

Physics Unit 19 Exam Questions and Suggested Answers

1. An electric kettle is marked “2000W 240V”. Explain what is meant by “2000W 240V”.
It means that when an operating voltage of 240V is applied across the heating element, the appliance operates at 240V and it converts electrical energy to thermal energy at a rate of 2000W.
2. The kilowatt-hour (kWh) is the unit of electricity usage. Explain what is meant by one kWh.
One kWh is the amount of electrical energy used by a 1 kW device in 1 hour.
3. Explain how damaged insulation of cables of electrical appliances is dangerous.
 - **When the insulated cable is damaged, the conducting wires will be exposed. The exposed live wire, which carries a high voltage, will cause electric shock if touched (due to the potential difference)**
 - **If the insulation between the live and neutral wires is damaged, the live and neutral wires might come into contact with each other. This will cause a short circuit and overheating of wires, which may cause a fire.**
4. Explain why it is dangerous to plug in too many appliances to a wall socket using multi-way adaptors.
Excessive current may flow through the cables due to overloading, causing overheating of the cables. The heat produced may result in a fire.
5. Wires of a given diameter can only carry a certain amount of current. Explain why wires supplying electric current to the water heater are thicker than those supplying current to the lights.
The water heater has a higher power rating and will draw more current. Thus, the thicker wires (which have a lower resistance) will produce less heat when the appliance is in operation (due to resistance of wire) to prevent overheating. Lights will draw less current, so thinner wires may be used.
6. An electric kettle, which has a current of 10.4A when in operation, uses a 1.25mm wire. Explain why it is dangerous to use a thinner wire for the kettle.
If a thinner wire is used, the resistance of the wire increases. When the same current flows through the wire, it will overheat (due to higher resistance of wire). This may damage the insulation and cause a fire.
7. Explain why the loss of thermal energy from a cable of an electric kettle is

less, if it is thicker. [3]

If the cable is thicker, its resistance decreases. Therefore, the rate of loss of thermal energy decreases. Since

Power (rate of thermal energy loss) = (Current)² x resistance,
a lower resistance means that the rate of loss of thermal energy is lesser.

8. Explain why it is dangerous to turn a switch on with wet hands.
The water on our hands will provide a conducting path for the large current to flow. When our skin is wet, the resistance of the skin is lowered. This will allow the current to flow through the body, causing an electric shock.
9. State the function of
(a) live wire
(b) neutral wire
(c) earth wire.
State the voltage of each of the wires under normal conditions, given that the voltage supplied by the power station is 240V.
- (a) Live wire is the wire connected to the high current, and which delivers the electrical energy to the appliance. 240V**
(b) Neutral wire is the wire which allows the current from the appliance to flow back to the supply, and which provides a return path for the current to create a complete circuit. 0V
(c) Earth wire is to divert large current due to electrical faults from the metal casing of the appliance to the ground. 0V
10. In a typical home circuit, explain why the air-conditioner unit is separate from the lighting circuit.
The air-conditioner draws more current from the mains than the lights. Therefore, the circuits are separate to allow the circuit breaker for the air-conditioner to have a higher current rating.
11. Explain the use of the following in electrical circuits
(a) Miniature Circuit Breaker (MCB)
(b) Earth Leakage Circuit Breaker (ELCB)
a) The MCB prevents excessive current flow through the circuit by tripping when the current exceeds a fixed rating. This causes electrical supply for the circuit to be cut off.
b) The ELCB detects current leakages from the live wire to the earth wire by monitoring the current flowing from the live wire. When an electrical fault occurs, there will be current leakage to earth via the earth wire. Therefore, the current in live wire will be greater than the neutral wire, causing the ELCB to trip.

12. Explain the function of a fuse.
A fuse is a safety device included in an electrical circuit to protect the appliance by preventing excessive current flow. When the current exceeds the fuse rating, the wire in the fuse melts, thus cutting the circuit and prevents the excessive current from flowing through the appliance.
13. Explain why a lamp marked 6.0V should not be connected directly across a 10V power supply. [1] Explain how a fuse with a 7.0V rating can protect the appliance in this case.
If the voltage supplied is above the operating voltage of the lamp, excessive current will flow through the filament of the lamp. This may cause the temperature of the filament to be excessively high and melt the filament, thus damaging the lamp. With a fuse, the excessive current will melt the wire in the fuse and break the circuit, preventing the excessive current from flowing through the lamp.
14. In an electric kettle, the original 13A fuse is replaced with a 25A fuse. Explain why this presents a risk of danger. [2]
A current higher than 13A but lower than 25A may be sufficient to cause damage to the appliance. When this current flows through, the fuse will not melt not cut off the excessively high current. However, this high current will damage the appliance, and cause overheating of the cables.
15. Suggest one advantage of using a circuit breaker rather than a fuse to protect an appliance. [1]
A circuit breaker can be easily reset to work again, while a melted fuse has to be replaced with a new one.
16. Describe one fault in the cable of an electric kettle that will cause the fuse in the plug to melt. [1]
The insulating material between the live and neutral wires is damaged. When this happens, a short circuit occurs, resulting in an excessively high current. This causes the fuse to melt.
17. Explain how the following safety features protect the user of an electrical appliance.
(a) earthing the metal casing (using earth wire)
(b) double insulation.
**(a) If the live wire is not properly connected and it touches the metal casing of the appliance, the earth wire connected to the metal casing will divert the large current (due to the electrical fault) to the ground. This prevents people who touch it from suffering an electric shock: the large current flows through the earth wire which is of much lower resistance than the person's resistance.
(b) The electric cable is insulated from the internal components of the**

appliance; and the internal components are also insulated from the external casing. As appliances with this feature normally have non-metallic casings, it prevents any current from reaching the user even in the event of an electrical fault.

18. A table lamp made of plastic has only two wires in the cable. Explain why the lamp is safe to use even though it has only two wires. [2]
The lamp is double insulated. As appliances with this feature normally have non-metallic casings, it prevents any current from reaching the user even in the event of an electrical fault. Therefore, this feature acts as a substitute for the earth wire, and is hence safe to use.
19. Explain why the following safety features must be wired into the live conductor, instead of the neutral wire.
- (a) Circuit breaker
 - (b) Fuse
- (a) To prevent the circuit from being charged even after the circuit breaker has tripped due to an overflow of current. Otherwise, the excessive current will still flow through the circuit as it is still connected to the live wire. This causes**
- overheating of live wire
 - damage to appliances
- (b) To prevent the appliance from being charged even after the fuse has melted due to an overflow of current. Otherwise, the excessive current will still flow through the appliance as it is still connected to the live wire, even though the fuse has broken. This causes**
- damage to the appliance

**BOTH RELATED TO EXCESSIVE CURRENT, NOT VOLTAGE
BOTH IS TO PROTECT APPLIANCE, DOES NOT PROTECT THE USER FROM ANY ELECTRIC SHOCK**

20. Explain why the switch must be fixed onto the live wire, instead of the neutral wire.
- **This is to ensure that switching off disconnects the high voltage by the live wire from an appliance.**
 - **Otherwise, the appliance will still be at high voltage as it is still connected to the live wire.**
 - **Anyone who touches the metal casing of the appliance will experience an electric shock (current will flow through the person to the earth)**

**RELATED TO VOLTAGE WHICH WILL FLOW THROUGH THE APPLIANCE
SWITCH IS TO PROTECT USER, DOES NOT PROTECT APPLIANCE (voltage is constant)**