THE OPEN UNIVERSITY OF SRI LANKA

B. Sc./B .Ed Degree Programme — 2010/2011

Level 4 — CMU 2122/CME 4122

Assignment Test II (NBT)

14th October 2010 (Thursday)	Duration: 1.30 hours	4.00 — 530 p.m.

Gas constant (R)	=	$8.314\ JK^{-1}mol^{-1}$
Avogadro constant (N_A)	=	$6.023\times10^{23}\ mol^{-1}$
Faraday constant (F)	=	$96,500\ C mol^{-1}$
Planck constant (h)	=	$6.63\times10^{-34}\ Js$
Velocity of light (c)	=	$3.0\times10^{8}\ ms^{-1}$
Standard atmospheric pressure	=	$10^{5}\ Pa\left(Nm^{-2}\right)$
$Log_e(X)$	=	$2.303\ Log_{10}(X)$

Part A – 15 Multiple Choice Questions (90 Marks)

Answer all questions

Select the most correct answer to each question given below and mark a cross **X** over the answer on the **given answer sheet.** Any answers with more than one **X** will not be counted. 1/6th of a mark will be deducted for each incorrect answer.

1. An operational definition of symmetry involves
   (a) a geometric element.
   (b) an operation.
   (c) a procedure.

   The correct statements, out of (a), (b) and (c) above, are
   (1) (a) and (b) only. (2) (a) and (c) only. (3) (b) and (c) only.
   (4) All (a), (b) and (c). (5) None of the answers (1), (2), (3) or (4), is correct.

2. Symmetry of a molecule is determined by
   (a) its nuclear skeleton.
   (b) its electron density distribution.
   (c) the relative lengths of chemical bonds and the angles between chemical bonds.

   The correct statements, out of (a), (b) and (c) above, are
   (1) (a) and (b) only. (2) (a) and (c) only. (3) (b) and (c) only.
   (4) All (a), (b) and (c). (5) None of the answers (1), (2), (3) or (4), is correct.

3. The *total* set of *distinct symmetry operations* about an axis of order 5 is

   (1) $C_5, C_5^3, C_5^5, C_5^7, E$ (2) $C_5^2, C_5^4, C_5^6, C_5^8, C_5^{10}$ (3) $C_5, C_5^3, C_5^2, C_5^4, E$

   (4) $C_5, C_5^3, C_5^5, C_5^9, E$ (5) None of the answers (1), (2), (3) or (4), is correct.

4. Identical configurations of a molecule are
   (a) equivalent configurations.
   (b) nuclear configurations where similar nuclei occupy slightly different positions in space.
   (c) nuclear configurations where identical nuclei occupy identical positions in space.

   The correct statement/s, out of (a), (b) and (c) above, is/are
   (1) (b) only. (2) (c) only. (3) (a) and (b) only.
   (4) (a), and (c) only (5) (b) and (c) only

5. A symmetry operation
   (a) always carries the nuclei of a molecule from one configuration to an identical configuration.
   (b) always carries the nuclei of a molecule from one configuration to an equivalent configuration.
   (c) on a molecule can always be realised, physically, without altering the chemical bonds during the process.

   The correct statement/s, out of (a), (b) and (c) above, is/are
   (1) (a) only. (2) (b) only. (3) (a) and (b) only.
   (4) (a), and (c) only (5) (b) and (c) only

6. Consider the following statements.
   (a) Identity operation carries a nuclear configuration of a molecule to an *equivalent configuration.*
   (b) Identity operation carries a nuclear configuration of a molecule to an *identical configuration.*
   (c) Identity operation is denoted by E.

   The correct statement/s, out of (a), (b) and (c) above, is/are
   (1) (b) only. (2) (c) only. (3) (a) and (b) only.
   (4) (a), and (c) only (5) All (a), (b) and (c)

7. Consider the following statements.
   (a) *Always* one can perform a rotation operation about <u>any axis</u> in a molecule.
   (b) *Always*, a given molecule has only a limited number of axes of rotation.
   (c) *Always* one must be able to perform a rotational symmetry operation, where the angle of rotation is less than 360°, about an axis of rotation.

   The correct statements, out of (a), (b) and (c) above, are
   (1) (a) and (b) only. (2) (a) and (c) only. (3) (b) and (c) only.
   (4) All (a), (b) and (c). (5) None of the <u>answers</u> (1), (2), (3) or (4), is correct.

8. Out of the following, which molecules have a C_{∞} axis?

   (a) HBr (b) CS_2 (c) CH_3-CH_2-CH_2-CH_3 (d) $CH \equiv CH$

   (1) Only (a), (b) and (c). <u>(2) Only (a), (b) and (d).</u> (3) Only (a), (c) and (d).
   (4) Only (b), (c) and (d) (5) All (a), (b), (c) and (d).

9. Consider the following statements.
   (a) A vertical plane is *always* a dihedral plane.
   (b) A dihedral plane is *always* perpendicular to a horizontal plane (when it exists).
   (c) A vertical plane is *always* perpendicular to a horizontal plane (when it exists).

   The correct statements, out of (a), (b) and (c) above, are
   (1) (a) and (b) only. (2) (a) and (c) only. (3) (b) and (c) only.
   (4) All (a), (b) and (c). (5) None of the answers (1), (2), (3) or (4), is correct.

10. Consider the following symmetry planes.
   (a) σ_v of H_2O (b) σ_h of $PtCl_4^{2-}$ (c) σ_h of eclipsed ethane

   The numbers of reflection symmetry operations, which produce distinct outcomes, that can be carried out with respect to each of the above symmetry planes is
   (1) 2,2,1. (2) 1,2,2. (3) 2,1,1. (4) 2,2,2. (5) 2,1,2.

11. Consider the following statements.
   (a) *Always* an inversion centre (of a molecule) is located at a nucleus.
   (b) A molecule can have, at most, *one* inversion centre.
   (c) *In principle*, a macromolecule can have an inversion centre.

   The correct statements, out of (a), (b) and (c) above, are
   (1) (a) and (b) only. (2) (a) and (c) only. (3) (b) and (c) only.
   (4) All (a), (b) and (c). (5) None of the answers (1), (2), (3) or (4), is correct.

12. Consider the following statements.
   (a) All the rotation axes of a molecule must pass through the inversion centre, when it exists.
   (b) A molecule having an inversion centre cannot have a principal axis.
   (c) *All* the symmetry planes of a molecule must pass through the inversion centre, when it exists.

   The correct statements, out of (a), (b) and (c) above, are
   (1) (a) and (b) only. (2) (a) and (c) only. (3) (b) and (c) only.
   (4) All (a), (b) and (c). (5) None of the answers (1), (2), (3) or (4), is correct.

13. Consider the following statements.
   (a) *Always* there are *only* 5 distinct symmetry operations about an S_5 axis.
   (b) *Always* there is a C_5 coincident with an S_5 axis.
   (c) *Always* there is a σ perpendicular to an S_5.

   The correct statements, out of (a), (b) and (c) above, are
   (1) (a) and (b) only. (2) (a) and (c) only. (3) (b) and (c) only.
   (4) All (a), (b) and (c). (5) None of the answers (1), (2), (3) or (4), is correct.

14. Consider the following statements, about the S_4 axis in $PtCl_4^{2-}$.

(a) It is perpendicular to the ionic plane.
(b) It is redundant.
(c) The symmetry operations about it can generate *only* 2 distinct outcomes.

The correct statements, out of (a), (b) and (c) above, are
(1) (a) and (b) only. (2) (a) and (c) only. (3) (b) and (c) only.
(4) All (a), (b) and (c). (5) None of the answers (1), (2), (3) or (4), is correct.

15. Consider the following four relationships.

(a) $S_6^2 = S_6^4$ (b) $S_6^2 = S_6^8$ (c) $S_6^3 = S_6^9$ (d) $S_6^{12} = E$

The correct relationships, out of (a), (b), (c) and (d) above, are
(1) (a) and (b) only. (2) (b) and (c) only. (3) (c) and (d) only.
(4) (a), (b) and (c) only. (5) (b), (c) and (d) only.

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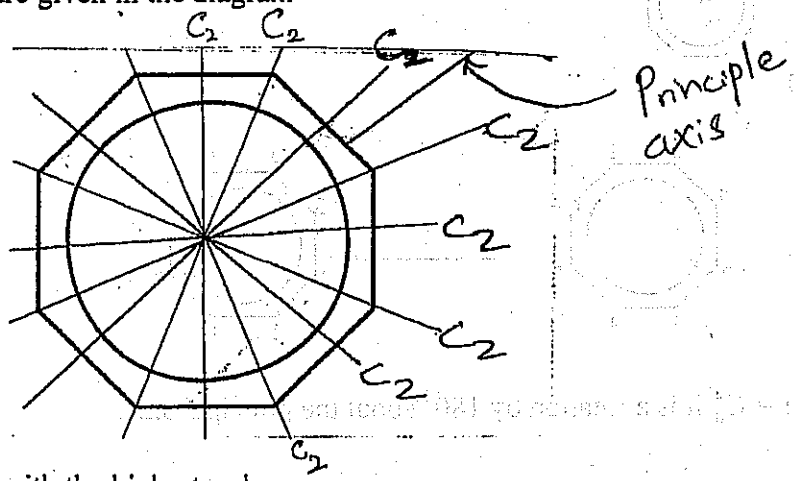
CMU2122 - Inorganic Chemistry - Level 4
Assignment Test - II Answer Guide

Part A – MCQ ANSWERS

1. (4)	**2.** (2)	**3.** (2) (3)	**4.** (4)	**5.** (2)
6. (5)	**7.** (2)	**8.** (2)	**9.** (3)	**10.** (5)
11. (3)	**12.** (2)	**13.** (3)	**14.** (1)	**15.** (5)

Q 1. Answers for part (a), (c) are given in the diagram



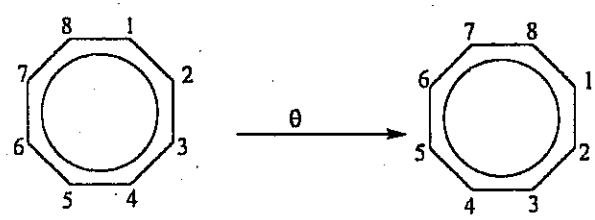
(b) 9

(d) It is the symmetry axis with the highest order.

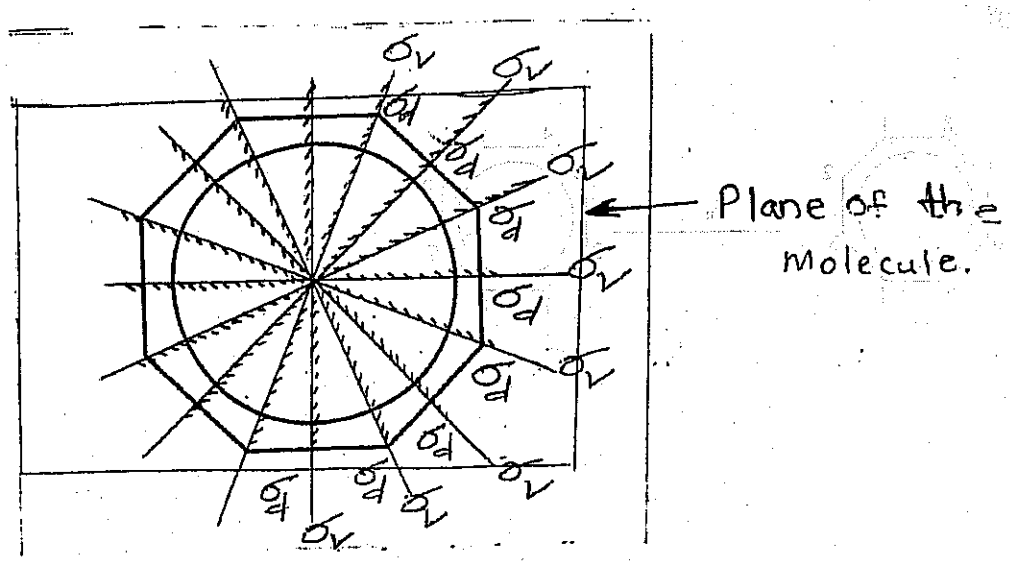
(e) $C_8\ C_8^2\ C_8^3\ C_8^4\ C_8^5\ C_8^6\ C_8^7\ C_8^8$

(f) $\theta = 360^0/8 = 45^0$

(g)



Q 2. Answers for part (a), (c) and (e) are given in the diagram



(b) 9

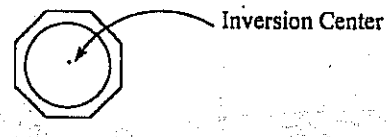
(d) A vertical symmetry plane contains the principal axis. All 8 of the indicated planes contain the principal axis.

(f) (All the above vertical planes are dihedral planes)

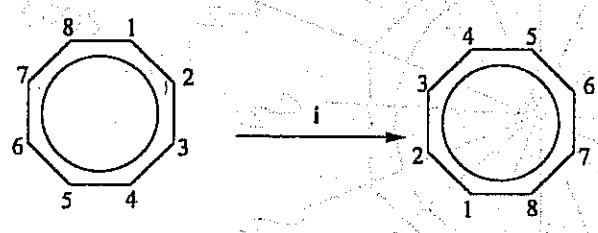
- A dihedral plane is a vertical plane which bisects the angle between two C_2 axes which are perpendicular to the principal axis.

-All the vertical planes satisfy this condition.

Q 3. (a)

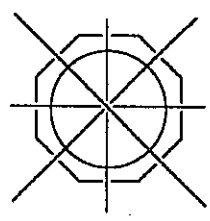


(b)



(c) $i = C_8^4$ It is a rotation by 180^0 about the principal axis.

Q 4. (a)



One of the axis.

(b) Order = 2

The smallest angle of improper rotation about this axis in 180^0 $n = 360^0/180^0 = 2$

(c) 180^0

(d)