,(l) \quad \Delta H = z$

A. $x + y + z$

B. $-x - y + z$

C. $x - y - z$

D. $x - y + z$ [1]

30. [Maximum mark: 1]

What volume of carbon dioxide, $CO_2\,(g)$, can be obtained by reacting 1 dm^3 of methane, $CH_4\,(g)$, with 1 dm^3 of oxygen, $O_2\,(g)$?

$CH_4\,(g) + 2O_2\,(g) \rightarrow CO_2\,(g) + 2H_2O\,(l)$

A. 0.5 dm^3

B. 1 dm^3

C. 2 dm^3

D. 6 dm^3 [1]

31. [Maximum mark: 1]

What is the enthalpy change of reaction for the following equation?

$$C_2H_4(g) + H_2(g) \rightarrow C_2H_6(g)$$

$$C_2H_4(g) + 3O_2(g) \rightarrow 2CO_2(g) + 2H_2O(l) \qquad \Delta H = x$$

$$C_2H_6(g) + \frac{7}{2}O_2(g) \rightarrow 2CO_2(g) + 3H_2O(l) \qquad \Delta H = y$$

$$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l) \qquad \Delta H = z$$

A. $x+y+z$

B. $-x-y+z$

C. $x-y-z$

D. $x-y+z$

[1]

32. [Maximum mark: 1]

What is the IUPAC name of $NiCO_3$?

A. nickel(II) carbonate

B. nickel carbonate

C. nickel(I) carbonate

D. nitrogen(I) carbonate [1]