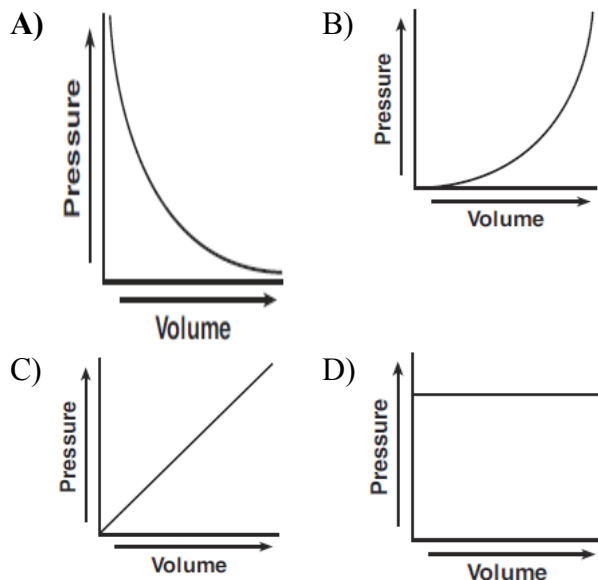# Gases & Solution After School Regents Review Practice

1. A rigid cylinder with a movable piston contains a sample of helium gas. The temperature of the gas is held constant as the piston is pulled outward. Which graph represents the relationship between the volume of the gas and the pressure of the gas?

A)

B)

C)

D)

2. The kinetic molecular theory states that all particles of an ideal gas are

A) colliding without transferring energy
B) in random, constant, straight-line motion
C) arranged in a regular geometric pattern
D) separated by small distances relative to their size

3. Which statement describes particles of an ideal gas, based on the kinetic molecular theory?

A) Gas particles are separated by distances smaller than the size of the gas particles.
B) Gas particles do not transfer energy to each other when they collide.
C) Gas particles have no attractive forces between them.
D) Gas particles move in predictable, circular motion.

4. At 25ºC, gas in a rigid cylinder with a movable piston has a volume of 145 mL and a pressure of 125 kPa. Then the gas is compressed to a volume of 80. mL. What is the new pressure of the gas if the temperature is held at 25ºC?

A) 69 kPa   B) 93 kPa
C) 160 kPa   **D) 230 kPa**

5. Which temperature change would cause a sample of an ideal gas to double in volume while the pressure is held constant?

A) from 400. K to 200. K
B) from 200. K to 400. K
C) from 400.°C to 200.°C
D) from 200.°C to 400.°C

6. A rigid cylinder with a movable piston contains 50.0 liters of a gas at $30.0°C$ with a pressure of 1.00 atmosphere. What is the volume of the gas in the cylinder at STP?

A) 5.49 L   **B) 45.0 L**
C) 55.5 L   D) 455 L

7. When a sample of gas is cooled in a sealed, rigid container, the pressure the gas exerts on the walls of the container will decrease because the gas particles hit the walls of the container

A) less often and with less force
B) less often and with more force
C) more often and with less force
D) more often and with more force

8. At 50.°C and standard pressure, intermolecular forces of attraction are strongest in a sample of

A) ethanoic acid   B) ethanol
C) propanone   D) water

9. At standard pressure, CH_4 boils at 112 K and H_2O boils at 373 K. What accounts for the higher boiling point of H_2O at standard pressure?

A) covalent bonding   B) ionic bonding
C) hydrogen bonding D) metallic bonding

10. At standard pressure, a certain compound has a low boiling point and is insoluble in water. At STP, this compound most likely exists as

A) ionic crystals
B) metallic crystals
C) nonpolar molecules
D) polar molecules

11. Which liquid has the highest vapor pressure at 75°C?

A) ethanoic acid   B) ethanol
C) propanone   D) water

12. What happens when NaCl(s) is dissolved in water?

    A) Cl^- ions are attracted to the oxygen atoms of water molecules.
    B) Na^+ ions are attracted to the oxygen atoms of water molecules.
    C) Cl^- ions are repelled by the hydrogen atoms of water molecules.
    D) Na^+ ions are repelled by the oxygen atoms of water molecules.

13. After being thoroughly stirred at 10.°C, which mixture is heterogenous?

    A) 25.0 g of KCl and 100. g of H_2O
    B) 25.0 g of KNO_3 and 100. g of H_2O
    C) 25.0 g of NaCl and 100. g of H_2O
    D) 25.0 g of $NaNO_3$ and 100. g of H_2O

14. Powdered sulfur is yellow, and powdered iron is gray. When powdered sulfur and powdered iron are mixed at 20ºC, the powdered iron

    A) becomes yellow
    B) becomes a liquid
    C) remains ionic
    D) remains magnetic

15. Which sample of matter is a mixture?

    A) $H_2O(s)$ B) $H_2O(g)$
    C) $NaCl(\ell)$ **D) NaCl(aq)**

16. A 1-gram sample of a compound is added to 100 grams of $H_2O(\ell)$ and the resulting mixture is then thoroughly stirred. Some of the compound is then separated from the mixture by filtration. Based on Table F, the compound could be

    A) AgCl   B) $CaCl_2$
    C) NaCl   D) $NiCl_2$

17. A beaker contains both alcohol and water. These liquids can be separated by distillation because the liquids have different

    A) boiling points   B) densities
    C) particle sizes   D) solubilities

18. Based on Reference Table F, which of the following compounds is *least* soluble in water?

    A) NaCl   B) Pb_2ClO_3
    C) Na_2CrO_4 **D) $PbCrO_4$**

19. According to Table G, which substance forms an unsaturated solution when 80. grams of the substance are stirred into 100. grams of H_2O at 10.°C?

    A) KNO_3 **B) KI**
    C) NH_3 D) NaCl

20. At standard pressure, which substance becomes *less* soluble in water as temperature increases from 10.°C to 80.°C?

    A) HCl   B) KCl
    C) NaCl   D) NH_4Cl

21. Carbon dioxide gas is most soluble in water under conditions of

    A) high pressure and low temperature
    B) high pressure and high temperature
    C) low pressure and low temperature
    D) low pressure and high temperature

22. Based on Table F, which equation represents a saturated solution having the lowest concentration of Cl^- ions?

    A) $NaCl(s) \rightleftharpoons Na^+(aq) + Cl^-(aq)$
    B) $AgCl(s) \rightleftharpoons Ag^+(aq) + Cl^-(aq)$
    C) $NH_4Cl(s) \rightleftharpoons NH_4^+(aq) + Cl^-(aq)$
    D) $KCl(s) \rightleftharpoons K^+(aq) + Cl^-(aq)$

23. What is the total mass of KNO_3 that must be dissolved in 50. grams of H_2O at 60.°C to make a saturated solution?

    A) 32 g   **B) 53 g**
    C) 64 g   D) 106 g

24. What is the molarity of a solution that contains 0.500 mole of KNO_3 dissolved in 0.500-liter of solution?

    A) 1.00 M   B) 2.00 M
    C) 0.500 M   D) 4.00 M

25. What is the concentration of AgCl in an aqueous solution that contains 1.2×10^{-3} gram of AgCl in 800. grams of the solution?

   A) 1.2 ppm   **B) 1.5 ppm**
    C) 7.2 ppm   D) 9.6 ppm

26. Which sample, when dissolved in 1.0 liter of water,
    produces a solution with the highest boiling point?

    A) 0.1 mole KI   B) 0.2 mole KI
    C) 0.1 mole MgCl$_2$ **D)** 0.2 mole MgCl$_2$

Base your answers to questions **27** through **29** on the information below and on your knowledge of chemistry.

     A solution of ethylene glycol and water can be used as the coolant in an engine-cooling system. The ethylene glycol concentration in a coolant solution is often given as percent by volume. For example, 100. mL of a coolant solution that is 40.% ethylene glycol by volume contains 40. mL of ethylene glycol diluted with enough water to produce a total volume of 100. mL. The graph below shows the freezing point of coolants that have different ethylene glycol concentrations.

Freezing Points of Coolants
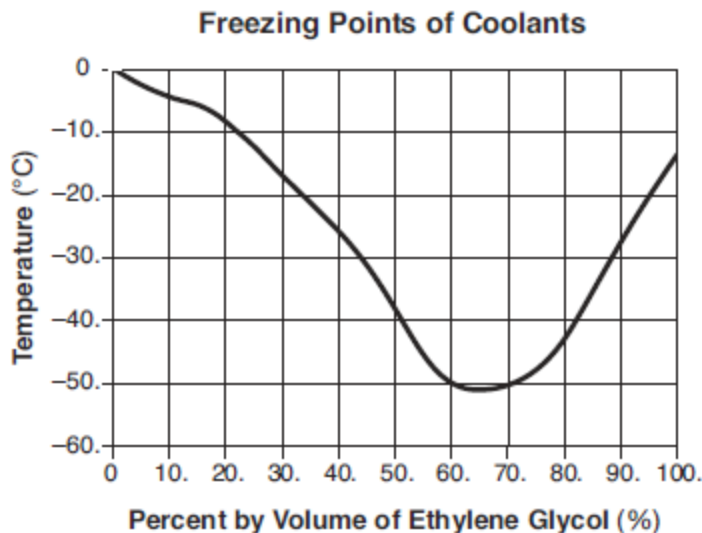
27. One engine-cooling system has a volume of 6400 mL. Determine the volume of ethylene glycol in the completely filled engine-cooling system when the concentration of ethylene glycol is 50.% by volume.

28. Explain, in terms of the molecular polarity, why ethylene glycol dissolves in water to form a solution.

29. Explain, in terms of particle distribution, why a coolant solution is a homogeneous mixture.

Base your answers to questions **30** and **31** on the information below and on your knowledge of chemistry.

The diagram and data below represent a gas and the conditions of pressure, volume, and temperature of the gas in a rigid cylinder with a moveable piston.

$N_2(g)$
$P = 1.0$ atm
$V = 2.5$ L
$T = 298$ K
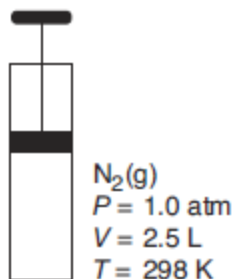
30. State *one* change in temperature and *one* change in pressure that will cause the gas in the cylinder to behave more like an ideal gas.

31. Determine the volume of the gas in the cylinder at STP.

Base your answers to questions **32** through **34** on the information below and on your knowledge of chemistry.

A sample of helium gas is placed in a rigid cylinder that has a movable piston. The volume of the gas is varied by moving the piston, while the temperature is held constant at 273 K. The volumes and corresponding pressures for three trials are measured and recorded in the data table below. For each of these trials, the product of pressure and volume is also calculated and recorded. For a fourth trial, only the volume is recorded.

**Pressure and Volume Data for
a Sample of Helium Gas at 273 K**

Trial Number	Pressure (atm)	Volume (L)	P × V (L•atm)
1	1.000	0.412	0.412
2	0.750	0.549	0.412
3	0.600	0.687	0.412
4	?	1.373	?

32. Compare the average distances between the helium atoms in trial 1 to the average distance between the helium atoms in trial 3.

33. Determine the pressure of the helium gas in trial 4.

34. State evidence found in the data table that allows the product of pressure and volume for the fourth trial to be predicted.

Base your answers to questions **35** through **37** on the information below and on your knowledge of chemistry.

A laboratory technician is given the table below and a sample of one of the three substances listed in the table. The technician makes an aqueous solution with a portion of the sample. When a conductivity tester is lowered into the solution, the lightbulb on the tester glows brightly. Another portion of the sample is placed in a heat-resistant container that is placed in an oven at 450°C. The sample melts.

Some Properties of Three Substances

Property	Substance		
	Sodium nitrate	Potassium chromate	Sulfur
solubility in water at 20.°C	soluble	soluble	insoluble
electrical conductivity of aqueous solution	good	good	not applicable
melting point (°C)	307	974	115

35. Explain, in terms of ions, why an aqueous solution of potassium chromate conducts an electric current.

36. State evidence that makes it necessary to use more than one property to identify the substance given to the technician.

37. Identify the substance given to the technician.

___

Base your answers to questions **38** through **40** on the information below and on your knowledge of chemistry.

Seawater contains dissolved salts in the form of ions. Some of the ions found in seawater are $Ca^{2+}, Mg^{2+}, K^+, Na^+, Cl^-, HCO_3{}^-,$ and $SO_4{}^{2-}$.
An investigation was conducted to determine the concentration of dissolved salts in seawater at one location. A 300.-gram sample of the seawater was placed in an open container. After a week, all the water had evaporated and 10. grams of solid salts remained in the container.

38. At standard pressure, compare the freezing point of seawater to the freezing point of distilled water.

39. Explain why the evaporation that occurred during the investigation is an endothermic process.

40. Determine the concentration, expressed as percent by mass, of the dissolved salts in the original sample of seawater.

Answer Key
Gases and Solutions Review

1. __A__
2. __B__
3. __C__
4. __D__
5. __B__
6. __B__
7. __A__
8. __A__
9. __C__
10. __C__
11. __C__
12. __B__
13. __B__
14. __D__
15. __D__
16. __A__
17. __A__
18. __D__
19. __B__
20. __A__
21. __A__
22. __B__
23. __B__
24. __A__
25. __B__
26. __D__
27. 3200 mL *or* 3.2 x 10^3 mL
28. – Water molecules and ethylene glycol molecules are both polar. – Water and the glycol have similar polarities.

29. – The particles are distributed uniformly throughout the coolant mixture. – There is an even distribution of molecules in the solution. – The water and ethylene glycol molecules mix uniformly. – All particles are evenly dispersed.
30. Temperature: higher/increase, Pressure: lower/decrease Temperature: above 298 K, Pressure: below 1.0 atm
31. 2.3 L
32. — The average distance between helium atoms is smaller in trial 1 than in trial 3. — In trial 3, the atoms are farther apart. — The separation is greater in trial 3. — Atoms are closer in trial 1. — The smaller the volume, the closer the gas molecules.
33. 0.300 atm

34. — Pressure times volume for the first three trials is constant at 0.412. — As the volume is increased, the pressure decreases proportionally. — There is no change for P x V. — $P_1V_1 = P_2V_2 = P_3V_3$ —PV = constant
35. —An aqueous solution of potassium chromate has mobile ions that conduct electricity. —The K_2CrO_4 dissociated into mobile ions. —Aqueous potassium chromate has charged particles that can move. —The $K^+(aq)$ and $CrO_4{}^{2-}(aq)$ move freely.

36. —Sodium nitrate and potassium chromate are both soluble in water and are good conductors in solution. Therefore, the melting points are needed to identify the substance. —Solubility alone cannot be used because two of the substances are soluble in water. —Two of the substances melt below 450.°C. —Electrical conductivity is not sufficient to differentiate the two salts.
37. —sodium nitrate — $NaNO_3$
38. — Water has a higher freezing point than seawater. — Seawater's is lower.
39. — Energy is needed to overcome the intermolecular forces. — Energy is required to change liquid to water vapor. — The heat of vaporization is positive.
40. — 3.3% — 3% — 3.3333%