Note: For all questions involving solutions, assume that the solvent is water unless otherwise stated.

Throughout the test the following symbols have the definitions specified unless otherwise noted.

H	= enthalpy	atm	= atmosphere(s)
M	= molar	g	= gram(s)
n	= number of moles	J	= joule(s)
P	= pressure	kJ	= kilojoule(s)
R	= molar gas constant	L	= liter(s)
S	= entropy	mL	= milliliter(s)
T	= temperature	mm	= millimeter(s)
V	= volume	mol	= mole(s)
		V	= volt(s)

Part A

Directions: Each set of lettered choices below refers to the numbered statements or questions immediately following it. Select the one lettered choice that best fits each statement or answers each question and then fill in the corresponding circle on the answer sheet. A choice may be used once, more than once, or not at all in each set.

Questions 1-3 refer to the following pieces of laboratory equipment.

(A) Condenser
(B) Funnel
(C) Pipet
(D) Balance
(E) Barometer

1. Commonly used to transfer an exact volume of liquid from one container to another

2. Commonly used in a distillation setup

3. Commonly used in a filtration setup

Questions 4-6 refer to the following information.

Na_2CrO_4, a soluble yellow solid
$PbCrO_4$, an insoluble yellow solid
$NaNO_3$, a soluble white solid
$Pb(NO_3)_2$, a soluble white solid

(A) Yellow solid and colorless solution
(B) Yellow solid and yellow solution
(C) White solid and colorless solution
(D) No solid and yellow solution
(E) No solid and colorless solution

4. Observed when 1.0 mol of Na_2CrO_4 and 2.0 mol of $Pb(NO_3)_2$ are mixed with 1 L of water

5. Observed when 3.0 mol of Na_2CrO_4 and 1.0 mol of $Pb(NO_3)_2$ are mixed with 1 L of water

6. Observed when 1.0 mol of $NaNO_3$ and 1.0 mol of $Pb(NO_3)_2$ are mixed with 1 L of water

Questions 7-9 refer to the following.

(A) Reduction potential
(B) Ionization energy (ionization potential)
(C) Electronegativity
(D) Heat of formation
(E) Activation energy

7. Is the energy change accompanying the synthesis of a compound from its elements in their standard states

8. Is the energy needed to remove an electron from a gaseous atom in its ground state

9. Is the minimum energy needed for molecules to react and form products

Questions 10-13 refer to the following pairs of substances.

(A) NH_3 and N_2H_4
(B) ^{16}O and ^{17}O
(C) NH_4Cl and NH_4NO_3
(D) CH_3OCH_3 and CH_3CH_2OH
(E) O_2 and O_3

10. Are isotopes

11. Have both ionic and covalent bonds

12. Are allotropes

13. Are strong electrolytes in aqueous solution

Questions 14-17 refer to the following subshells.

(A) 1*s*
(B) 2*s*
(C) 3*s*
(D) 3*p*
(E) 3*d*

14. Contains up to ten electrons

15. Contains one pair of electrons in the ground-state electron configuration of the lithium atom

16. Is exactly one-half filled in the ground-state electron configuration of the phosphorus atom

17. Contains the valence electrons in the ground-state electron configuration of the magnesium atom

Questions 18-20 refer to the following gases.

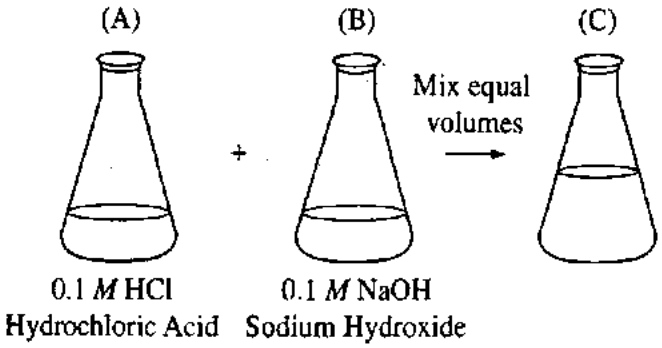
(A) O_3
(B) O_2
(C) CO
(D) Cl_2
(E) SO_2

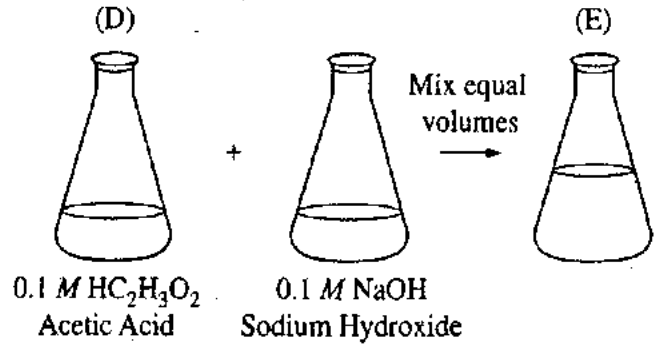
18. Contributes to acid rain

19. In the stratosphere, screens out a large fraction of ultraviolet rays from the Sun

20. Is a product of the incomplete combustion of hydrocarbons

Questions 21-24 refer to the lettered solutions in the laboratory schemes represented below.





21. Has a hydroxide ion concentration of 10^{-7} *M* at 298 K

22. Has the highest pH at 298 K

23. Has a pH greater than 7, but less than 13 at 298 K

24. Has a pH greater than 2, but less than 7 at 298 K

PLEASE GO TO THE SPECIAL SECTION LABELED CHEMISTRY AT THE LOWER LEFT-HAND CORNER OF THE PAGE OF THE ANSWER SHEET YOU ARE WORKING ON AND ANSWER QUESTIONS 101-115 ACCORDING TO THE FOLLOWING DIRECTIONS.

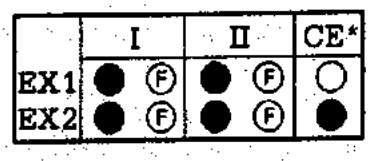
Part B

Directions: Each question below consists of two statements, I in the left-hand column and II in the right-hand column. For each question, determine whether statement I is true or false and whether statement II is true or false and fill in the corresponding T or F circles on your answer sheet. Fill in circle CE only if statement II is a correct explanation of the true statement I.

EXAMPLES:

	I		II
EX 1.	**H_2SO_4 is a strong acid**	**BECAUSE**	**H_2SO_4 contains sulfur.**
EX 2.	**An atom of oxygen is electrically neutral**	**BECAUSE**	**an oxygen atom contains an equal number of protons and electrons.**

SAMPLE ANSWERS



	I		II
101.	C_2H_2 and C_6H_6 have the same chemical and physical properties	BECAUSE	C_2H_2 and C_6H_6 have the same percentages by mass of hydrogen.
102.	The melting of ice is an exothermic process	BECAUSE	water has a relatively high specific heat capacity.
103.	A 2 g sample of nitrogen and a 2 g sample of oxygen contain the same number of molecules	BECAUSE	equal masses of gaseous substances contain the same number of molecules.
104.	When an atom absorbs a photon of visible light, one of its electrons is promoted to a higher energy state	BECAUSE	an electron has a negative charge.
105.	The alkali metals are very good reducing agents	BECAUSE	the alkali metals are easily oxidized.
106.	A 1.0 g sample of calcium citrate, $Ca_3(C_6H_5O_7)_2$ (molar mass 498 g/mol), contains more Ca than a 1.0 g sample of calcium carbonate, $CaCO_3$ (molar mass 100 g/mol),	BECAUSE	there are more Ca atoms in 1.0 mol of calcium carbonate than in 1.0 mol of calcium citrate.
107.	The water molecule is polar	BECAUSE	the radius of an oxygen atom is greater than that of a hydrogen atom.

	I		II
108.	All indicators are colorless in neutral solution	BECAUSE	indicators develop color only in the presence of a strong acid or a strong base.
109.	A 1 *M* sucrose solution and a 1 *M* NaCl solution have the same freezing point	BECAUSE	a 1 *M* sucrose solution and a 1 *M* NaCl solution contain the same number of solute particles per liter of solution.
110.	The average kinetic energy of gas molecules increases as the temperature increases	BECAUSE	the average speed of gas molecules decreases as the temperature increases.
111.	When a concentrated acid is diluted, the acid should be added slowly to the water	BECAUSE	if water is added to a concentrated acid, violent splattering might occur.
112.	Methane, CH_4, is very soluble in water	BECAUSE	water molecules form hydrogen bonds with methane molecules.
113.	A 1 mol sample of electrons is required to reduce 0.5 mol of chlorine gas to chloride ions	BECAUSE	chlorine molecules are diatomic and the charge on the chloride ion is −1.
114.	In 0.1 *M* acetic acid, $[H^+]$ is smaller than $[H^+]$ is in 0.1 *M* hydrochloric acid	BECAUSE	a molecule of acetic acid contains more atoms than does a molecule of hydrogen chloride.
115.	A fluoride ion, F^-, and an oxide ion, O^{2-}, have the same diameter	BECAUSE	the fluoride ion, F^-, and the oxide ion, O^{2-}, have the same number of electrons.

RETURN TO THE SECTION OF YOUR ANSWER SHEET YOU STARTED FOR **CHEMISTRY** AND ANSWER QUESTIONS 25-70.