Delta Science Education

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HKDSE Physics

Core 4: Electricity and Magnetism

Chapter 3: Domestic Electriciy

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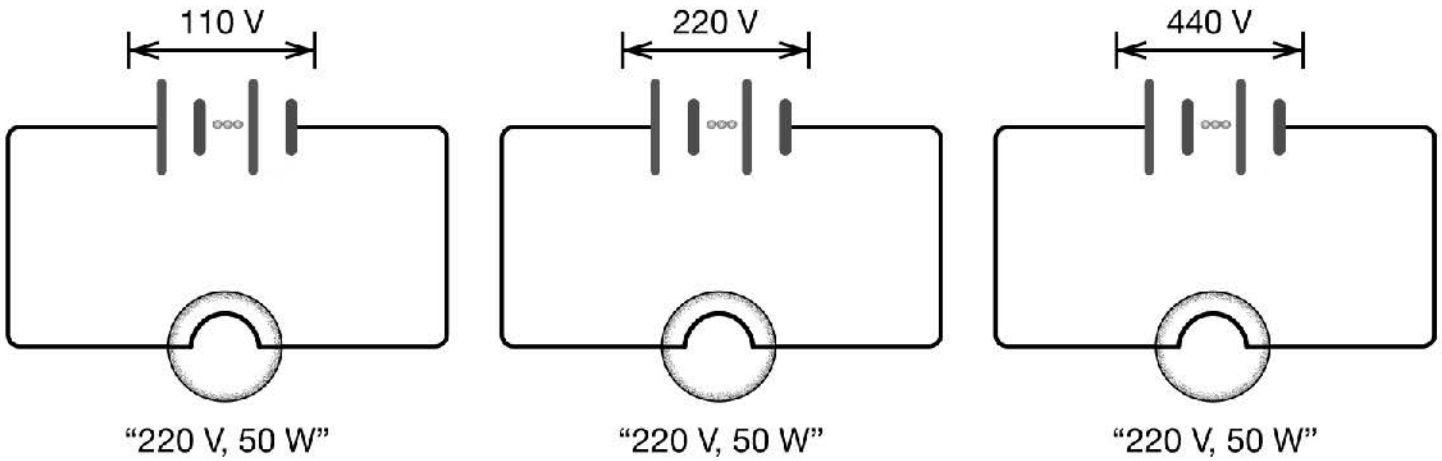
1. Rated Values

(1) Rated Values

- All electrical appliances have a label similar to the one below:

- **Rated Voltage:**
- **Rated Power:**
- **AC Frequency:**
- **Rated Current (calculated):**

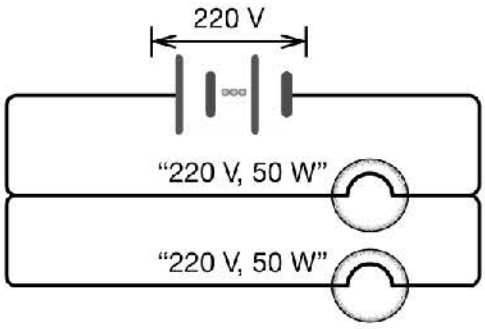
- The voltage applied can be different from the rated voltage:
  - If **applied voltage** = **rated voltage**, the appliance work under **rated/normal condition**. The power [ ] will be the rated power.
  - If **applied voltage < rated voltage,** the power consumed will be **less** than the rated power.
  - If **applied voltage > rated voltage**, the power consumed will be **larger** than the rated power. The current drawn will be larger than the rated current and the appliance will then [ ] and may [ ].

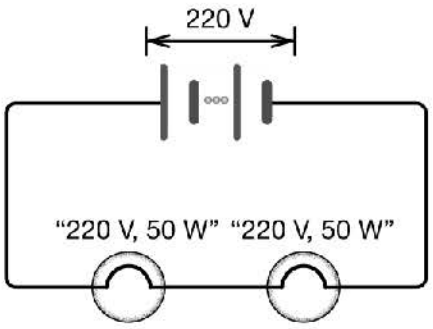


- [ ] of the electrical appliance does not change even though the applied voltage varies.

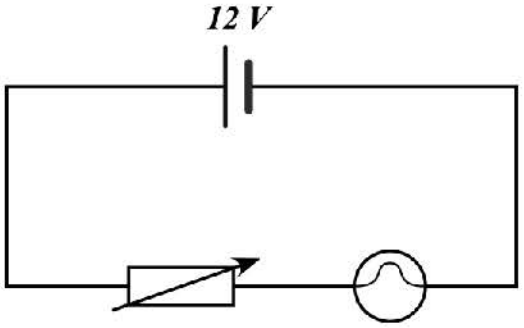
Examples that you must fully understand

1. Find the total power given out by the two light bulbs in the two circuits below.





2. In the circuit shown, the light bulb has a rated voltage of 8 V and rated power of 4 W.

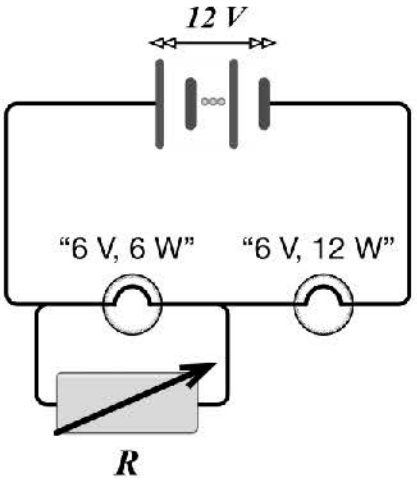


(a) Find the resistance of the rheostat required for the bulb to give normal brightness.

(b) If the resistance of the rheostat is adjusted to 32 Ω, calculate (1) the current through the light bulb; and (2) the power output by the light bulb.

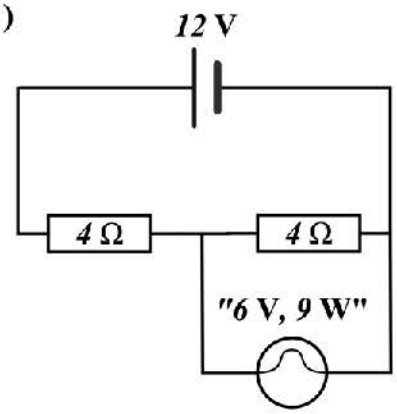
Examples that you must fully understand

3. What should be the resistance R of the rheostat so that the two light bulbs can give out normal brightness?



4. Which of the following three circuits may a "6 V, 9 W" light bulb work at its rated condition?

(1)



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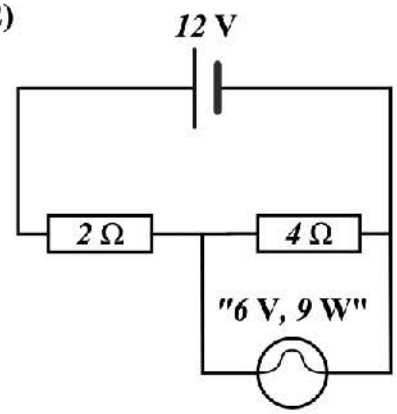
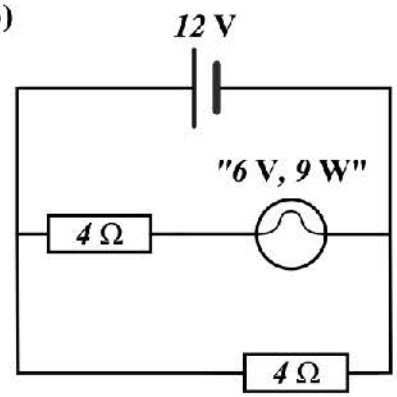
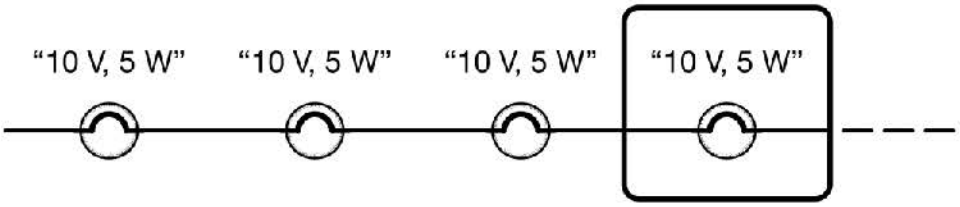


(3)



5. A 10 V, 5 W light bulb in a stream of lights burns out. When David replaces it by another one, he finds that the light it gives is very dim, although the other bulbs light up brightly. Which of the following is a possible reason for this?



(1) The current through the new light bulb is much less than that through the other bulbs.

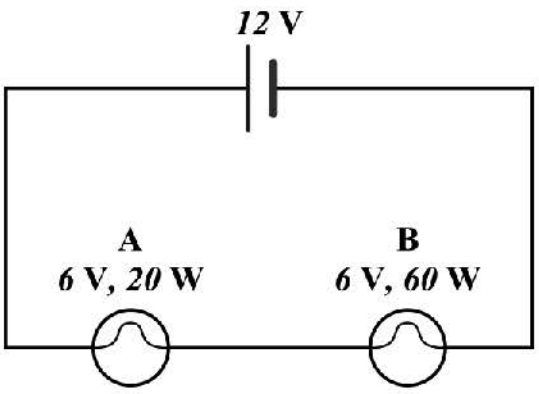
(2) The supply voltage has dropped.

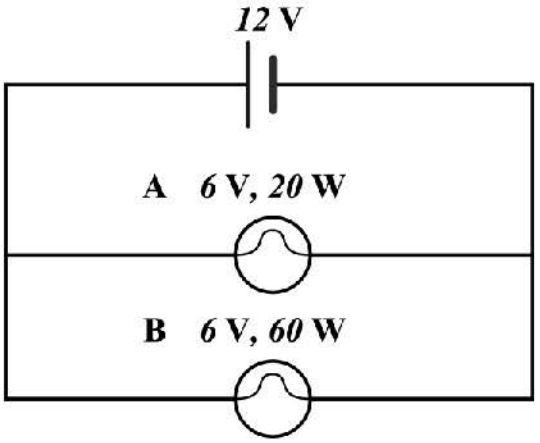
(3) The new bulb is designed to give out the same wattage but work at a lower voltage than the original one.

(4) The new bulb is designed to work at the same voltage but give a lower rated wattage than the original one.

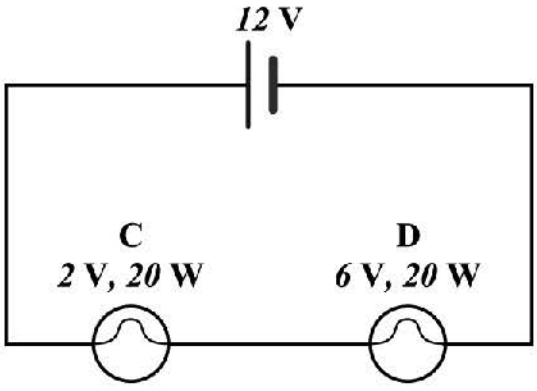
Examples that you must fully understand

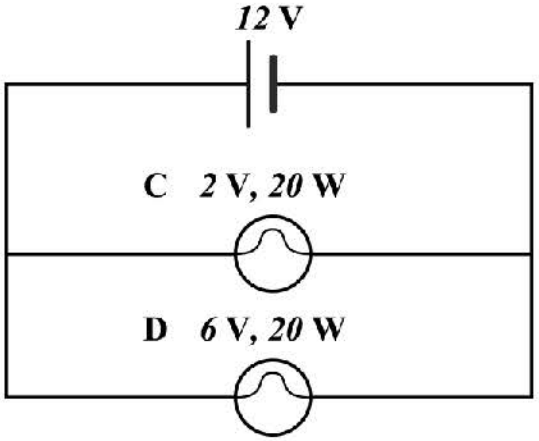
6. Two light bulbs, A and B are connected in series and in parallel separately. State which lightbulb is brighter in each of the circuits. Hence, calculate the power of the brighter one.





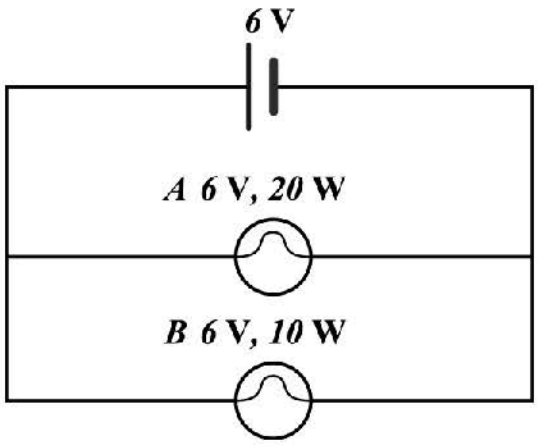
7. Two light bulbs, C and D are connected in series and in parallel separately. State which lightbulb is brighter in each of the circuits. Hence, calculate the power of the brighter one.





Examples that you must fully understand

8. Light bulbs A and B are connected in parallel as shown. Which of the following statements is / are correct?



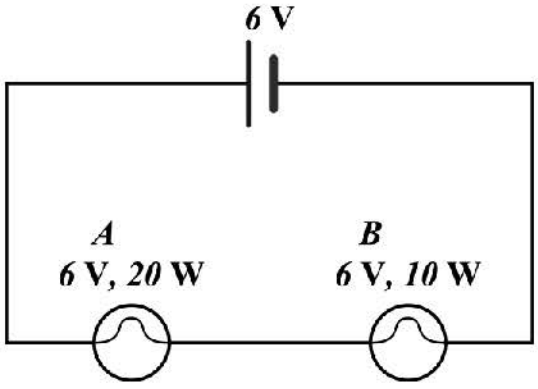
(1) Both of the bulbs can give their normal brightness.

(2) Bulb A is brighter than that of bulb B.

(3) The resistance of A is smaller than that of B.

(4) The current through bulb A is greater than the current through bulb B.

9. Light bulbs A and B are connected in series as shown. Which of the following statements is / are correct?



(1) The voltage across A is equal to the voltage across B.

(2) The current through A is greater than that through B.

(3) A is brighter than B.

(4) The total power consumed is 15 W.

Examples that you must fully understand

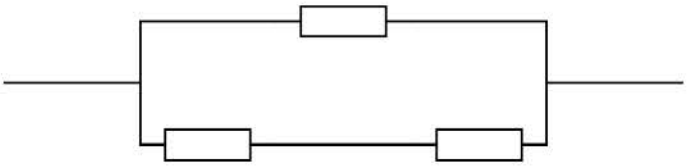
10. Two electric heaters X and Y are of ratings '110 V, 40 W' and '110 V, 80 W' respectively. Which of the below deductions about the two heaters is / are correct?

(1) The operating resistance of X is twice that of Y.

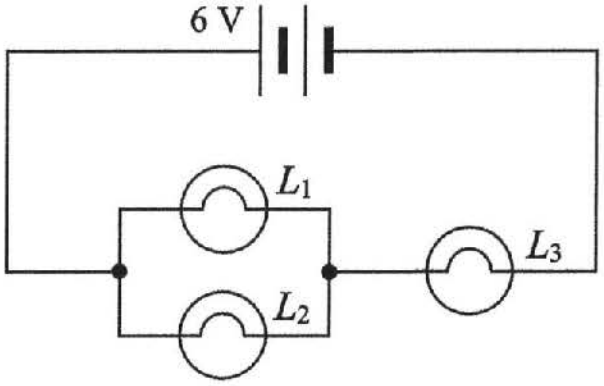
(2) X will consume a power of 80 W when it is connected to a 220 V mains supply.

(3) Both heaters work at their rated values when they are connected in series to a 220 V mains supply.

11. Three identical resistors are arranged as shown. The rated power of each resistor is 12 W. If no resistor exceeds its rated power, what is the maximum power dissipation in such an arrangement?



12. Three identical lamps L_1, L_2 and L_3 of ratings '6 V, 12 W' are connected to a 6 V battery as shown in the figure. Which of the following statements is correct?



(1) The voltage across L_2 is 3 V.

(2) The current passing through L_1 is 2 A.

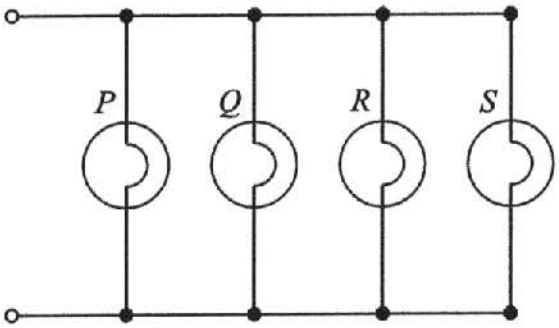
(3) The total power dissipated in L_1 and L_2 is smaller than that in L_3.

(4) The total power drawn from the battery is 12 W.

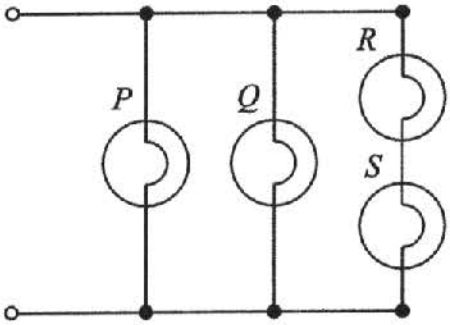
Examples that you must fully understand

13. P and Q are bulbs of rating "40 W, 200 V" while R and S are of rating "60 W, 200 V". Which of the following circuits gives the maximum brightness?
(Assume all circuits are connected to the same voltage.)

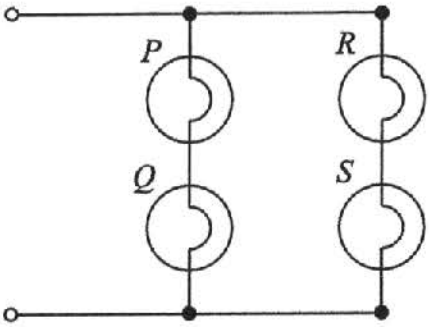
A.



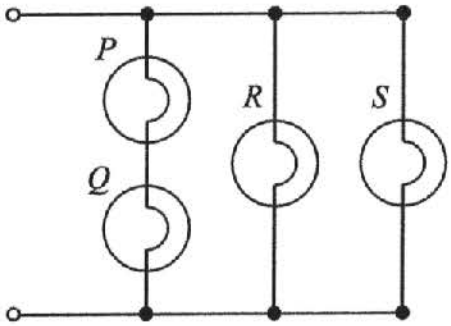
B.



C.



D.



(2) Rated Power of Common Appliances

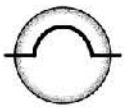
- Power of common appliances:

Electrical Appliances	Rated Power
Water heater	4000 W
Air-conditioner	1500 W
Electric iron	1000 W
Refrigerator	100 W
Vacuum cleaner	1000 W
TV set	150 W
Washing machine	500 W
Hi-fi set	100 W

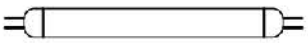
- The one with greater power will have lower resistance:

Examples that you must fully understand

14. A 100 W light bulb is dimmer than a 100 W fluorescent lamp working under their rated conditions. Which of the following statements is / are correct?



Incandescent Lamp



Fluoroscent Lamp

LED

(1) A 100 W light bulb gives out less power than a 100 W fluorescent lamp under the rated conditions.

(2) The resistance of a light bulb is greater than that of the fluorescent lamp.

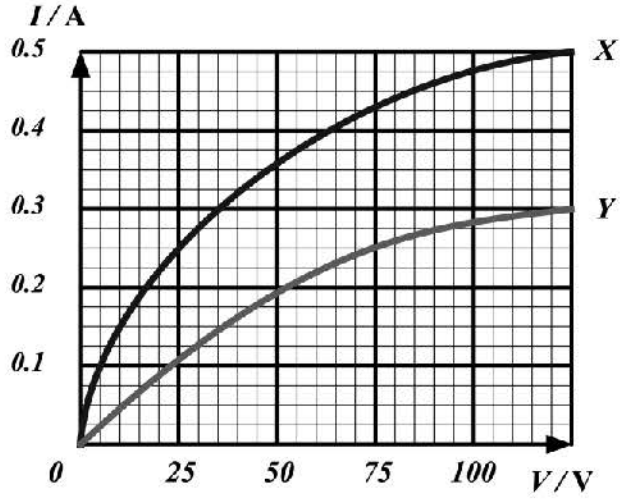
(3) A 100 W light bulb has a stronger hearing effect than a 100 W fluorescent lamp under rated conditions.

15. The power ratings and resistance of two filament lamps are "24 W, 6 Ω" and "9 W, 4 Ω" respectively. If these two filament lamps are connected in parallel to a power supply, what is the maximum current drawn from the power supply so that both of them are working within their rated power?

A. 2.0 A
B. 2.5 A
C. 3.5 A
D. 4.8 A

Examples that you must fully understand

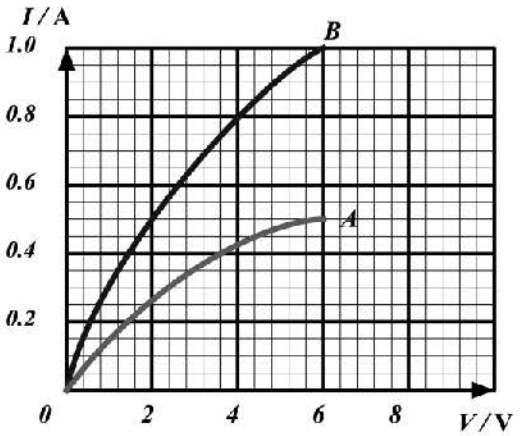
16. The graph shows the *I-V* characteristic of two light bulbs *X* and *Y*, which are marked respectively as "100 V, 50 W" and "100 V, 30 W".



(a) Find the resistance of X and Y when they work in their normal conditions.

(b) Find the resistance of X and Y when they are connected in series to a 100 V power supply. Hence, the power consumed by X and Y respectively.

17. Two light bulbs *A* and *B* are marked as "6 V, 3 W" and "6 V, 6 W" respectively and their *I-V* characteristics are shown in the graph. When they are connected in series to a d.c. supply, one of them operates at its normal rating while the other one is dimly lit. Which of the following statements is / are correct when they are connected in series to that d.c. supply?



(1) Light bulb B is dimly lit.

(2) The power consumed by light bulb B is 1.5 W.

(3) The resistance of light bulb Y in this circuit is 6 Ω.

(3) Different Ratings of Heating Appliances

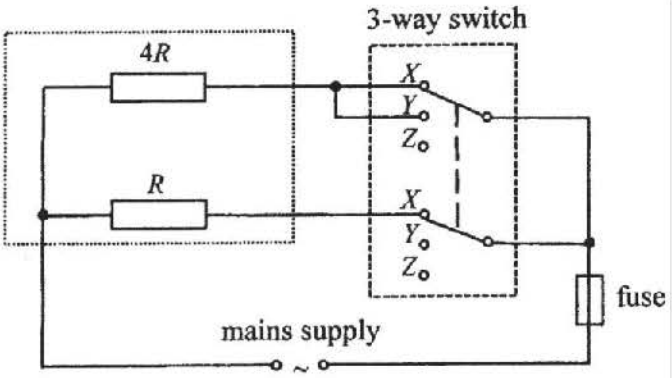
- Different combination of different resistors can give out different rated power.
- To change the brightness of a light bulb, a **rheostat** is connected in [ ] with it. By adjusting the resistance of the rheostat, the [ ] through the light bulb is varied and thus the brightness of the light bulb is adjusted.

Examples that you must fully understand

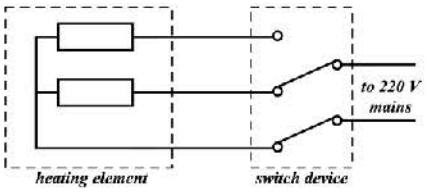
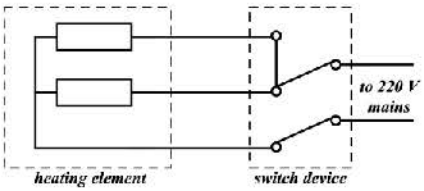
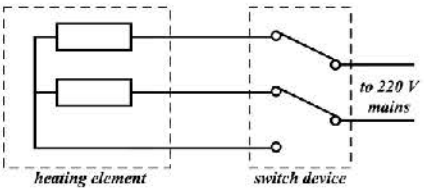
18. Figure shows the schematic diagram of an electric heater which can operate in two modes, namely, 'heating (800 W)' and 'keeping warm (160 W)'. The heating elements of resistances $4R$ and R are connected to the mains supply via a 3-way switch with its two poles tied together. That is, both poles can be connected to one of the three pairs of terminals X, Y or Z.

(a) To which terminals, X, Y or Z, should the switch connect to when the heater is in 'heating' mode?
To [ ]

(b) If the switch now connects to terminal Y, calculate the current passing through resistor R.



19. A hair dryer with a plastic case has three settings of power output: high, medium and low. The settings are selected by the use of a switch device. The Figures below show the circuits of these three settings in random order. All the resistors in the heating element have the same resistance. Write down the power setting for the respective circuits.

Circuit X	Circuit Y	Circuit Z
		

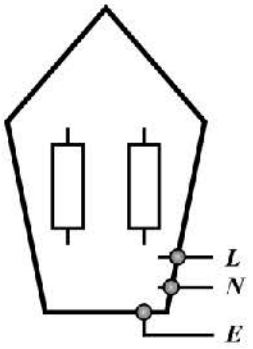
Examples that you must fully understand

20. There is a travel steam iron with a rated power of 1100 W. The water tank in the iron is filled with water. When the iron is turned on, water drips continuously from the tank to a hot plate inside the iron, generating steam for ironing clothes. The iron is designed to operate at 220 V or 110 V with the same power output of 1100 W.

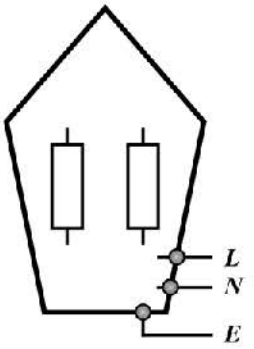
(a) In each of the following cases, find the resistance of the heating element of the iron when (1) it operates at 220 V and (2) it operates at 110 V.

(b) The heating element of the iron consists of two identical resistance wires as shown in the figure below. Draw in diagrams to show how the resistance wires are connected to "L" and "N" when the iron is operating at 220 V and at 110 V respectively. Hence, calculate the resistance of each resistance wire.

At 220 V



At 110 V



***The resistance of each resistance wire is* ☐.**

(c) A tourist switches the iron to the 220 V mode but connects it to a 110 V supply. Explain whether the iron can function normally.

Since the output power is proportional to* ☐, *the output power is much* ☐ *than the rated value when it is connected to a 110 V supply. So the iron* ☐ *function normally.

(d) Another tourist switches the iron to the 110 V mode but connects it to a 220 V supply. Explain what will happen.

The output power will be much* ☐. *A large* ☐ *will be drawn. The iron may* ☐ *and burn.

2. Cost of Electricity

- The electrical energy consumed is calculated by:

- Unit of energy:
  - Assume there is a **1500 W** heater, switched on for **3 hours**:

Energy consumed = Pt	Energy consumed = Pt

  - Converts **1 kilowatt-hour** into **joule**:

    1 kW h

- One unit of electrical energy is equal to **1 kW h** which is used to calculate the cost of electricity.
- A **kilowatt-hour meter** is used to measure the electrical energy consumed in **kW h**.

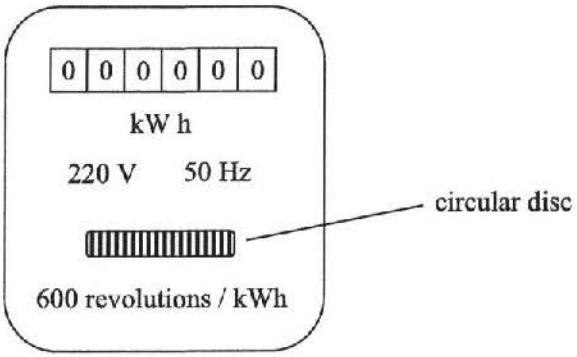
Examples that you must fully understand

21. Five light bulbs each of "220 V, 60 W" and a refrigerator of "220 V, 300 W" are connected in parallel to a 220 V power supply. Assume they have been switched on for **1 month (30 days)** continuously, calculate the cost of electricity. Given that the charge of electrical energy is **90 cents per unit.**

Examples that you must fully understand

22. The following shows part of an electric bill. From the data given, calculate the current cost of electricity per unit **kW h**.

23. The figure shows the label of a kilowatt-hour meter connected to a mains supply. When an appliance is switched on for **2 minutes**, the circular disc rotates through **24 complete revolutions**. What is the electric power consumed by the appliance?



24. The resistance of the heating unit of an electric kettle is **100 Ω**. It is connected to the mains at **220 V**. How much does it cost to heat **1.2 kg** of water from **25 °C** to the boiling point? Each unit of electrical energy costs **$0.9**.

25. The figure shows the energy label of a washing machine. If the average working time per wash is **1.8 hours**, estimate the average electric power consumed by the machine.

3. Efficiency

- Energy conservation in an electric appliance:

Energy/Power input = (Useful) Energy/Power output + Energy/Power loss

=

- Efficiency of an electric appliance:

Examples that you must fully understand

26. An electric kettle has the rating values of "220 V, 3 kW".

(a) If the efficiency of the kettle is 75%, how long will it take to heat 1.2 kg of water from 25°C to the boiling point?

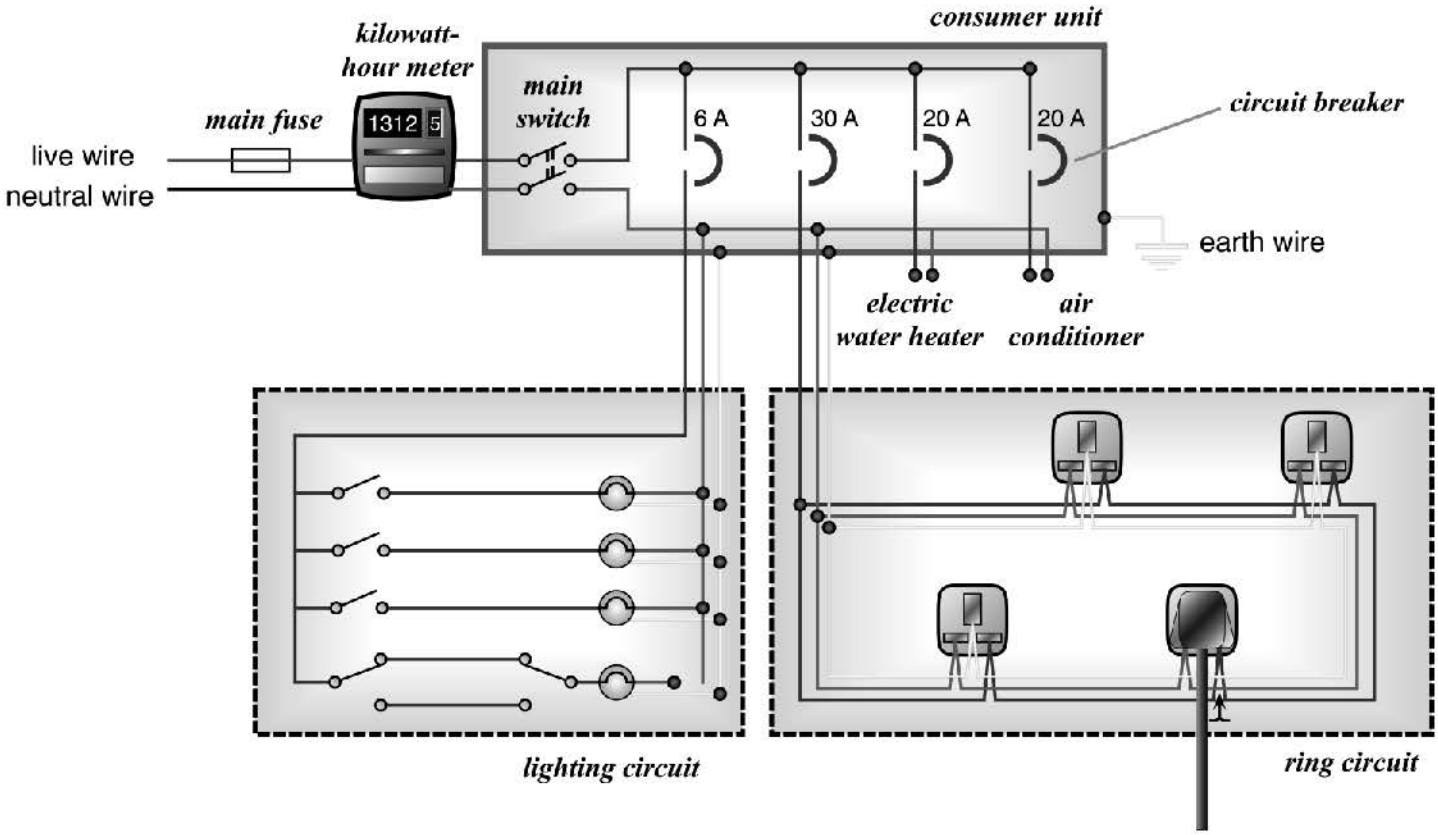
(b) Give two reasons why the efficiency of the kettle is lower than 100%.

Some energy is lost to _____.

Some energy is lost to _____.

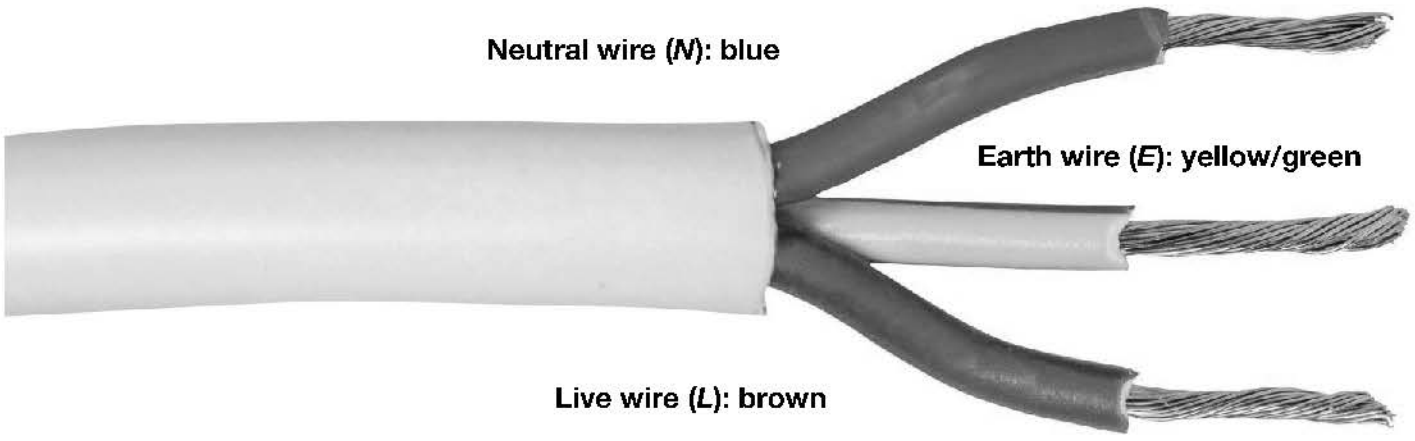
27. A 60 W filament light bulb gives out 12 W light and 48 W heat when operated while a 15 W energy saving bulb gives out 12 W light and 3 W heat when operated. Find the efficiency of the two bulbs respectively.

4. Household Wiring

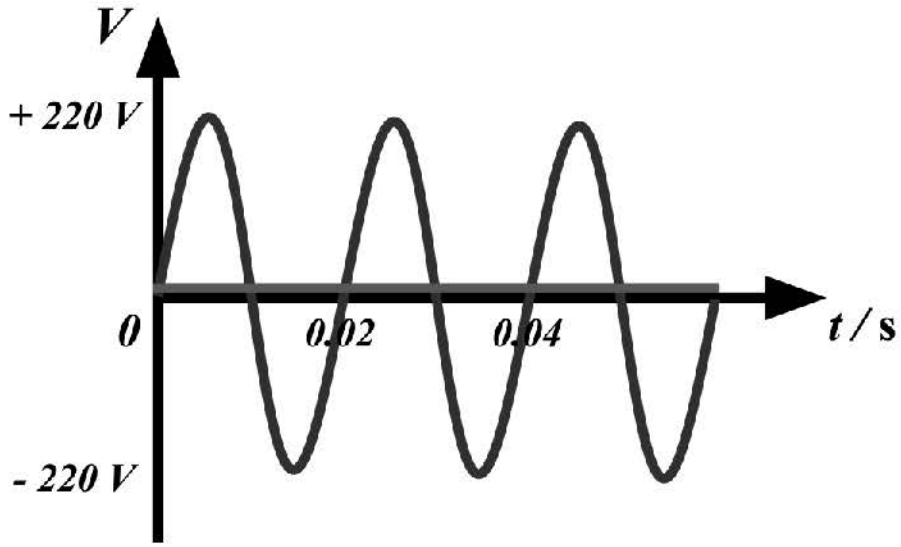


(1) Mains Voltage Supply and Cable

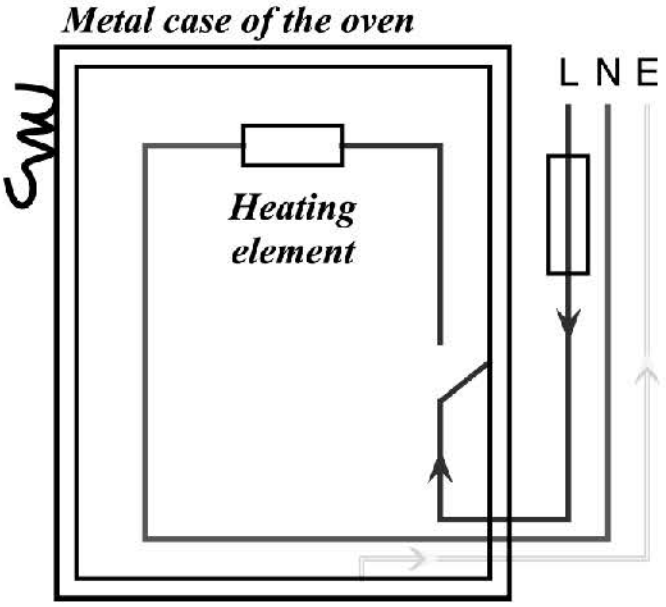
- The voltage supply of the mains circuit is an **a.c. (** ____ **current)** voltage of ____ (r.m.s.) with a frequency of ____ in Hong Kong.
- The mains voltage varies from **100 V** to **240 V** worldwide and the frequency is usually **50 Hz** or **60 Hz**.
- In Japan, the mains voltage is **100 V / 60 Hz** while in USA, the mains voltage is **120 V / 60 Hz**.



- The **live wire** provides a varying voltage (or potential) from +220 V to -220 V. If touched, an [ ] would be received.
- The **neutral wire** is always set at [ ] **voltage (or potential)** at the power station.



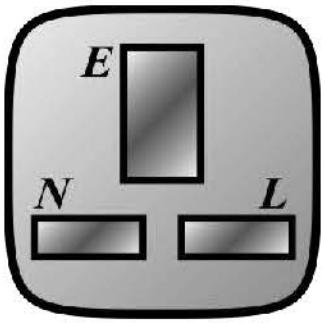
- The **earth wire** is set at [ ] **voltage** by connecting to the Earth through the building and it is connected to the [ ] **case** of the electric appliances.



- If an appliance with metal case connected to the earth wire, then when the live wire **accidentally touches the metal case**, current would then be **conducted to the Earth via the** [ ] **resistance earth wire**. Someone who touches the metal case would [ ] have electric shock.
- An electrical appliance with [ ] does not require an earth wire.

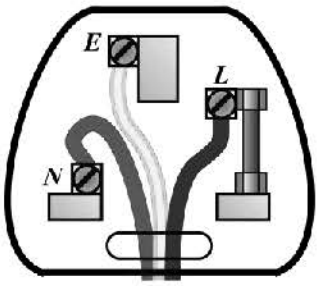
(2) Wall Socket and the Plug

Wall socket



- Some sockets contain a **fuse** that prevents **overloading**.
- Some sockets contain **shutters** for **live and neutral apertures** to:
  - **prevent accidental** [ ] **of conducting objects**; and
  - **ensure the** [ ] **pin is inserted before the insertion of the live and neutral pin.**

Plug



- There are 2-pin plugs and 3 pin plugs but only 3-pin plug is allowed in Hong Kong since:
  - a 2-pin plug contains **no earth pin**; and
  - a 2-pin plug may **lose contact easily** and it inrease the change of **electricity leakage**.
- Some plugs may contain fuse to prevent overloading.
- **Earth pin** being [ ] than the other two pins is to ensure the electric eppliance is earthed before connecting to the live wire.

Examples that you must fully understand

28. The average monthly bill of electricity is about $1200 in John's home when the mains voltage is 200 V.

(a) What is the percentage increase of power consumption in John's home after the mains voltage has been to 220 V?

(b) How much does John have to pay after the increase in voltage?

29. An electric iron of 1800 W sold in HK is connected to a 110 V, 60 Hz mains socket in another country. How does its performance compare on the same ironing setting?

A. The electric iron does not work because the a.c. supply is 60 Hz instead of 50 Hz.

B. The electric iron is as hot as it is used in Hong Kong.

C. The electric iron is hotter than when it is used in Hong Kong.

D. The electric iron is colder than when it is used in Hong Kong.

30. An electric appliance draws a current 2 A when it is operating at 220 V. Which of the following is the best description of the current and the voltage of each wire of the electric appliance when it is connected to a 220 V mains supply?

	Live wire		Neutral wire		Earth wire	
	Current	Voltage	Current	Voltage	Current	Voltage
A.	2 A	220 V	1 A	220 V	1 A	0
B.	2 A	220 V	2 A	220 V	0	0
C.	2 A	-220 V	2 A	0	0	0
D.	2 A	-220 V	0	0	0	0

31. Which of the following statements about the earth wire in an electric iron is/are correct?

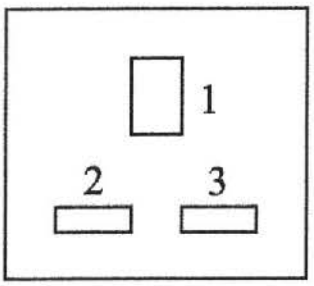
(1) The earth wire should be connected to the metal body of the iron.

(2) If the iron is working properly, no current pass through the earth wire.

(3) In case the neutral wire is broken, the earth wire provides a spare wire for the return path to the mains socket.

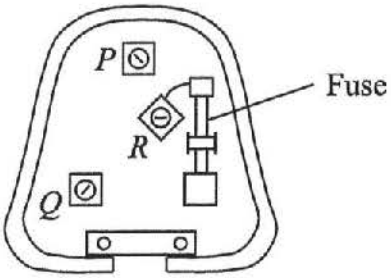
Examples that you must fully understand

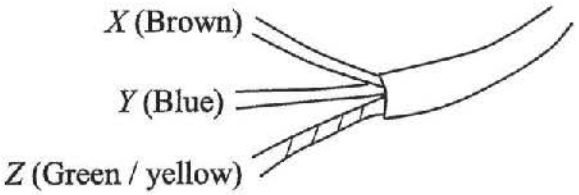
32. A standard three-pin socket on the wall is shown in the figure. Which of the following is correct?



	Pin (1)	Pin (2)	Pin (3)
A.	*neutral*	*live*	*earth*
B.	*neutral*	*earth*	*live*
C.	*earth*	*live*	*neutral*
D.	*earth*	*neutral*	*live*

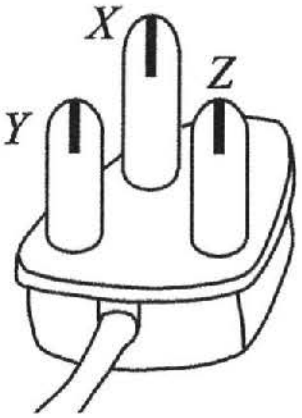
33. The diagram above shows a three-pin plug and the wires connected to it. To which of the pins should each of the wires X, Y and Z be connected?





	P	Q	R
A.	Z	Y	X
B.	Y	X	Z
C.	Y	Z	X
D.	Z	X	Y

34. In the three-pin plug as shown, X, Y and Z are respectively connected to the... And, which of the following is a function of pin X?



X: **; Y:** **; Z:**

(1) It prevents the appliance from being short-circuit.

(2) It protects the user from getting an electric shock.

(3) It provides a return path for the current.

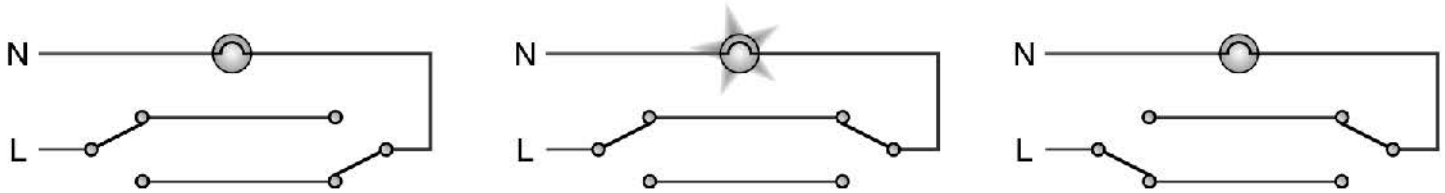
(4) It opens the shutters at the live and neutral apertures.

(5) It protects the user from getting an electric shock.

(6) It can break the circuit when the current flowing through the appliance is too large.

(3) Mains Voltage Supply

- Switch must be installed on the [ ] **wire** so that the appliance **is at** [ ] **when the switch is off**. Thus the appliance **is safe to touch and there will be no electric shock.**
- A **two-way switch** is commonly installed in lighting circuit:



(4) Fuse

- A **fuse** has a thin metal wire made of an [ ]. Its composition controls the [ ] of the fuse. The melting point of a fuse is [ ] than a copper wire.
- When current through the fuse is **larger than its fuse rating** (e.g. during short circuit), the wire [ ]. The fuse will blow or is said to be [ ]. Thus, the circuit is **broken**.
- A fuse is used to limit the current and **prevent** [ ] **of the circuit and the electrical appliances**.
- Choose a fuse with rating [ ] **larger than the normal operating current** of the device.
- Common fuse rating: **2 A, 3 A, 5 A, 10 A, 13 A** and **15 A**.
- A fuse must be installed on the [ ] **wire** so that the appliance is at [ ] **voltage when it is blown**. Thus the appliance is **safe to touch and there will be no electric shock**.

Examples that you must fully understand

35. If the switch of an electric appliance is wrongly connected to the neutral wire, which of the following statements is / are correct?

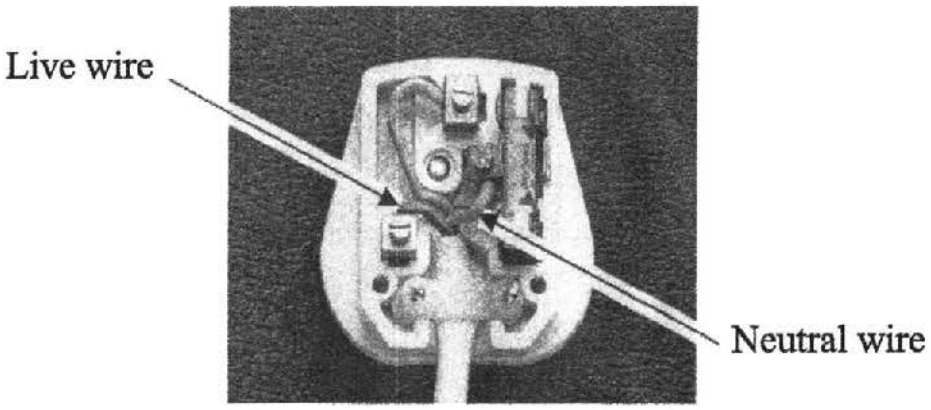
(1) The electric appliance would not work properly.

(2) The electric appliance cannot be switched off.

(3) The electric appliance still has current flowed even when the switch is off.

(4) The electric appliance can still be at a high voltage when the switch is off.

36. If the live and neutral wires of an electric kettle are mistakenly interchanged inside the plug as shown above, which of the following will happen?



A. The kettle will not operate.

B. The fuse of the kettle will blow.

C. The metal case of the kettle will still stand at a high voltage even when the switch of the kettle is off.

D. The heating element of the kettle will still stand at a high voltage even the switch of the kettle is off.

Examples that you must fully understand

37. Which of the following statements about the use of a fuse is correct?

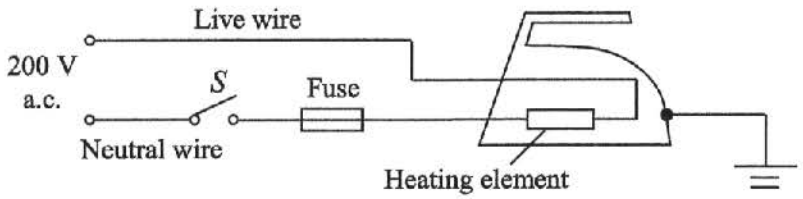
(1) A fuse should be installed in the neutral wire.

(2) A fuse is not required in an electrical appliance with double insulation/with plastic case.

(3) A 5 A fuse is suitable for a heater of rating "220 V, 1500 W".

(4) The melting point of a fuse should not be lower than that of copper.

38. The switch S and the fuse of an iron are incorrectly fitted in the neutral wire as shown above, which of the following statements is / are correct?



(1) The iron will not work properly.

(2) The iron will not operate even when S is on.

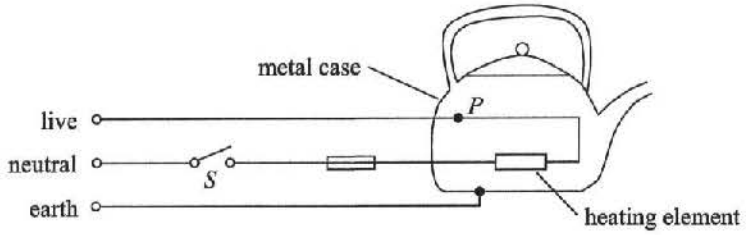
(3) The iron still has current flowed even when the switch is off.

(4) The iron will still operate, but if there is a high current, the fuse will not blow.

(5) After the fuse has blown, the iron is still at a high voltage.

(6) The iron will still operate, but the heating element will remain at a high voltage even when S is off.

39. In the figure above, the kettle with metal case is wired incorrectly. Which of the following statements is correct when point P is accidentally connected to the metal case?



(1) A current will flow through the live wire even when S is open.

(2) If someone touches the case of the kettle, he will receive an electric shock even when S is open.

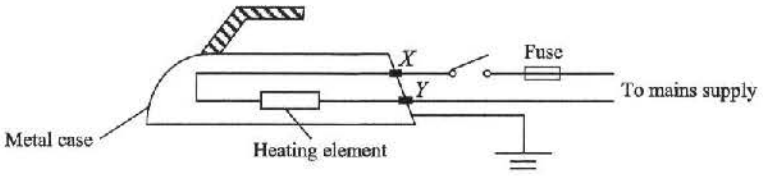
(3) The kettle will still operate at its rated value when S is closed.

(4) The fuse will blow when S is closed.

(5) The heating element will burn out when S is closed.

Examples that you must fully understand

40. The above diagram shows the main parts of an electric iron. In which of the following situations will the fuse blow when the switch is closed?



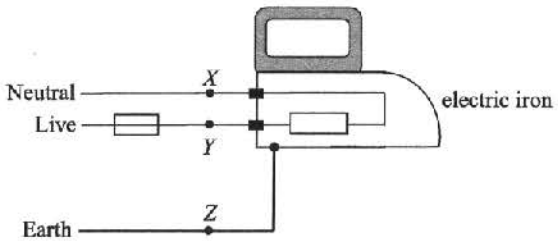
(1) The insulation at contact point X is worn out so that the wire touches the metal case.

(2) The insulation at contact point Y is worn out so that the wire touches the metal case.

(3) The heating element is broken and becomes an open circuit.

(4) The earth wire is worn out and becomes disconnected.

41. The figure shows a simple domestic circuit for an electric iron. The fuse will blow when which of the following points are short-circuited?



(1) X and Y

(2) Y and Z

(3) X and Z

42. If a 15 A fuse is installed in the plug of an electric kettle of rating value '220 V, 900 W', state what happens when the kettle is plugged in and switched on.

(1) The kettle will not operate.

(2) The output current will be 15 A.

(3) The kettle will be short-circuited.

(4) The output power of the kettle will be increased.

(5) The chance of the kettle being damaged by an excessive current will be increased.

43. An electrical appliance is protected by a fuse in a domestic circuit. When the appliance is switched on, the fuse blows immediately. Which of the following statements is/are possible reason(s) for this phenomenon?

(1) The appliance is short-circuited.

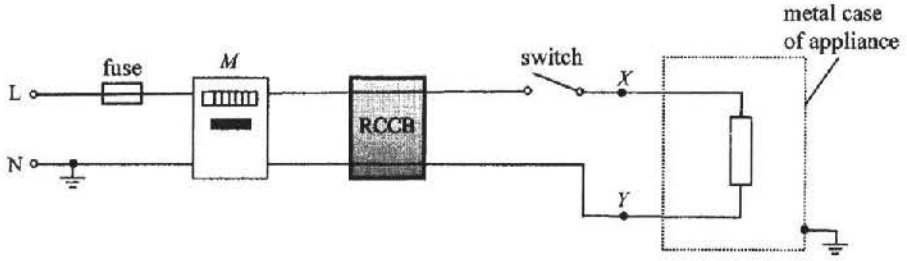
(2) The rated value of the fuse is too small.

(3) The resistance of the appliance is too large.

(4) The fuse is placed on the wrong wire.

Examples that you must fully understand

44. An *RCCB* is a kind of safety device that cuts off the supply automatically whenever there is a small difference between the currents in the live (*L*) and neutral (*N*) wires. State, in each of the following situations, which device(s) will respond (i.e. the fuse blows and/or the *RCCB* cuts off the supply).



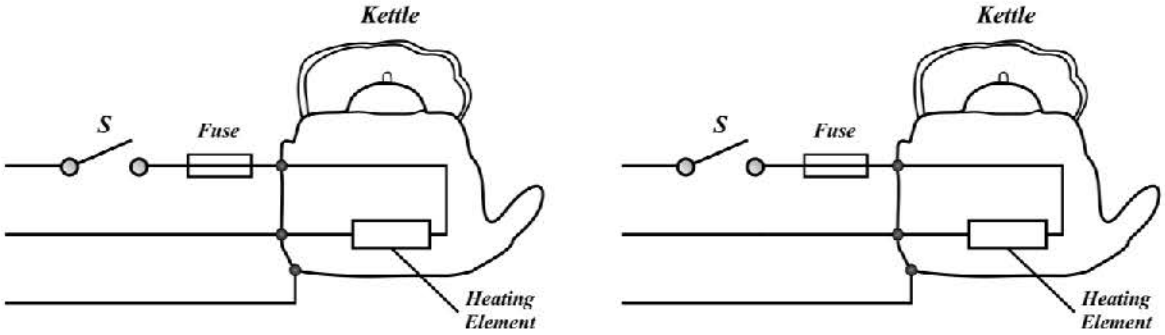
(a) A short circuit occurs between points X and Y.

Only the

(b) A short circuit occurs between point Y and the metal case of the appliance.

Only the

45. Figure below shows a kettle made with metal case.



(a) Suppose the live wire accidentally touches the metal case of the kettle. What will happen?

If the live wire touches the metal case of the kettle, ☐ ***occurs between the live and the earth wire.***

The fuse will ☐ ***due to the*** ☐ ***current.***

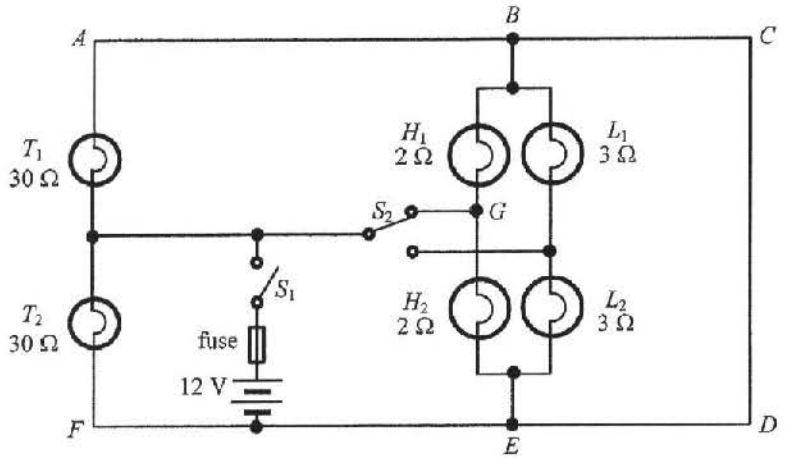
The kettle will ☐.

(b) What happens to the kettle if the neutral wire accidentally touches the metal case of the kettle?

If the neutral wire touches the metal case, current can still flows through the ☐ ***of the kettle to complete the circuit, thus the kettle will*** ☐

Examples that you must fully understand

46. The Figure shows a simplified circuit of the lighting system of a car. Each of the taillights (T_1, T_2), high-beam headlights (H_1, H_2) and low-beam headlights (L_1, L_2) has resistance 30 Ω, 2 Ω and 3 Ω respectively. The internal resistance of the 12 V battery and the resistance of the fuse are negligible.



When switch S_1 is closed and switch S_2 is set at the position shown in Figure, only T_1 and T_2 as well as H_1 and H_2 are lit.

(a) Explain why L_1 and L_2 are not lit.

The p.d. across L_1 and L_2 is [ ].

(b) What is the potential difference across the taillight T_2?

(c) Indicate on the above figure the direction of current in each of the branches AB, GB and BC. Which branch carries the largest current?

(d) Calculate the power delivered by the battery and show that the equivalent resistance of the circuit is slightly less than 1 Ω in this setting.

(e) Based on your answer in (d), explain which fuses, 12 A fuse, 15 A fuse and 18 A fuse, is suitable for this circuit.

The [ ] fuse is the most suitable one since its fuse rating is [ ] higher than the maximum current.

The 12 A fuse is not suitable since the maximum current [ ] 12 A and the 18 A fuse is not suitable since the circuit may be [ ].

(f) Suppose the fuse in the circuit is blown, someone replaces the fuse by a thin copper wire.

(i) Would the circuit still work?

[ ], *since the copper wire* [ ], *the circuit* [ ] *work.*

(ii) Explain why it is dangerous to use the copper wire to replace the fuse.

Since copper has a [ ] *than a fuse, the copper wire* [ ] *even when the current* [ ] *the rated value.*

(g) On which wire should the fuse be placed on? Explain briefly.

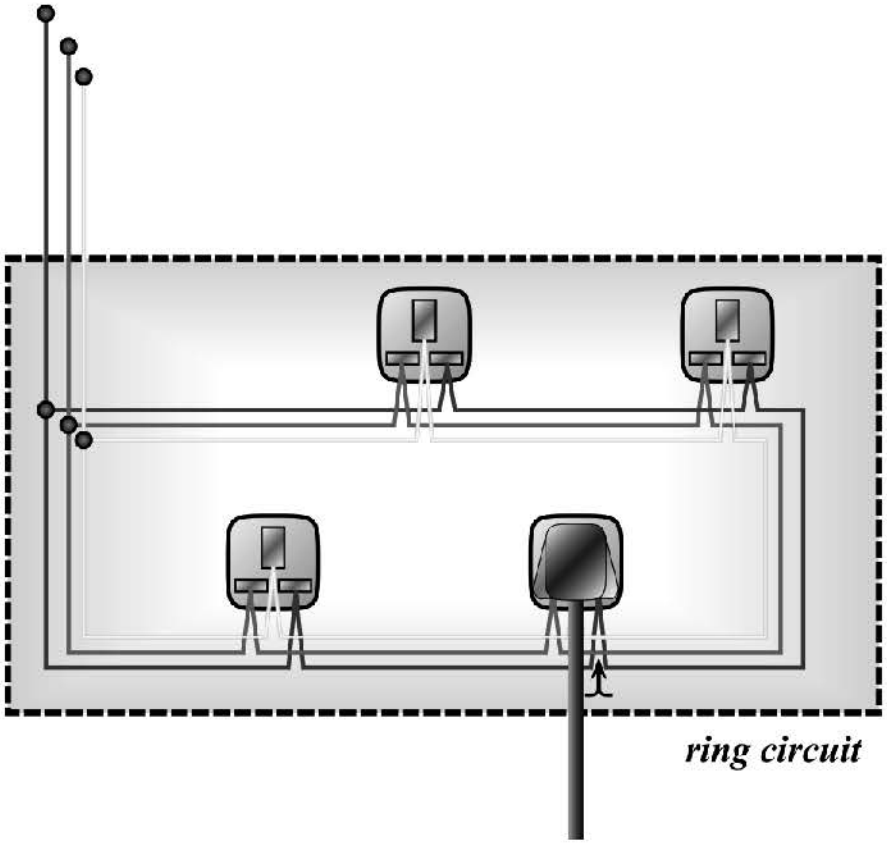
It has to be installed on the wire connecting the positive terminal of the battery so that the electric appliance remains [ ] *(or cut off from high voltage) when the fuse blows. So that the electric appliance is* [ ].

(5) Circuit Breaker

- The consumer unit is usually fitted with circuit breakers. It is an automatic switch which **opens the circuit when the current is larger than a specified value**.
- Unlike the fuse, the circuit breaker can be **closed again by pressing the switch**.
- Similar to switch and fuse, it has to be installed on the [ ] **wire** so that the electric appliance remains **zero potential** (or cut off from high voltage) when circuit breaker breaks the circuit. So that the electric appliance is **safe to be touched without electric shock.**

(6) Ring Main Circuit

- A ring main circuit consists of **a cable looped round the house.** Sockets can be "tapped off" from the ring circuit at any necessary positions.



- **Advantages** of ring circuit:
  - When the ring circuit **is broken at one point**, the circuit **can still function**.
  - Current is **divided into** [ ] **via two paths to reach the appliance**. [ ] can be **reduced** and [ ] **and** [ ] **cables** can be used.
- Electrical appliances connected to a ring circuit are connected in [ ], so that:
  - each appliance **is given the same 220 V** voltage so that they **can work at the rated voltage and operate normally**;
  - each appliance **can be switched on and off independently**; and
  - when one appliance burns out (and become an open circuit), the other appliances **can still function.**
- A fuse is used to limit the current and prevent overloading of the circuit and the electrical appliances.

(7) Independent Socket

- Some electric appliances consume **very large power and current**. Examples include electric heater, air-conditioner, and induction cooker (used in kitchen).
- Since these electrical appliances draw very large current, they **should not be connected together with other electric appliances in the ring circuit. Otherwise,** [ ] **may occur.**
- Instead, they should be **connected to the mains directly via a separate circuit**.

(8) Selection of Power Cables

- **Thin power cables:**
  - Suitable for electrical appliances with small power rating.
  - Lighter and cheaper
- **Thick power cables:**
  - Suitable for electrical appliances with **large power rating,** e.g. electric heater and air-conditioner.
  - They have [ ] **resistance and** [ ] **energy dissipation.**
  - Thus, even when the current passing through the cables is large, the cable will not overload.
  - **Heavier** and **more expensive**

Examples that you must fully understand

47. Which statement is a reason why mains socket at home are connected in parallel instead of a series circuit?

(1) Electrical appliances connected to different sockets can be switched on or off independently.

(2) Voltage supplied to each socket is fixed and all electrical appliances can operate at their rated voltage.

(3) When an electrical appliance breaks down and becomes an open circuit, other appliances can still work normally.

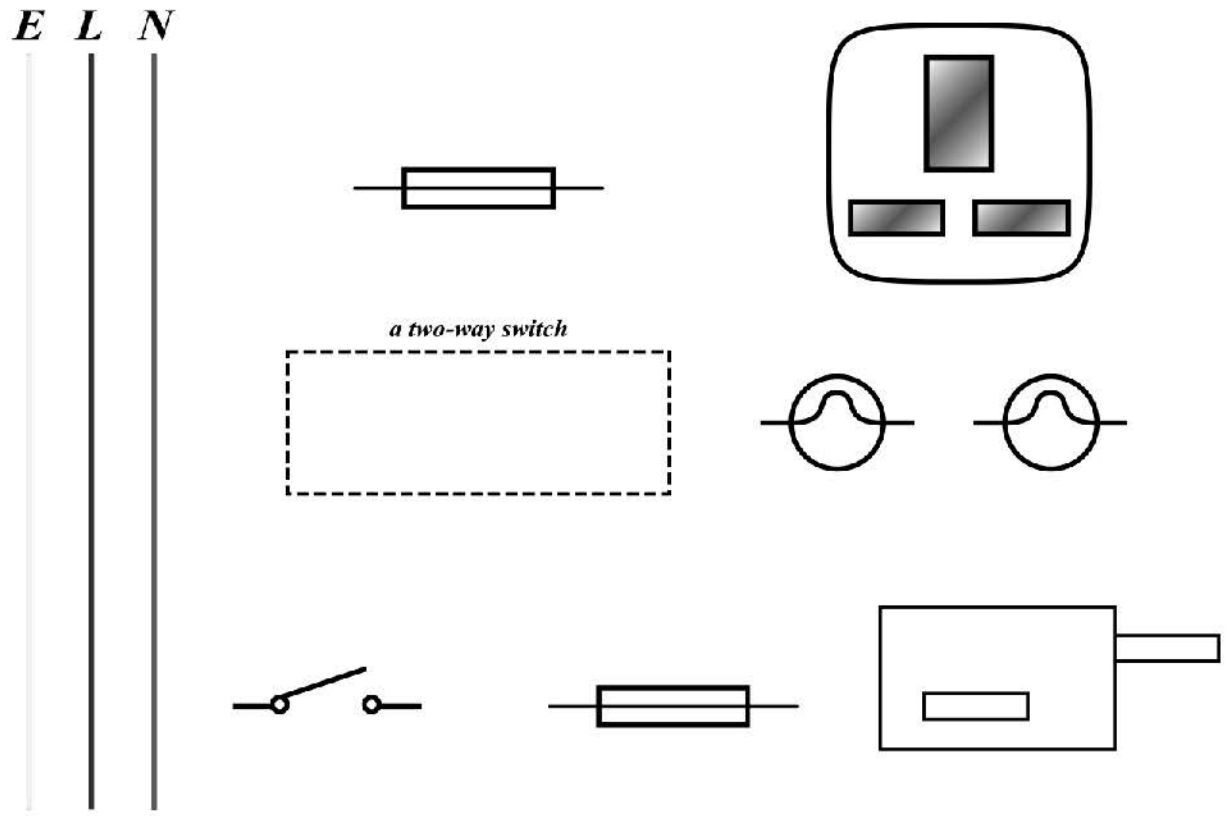
(4) The current supplied can be reduced and thinner cables can then be used.

48. Draw wires below to make proper connections:

(a) A fuse is connected to the socket.

(b) A two-way switch is used to control two lamps working at 220 V at the same time;

(c) A kettle with metal case is connected together with a fuse and a switch.



Examples that you must fully understand

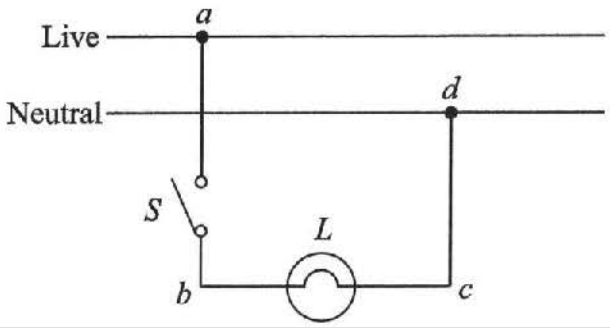
49. The figure shows part of a domestic lighting circuit in which the bulb L does not light up when switch S is closed. The circuit is then checked with switch S closed. Using a voltage tester to touch points b and c in turns, the tester indicates that both points are at high voltage. When touching points a and d in turns, the tester indicates only point a is at high voltage. Which of the following can be a reason for the fault?

(1) The switch S has been damaged.

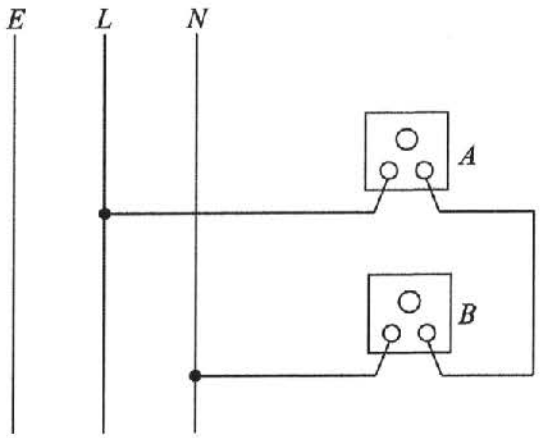
(2) The filament of bulb L has been burnt out and becomes an open circuit.

(3) There is a short circuit between a and d.

(4) There is an open circuit between c and d.



50. Given socket A and socket B, an unqualified electrical technician wires the two sockets to the live L, the neutral N, the earth E of the 220 V mains supply for a heater rated at "220 V, 1000 W" and a cooker rated at "220 V, 800 W" as shown in the figure below. (The sockets are viewed from the front.)



(a) If either one of these appliances is plugged into one of the sockets, would there be any current drawn from the mains with the switch of the appliance on? Explain briefly.

[ ]. Since sockets A and B are connected in [ ] to the mains, if only one of the sockets is plugged, the circuit is [ ].

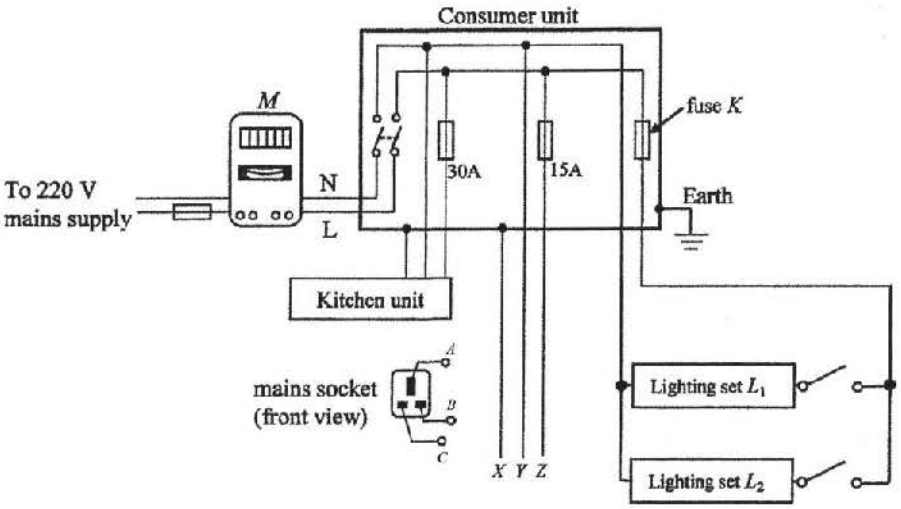
(b) If both appliances are plugged into the sockets, would the appliances work at the rated power (1000 W and 800 W) with switches on? Explain briefly.

[ ]. Since sockets A and B are connected in [ ] to the mains, when both appliances are plugged in, the voltage across each appliance is [ ] than the rated voltage, 220 V.

(c) Draw on the figure to show how the two sockets should be connected to the live, the neutral and the earth of the mains supply with a fuse placed at a proper position. The fuse is to protect both sockets.

Examples that you must fully understand

51. The Figure shows a household electrical wiring circuit. The mains cable (containing live wire L and neutral wire N) is connected to a consumer unit via a kilowatt-hour meter M. At the consumer unit, the wires branch out into a number of parallel circuits.



(a) Lighting sets L_1 and L_2 of power ratings 300 W and 450 W respectively are connected in parallel to the branch with fuse K.

(i) State one advantage of connecting L_1 and L_2 in parallel instead of in series to the branch.

If one of the lighting sets [ ], the other can still work [ ].

Both can work at their [ ] power.

Each lighting set can be [ ] independently.

(b) The family wants to install a water heater in the kitchen. Its rating value is "220 V, 6000 W". The electrician suggests connecting the water heater directly to the mains via a separate circuit instead of connecting to the sockets in the rings circuit. Explain why.

Since the water heater draws a large current when operates, if it is connected in parallel with other electric appliances in the rings circuit, [ ] may occur.

(c) The kitchen unit includes the following electrical appliances:

	Rating
a refrigerator	220 V, 500 W
an electric kettle	220 V, 2500 W
an induction cooker	220 V, 3700 W

What will happen if all of the appliances are switched on at the same time?

Since the total current is [ ] than 30 A, the circuit breaker will [ ] the circuit.