Final Exam Review

Sec. 4 Science and Technology, Part B

Secondary 4 General Science & Technology Exam Review "Part B"

1) A dental assistant needs to organize fluoride solutions in their supply cabinet but their labels use different units. Arrange the following solutions in order of increasing fluoride concentrations:

Fluoride Concentration

Solution A: 7 g/l
Solution B: 200 ppm
Solution C: 0.3% (m/v)
Solution D: 8g/300ml

Solution A	Solution B	Solution C	Solution D
$\frac{7g}{1000mL} = \frac{x}{1\,000\,000mL}$ 7000ppm	200ppm	$\frac{0.3g}{100mL} = \frac{x}{1000000mL}$ 3000ppm	$\frac{8g}{300mL} = \frac{x}{1\,000\,000mL}$ 26 667ppm

In order of increasing concentration the solutions should be arranged:

Lowest Concentration B C A D Highest Concentration

2) A solution of acid with pH 2 is diluted to pH 6. How much weaker is the resulting diluted acid solution?

pH 6-2=4

$10 \times 10 \times 10 \times 10 = 10\,000$

×10 ×10 ×10 ×10

1 2 3 4 5 6 7 8 9 10 11 12 13 14

The solution is 10000 x weaker than the original acid.

3) $HCl + Ca(OH)_2 \rightarrow CaCl_2 + H_2O$

a) What type of reaction is described by the above formula. Explain your choice

Acid - Base Neutralization.
An acid (HCl) and a base ($Ca(OH)_2$) react to form a salt ($CaCl_2$) and water (H_2O).

b) Rewrite the above equation as a balanced chemical equation.

$$2HCl + Ca(OH)_2 \rightarrow CaCl_2 + 2H_2O$$

c) If 74g of $Ca(OH)_2$ is reacted with 73g of HCl to form $CaCl_2$ and 36g of water. What mass of salt would be formed by this reaction?

$$Ca(OH)_2 + 2HCl \rightarrow CaCl_2 + 2H_2O$$

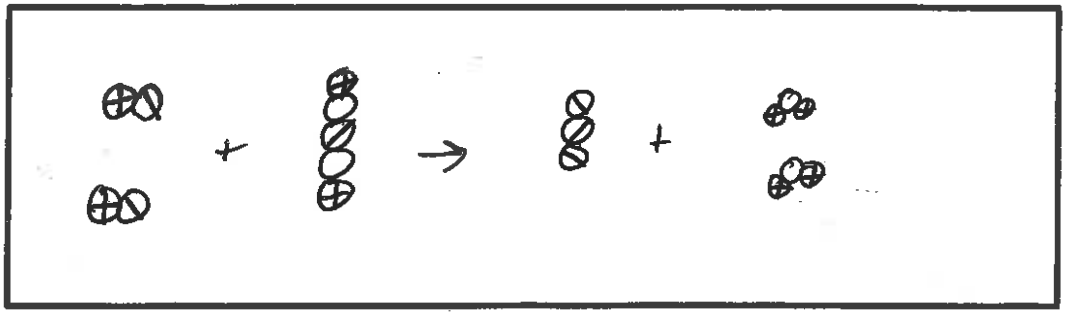
$74g + 73g = ? \quad 36g$

$147g - 36g = ? = 111g$

111g of salt would be formed.

d) Draw the above chemical equation using the particle model and the legend below:

Hydrogen (H) Chlorine (Cl) Calcium (Ca) Oxygen (O)



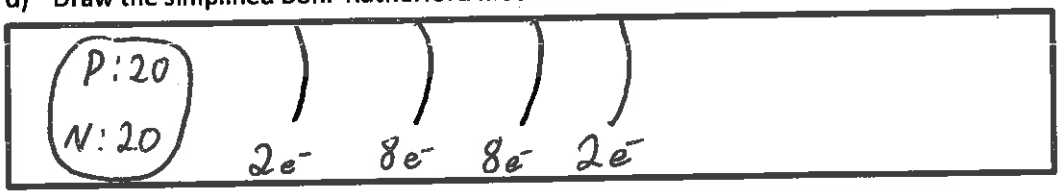
4) Identify the alkaline earth metal in period 4 of the periodic table: Calcium

a) How many electrons does it have? 20

b) How many protons does it have? 20

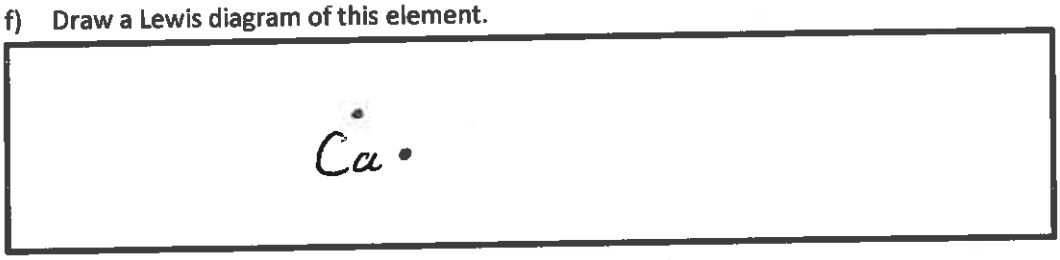
c) How many neutrons does it have? 20

d) Draw the simplified Bohr-Rutherford model of this element.



e) How many valence electrons does it have? 2

f) Draw a Lewis diagram of this element.

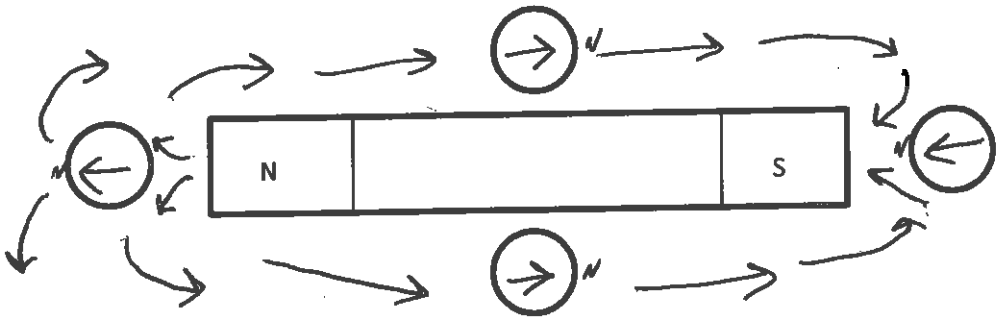


g) Is the element a metal or non-metal? Metal

h) Describe the properties of this element.

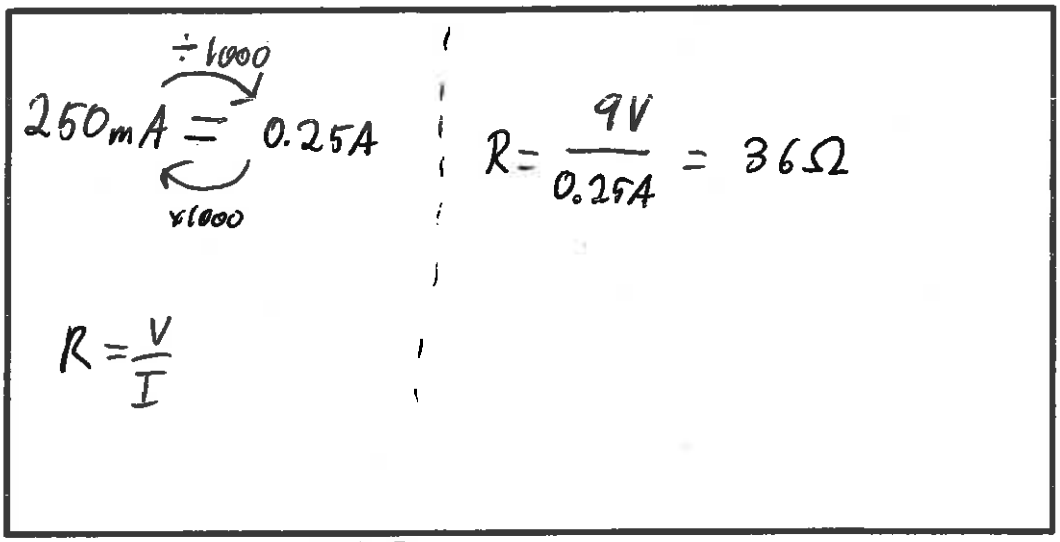
- Lustrous/Shiny
- Malleable
- Ductile
- Electrical Conductor
- Thermal Conductor

5) a) Draw the magnetic field around this bar magnet:



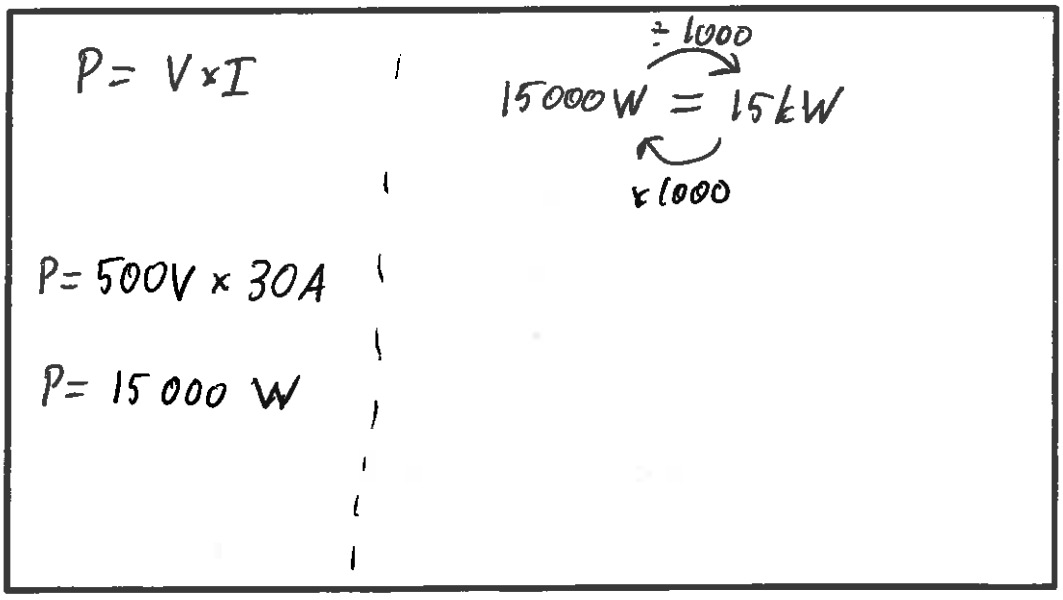
b) Draw the compass needle for each of the compasses below as if they were positioned around the bar magnet.

6) A series circuit with a single resistor is set up and measurements for current and potential difference are taken using an ammeter and voltmeter. The current is measured to be 250 mA while the potential difference is 9V. What is the resistance of the resistor in ohms (Ω)?



The resistance is equal to 36Ω.

7) Bruce is buying an electric golf cart for his father. The motor has a potential difference of 500V and draws a current of 30A. What is the power rating of the golf cart motor in kW?



The power rating is equal to 15kW.

8) A) If a 120W lightbulb is turned on for 5 minutes, how much energy, in joules (J), will it consume in that time?

÷60 ↖ 5min = 300 sec ↙ ×60

$P \times \Delta t = E$

$W \times sec = J$

$120W \times 300s = 36\,000\,J$

The the bulb will consume 36 000 J of energy.

B) A different light bulb with a power rating of 80W is turned on for 120 minutes. How much energy will the 80W bulb consume in that time? State your answer in Wh (watt hours).

÷60 ↖ 120min = 2 hours ↙ ×60

$P \times \Delta t = E$

$W \times h = Wh$

$80W \times 2h = 160\,Wh$

The the bulb will consume 160 Wh of energy.

C) A dishwasher with a power rating of 6000W is used for 3 hours each week to clean a family's dirty dishes. How much energy, in kWh, is consumed by the dishwasher in that 3 hour period?

×1000 ↖ 6000W = 6kW ↙ ÷1000

$P \times \Delta t = E$

$kW \times h = kWh$

$6kW \times 3h = 18\,kWh$

The the dishwasher will consume 18 kWh of energy.

D) How much will it cost each week to run the dishwasher from part C if the rate for electricity is $0.07 per kWh?

$Cost = Rate \times Energy$

$Cost = \frac{\$0.07}{kWh} \times 18\,kWh = \$1.26$

The dishwasher will cost $1.26 in electricity each week.

9) a) Baking a loaf of bread requires 120 000J of heat energy. If the Kelvin Klein oven has an energy efficiency of 70%, how much energy will it consume while baking a loaf of bread?

$$\frac{\text{Useful Energy}}{\text{Energy Consumed}} = \frac{70}{100} = \frac{120\,000\text{J}}{x}$$

$$70x = 12\,000\,000\text{J}$$

$$x \approx 171\,428\text{J} \text{ or } 171\text{ kJ}$$

The Kelvin Klein oven will consume 171 428J of energy to bake the loaf of bread.

b) How much energy is lost/wasted in the process of using the Kelvin Klein oven to bake bread?

$$\text{Lost Energy} = \text{Energy Consumed} - \text{Useful Energy}$$

$$= 171\,428\text{J} - 120\,000\text{J} = 51\,428\text{J}$$

51 428J of energy were lost.

10) For the pairs of gears in the tables below fill in the missing piece of information (X) using the information given in the table.

	Gear Radius	Speed
Driver	12 cm	X
Driven	30 cm	400 rpm

X is equal to 1000 rpm

$$\frac{\text{Driver}}{\text{Driven}} = \frac{12\text{cm}}{30\text{cm}} = \frac{2}{5}$$

* Smaller gear rotates faster

$$400\text{rpm} \times \frac{5}{2} = 1000\text{rpm}$$

	Number of Teeth	Speed
Driver	45	300 rpm
Driven	X	30 rpm

X is equal to 450 teeth

$$\frac{\text{Driver}}{\text{Driven}} = \frac{300\text{rpm}}{30\text{rpm}} = \frac{10}{1}$$

* Larger gear rotates slower

$$45\text{teeth} \times \frac{10}{1} = 450\text{ teeth}$$

11) How does the melting of glaciers and pack ice affect thermohaline circulation?

Glaciers	Pack Ice
- Fresh water melt dilutes the salty ocean water decreasing salinity. The decrease in salt concentration slows thermohaline Circulation. — Glacial melt water causes sea levels to rise by increasing ocean volume. This causes flooding on the shoreline.	- Fresh water from melting pack ice also dilutes the salinity of ocean water. This change in salt concentration slows thermohaline circulation.

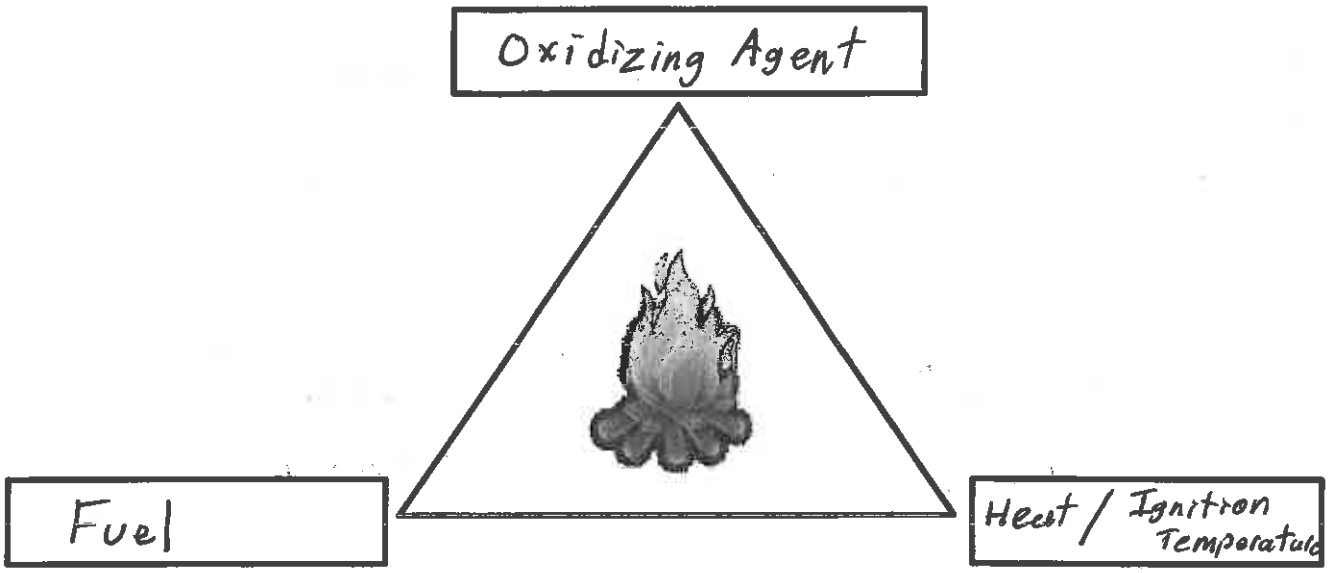
12) In what way does melting permafrost affect the greenhouse gas effect?

When the soil thaws, the organic matter in the soil is metabolized by microbial activity. This releases greenhouse gases such as methane (CH_4) and CO_2 which contribute to the greenhouse gas effect.

13) Explain how salts, acids and bases conduct electricity.

When these substances, called electrolytes, dissolve in water they dissociate into two or more ions of opposite (+/-) charges that are capable of moving independently through the solution. An electric current represents a net directional movement of charges; this is made possible due to the independent mobility of the ions.

14) What are the three components required for a rapid combustion reaction to occur? Fill in the three boxes below.



15) A) $6CO_2 + 6H_2O + \text{Light} \rightarrow 6O_2 + C_6H_{12}O_6$

What is the name of the reaction shown above? Photosynthesis

Justify your answer.

Photosynthesis is the chemical combination of CO_2 and H_2O using light energy to form sugar ($C_6H_{12}O_6$) and Oxygen (O_2).

B) $6O_2 + C_6H_{12}O_6 \rightarrow 6CO_2 + 6H_2O + \text{Energy}$

What is the name of the reaction shown above? Respiration

Justify your answer.

Respiration is the oxidation of glucose ($C_6H_{12}O_6$) by oxygen (O_2) to form CO_2 and water (H_2O) and release energy.

Glass +
Silver –
Wool +
Polyester –

16) A glass rod is rubbed with a polyester cloth; the glass rod gives up its electrons and becomes positively charged. A silver plate is then rubbed with a wool rag; the plate receives electrons from the wool and becomes negatively charged.

What will happen if the polyester cloth and wool rag are brought together?

They will be attracted to one-another.

17) List the four factors that must be considered to improve the conductivity of an electrical wiring system:

Short — Cold

Fat — Copper

18) List the three factors that affect the strength of the magnetic field of an electromagnet (solenoid).

Type of Core — Current

(Number) # of Turns/Length of Coil

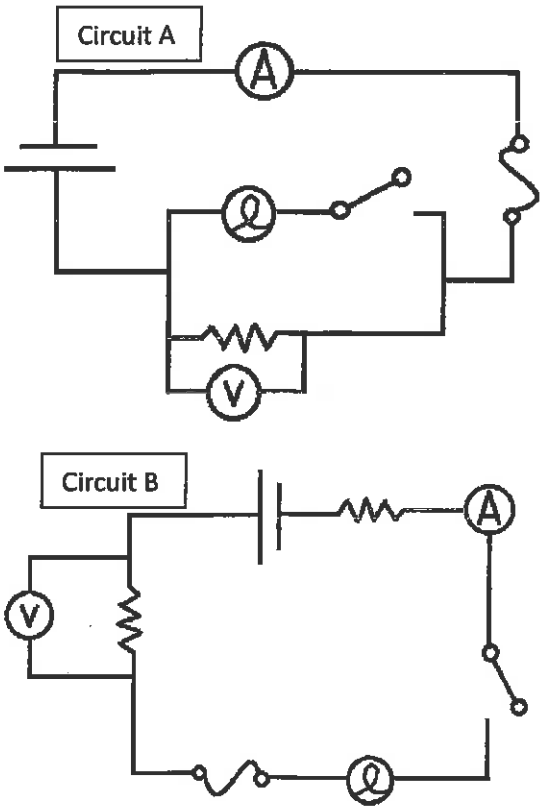
19) A) Describe the link formed between a plastic bottle and its screw-on cap using the four characteristics of links.

- Direct
- Partial
- Flexible
- Removable

B) What type of guiding control is demonstrated by the bottle and cap system? Helical

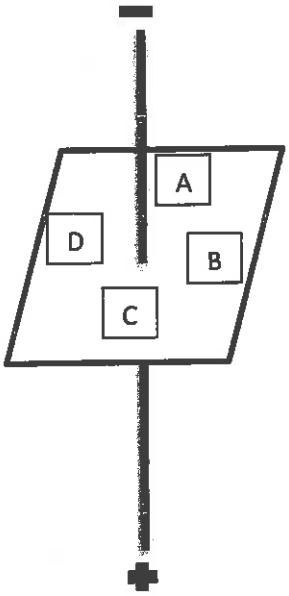
20) Name the components of the following circuits, state the function of each component and determine if the circuits are in series or parallel.

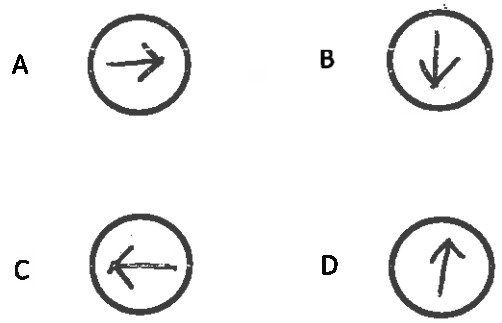
Symbol	Component	Function
	Fuse	Protection
	Light-Bulb	Transform electricity into light
	Resistor	Limit Current ↑R
	Ammeter	Measure Current in Series
	Voltmeter	Measure Potential Difference in Parallel
	Switch	Control
	Power Supply	Power Supply source of current



Circuit A is connected in Parallel and circuit B is connected in Series.
Explain.

21) Determine the direction a compass needle would point if it were placed at the following four positions around a live electrical wire:

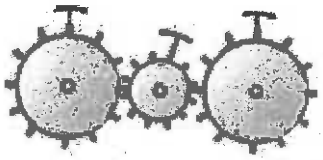
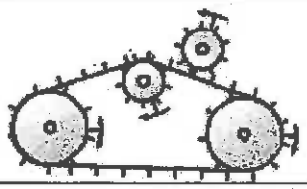
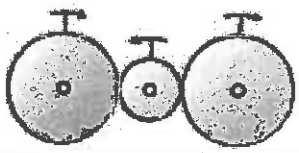
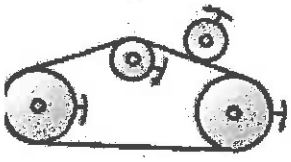
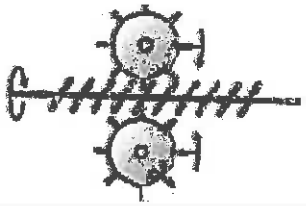




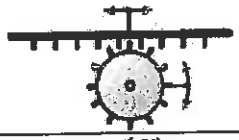
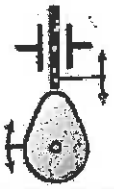
22) Several technological devices are listed in the following table. For each device describe the transformation of energy from one form to another. (ex. An electric light bulb transforms electrical energy into light energy)

Device	Energy Transformation
Gasoline Engine	Chemical → Mechanical
Wind Turbine	Mechanical → Electrical
Toaster	Electrical → Heat
Headphone Speakers	Electrical → Sound
Television Screen	Electrical → Light (Luminous)
Piano	Mechanical → Sound
Photovoltaic Cell	Luminous (Light) → Electrical
Piezoelectric Crystals	Electrical → Mechanical
Battery	Chemical → Electrical
Geothermal Power Plant	Thermal / Heat → Electrical
Blender	Electrical → Mechanical
Glow Stick	Chemical → Light (Luminous)
Hydroelectric Dam	Mechanical → Electrical

23) For each of the following motion transmission systems indicate the name of the system and whether or not it is reversible.

	Name of System	Reversible (Yes/No)
	Gear Train	yes
	Chain and Sprocket.	yes
	Friction Gears	yes
	Belt and Pulley	yes
	Worm and Worm Gear	No

24) For the following table of motion transformation systems indicate the name of the system, whether or not the system is reversible and in what way(s) the system can transform motion.

	Name of System	Reversible (Yes/No)	Type(s) of Transformation ex. Translational to Rotational
	Rack and Pinion	Yes	Rotation → Translation Translation → Rotation
	Screw Gear	NO	Rotation → Translation
	Cam and follower	NO	Rotation → Translation
	Slider - Crank	yes	Rotation → Translation Translation → Rotation

25) For the following situations indicate the constraints involved.

	Situation	Constraint
A)	Two groups of children playing Tug-O-War	Tension 
B)		Torsion 
C)	A towel being wrung dry	Torsion 
D)		Deflection 
E)	A piece of paper being torn up	Shearing 
F)		Compression 

26) For the following basic materials state at least two advantages and two disadvantages of each material and state how each material can be protected.

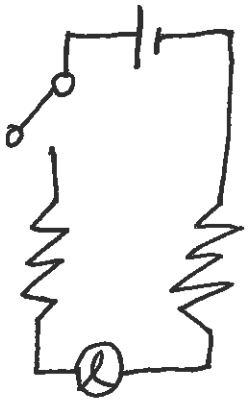
	Advantages	Disadvantages	Protective Measures
Ceramic	1. Hardness 2. Durable Low Conductivity (Thermal ↑ Electric)	1. Shattering 2. Acid Corrosion Low Conductivity (Thermal ↑ Electric)	-Avoid Shock - Physical - Thermal
Wood	1. Hardness Elasticity 2. Toughness Easily Assembled Lightweight	1. Flammable 2. Rot Low Conductivity (Thermal ↑ Electric)	Dipping in alkaline solution or Heating to high temperature
Metal	1. Shiny Hard Durable 2. Ductile Malleable Good Conductivity (Thermal ↑ Electric)	1. Heavy 2. Oxidization High Conductivity (Thermal ↑ Electric)	-Coating treatment - Tempering - Annealing - Quenching
Plastic	1. Lightweight Durable 2. Easily Shaped Hard Low Conductivity (Thermal ↑ Electric)	1. Irreversible Degredation 2. Made of fossil fuels Low Conductivity (Thermal ↑ Electric)	Waterproof Coating UV absorbing pigments Antioxidant Addition

27) For the following table of energy resources indicate whether or not the type of energy plant uses renewable energy, produces atmospheric pollutants, produces hazardous materials or can be constructed anywhere. Also indicate if the source of energy is part of the lithosphere, hydrosphere or atmosphere.

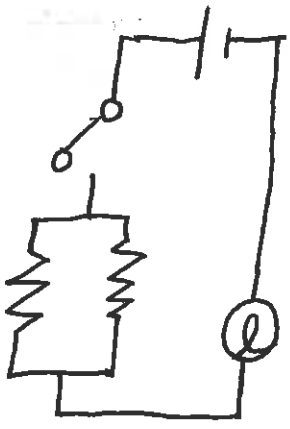
Type of Energy Facility	Renewable (Yes/No)	Atmospheric Pollution (Yes/No)	Hazardous Materials (Yes/No)	Constructed Anywhere (Yes/No)	Lithosphere, Hydrosphere or Atmosphere
Geothermal	Yes	NO	No	No	Litho "
Hydroelectric	Yes	NO	No	NO	Hydro "
Solar [Photovoltaic]	Yes	NO	NO	NO	Atmo "
Tidal	Yes	NO	NO	NO	Hydro "
Wind	Yes	NO	No	NO	Atmo "
Coal-Fired	No	Yes	NO	Yes	Litho "
Nuclear	No	No	Yes	yes	Litho "

28) In the space labeled "Series" provided below draw a series circuit that contains two resistors, a power supply, a switch and a light. In the space labeled "Parallel", draw a parallel circuit that contains the same components. (Hint: The resistors should be connected in parallel to one another)

Series



Parallel



29) Explain how human influence has caused the greenhouse gas effect to become an important factor to the increase of global average temperature.

Humans burn fossil fuels for energy. This releases greenhouse gases such as CO_2, N_2O, CH_4. These gases trap heat energy in the atmosphere. Greater amounts of greenhouse gases results in more heat in the atmosphere and thereby Greater/higher temperatures.