I, V, & Q Questions for A-level Physics

1. What is electric charge, and what is its SI unit?

Electric charge is a physical property of matter that causes it to experience a force when placed in an electric or magnetic field. It comes in two types: positive and negative. The SI unit of electric charge is the ***coulomb (C)****.*

2. Define electric current. What is its SI unit?

Electric current is the rate at which electric charge flows through a conductor or circuit. It is the flow of electric charge per unit time. The SI unit of electric current is the ***ampere (A)****, where 1 ampere equals 1 coulomb of charge passing through a point in one second.*

3. What is potential difference (voltage) in a circuit? State its unit.

Potential difference, or voltage, is the difference in electric potential energy between two points in a circuit. It represents the work done per unit charge to move a charge between these two points. The SI unit of potential difference is the ***volt (V)****.*

4. How are charge, current, and time related in a circuit?

Q = It where Q is charge in coulombs, I is current in amps, and t is time in seconds.

Charge is the product of the current flowing and the time given.

5. What is the charge on a single electron?

-1.6×10^{-19} Coulombs

6. A circuit has a current of 2 A. How much charge flows through the circuit in 10 seconds?

Q = I t = *2 x 10* = ***20C***

7. Explain the difference between conventional current and electron flow.

Conventional current flows from an area of positive electric potential to an area of negative potential (or less positive potential). The theory of electrical was developed before the discovery of the electron, which is negative. Electrons conversely move from negative to positive. Despite this, we have kept the original convention of current.

8. A current of 1.5 A flows through a conductor for 120 seconds. How much charge has flowed through the conductor?

Q = I t = *1.5 x 120* = ***180C***

9. What is the potential difference between two points if 15 J of energy is required to move 3 C of charge between them?

V = ΔW / Q = *15 / 3* = ***5V***

10. Explain why current is the same at all points in a series circuit.

The charge flowing from a power supply must equal the charge flowing into it. As there is only one path in a series circuit, the same rate of flow of charge (current) must be maintained through all components and wires.

11. If a charge of 5 C moves through a circuit with a potential difference of 20 V, how much energy is transferred to the charge?

$\Delta W = V\,Q$ = 20×5 = ***100J***

12. What is the definition of one volt, and how does it relate to energy and charge?

Voltage is the change in energy per unit of charge between two points. One volt is equal to one joule per coulomb.

13. A battery transfers 120 J of energy to 4 C of charge. Calculate the potential difference across the battery.

$V = \Delta W / Q$ = $120 / 4$ = ***30V***

14. A current of 0.8 A flows through a wire for 10 minutes. Calculate the total charge transferred through the wire during this time.

$Q = I\,t$ = $0.8 \times (10 \times 60)$ = ***480C***

(10 x 60 to convert from minutes to seconds)

15. How much energy is transferred by a 12 V battery when a current of 2 A flows for 5 minutes?

$\Delta W = V\,Q$ $Q = I\,t$

$\therefore$ $\Delta W = V\,I\,t$ = $12 \times 2 \times (5 \times 60)$ = ***7200J***

16. In a time of 2 minutes, a current of 4 A flows through a section of a circuit. If the energy transferred during this time is 720 J, determine the potential difference across the circuit.

$V = \Delta W / Q$ $Q = I\,t$

$\therefore\ V = \Delta W / I\,t$ $= 720 / (4 \times 2\ 60)$ $= 720 / 480$ $=$ ***1.5V***

17. A lightning strike transfers a total charge of 30 C to the ground in a time interval of 50 milliseconds. Calculate the average current produced by the lightning strike

$I = \Delta Q / \Delta t$ $= 30 / 50 \times 10^{-3}$ $=$ ***600A***

18. If a charge of 50 µC is placed in an electric field where the potential difference between two points is 500 V, calculate the work done in moving the charge between the two points.

$\Delta W = V\,Q$ $= 500 \times 50 \times 10^{-6}$ $=$ ***0.025J***

19. Derive the formula P=VI for the power dissipated in an electrical component.

$V\,Q = \Delta W$ & $\Delta t = Q / I$

Power is the rate that work is done, $P = \Delta W / \Delta t$

$\therefore\ P = V\,Q / (Q / I) = V\,I$

20. A beam of charged particles carries a total charge of 25 C per second. If the potential difference applied across the beam is 250 V, calculate the total power delivered by the beam of particles.

$P = V\,I$ $= V(\Delta Q / \Delta t)$ $= 25 \times 250$ $=$ ***6250 W***