Name:_____( ) Class:_____ Date:_____ Practical Electricity: Worksheet 1

Have the right mindset: You are not supposed to understand everything the first time around. Care, perseverance and craftsmanship are what count

Practical electricity

1. *Some uses of electricity

(a) electric _heater_

eg : electric iron, electric stove, electric kettles. The heating elements are made of nichrome because of its high resistivity and high melting point.

(b) electric _light_

eg: filament lamp and fluorescent lamp
wire used to make the filament is tungsten. It has high melting point (3400^0C)

(c) electric _motor

eg: in fan, washing machine, hair dryer, blender.

2. *Measurement of electrical energy and electrical power

Formulae:

$$\text{Power} = \frac{energy}{time}$$

Therefore,

3. *Power ratings

$E = QV$

$= Ivt$

$= I^2Rt = \frac{V^2}{R}t$

$P = \frac{QV}{t}$

$= IV$

$= I^2R = \frac{V^2}{R}$

Criteria fro success:

You can

a) apply appropriate formula from the list to new situations

b) explain the meaning of power rating

c) Describe the 3 possible causes for danger of electricity.

d) describe an a.c power supply

Heating elements are usually marked with a voltage and power rating. Eg: A bulb has a voltage and power rating of 240 V, 100W. This means that the bulb dissipates_100_ J of

electrical energy every _1 second__ (100 W) if the p.d across it is _240__ V. It will not dissipate 100 W if it the p.d across it is not 240 V.

If the voltage across the bulb is less than 240V, then the bulb is dim and the power dissipated is less than __100_ W.
If the p.d across the bulb is very much greater, then the bulb will glow brighter than normal and it may blow.

4. *Dangers of electricity

There are three possible causes:

a) damaged insulation
b) overheating of cables; and
c) damp conditions.

5. *Damaged insulation

Insulating material derteriorate with time and use. If the rubber covering the live wire is damaged, the exposed wire can caused a severe electric shock to the user if the user touches it accidentally. This can lead to serious injury and even death.

6. *Overheating of cables

The overheating of cables refers to the unusually large current flowing in the conducting wires under certain conditions such as short circuit or overloading.

A short circuit can result when the live wire makes contacts with the neutral wire due to damaged insulation between them. This will produce a large current and the large amount of heat generated can melt the insulation and start a fire.

7. *Damped conditions

If water touches the live wire, it provides a conducting path for a large amount of current to flow through it.

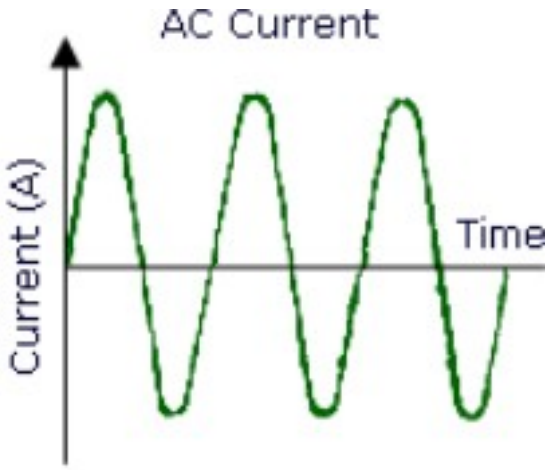
8. Electricity in the house

a) The electrical power is supplied by means of two cables. One is the live cable at an alternating voltage of +/-240 V and the other is the neutral cable of a potential of 0 V.

b) The electricity supply to homes is an _alternating_ current (a.c.) with a potential difference of 240 V.

c) a.c: current that _changes_ direction of flow every half a cycle. d)

Sketch the I-t graph to illustrate an a.c



Name:_____( ) Class:_____ Date:_____ Practical Electricity: Worksheet 2

Have the right mindset: Mistakes are not a sign of weakness. Mistakes help me learn.

Safety Measures

1 *Switches

All switches are designed to perform the same function of breaking or completing an electrical circuit. It must be fitted onto the _live_ wire so that switching off disconnects the __high_ voltage from the appliance. The appliance is safe to touch.

Criteria for success:
You must be able to explain
1) why switch is connected to the live wire
2) describe function of fuse and explain why it is connected to live wire

2 *Fuses

(a) A fuse is a _safety_ device that is inserted into an electrical circuit to protect the equipment and wiring against any __excessive__ current flow. It is a short thin piece of tin-coated copper wire which becomes hot and melts when the current through it is _higher__ than its rated value.

We choose a fuse which can take a current slightly larger than the maximum current that can pass through an appliance before it overheats.

(b) Fuses should be connected to the _live___ wire so that the appliance will not become __damaged_ after the fuse has blown.

(c) Symbol of fuse: 

(d) Commercial fuses are normally rated at 1A, 2 A, 5 A, 10 A and __13___ A.

(e) We use the formula P = _I x V__ to calculate the fuse rating. **The fuse rating** chosen will be the next **integer higher** than the value of the current.

(f) Calculate the current taken by a 800 W vacuum cleaner connected to a 240 V supply. Suggest a suitable rating for a fuse to be used to prevent this cleaner

from overheating.

P = I x V
800 = I x 240
I = 3.33 A
Suitable fuse rating : 5 A

Criteria for success
Your answer includes
1) proper presentation of working 2) formula used for calculation

3

3. *The Earth wire

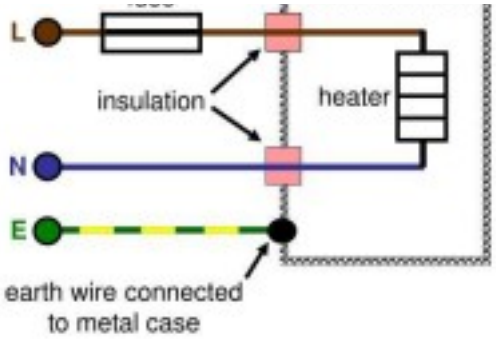
a) The earth wire is a low resistance wire, connected to the _metal_ casing of the appliance. Earthing protects any user of the appliance from an electric shock, if the metal casing should accidentally become _live__ (e.g when the live wire is not properly screwed on and touches the metal casing of the appliance). The large current that flows from the loose live wire through the metal casing and the earth wire (a low resistance wire) will blow the circuit and cut off the supply to the appliance. This makes the appliance safe to touch.

Criteria for success
You must be able to

b) What are the colours of live, neutral and earth wires? Live – Brown
Neutral – Blue

Earth – Green and Yellow
1) explain the function of earth wire and why it is connected to the metal casing
2) the colour code for Live, Neutral and Earth

c) Draw a circuit diagram to show how a water heater is wired to a three pin plug. Include a fuse and a switch in your diagram. Label clearly the positions of Live, Neutral and Earth.



by having the **EARTH** wire connected to their metal case.

Normally current flows to and fro between the **LIVE** and **NEUTRAL** wires through the heater of the dryer.

The metal case is at zero volts and is safe to touch.

4. Double insulation

(a) Double insulation is a safety feature in an electrical appliance that can substitute for an earth wire. In this case, only the _live_and _neutral_ wires are required for the appliance.

(b) This safety feature provides two_ levels of insulation. Firstly, the electric cable is

insulated from the internal components of the appliance. Secondly, the internal metal parts which could become live if a fault developed are also insulated from the external casing.
Appliances with double insulation are hair dryers and electric

shavers (c) Symbol: 

4

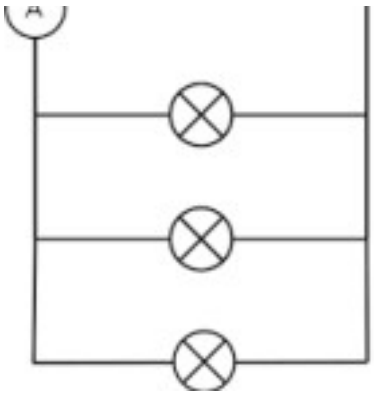
5. Wiring at home

(a) All appliances are wired in _parallel_ so that when one is faulty it does not affect the working of the rest of electrical components.

(b) There are three filament lamps, each marked '240 V, 60 W'

(i) Sketch a lighting circuit to show how these three lamps can be operated from a 240 V mains supply with one switch controlling the remaining two at the same time.

(ii) A fuse is to be inserted into the circuit. Should a 1 A or a 5 A rating fuse to used? Why? Add this fuse to your sketch of the circuit.



6.

Cost of electrical energy

ii) current required for each bulb:

P = IV
60 = I x 240
I = 0.25 A

Since bulbs are connected in parallel, I = I1 + I2 + I3

Total current in the circuit is 0.75 A

Add fuse to live wire

Criteria for success
You must
a) know wiring is done in parallel at home
b) draw a circuit diagram to show a certain requirement of arrangement using all proper circuit symbols
3) apply E= Pt and use kWh in calculating electrical cost

(a) The commercial unit of electrical energy is the kilowatt-hour_ (kWh). 1 unit on a electricity bill = 1 kWh

(b) The kilowatt hour (kWh) is the energy used by a device at a rate of _1000_ watts in __one___ hour.

(c) Calculate how many joules of energy are there in 1kWh

1 kWh = 1000 W x 1h x 60 x 60 s = 3600000 J

(d) To find the cost of electrical energy consumed, the total energy is calculated in ___kWh__ and not in ___Joules_____.

(e) Find the cost of having five 60 W lamps and three 100 W lamps lighted for eight hours if the electrical energy costs 15 cents per unit.

$E = P \times t$
$= (5 \times 60 + 3 \times 100)/1000\ kW \times 8\ h$
$= 4.8\ kWh$

cost = 4.8 kWh x 15 cents = 72 cents

7.

Name:_____( ) Class:_____ Date:_____ Practical electricity: Worksheet 3

Have the right mindset: Mistakes are not a sign of weakness. Mistakes help me learn.

- In Singapore, the majority of the electrical energy consumed is produced by burning **fossil fuels**.
- Our dependency on other countries for fossil fuels and the negative effects of burning fossil fuels on the environment point to a need for alternative sources of energy.
- Fossil fuels are a **non-renewable** source of energy.

Two types of energy source

a) Renewable energy is defined as energy from sources that can be replenished naturally.

b) Non-renewable energy is defined as energy from natural sources that cannot be replenished at a sustainable rate.

Renewable sources of Electricity

	Solar power Light energy-> electrical energy	**Hydroelectric power** G.P.E-> electrical energy	**Wind power** Kinetic energy -> electrical energy
Efficiency	• High efficiency when there is daylight and minimal cloud cover • Excess energy generated can be stored or fed back to the power grid	Most efficient energy source as water flow is concentrated and can be easily controlled.	Efficiency depends on wind direction and speed
Cost	• Solar panel cost is high • Cost of fuel is free	Cost of constructing and maintaining dam and power plant is high	• Cost falling with improving technology • Wind energy is free, therefore costs mainly go towards maintenance
Environmental impact	Clean energy, but requires large areas to be	Clean energy, but dam construction disrupts	Clean energy, but requires large open areas and

	cleared for solar panel installation	ecosystems	possible noise pollution

Non-renewable sources of electricity

	Nuclear power	**Fossil fuels**
Efficiency	High efficiency Small amount of uranium is enough to generate large quantity of energy	Most countries have well-established fossil fuel power plants
Cost	Additional cost incurred for disposal of radioactive waste	Cost rising due to declining supplies
Environmental impact	Waste produced can contaminate groundwater and sources of surface water	• Mining disrupts ecosystems • Burning fossil fuels results in air pollution

Criteria for success:

You are expected to

a) describe what is renewable and non- renewable energy and state examples of both categories.

b) compare the cost, conversion efficiency and environmental effects of using renewable and non- renewable energy sources.