# Atomic Structure

*(International Baccalaureate Diploma Programme HL Past Year Topical Questions )*

Specimen Paper (Higher Level) Paper 1A

**3.** The table lists successive ionization energies of an element **Z**.

| **Ionization number** | **1st** | **2nd** | **3rd** | **4th** | **5th** | **6th** |
|---|---|---|---|---|---|---|
| **Ionization energy / kJ mol$^{-1}$** | 577.54 | 1816.68 | 2744.78 | 11577.5 | 14841.9 | 18379.0 |

Which is the formula of the stable oxide of the element **Z**?

A. $Z_2O$

B. ZO

C. $Z_2O_3$

D. $ZO_2$

Specimen Paper (Higher Level) Paper 1A

**3.** Which electron transition in the hydrogen atom emits radiation with the highest energy?

A. n = 1 to n = 2

B. n = 2 to n = 3

C. n = 2 to n = 1

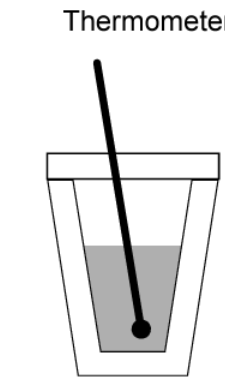
D. n = 3 to n = 2

# Energetics/Thermochemistry

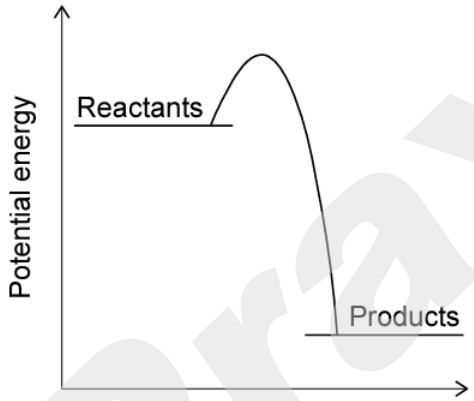
*(International Baccalaureate Diploma Programme HL Past Year Topical Questions )*

Specimen Paper (Higher Level) Paper 1A

**20.** The potential energy profile for a "coffee cup" calorimetry experiment is shown.




Coffee cup calorimeter




What is the correct interpretation of this reaction?

| | Temperature | Type of reaction |
|---|---|---|
| A. | increases | exothermic |
| B. | increases | endothermic |
| C. | decreases | exothermic |
| D. | decreases | endothermic |

**16.** Which set of conditions describe a reaction in which the reactants are more stable than the products?

A. endothermic and $\Delta H$ negative

B. endothermic and $\Delta H$ positive

C. exothermic and $\Delta H$ negative

D. exothermic and $\Delta H$ positive

**17.** Which enthalpy changes can be calculated using only bond enthalpy data?

I. $N_2(g) + 2H_2(g) \rightarrow N_2H_4(g)$

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

III. $H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$

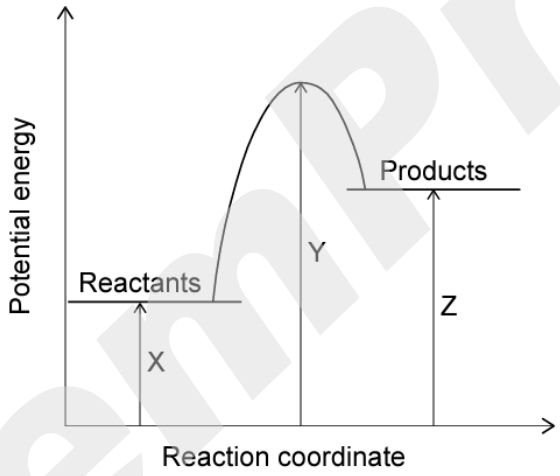
A. I and II only

B. I and III only

C. II and III only

D. I, II and III

**22.** The diagram shows the energy profile of a reaction.




Which combination is correct?

| | Activation energy of forward reaction | Activation energy of reverse reaction |
|---|---|---|
| A. | X | Z |
| B. | Y – X | Y – Z |
| C. | Y | Y |
| D. | Y – X | Z – X |

# Equilibrium

*(International Baccalaureate Diploma Programme HL Past Year Topical Questions )*

Specimen Paper (Higher Level) Paper 1A

**24.** What is correct as a system approaches equilibrium?

A. $Q$ remains constant.

B. $K_c$ increases.

C. $\Delta G^{\ominus}$ becomes more negative.

D. $\Delta G$ approaches zero.

**28.** What is the equilibrium constant expression for the following reaction?

$$2SO_3(g) \rightleftharpoons 2SO_2(g) + O_2(g)$$

A. $\frac{[SO_2]^2[O_2]}{[SO_3]^2}$

B. $\frac{[SO_2]^2 + [O_2]}{[SO_3]^2}$

C. $\frac{[SO_3]^2}{[SO_2]^2[O_2]}$

D. $\frac{2[SO_2][O_2]}{2[SO_3]}$

**30.** The equation for the reaction between two gases, A and B, is:

$$A(g) + 2B(g) \rightleftharpoons 2C(g)$$

When the reaction is at equilibrium at 600 K, the concentrations of A, B, and C are 2, 1, and 2 mol $dm^{-3}$ respectively. What is the value of the equilibrium constant at 600 K?

A. 0.25

B. 1

C. 2

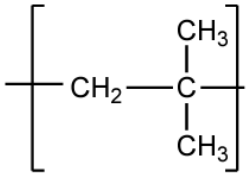
D. 4

# Organic Chemistry

*(International Baccalaureate Diploma Programme HL Past Year Topical Questions )*

Specimen Paper (Higher Level) Paper 1A

**12.** The structure shows the repeating unit of a polymer found in some plastics.




Which monomer is used to form this plastic?

A. $H_2C=C(CH_3)_2$

B. $CH_3CH(CH_3)_2$

C. $(H_3C)_2C=C(CH_3)_2$

D. $(H_3C)_2C=CHCH(CH_3)_2$

**14.** Which molecule has a carbonyl functional group?

A. $CH_3OCH_3$

B. $CH_3COCH_3$

C. $CH_3CH_2OH$

D. $CH_3CH_2NH_2$

**39.** Which statement is correct when 2-chloro-2-methylpentane reacts with water to form 2-methylpentan-2-ol?

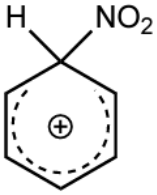
A. Water acts as a nucleophile and attacks the chlorine atom.

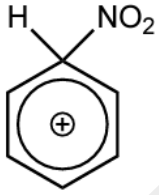
B. The reaction occurs in a single step.

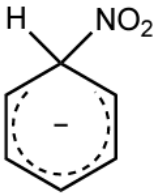
C. A carbocation intermediate is formed.

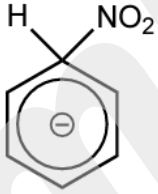
D. Homolytic bond fission occurs.

**40.** Which illustrates the correct intermediate formed in the nitration of benzene by $NO_2^+$?

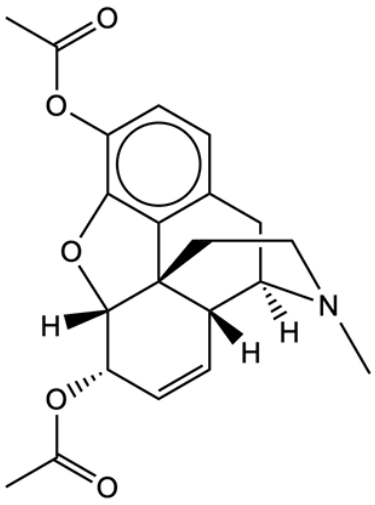
A. 


C. 


B. 


D. 

**12.** Which functional groups are present in this molecule?




A. amino, alkoxy, ester

B. ether, carboxyl, amino

C. carboxyl, alkoxy, ester

D. ester, amino, carboxyl

**28.** What is the organic product of the reaction of 1-chloropentane with aqueous sodium hydroxide?

A. pentan-1-ol

B. 1-chloropentan-1-ol

C. 1-chloropent-1-ene

D. 1-chloropent-2-ene

**30.** Which species can act as an electrophile?

A. $CH_4$

B. $Cl_2$

C. $Cl^-$

D. $OH^-$