

# Sample Diploma Problem

*Use the following information to answer question 17.*

To prevent the growth of mould and bacteria, winemakers use sulfur dioxide,  $\text{SO}_2(\text{g})$ , when making wine.

17. Sulfur dioxide in an aqueous solution can react to form

A.  $\text{SO}(\text{aq})$

B.  $\text{CS}_2(\text{aq})$

C.  $\text{H}_2\text{S}(\text{aq})$

D.  $\text{H}_2\text{SO}_3(\text{aq})$






# Sample Diploma Question

Use the following information to answer numerical-response question 5.

Conductivity and pH tests are performed on a sample of a buffer solution.

## Possible Test Results

- 1 Conducts electricity 
- 2 ~~Does not conduct electricity~~ 
- 3 Turns red litmus paper blue
- 4 Turns blue litmus paper red 
- 5 Maintains a constant pH when a small amount of strong acid is added
- 6 Maintains a constant pH when a small amount of strong base is added

**Buffer needs to be  
a weak acid base  
conjugate pair  
Ex:  $\text{HCO}_3^- / \text{CO}_3^{2-}$**

## Numerical Response

5. The test results listed above that would be obtained when a buffer solution that has a pH of 5.610 is tested are numbered \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.

**5.6 is a weak  
acid**

(Record all **four digits** of your answer in the response boxes at the bottom of the screen.)

**1, 4, 5, 6**

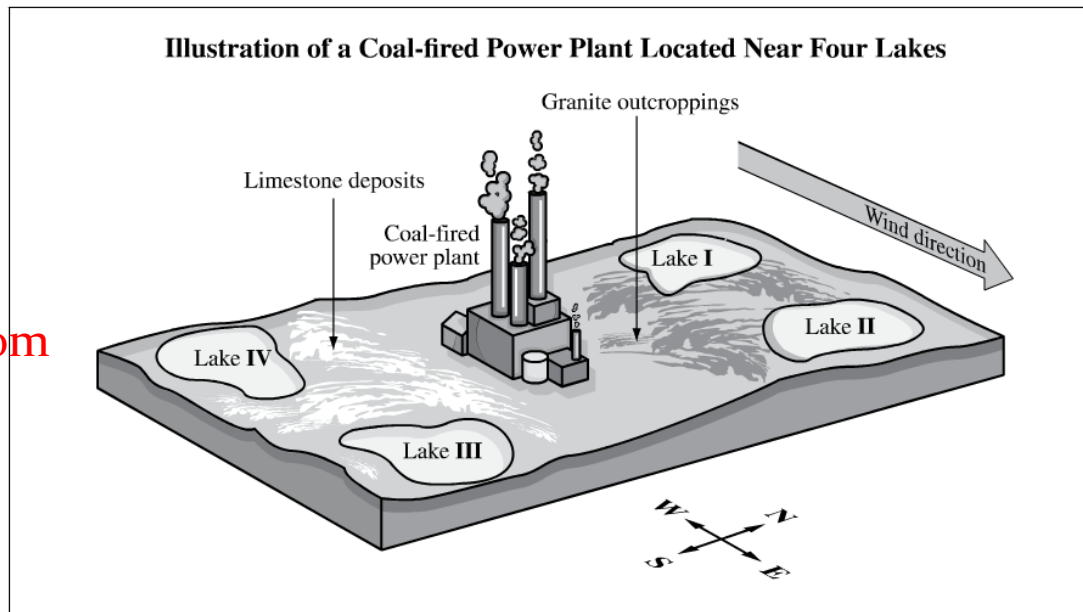
# Sample Diploma Question

**10.** Acid deposition has been **most directly** linked to

- A.** metal leaching
- B.** global warming
- C.** genetic mutations
- D.** increased UV radiation

# Sample Diploma Question

Limestone helps to prevent damage from acid rain (buffer)



12. Which of the lakes above would be **most affected** by emissions from the coal-fired power plant?

- A. Lake I
- B. Lake II
- C. Lake III
- D. Lake IV

ii: wind is going that direction and bc westerly winds (prevailing winds)

# Sample Diploma Question

19. Which of the following rows describes a property of ozone,  $O_3(g)$ , in the upper atmosphere and a property of ozone at ground level?

Row	Ozone in the Upper Atmosphere	Ozone at Ground Level
<b>A.</b>	Absorbs ultraviolet (UV) radiation	Contributes to photochemical smog
<b>B.</b>	Absorbs ultraviolet (UV) radiation	<del>Biomagnifies in predators</del>
<b>C.</b>	<del>Contributes to acid deposition</del>	Contributes to photochemical smog
<b>D.</b>	<del>Contributes to acid deposition</del>	<del>Biomagnifies in predators</del>

# Sample Diploma Question

Use the following information to answer question 20.

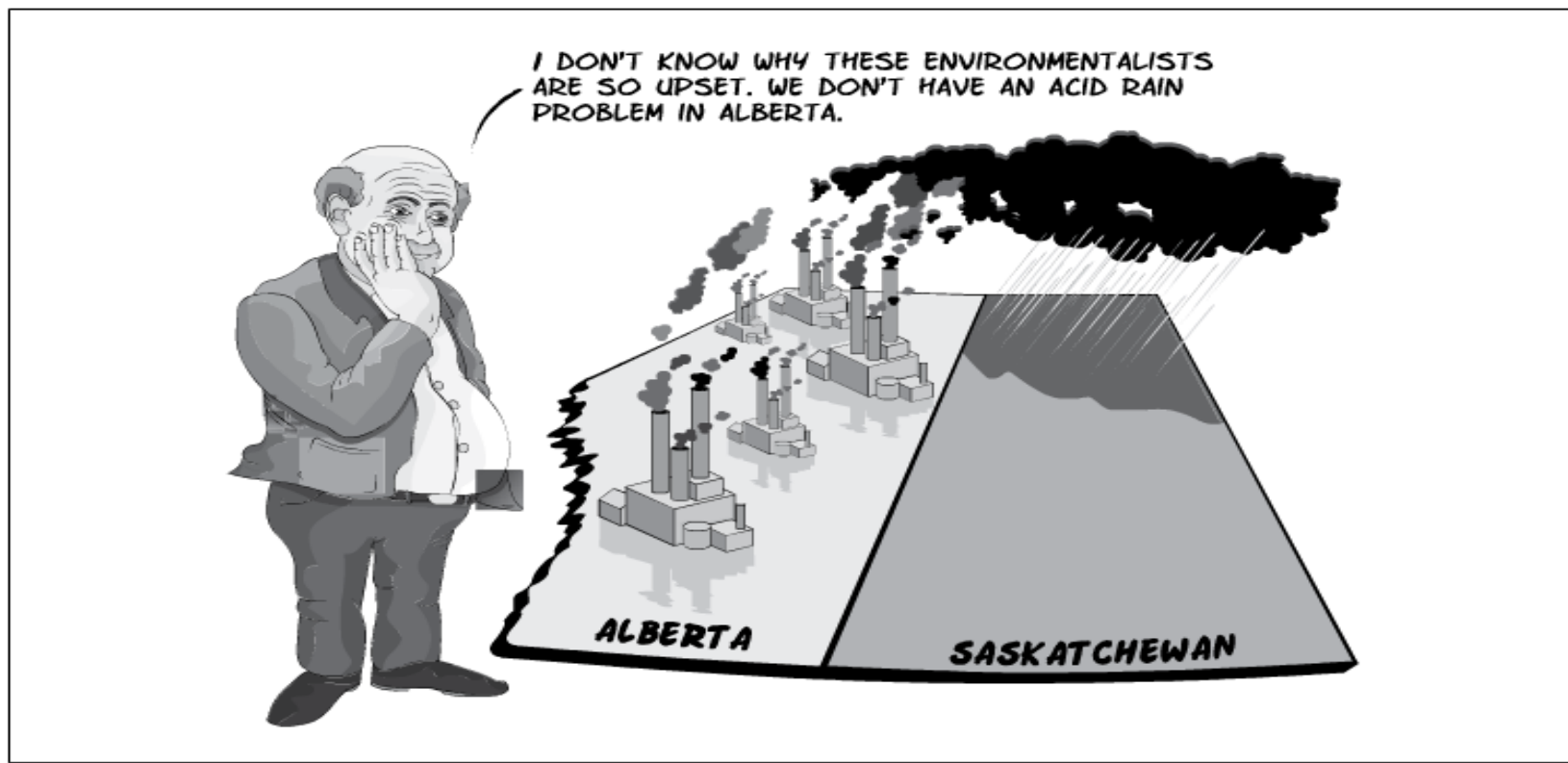
## Some Environmental Impacts of Pollution

- |   |  |                         |
|---|--|-------------------------|
| 1 | Metal leaching from soil                     | Acid rain               |
| 2 | Increased exposure to UV radiation           |                         |
| 3 | Decreased dissolved nutrients in soil        | Leaching from acid rain |
| 4 | Increased cases of respiratory infections    | ←                       |
| 5 | Accelerated corrosion of metal structures    | Not environmental       |
| 6 | Increased algal growth in lakes and ponds    | fertilizers             |
| 7 | Increased ground level ozone concentrations  | Photochemical smog      |
| 8 | Decreased oxygen content in lakes and rivers |                         |

20. The environmental impacts that are **most directly** linked to photochemical smog are

- A. 1 and 5
- B. 2 and 8
- C. 3 and 6
- D. 4 and 7**

Use the following information to answer question 22.



22. The **main** point of the cartoon is that

- A. emissions from industries in Alberta do not result in significant acid deposition
- B. Saskatchewan is more environmentally friendly than Alberta because it does not rely on fossil fuels
- C. fossil-fuel-based industries affect the environment more in Alberta than in Saskatchewan
- D.** prevailing winds carry acid-forming emissions away from Alberta and affect the environment elsewhere





# Sample Diploma Question

11. One major environmental concern related to the burning of coal is the emission of
- A. ozone,  $O_3(g)$
  - B. sulfur dioxide,  $SO_2(g)$**
  - C. chlorofluorocarbons, CFCs
  - D. dichlorodiphenyltrichloroethane, DDT

# Sample Diploma Problem

18. A major concern associated with the release of  $\text{CO}_2(\text{g})$  into the atmosphere is that it contributes **directly** to
- A. acid deposition
  - B. global warming
  - C. ozone depletion
  - D. biomagnification

# Indicators



## ECONOMIC INDICATORS

When the hamster has more money than you, you know times are bad

# Curriculum

- trace the historical use of acid-base indicators;
- use a pH meter and/or pH paper and indicators to measure the pH of solutions;
- use indicators and a conductivity meter to differentiate between a strong acid and a weak acid

# Measuring pH

- For centuries people have known that substances change color depending whether they are in acidic or basic conditions
- Dyers or painters used this property to their advantage by adding an acid or a base to a dye or pigment to achieve a different color



# Indicators

- Scientists use indicators to tell if a substance is an acid or a base
- An **acid-base indicator** is something that changes color in an acidic or basic solution
- Once chemists found how to measure the exact concentration of hydronium ions, they could link the color change to a specific pH

# Data Booklet

## *Acid–Base Indicators at 25°C*

<b>Indicator</b>	<b>Abbreviation (acid/conjugate base)</b>	<b>pH Range</b>	<b>Colour Change as pH Increases</b>
methyl violet	$\text{HMv(aq)} / \text{Mv}^{-}(\text{aq})$	0.0 – 1.6	yellow to blue
thymol blue	$\text{H}_2\text{Tb(aq)} / \text{HTb}^{-}(\text{aq})$	1.2 – 2.8	red to yellow
thymol blue	$\text{HTb}^{-}(\text{aq}) / \text{Tb}^{2-}(\text{aq})$	8.0 – 9.6	yellow to blue
orange IV	$\text{HOr(aq)} / \text{Or}^{-}(\text{aq})$	1.4 – 2.8	red to yellow
methyl orange	$\text{HMo(aq)} / \text{Mo}^{-}(\text{aq})$	3.2 – 4.4	red to yellow
bromocresol green	$\text{HBg(aq)} / \text{Bg}^{-}(\text{aq})$	3.8 – 5.4	yellow to blue
litmus	$\text{HLt(aq)} / \text{Lt}^{-}(\text{aq})$	4.5 – 8.3	red to blue
methyl red	$\text{HMr(aq)} / \text{Mr}^{-}(\text{aq})$	4.8 – 6.0	red to yellow
chlorophenol red	$\text{HCh(aq)} / \text{Ch}^{-}(\text{aq})$	5.2 – 6.8	yellow to red
bromothymol blue	$\text{HBb(aq)} / \text{Bb}^{-}(\text{aq})$	6.0 – 7.6	yellow to blue
phenol red	$\text{HPr(aq)} / \text{Pr}^{-}(\text{aq})$	6.6 – 8.0	yellow to red
phenolphthalein	$\text{HPh(aq)} / \text{Ph}^{-}(\text{aq})$	8.2 – 10.0	colourless to pink
thymolphthalein	$\text{HTh(aq)} / \text{Th}^{-}(\text{aq})$	9.4 – 10.6	colourless to blue
alizarin yellow R	$\text{HAy(aq)} / \text{Ay}^{-}(\text{aq})$	10.1 – 12.0	yellow to red
indigo carmine	$\text{HIc(aq)} / \text{Ic}^{-}(\text{aq})$	11.4 – 13.0	blue to yellow
1,3,5–trinitrobenzene	$\text{HNb(aq)} / \text{Nb}^{-}(\text{aq})$	12.0 – 14.0	colourless to orange

# Acid-Base Indicators

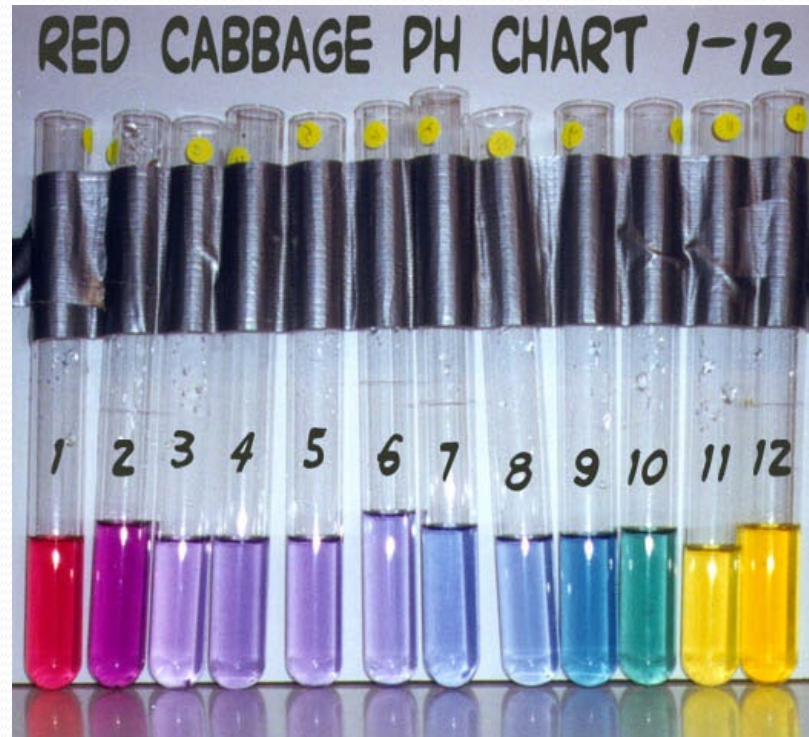
- Indicators can be solutions or soaked on paper and dried
- When a variety of different acid and base indicators are added together you get a **universal indicator**





# Natural Indicators

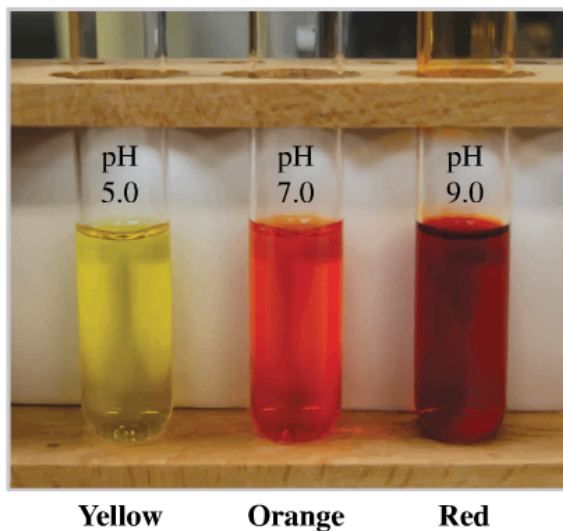
- Tea, grape juice, the juice of a red cabbage, and blueberries will all change color in the presence of acids or bases



chlorophenol red	HCh(aq) / Ch <sup>-</sup> (aq)	5.2 – 6.8	yellow to red
bromothymol blue	HBb(aq) / Bb <sup>-</sup> (aq)	6.0 – 7.6	yellow to blue
<u>phenol red</u>	HPr(aq) / Pr <sup>-</sup> (aq)	6.6 – 8.0	yellow to red
phenolphthalein	HPh(aq) / Ph <sup>-</sup> (aq)	8.2 – 10.0	colourless to pink
thymolphthalein	HTh(aq) / Th <sup>-</sup> (aq)	9.4 – 10.6	colourless to blue
alizarin yellow R	HAY(aq) / Ay <sup>-</sup> (aq)	10.1 – 12.0	yellow to red

Use the following information to answer question 5.

The same acid–base indicator is added to three different test tubes containing solutions with pH 5.0, pH 7.0, and pH 9.0. A photograph of the resulting indicator colours is shown below.



3. Which of the following indicators was added to the three test tubes shown in the photograph above?

- A. Alizarin yellow R
- B. Methyl orange
- C. Phenol red
- D. Orange IV

Use the following information to answer numerical-response question 1.

A different acid–base indicator is added to each of four different samples of a solution with a pH of 8.73.

### Possible Colours of Resulting Solutions

- 1 Red
- 2 Pink
- 3 Blue
- 4 Green
- 5 Yellow
- 6 Orange

Thymol blue there are two of them. When its in the middle of yellow and blue it turns green.

### Numerical Response

1. Match the colours of the resulting solutions numbered above with each of the indicators listed below. (You may use a number more than once.)

Colour:	<u>Blue (3)</u>	<u>red (1)</u>	<u>green (4)</u>	<u>red (1)</u>
Indicator:	<u>Bromothymol blue</u>	<u>Chlorophenol red</u>	<u>Thymol blue</u>	<u>Phenol red</u>

(Record all **four digits** of your answer in the response boxes at the bottom of the screen.)

# Sample Diploma Question

*Use the following information to answer question 8.*

The juice from boiled red cabbage leaves turns different colours when placed in solutions with different pH values.

8. Based on the information above, red cabbage juice can be used as
- A. a buffer solution
  - B. a scrubber solution
  - C. an acid–base indicator
  - D. an indicator of biomagnification

