Leaving Cert Physics Long Questions 2018 - 2002

9. *Effects of an electric current*

Please remember to photocopy 4 pages onto one sheet by going A3→A4 and using back to back on the photocopier

Contents

Ordinary level questions

The unit of energy is called the kilowatt hour
One kilowatt hour is the amount of energy used by a 1000 watt appliance in one hour.
Number of kilowatt hours = number of kilowatts × number of hours.

2012 Question 8 [Ordinary Level]

A plug is used to connect an electrical appliance in the home to the 230 volt mains supply.
Modern plugs contain a small fuse which comes with a rating of 1A, 2A, 3A, 5A or 13A.
The electrical energy supplied to the home is measured in kW h (*kilowatt-hour*).
(i)   What is the colour of the wire that should be connected to the fuse in a plug?
(ii) Why is there a fuse in a plug?
(iii) Explain how a fuse works.

(iv) A vacuum cleaner has a power rating of 900 W.
     What is the most suitable fuse to use in the plug of the vacuum cleaner?
(v) Why is a fuse of a lower rating unsuitable?
(vi) Name a device found in modern domestic circuits that has the same function as a fuse.
(vii)   If the vacuum cleaner is used for 90 minutes, calculate the number of units of electricity used.
(viii)   Calculate the cost of the energy used if the price of each unit of electricity is 22 cent.

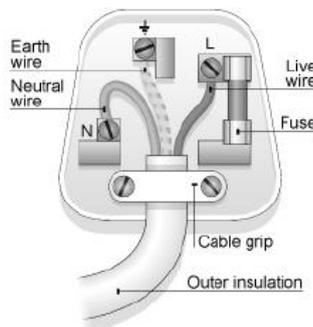**2011 Question 12 (c) [Ordinary Level]**
(i)   What is an electric current, and give its unit of measurement?
(ii) State the three effects of an electric current.
(iii) How would you demonstrate one of the effects?
(iv) An electric screwdriver has a power rating of 120 W when connected to its 24 V battery.
     Calculate the current supplied by the battery when the screwdriver is turned on.

2010 Question 12 (c) [Ordinary Level]
The diagram shows a plug which contains a fuse, an MCB and an RCD, all of which are used in domestic circuits.

(i)   Explain how a fuse works
(ii) How does the fuse improve safety?
(iii) What is an MCB?
(iv) What is the function of an RCD?
(v) Why should an appliance be earthed?
(vi) Give one other precaution that should be
     taken to improve safety when using
     electricity in the home.

2016 Question 12 (c) [Ordinary Level]
(i)   A ring circuit is used in domestic wiring.
     State one advantage of using of a ring circuit when wiring a house.
(ii) Earthing is a safety measure included in domestic circuits.
     What is meant by earthing?
(iii) How does earthing contribute to safety?
(iv) Name one other safety device used in domestic wiring.
(v) In a standard domestic three-pin plug, the live wire is covered in brown plastic.
     Name the other two wires and state the colour associated with each of them.

2009 Question 8 [Ordinary Level]

Plugs are used to connect electrical appliances in the home to the 230 volt ESB supply.
Modern plugs contain a small fuse which comes with a rating of 1A, 2A, 3A, 5A or 13A.
The electrical energy supplied by ESB to the home is measured in kWh (kilowatt-hour).

(i) What is the colour of the wire that should be connected to the fuse in a plug?
(ii) What is the function of a fuse?
(iii)Explain how a fuse works.
(iv)Name another device with the same function as a fuse.
(v) A coffee maker has a power rating of 800 W.
What is the most suitable fuse to use in the plug of the coffee maker?
(vi)Why would it be dangerous to use a fuse with too high a rating?
(vii)   If the coffee maker was in use for 150 minutes:
Calculate the number of units of electricity used by the coffee maker.
(viii)   Calculate the cost of the electricity used if each unit costs 15 cent.

2006 Question 11 [Ordinary Level]

Read this passage and answer the questions below.

Electricity is so much part of modern living that we often take it for granted. It is a powerful and versatile energy of great use in the home but can be dangerous if not used properly. The electricity connection into your home comes through the ESB main fuse and the ESB meter. Almost all new electrical appliances now come complete with a fitted 13 Amp, 3-pin plug. Remember, a wrongly wired plug can result in a serious or fatal accident. The first thing to know is the colour code for connecting the cables to the appropriate pin/terminal in the plug. The cables consist of a metal conductor covered in coloured plastic.

When wiring a plug it is most important that all the screw connections are fully tightened. You should leave a little extra slack on the earth wire. You must also fit the correct size fuse. When an appliance is *double insulated* it does not need to be earthed. These appliances will only have two wires, the brown live and the blue neutral, they do not have an earth wire.

(Adapted from *The Safe Use Of Electricity In The Home* by The ESB.)

(a) Give one use for electricity in the home.
(b) What is the function of the ESB meter?
(c) What will happen when a current of 20 A flows through a fuse marked 13 A?
(d) Give one safety precaution that should be taken when wiring a plug.
(e) What is the colour of the earth wire in an electric cable?
(f) Name a common material used to conduct electricity in electric cables.
(g) Why is the coating on electric cables made from plastic?
*(h)* Why are some appliances not earthed?

2004 Question 9 [Ordinary Level]

(i) What is an electric current?
(ii) An electric current can cause a heating effect. Name two other effects of an electric current.
(iii)Describe an experiment to show the heating effect of an electric current.
(iv)State two factors on which the heating effect of an electric current depends.
(v) An electric heater has a power rating of 2 kW when connected to the ESB mains supply of 230 V.
Calculate the current that flows through the heater.
(vi)What is the kilowatt-hour?
(vii)   Calculate the cost of using a 2 kW electric heater for 3 hours at 10 cent per kilowatt-hour.

2003 Question 8 [Ordinary Level]

(i)   What is an electric current?

(ii) Give the standard colour of the insulation on the wires connected to each of the terminals L, N and E on the plug in the diagram.

(iii)What is the purpose of the wire connected to the terminal E on the plug?

(iv)Explain why a fuse is used in a plug.

(v) The fuse in the plug of an electric kettle was replaced with a 5 A fuse. The kettle has a power rating of 2 kW when connected to the ESB mains voltage of 230 V. Calculate the current that flows when the kettle is first plugged in.

(vi)This current will only flow for a very short time. Explain why.

(vii)   Bonding is a safety precaution used in domestic electric circuits How does bonding improve safety in the home?

(viii)   Name a device that is often used nowadays in domestic electric circuits instead of fuses.
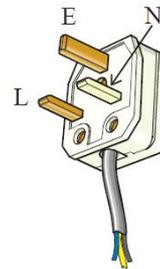
2017 Question11 [Ordinary Level]

Read the following passage and answer the questions below.

The Electricity Connection to your Home

The electricity connection to your home is an a.c. supply and comes through ESB Networks' main fuse and meter. The ordinary fuses or miniature circuit breakers in the distribution board respond to overloaded circuits by 'blowing' and switching off the flow of electricity in the circuit. Additional protection against electric shock or fire is provided by a Residual Current Device, RCD. In simple terms, an RCD detects an abnormal flow of electricity out of a circuit when, for instance, a cable is damaged or a fault develops in an appliance allowing electricity to 'leak' out. The RCD responds instantaneously to such 'leakage' and disconnects the supply from the circuit. All RCDs have a test button to check that the mechanism is working properly.

Making the Connection – Plugs and Cable Colours

Almost all new electric appliances now come complete with a fitted 13 A 3-pin plug. The first thing to know is the colour code for connecting the cables to the appropriate pin/terminal in the plug. When you connect each wire to the appropriate terminal, it is most important that no loose strands of wire are exposed and that all the screw connections are fully tightened. You should also leave a little extra slack on the green/yellow wire within the plug in order to avoid strain on this vital connection. The ordinary 13 A plug suits most of the commonly used 'non-fixed' appliances in the home – heaters, washing machines, dryers, microwave ovens, tools, entertainment equipment, etc. Appliances with a higher loading should be permanently connected to their own circuit through a switch. The most vulnerable parts of many appliances are the connecting flex and the plug. Most electrical accidents associated with electric appliances are caused either by damaged flexes or wrongly wired plugs. For your own safety, keep electric appliances well maintained and don't abuse them.

(Adapted from *The Safe Use of Electricity in the Home*, ESB Networks)

(*a*) What is the function of the electricity meter?

(*b*) What is meant by the term a.c.?

(*c*) Name three safety devices found in domestic circuits.

(*d*) What is the cause of most accidents associated with electrical appliances?

(*e*) What is the function of the test button on an RCD?

(*f*) Name the pins labelled A, B and C in the diagram.

(*g*) State one precaution that should be taken when wiring a plug.

(*h*) What is the maximum power that an appliance with a 13 A plug can use when connected to a 220 V supply?
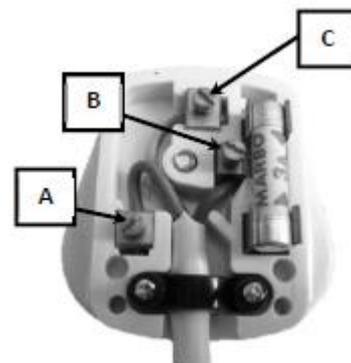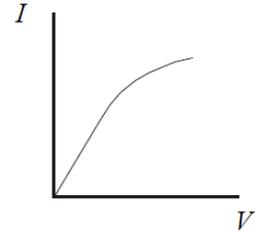
2005 Question 8 (a) [Ordinary Level]
(i) State Ohm's Law.
(ii) The graphs show how current (I) varies with
     potential difference (V) for
     (a) a metal, (b) a filament bulb.
     Which conductor obeys Ohm's law?
(iii)Explain your answer.
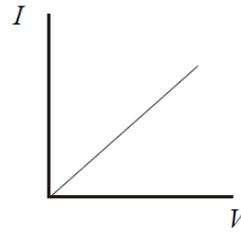
(a) a metal   (b) a filament bulb

2013 Question 8 (a) [Ordinary Level]
(i) An electric current is the flow of charge in a conductor when there is a
     potential difference between its ends. Name the unit of current.
(ii) Give an example of a conductor.
(iii)Name a source of potential difference.
(iv)What are the charge carriers in semiconductors?
(v) What type of conductor does the I-V graph in the diagram represent?
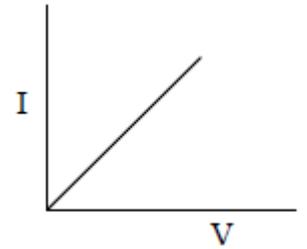
2015 Question 12 (c) [Ordinary Level]
(i) Define resistance.
(ii) What is the unit of resistance?
(iii)Describe an experiment to demonstrate the heating effect of an electric current.
(iv)Electrical conduction in different materials is due to the movement of charge carriers.
State the charge carriers that are responsible for conduction in each of the following.
   * gases
   * semiconductors
   * metals
   * solutions

Higher level questions

2006 Question 9 [Higher Level]
(i) What is an electric current?
(ii) Define the ampere, the SI unit of current.
(iii) Describe an experiment to demonstrate the principle on which the definition of the ampere is based.
(iv) Sketch a graph to show the relationship between current and time for
    a)   alternating current;
    b)   direct current.
(v) The peak voltage of the mains electricity is 325 V. Calculate the rms voltage of the mains.
(vi) What is the resistance of the filament of a light bulb, rated 40 W, when it is connected to the mains?
(vii)   Explain why the resistance of the bulb is different when it is not connected to the mains.

2003 Question 8 [Higher Level]
(i) Define the unit of current, i.e. the ampere.
(ii) Describe an experiment to demonstrate the principle on which the definition of the ampere is based.
(iii) Various materials conduct electricity. Draw a graph to show the relationship between current and voltage for each of the following conductors:
    a)   a metal at constant temperature
    b)   an ionic solution with inactive electrodes
    c)   a gas.
(iv) How would the graph for the metal differ if its temperature were increasing?
(v) How would the graph for the ionic solution differ if its concentration were reduced?

Solutions to ordinary level *maths* questions

2017 Question 11

What is the maximum power that an appliance with a 13 A plug can use when connected to a 220 V supply?

P = IV = 13 × 220 = 2860 W

2012 Question 8

A vacuum cleaner has a power rating of 900 W.
What is the most suitable fuse to use in the plug of the vacuum cleaner?

P = VI   I = P/V = 900/230 = 3.9 amps

The most suitable fuse is the one with a current rating just above 3.9 amps so a 5 amp fuse should be used.

If the vacuum cleaner is used for 90 minutes, calculate the number of units of electricity used.

Power = 900 W = 0.9 kW   Time = 90 minutes = 1.5 hours

Number of kiloWatt hours = number of kilowatts × number of hours.
                    = (0.9)(1.5)   = 1.35 kiloWatt hours

Calculate the cost of the energy used if the price of each unit of electricity is 22 cent.

Cost = (1.35)(22)   = 29.7 cent / 30 cent

2011 Question 12 (c)

Calculate the current supplied by the battery when the screwdriver is turned on.

P = IV   120= (*I*)(24)   I = 5 A

2009 Question 8

A coffee maker has a power rating of 800 W.
What is the most suitable fuse to use in the plug of the coffee maker?

P = VI ⇒ I = P/V = 800/230 = 3.4 A

So the most suitable fuse is the 5 A fuse.

If the coffee maker was in use for 150 minutes calculate the number of units of electricity used by the coffee maker.

Power = 800 W = 0.8 kW   Time = 150 minutes = 2.5 hours

Number of kiloWatt hours = Number of kilowatts × Number of Hours.
                    = 0.8 × 2.5 = 2 kWh

Calculate the cost of the electricity used if each unit costs 15 cent.

Cost = 2 × 15   = 30 cent

2004 Question 9

An electric heater has a power rating of 2 kW when connected to the ESB mains supply of 230 V.
Calculate the current that flows through the heater.

P = VI   ⇒ I = P/V   ⇒ I = 2,000/230 = 8.7 A.

Calculate the cost of using a 2 kW electric heater for 3 hours at 10 cent per kilowatt-hour.

Number of kiloWatt hours = Number of kilowatts x Number of Hours
                    = 2 × 3 = 6 kW hrs.

Cost = 6 × 10 = 60 cent

2003 Question 8

Calculate the current that flows when the kettle is first plugged in.

P = VI ⇒ I = P/V   ⇒ I = 2000/230 = 8.7 A

Solutions to *all* higher level questions

2006 Question 9

(i) What is an electric current?

An electric current is a flow of charge.

(ii) Define the ampere, the SI unit of current.

The ampere is the amount of charge which, if flowing in two very long parallel wires one metre apart in a vacuum will experience a force of 2×10^{-7} N *per metre length*.

(iii) Describe an experiment to demonstrate the principle on which the definition of the ampere is based.

1. Connect two parallel conductors (aluminium strips will do nicely) in a circuit as shown.
2. Complete the circuit to switch on the current.
   Result: The strips will either move towards each other or repel each other, depending on the direction of the currents.
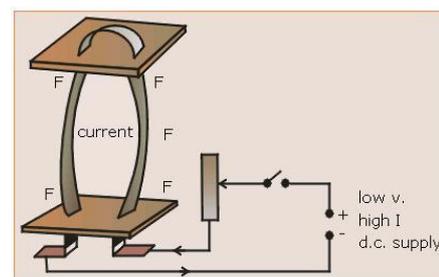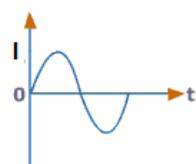

(iv) Sketch a graph to show the relationship between current and time for
    (i) direct current   **(ii) alternating current.**
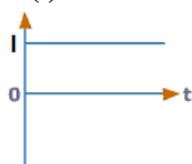
Direct current   Alternating current

(v) The peak voltage of the mains electricity is 325 V. Calculate the rms voltage of the mains.

$$V_{rms} = \frac{V_{max}}{\sqrt{2}} \qquad V_{rms} = \frac{325}{\sqrt{2}} \qquad V_{rms} = 229.81 \text{ V}$$

(vi) What is the resistance of the filament of a light bulb, rated 40 W, when it is connected to the mains?

$$P = \frac{V^2}{R} \qquad R = \frac{V^2}{P} \qquad R = \frac{229.81^2}{40} \qquad R = 1320 \text{ } \Omega$$

(vii)   Explain why the resistance of the bulb is different when it is not connected to the mains.

Resistance for a metal increases with temperature. When the filament is not connected to the mains it is colder and so has a lower resistance

## 2003 Question 8

(i) Define the unit of current, i.e. the ampere.

The ampere is the amount of charge which, if flowing in two very long parallel wires one metre apart in a vacuum will experience a force of 2×10^{-7} N *per metre length*.

(ii) Describe an experiment to demonstrate the principle on which the definition of the ampere is based.

1. Connect two parallel conductors (aluminium strips will do nicely) in a circuit as shown.
2. Complete the circuit to switch on the current.
   Result: The strips will either move towards each other or repel each other, depending on the direction of the currents. .
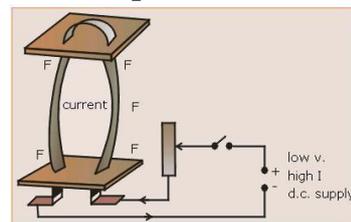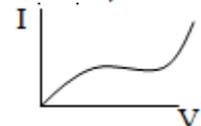
(iii) Draw a graph to show the relationship between current and voltage for a metal at constant temperature
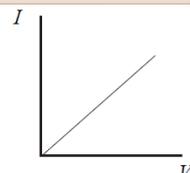
(iv) Draw a graph to show the relationship between current and voltage for an ionic solution with inactive electrodes
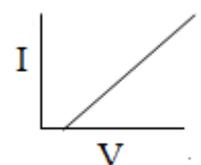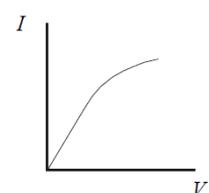
(v) Draw a graph to show the relationship between current and voltage for a gas.

(vi) How would the graph for the metal differ if its temperature were increasing?

If temperature was increasing it would no longer be linear; instead there would be a curve (similar to the VI graph for a filament bulb) because resistance would increase (see graph).

(vii) How would the graph for the ionic solution differ if its concentration were reduced?

The slope of the graph would be less (the resistance increases) due to less ions /charge carriers being present.