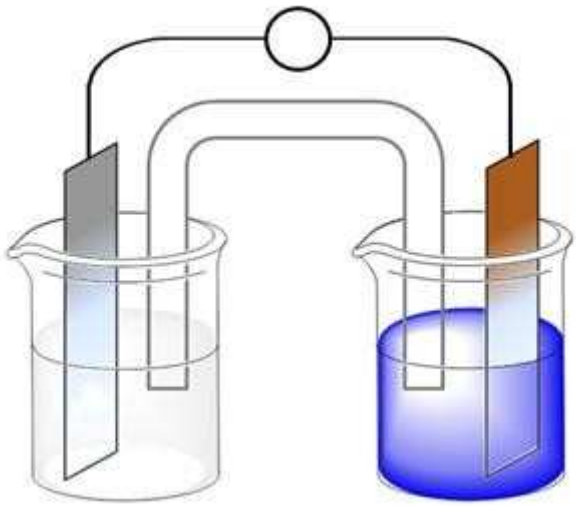
National 4/5 Chemistry



Homework

Unit 3 – Chemistry in Society

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Metals

1. Describe how metals are able to conduct electricity?

2. What is meant by the word “malleable” when referring to a metal?

3. Which property makes metals a good choice for making saucepans?

4. Give 2 reasons for recycling metals.

5.
   a. What is alloy?
   b. Give an example of an alloy.
   c. Why do chemists make alloys?

6. Which box(es) in the grid below contain:
   a. The name of the compound formed when magnesium burns in oxygen? (1 box)
   b. A metal that reacts with cold water? (2 boxes)
   c. A metal that is stored under oil? (1 box)
   d. A metal that reacts with acid and not cold water? (2 boxes)
   e. A metal that does not react with acid or water? (1 box)

A Zinc	B Magnesium oxide	C Gold
D Calcium	E Potassium	F Iron

7. Caesium metal behaves in many ways like potassium and sodium.
   a. Why is caesium stored under oil?
   b. Which gas is released when caesium is added to water?
   c. Name the other product formed in (b)
   d. Write a chemical equation for the reaction in (b)

8. Write word then chemical equations for the following reactions:
   a. Sodium reacting with water
   b. Magnesium reacting with hydrochloric acid
   c. Calcium reacting with oxygen
   d. Lithium reacting with oxygen

9. List the following metals in order of reactivity: aluminium, copper, gold, iron, lead, magnesium, silver, sodium.

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10. A metal with a silvery appearance reacted as follows:
It reacted very slowly with cold water;
It reacted quickly with dilute acid;
It could displace zinc from a solution of zinc chloride.

    a. Name the metal
    b. Write the equation for the metal reacting with hydrochloric acid.
    c. Explain why the metal could displace zinc from zinc chloride.

11. What type of energy change takes place in a battery (cell) when it is producing an electric current?

12. Pick the letter from the box below which shows:

    a. a substance which could be an electrode
    b. a substance which could be an electrolyte
    c. particles that move through wires when electricity is flowing
    d. particles that move through the electrolyte when electricity is flowing

A Ions	B Zinc
C Ammonium chloride (aq)	D Electrons

13. Explain why silver is a good conductor of electricity yet phosphorus is not.

14. Give an example of a rechargeable battery.

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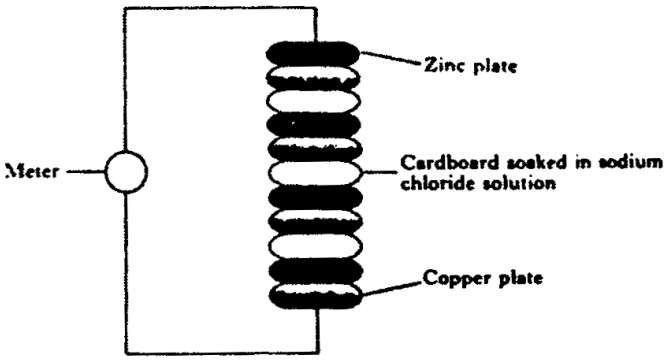
15. A pupil used a piece of zinc, a piece of copper, wires and a beaker of sodium chloride solution to create a cell.
    a. State which direction the current would flow (Zn→ Cu or Cu→ Zn)
    b. What is the purpose of the sodium chloride solution?
    c. Which particle flows through the wire when the cell is working?
    d. Suggest a metal which could be used instead of Cu to create a greater voltage.

16.



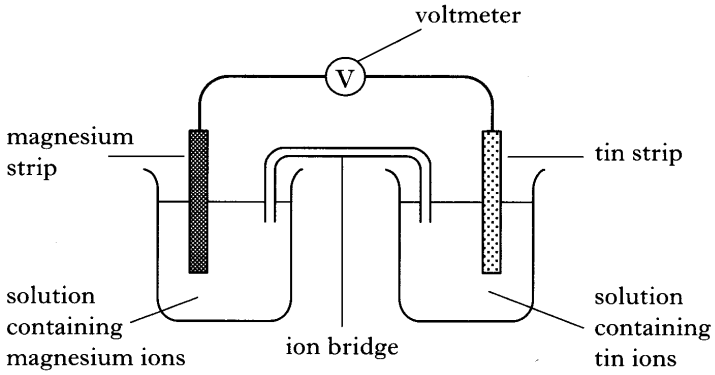
The Italian professor, Alessandro Volta, made one of the first batteries. It is called the "Voltaic Pile".

The diagram opposite shows the pile connected to a meter for measuring current.

    a. When the sodium chloride is replaced with potassium nitrate solution, a reading is obtained on the meter. When the hydrocarbon hexane is used no reading is obtained.
    b. Explain each of these results.

    c. What will happen to the reading on the meter if zinc is replaced by tin?

17.



For the cell above:
    a. state the direction of electron flow
    b. explain the purpose of the ion bridge
    c. Use page 7 of the data booklet to write ion electron equations for the reactions at the magnesium and tin electrodes.
    d. predict what would happen to the (i) direction of the current (ii) size of the voltage if the magnesium strip was replaced with copper.

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18.

a. What is meant by the terms oxidation and reduction?
b. In the cell in Q.7, at which electrode is oxidation taking place?

19. When a strip of magnesium is added to a test tube of copper(II) sulphate, the blue colour of the solution disappears and the magnesium strip becomes coated in a brown solid.

a. What type of reaction is taking place?
b. What is the brown substance that is seen to form on the magnesium?
c. Write ion electron equations to show what happens to the magnesium atom and the copper ion.

20. In which of the following reactions will displacement occur?

A. $Cu + MgSO_3 \rightarrow$	B. $Li + MgSO_3 \rightarrow$
C. $Zn + ZnNO_3 \rightarrow$	D $Cu + AgNO_3 \rightarrow$

21. Write ion electron equations for:

a. the oxidation of aluminium
b. the reduction of zinc(II) ions
c. the oxidation of sodium
d. the reduction of silver (I) ions
e. the reduction of lithium ions
f. the oxidation of potassium

22.

a. Explain what is meant by the term fuel cell.
b. In what way(s) do fuel cells differ from batteries?

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23.

A hydrogen molecule is made up of two hydrogen atoms joined together.

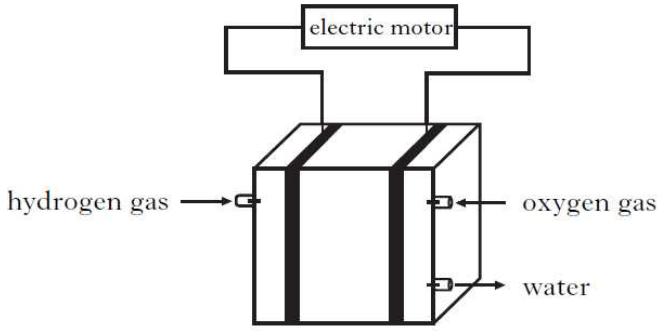
(*a*) What **term** is used to describe a molecule made up of **two** atoms?

_____ **1**

(*b*) Hydrogen can be obtained by passing electricity through dilute acid.
What name is used to describe this process?

_____ **1**

(*c*) Hydrogen can be used in fuel cells to supply electricity to run a car.



(i) Suggest **one** advantage of using fuel cells rather than petrol to power cars.

_____

_____

_____ **1**

(ii) Suggest a possible source of oxygen for use in the fuel cell.

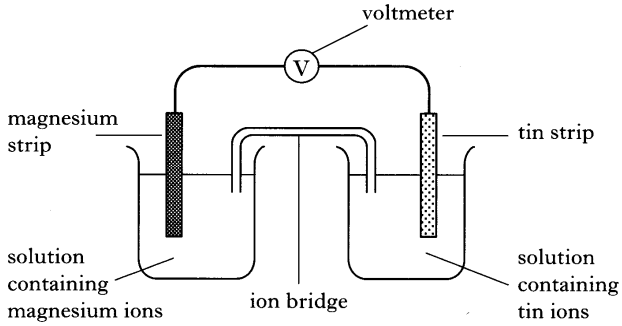
_____ **1**

(iii) Platinum is used as the catalyst in the fuel cell.
What is the purpose of a catalyst?

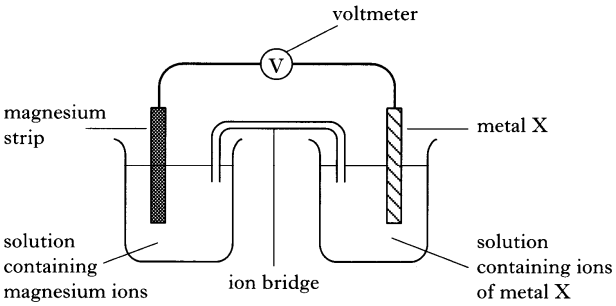
_____

_____ **1**
(5)

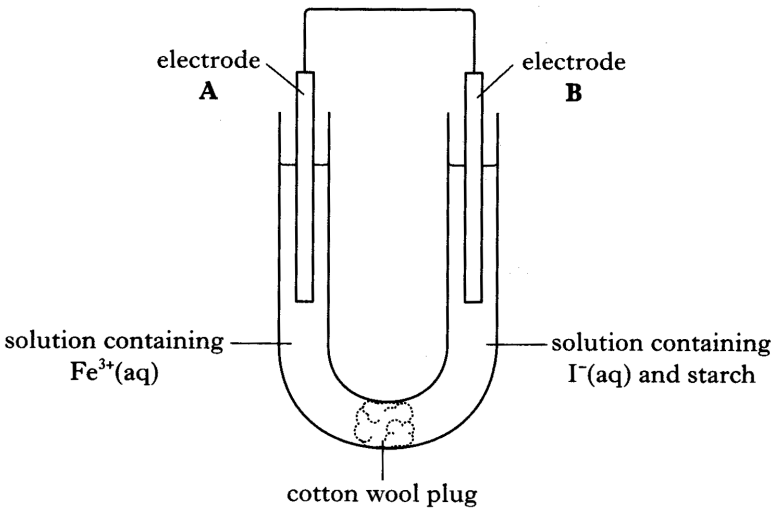
24. The following cell was set up by a fourth year pupil.



a. What is the purpose of the ion bridge?
b. Name a tin compound which could be used to make the solution containing ions. (You may wish to use p.5 of data book)
c. The following cell produces a higher voltage than the cell above. Suggest a name for metal X.



23.
Helen set up the cell shown below.



a. State the direction of electron flow.

b. What term is used to describe the type of chemical reaction taking place at electrode A?

c. Iodine forms at electrode B.

d. What would you see happening around electrode B?

The reaction taking place at electrode **A** is

$$Fe^{3+}(aq) + e^- \rightarrow Fe^{2+}(aq)$$

e. Write an ion-electron equation for the chemical reaction taking place at electrode B.

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Extraction

1. What is a metal ore?

2. Why is gold found uncombined in the earth's crust?

3. Why is extracting a metal from a metal oxide referred to as a reduction?

4. Which box(es) contain a metal oxide which is normally reduced by:
    a. heat alone
    b. heating with carbon
    c. electrolysis

A Silver oxide	B Copper oxide	C Magnesium oxide
D Gold oxide	E Zinc oxide	F Aluminium oxide

5. The oxides of X and Y are not affected by heat alone, but the oxide of Z gives off oxygen when heated. Oxide X and Z both breakdown when heated with carbon; oxide Y does not
    Place the metals in order of activity and suggest a possible name for each

6. In the blast furnace, iron(III) oxide is reduced by carbon monoxide.
    a. Write the formula for iron (III) oxide
    b. Write an equation to show the formation of carbon monoxide from carbon dioxide, in the blast furnace.
    c. Why can calcium oxide not be reduced in a blast furnace?

7.
    a. Name the process used to obtain aluminium from its ore.
    b. Suggest why aluminium was not discovered until the nineteenth century.
    c. Write an ion electron equation to show the formation of aluminium from its ions.

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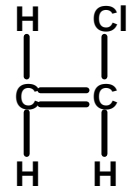
Polymers

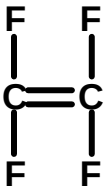
1. Polyethene is a synthetic plastic that is made from ethene. It is a very common plastic which is moulded into many different shapes, depending on its use. As it is non-biodegradable, many councils encourage householders to recycle this plastic rather than disposing of it in the bin, where it will end up in a landfill site, or incinerator.
    a. Why is Polyethene referred to as a "synthetic" material?
    b. Which raw material is used to produce most plastics?
    c. Draw the full structural formula for ethene.
    d. Ethene is a small molecule that is obtained from much larger hydrocarbons. Name the process that is used to produce ethene from much larger hydrocarbons.
    e. What is meant by the term "non-biodegradable"?
    f. Why is it dangerous to incinerate polyethene?
    g. Suggest why it is important to recycle plastics.

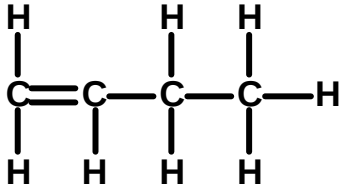
2. For each of the following examples, suggest a property of the plastic that makes it suited for the use described.
    a. Nylon is used for hiking jackets.
    b. PVC is used to make rain gutters and window frames.
    c. Polyethene is used to make plastic bags.

3. 3.
    a. Would a thermoplastic or thermosetting plastic be used for frying pan handles?
    b. Explain your answer to (a).

4. Draw the structures of the polymers formed from the following monomers. Show 3 monomer units linked together.

a. 

b. 

c. 

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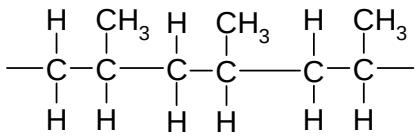
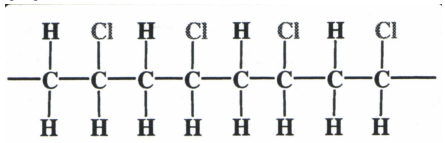
5. Draw the monomers and repeating units formed from the following polymers.

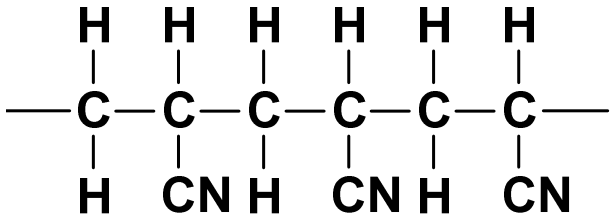
(a)



(b)



6. The structure of part of a polyacrylonitrile molecule is shown below.



   a. Draw the structural formula for the monomer used to make this polymer.

   b. Name a toxic gas produced when the polymer burns.

7. Polybutene is used to make pipes which carry hot water under pressure. This is very useful in plumbing and underfloor heating.
   a. Draw the structure of butene.
   b. Draw polybutene by showing 3 monomer units linked together.
   c. Butene has 3 isomers. Draw the isomer which
      i. could also be used to form a polymer
      ii. could not be used to form a polymer.

8. Describe 2 plastics which are thought of as ‘novel plastics’. Describe the properties of these plastics and uses for these materials.

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Fertilisers

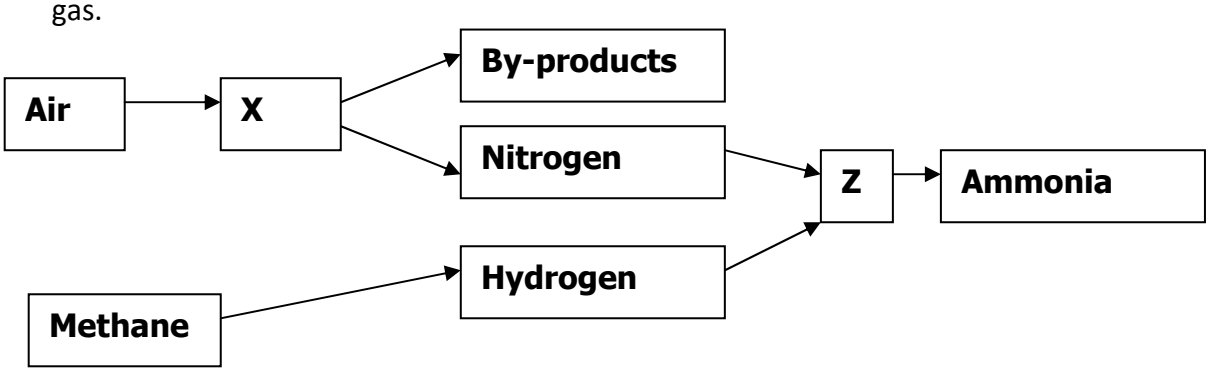
1.
   a. Name the three elements that are present in most fertilisers.
   b. Apart from containing nitrogen, suggest why nitrate salts are used as fertilisers (you may wish to use page 5 of the data booklet).

2. A pupil wanted to prove that a fertiliser contained an ammonium salt.
   a. Write the chemical formula for
      i. ammonium phosphate
      ii. ammonium sulphite.
   b. Describe how the pupil could use sodium hydroxide and pH paper to show the presence of the ammonium ion in the salt.

3. From the list of words below, select 4 descriptions which describe the properties of ammonia.

Brown soluble solid acidic odourless fishy smell alkaline
insoluble less dense than air more dense than air

4. The following flow diagram represents an industrial preparation of ammonia gas.



   a. What is happening at process X?
   b. Name the main gas that is present in the by-products.
   c. What name is given to process Z?
   d. Name the catalyst used in process Z
   e. In process Z, what are the conditions of pressure and temperature?
   f. Explain why the temperature of process Z cannot be left to reach very high temperatures.

5. A common use for ammonia is the manufacture of fertilisers. Two such fertilisers are ammonium sulphate and ammonium nitrate.
   a. Write the chemical formula for each fertiliser.
   b. Calculate the % of nitrogen in each fertiliser.

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6.

a. When some air was sparked, a brown gas formed.
b. Name the brown gas.
c. Write a balanced equation to show its formation.
d. When does this reaction occur in nature?
e. The brown gas was then dissolved in water. Give the name of the solution formed.
f. Why is step (a) not used in industry to prepare this acid?

7. The industrial preparation of nitric acid uses ammonia as its starting material.

a. Name the industrial process used to make nitric acid.
b. Name the catalyst used in this process.
c. Why does the catalyst not have to be heated once the reaction has started?

8. Nitrogen dioxide and bromine are both brown gases. Describe an experiment you could carry out to show which gas is which.

9.

a. Identify the 2 compounds which can be used as fertilisers.
b. Identify the 2 compounds which react together to produce ammonia.

A potassium nitrate	B sodium hydroxide	C lithium sulphate
D aluminium chloride	E ammonium phosphate	F calcium chloride

10. Ammonia is made by the Haber process.

a. The rate at which the hydrogen and nitrogen react increases as the temperature of the gases increases. Why is the Haber process carried out at only a moderate temperature?
b. How is the ammonia removed from the unreacted gases?
c. Name 2 chemicals that could be used to prepare ammonia in the lab.

11. Some plants can convert atmospheric nitrogen into nitrogen compounds. This is called fixing nitrogen.

a. How are some plants able to fix nitrogen?
b. Why would the development of cereal crops which fix nitrogen save on energy costs?

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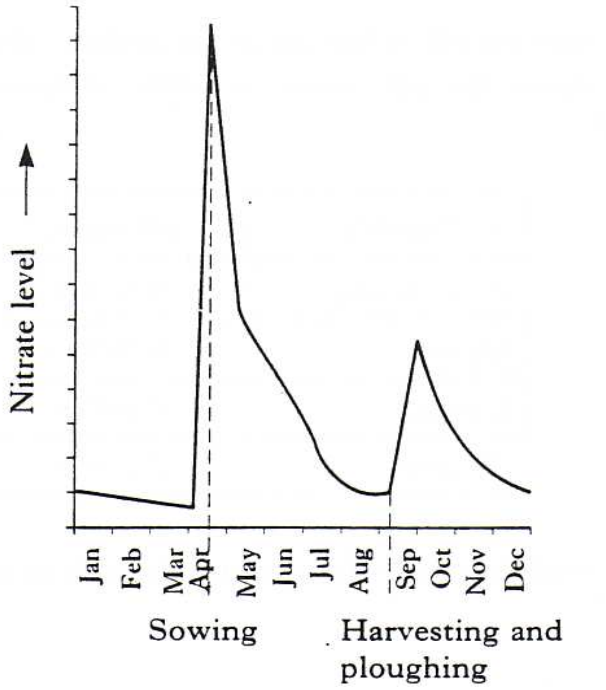
12. The graph shows how the level of nitrates in the soil of a farmer's field varied throughout the year.
    a. Suggest why the levels of nitrates increased in April.
    b. During periods of heavy rain, Nitrates from the soil are washed into rivers. What effect does this have on the rivers?



13. The Ostwald process is used to make nitric acid. The first step involves making nitrogen monoxide and then nitrogen dioxide from ammonia.

    a. Why is nitrogen dioxide made from ammonia and not from nitrogen?
    b. The reaction is exothermic. Why is this an advantage?
    c. Name the catalyst used.

14. Different elements are needed for healthy plant growth. Carbon, hydrogen and oxygen can be obtained from carbon dioxide and water. Phosphorus and potassium can be obtained from fertilisers.

    a. Name one other essential element needed by plants.
    b. Some fertilisers contain potassium sulphate, K_2SO_4.
    c. Calculate the formula mass of potassium sulphate
    d. Calculate the % K in potassium sulphate.
    e. Calcium phosphate is readily available but cannot be used directly in fertilisers. Suggest why it is unsuitable. Use page 5 of the data booklet.

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Nuclear Chemistry

1. Complete the following nuclear equations and identify X and Y.

   a. $^{238}_{92}U + {}^{4}_{2}He \rightarrow {}^{239}_{94}Pu + 3X$

   b. $^{6}_{3}Li + {}^{1}_{0}n \rightarrow Y + {}^{4}_{2}He$

2. Use the radioactivity decay series in the data booklet to answer the following.

$$^{224}_{88}X \rightarrow {}^{220}_{86}Y \rightarrow {}^{216}_{84}Z$$

   a. Name the elements represented by X, Y and Z.
   b. Name the particle emitted in the first stage.
   c. Which element in the series shown has the shortest half life?

3. Write a nuclear equation for
   a. ^{238}U decaying by α emission.
   b. ^{238}U decaying by β emission.

4. Element P is a radioactive isotope which undergoes transitions as follows:

$$P \rightarrow Q + \beta \rightarrow R + \beta \rightarrow S + \alpha$$

   If the atomic number of P is 88 and its mass number is 228, state the atomic and mass number of isotope S.

5. In each of the following, state whether or not both species have the same half-life.
   a. 1g of ^{212}Pb and 100g of ^{212}Pb
   b. 1g of ^{212}Pb and 1g of $^{212}Pb^{2+}$
   c. 1mole of ^{210}Pb and 1 mole of ^{212}Pb
   d. 1 mole of ^{210}Pb and 1mole of ^{210}PbO

6. The remains of an ancient fire found in a cave had a ^{14}C count rate of 15.3 counts/min per gram of C. The ^{14}C count rate in a newly cut piece of wood is 122.4 counts/min. The half life of 14C=5730years. Calculate the age of the fire.

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