Discussion questions:

Part I

1) How is a high voltage produced on the transmission networks? (2 pts)

- [x] By using step-up transformers
- [ ] By using step-down transformers
- [ ] By using a Darlington pair
- [ ] None of the above

2) Why is a high voltage used to transmit power on the transmission line network? (2 pts)

- [ ] It increases the amount of energy wasted in cables
- [x] It reduces the amount of energy wasted in cables
- [ ] The cables cannot transfer low voltage electricity
- [ ] So they can transfer the electricity at a high current

3) Electricity is sent through the National Grid using which type of electrical current? (2 pts)

- [x] Alternating current
- [ ] Direct current
- [ ] Neither alternating nor direct current
- [ ] Alternating and direct current

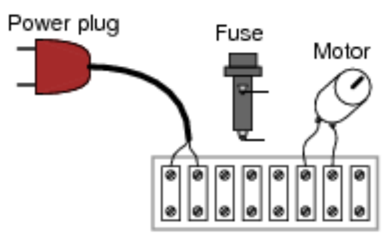
Part II

1) Compare between the fuse and circuit breaker. (8 pts)

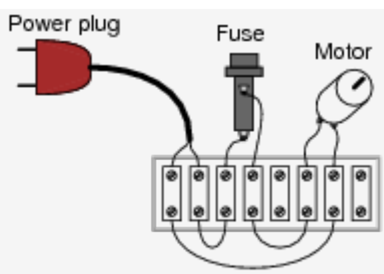
	Fuse	Circuit breaker
Operation	melts	Open the switch
# of times of use	Must be replaced	May be reset and is used repeatedly

Cost	inexpensive	expensive
Maintenance	No need	need

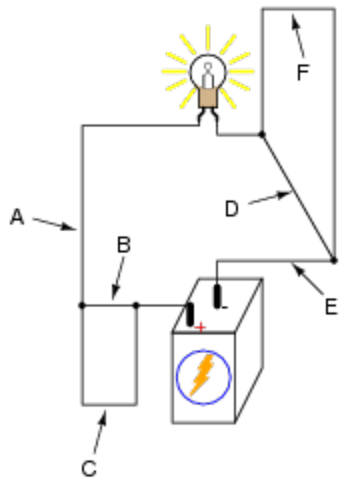
2) Connect the fuse to the circuit below, where an electric motor will be powered by the utility (220 volt AC) power: (6 pts)

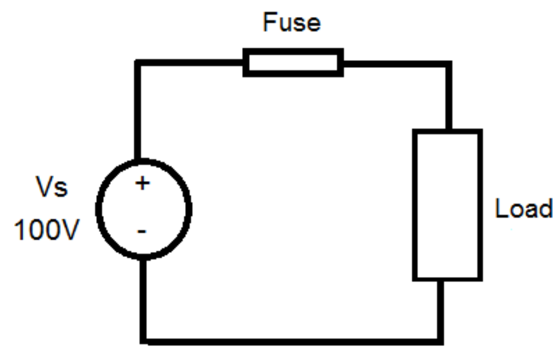


Answer



3) Will the light bulb work (energize) for each of the following breaks in the circuit. Consider only one break at a time:





Only choose one option for each point: (6 pts)

- break A: de-energize / no effect
- break B: de-energize / no effect
- break C: de-energize / no effect
- break D: de-energize / no effect
- break E: de-energize / no effect
- break F: de-energize / no effect

Answer

- A: de-energize
- B: no effect
- C: no effect
- D: no effect
- E: de-energize
- F: no effect

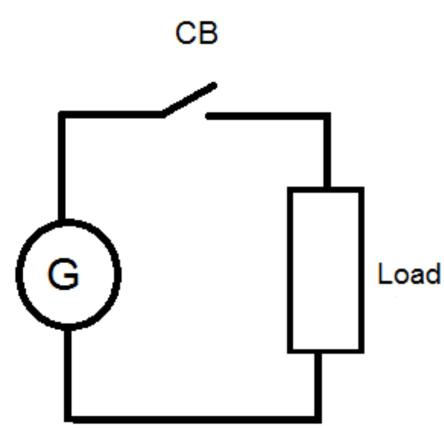
4) In the circuit shown, a 5A rated fuse is connected to protect the load. State the operation condition of the fuse for the two different loads. (4 pts)

Load	Fuse Operation
Load #1 is equal to 10Ω	Will melt because the current is 10A
Load #2 is equal to 20Ω	Will operate because the current is 5A

5) 1 KW generator is protected from overload by a series circuit breaker. State the operation of the circuit breaker with these different loads.

(4 pts)

Load	Operation (Open/closed)
Load 1 is (800 W)	CB closed
Load 2 is (1500W)	CB open (over load)



Part III

Power and time

Appliances are usually marked with the power at which they run. The amount of energy used can therefore be calculated using the following formula:

Energy = Power x Time

[Power in watts, time in seconds, energy in joules]

A normal house will use about 15 000 MJ of energy in a year.

http://www.bbc.co.uk/schools/gcsebitesize/science/edexcel_pre_2011/electricityworld/thecostofelectricityrev5.shtml

The cost

Electricity meters measure the number of units of electricity used in a home or other building. The more units used, the greater the cost. The cost of the electricity used is calculated using this equation:

Total cost = power (kW) × time (hour) × cost of 1 kWh (2 fils/kWh)

"1 kWh = 2 fils"

http://www.echalk.co.uk/Science/physics/electricityBills/electricityBills.pdf

1. What does the electrical energy cost to run: (6 pts)

"1 kWh = 2 fils"

(a) a 3 kW immersion heater for 20 mins

$$3\ kW \times 20 \frac{mins}{(60\frac{mins}{hr})} \times 2\frac{fils}{kWh} = 2\,fils$$

(b) a 200 W light bulb for 24 hours

$$0.2\ kW \times 24\ hrs \times 2\frac{fils}{kWh} = 9.6 fils$$

(c) a 2 kW electric fire for 4 hours a day for 3 months (=90 days)

$$2\ kW \times 4\ hrs \times 2\frac{fils}{kWh} = 16\ fils/day$$

$$16 fils/day \times 30\ days \times 3\ months = 1440\ fils$$

2. How long can you use the following for 100 fils: (6 pts)

(a) a 2 kW electric fire

cost = power (kW) × time (hour) × cost of 1 kWh (2 fils/kWh)

$$time(hr) = \frac{total\ cost(fils)}{power(kW) \times 2\ \frac{fils}{kWh}} = \frac{100}{2 \times 2} = 25\ hrs$$

(b) a 4 kW cooker ring

$$time(hr) = \frac{100}{4 \times 2} = 12.5\ hrs$$

(c) a 200 W light bulb

$$time(hr) = \frac{100}{\frac{200}{1000} \times 2} = 250\ hrs$$

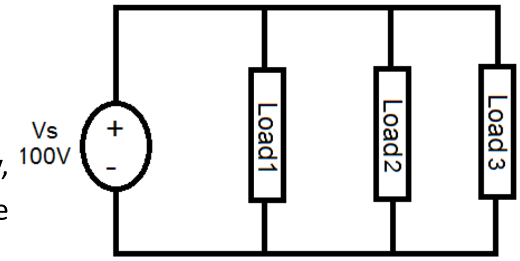
3) How much energy is used by a 150 W black and white television if is left on for 4 hours? (2 pts)

Energy = Power x time = 150 x 4 x 60 x 60 = 2160 000 = 2.16 MJ

4) How much energy is used by a 3 kW immersion heater in 45 minutes? (2 pts)

Energy = Power x time = 3000 x 45 x 60 = 8 100 000 = 8.1 MJ

3) Three different loads are connected in parallel to power supply of 100 V. If the loads draw 4A, 2A & 6A sequentially, Find:



a) The total power consumed by each load.

b) If these loads work for a total of 10 hours per day, calculate the energy consumed by each load.(assume that the month is 30 days)

c) If the Ministry of Electricity charges 2 fils/kWh, how much is the total cost of the monthly bill for all three loads (in KD/month).

Fill in the table below, (10 pts)

	Power (kW)	Energy (kWh)	Cost (KD/month)
Load #1	100X4 = 400 w = 0.4 KW	0.4 X 10 X30 = 120 kwh	= 120 X 4/1000 = 0.48 KD
Load #2	100X2 = 0.2 Kw	0.2 X 10 X30 = 60 kwh	=0.24 KD
Load #3	100X6 = 0.6 KW	0.6 X 10 X30 = 180 kwh	= 0.72 KD
		Total cost =	1.44KD

Saving energy

Electricity is an essential life requirement. If some of the heat escapes from the house, it costs money and wastes resources. There are several ways that heat can escape from a house, and different ways to reduce these losses. In deciding how cost-effective an energy-saving measure is, we need to know what its payback time is:

payback time = cost of energy(with saving measure) ÷ money saved each year

http://www.echalk.co.uk/Science/physics/electricityBills