

**Trinity High School**

**Physics Department**

**Cfe Higher**

**Unit 3 Electricity**



Learning Outcomes

Name……………………………………………… Class……………………

**Cfe Higher Unit 3 Electricity**

**✓ I am confident that I understand this and I can apply this to problems**

**? I have some understanding but I need to revise this some more**

**🗶 I don’t know this or I need help because I don’t understand it**

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| **Section 1 Electrons and Energy****Monitoring and measuring a.c.** | **Covered** **(✓)** | **How well can you do this?****🗶 ? ✓** |
| 1. Describe a.c. electric current and voltage in terms of the movement of charges in a circuit. |  |  🗶 ? ✓ |
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| 2. State that a.c. current and voltage can be measured using an  oscilloscope. |  |  🗶 ? ✓ |
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| 3. Describe how to measure the frequency and peak voltage of an alternating supply using an oscilloscope. |  |  🗶 ? ✓ |
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| 4. State that the r.m.s. voltage is equivalent to a d.c. voltage that produces the same power. |  |  🗶 ? ✓ |
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| 5. State the relationship between peak and r.m.s. values for a sinusoidally varying voltage and current. |  | 🗶 ? ✓ |
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| 6. Carry out calculations involving peak and r.m.s. values of voltage and current. |  | 🗶 ? ✓ |
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| **Section 1 Electrons and Energy****Current, voltage, power and resistance** | **Covered** **(✓)** | **How well can you do this?****🗶 ? ✓** |
| 7. State that voltage is defined as the energy transformed per  unit of charge. |  |  🗶 ? ✓ |
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| 8. State the relationship V = Ew/Q. |  | 🗶 ? ✓ |
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| 9. Carry out calculations involving the relationship between  energy, voltage and charge. |  | 🗶 ? ✓ |
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| 10. State that the energy transformed from an external source  to the circuit is known as the electromotive force (e.m.f.). |  | 🗶 ? ✓ |
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| 11. Give examples of sources of e.m.f. |  | 🗶 ? ✓ |
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| 12. State that the energy transformed into another form of  energy by a circuit component is known as the potential  difference (p.d.). |  | 🗶 ? ✓ |
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| 13. Carry out calculations involving the relationships between  power, current, voltage and resistance in series and parallel circuits.  |  | 🗶 ? ✓ |
| 14. State that a potential divider circuit consists of a number of resistors, or other components, connected across a supply.  |  | 🗶 ? ✓ |
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| 15. Carry out calculations involving potential differences and  resistances in potential dividers using the potential divider  equation and Ohm’s law.  |  | 🗶 ? ✓ |
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| **Section 1 Electrons and Energy****Electrical sources and internal resistance** | **Covered** **(✓)** | **How well can you do this?****🗶 ? ✓** |
| 16. State that a power supply is equivalent to a source of e.m.f. with a resistor in series, the internal resistance. |  |  🗶 ? ✓ |
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| 17. Describe the principles of a method for measuring the e.m.f. and internal resistance of a source |  | 🗶 ? ✓ |
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| 18. Explain why the e.m.f. of a source is equal to the open  circuit p.d. across the terminals of a source. |  | 🗶 ? ✓ |
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| 19. State that the closed circuit p.d. across the terminals of a  source is equal to the t.p.d. |  | 🗶 ? ✓ |
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| 20. State that the e.m.f. of a cell is equal to the sum of the t.p.d.  and the lost volts. |  | 🗶 ? ✓ |
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| 21. Carry out calculations involving the relationship between  the e.m.f., t.p.d. and lost volts. |  | 🗶 ? ✓ |
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| 22. Describe two methods of measuring e.m.f. and internal  resistance by graphical methods. |  | 🗶 ? ✓ |
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| 23. State the R = r for maximum transfer of energy between a source and a load. |  | 🗶 ? ✓ |
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| **Section 1 Electrons and Energy****Capacitors** | **Covered** **(✓)** | **How well can you do this?****🗶 ? ✓** |
| 24. State that the capacitance of a capacitor is a measure of its  ability to store charge. |  |  🗶 ? ✓ |
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| 25. State that a simple capacitor consists of two parallel  conducting plates separated by an air gap. |  | 🗶 ? ✓ |
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| 26. Describe the circuit symbol for a capacitor. |  | 🗶 ? ✓ |
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| 27. State that the charge Q stored on a capacitor is directly  proportional to the p.d. V across it. |  | 🗶 ? ✓ |
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| 28. Describe the principles of a method to show that the p.d. across a capacitor is directly proportional to the charge on  the plates. |  | 🗶 ? ✓ |
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| 29. State that capacitance is defined as the gradient of the  charge against p.d. graph or the ratio of charge to p.d. |  | 🗶 ? ✓ |
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| 30. State that the unit of capacitance is the farad and that one  farad is one coulomb per volt. |  | 🗶 ? ✓ |
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| 31. Carry out calculations involving the relationship between charge, capacitance and p.d. |  | 🗶 ? ✓ |
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| 32. Explain why work must be done to charge a capacitor. |  | 🗶 ? ✓ |
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| **Section 1 Electrons and Energy****Capacitors (continued)** | **Covered** **(✓)** | **How well can you do this?****🗶 ? ✓** |
| 33. State that the work done to charge a capacitor is given by the area under the graph of charge against p.d. |  |  🗶 ? ✓ |
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| 34. State that the energy stored in a capacitor is given by  ½ (charge × p.d.) and equivalent expressions. |  | 🗶 ? ✓ |
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| 35. Carry out calculations using the relationship between  energy, charge and p.d. or alternative expressions. |  | 🗶 ? ✓ |
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| 36. Draw qualitative graphs of current against time and of  voltage against time for the charge and discharge of a  capacitor in a d.c. circuit containing a resistor and capacitor  in series. |  | 🗶 ? ✓ |
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| 37. Carry out calculations involving voltage and current in CR  circuits. |  | 🗶 ? ✓ |
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| **Section 2 Electrons at work****Conductors, semiconductors and insulators** | **Covered** **(✓)** | **How well can you do this?****🗶 ? ✓** |
| 1. State that solids can be classified into three types according to their electrical properties as conductors, semiconductors and insulators. |  |  🗶 ? ✓ |
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| 2. Give examples of conductors, semiconductors and insulators. |  | 🗶 ? ✓ |
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| 3. State that the different electrical properties of conductors, semiconductors and insulators can be explained by Band  Theory. |  | 🗶 ? ✓ |
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| 4. State that in isolated atoms, the permitted energy levels  consist of a series of sharply defined states. |  | 🗶 ? ✓ |
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| 5. State that in solids, the permitted energy levels associated  with each state of the isolated atom forms a continuous  band. |  | 🗶 ? ✓ |
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| 6. State that the two highest bands are known as the valence band and the conduction band, respectively. |  | 🗶 ? ✓ |
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| 7. State that the valence band contains electrons that can be considered to be bound to the atom. |  | 🗶 ? ✓ |
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| 8. State that the valence band is full in insulators and  semiconductors. |  | 🗶 ? ✓ |
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| 9. State that the conduction band contains electrons that are free to move. |  | 🗶 ? ✓ |
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| 10. State that the conduction band is empty in insulators  and semiconductors, but partially filled in conductors. |  | 🗶 ? ✓ |
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| **Section 2 Electrons at work****Conductors, semiconductors and insulators (continued)** | **Covered** **(✓)** | **How well can you do this?****🗶 ? ✓** |
| 11. State that only partially filled bands may permit conduction. |  |  🗶 ? ✓ |
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| 12. State that there is an energy gap between the valence and conduction bands in insulators and  semiconductors. |  | 🗶 ? ✓ |
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| 13. State that an electron can absorb energy to move  between the valence band and the conduction band.  |  | 🗶 ? ✓ |
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| 14. State that in insulators, the energy gap is normally too large for electrons to jump to the conduction  band. |  | 🗶 ? ✓ |
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| 15. State that in semiconductors, the energy gap is much smaller and electrons can jump to the conduction  band as a result of thermal excitation. |  | 🗶 ? ✓ |
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| **Section 2 Electrons at work****Intrinsic and extrinsic semiconductors** | **Covered** **(✓)** | **How well can you do this?****🗶 ? ✓** |
| 16. State that in semiconductors, conduction occurs by  means of negative charge carriers, (electrons) or  positive charge carriers (holes). |  |  🗶 ? ✓ |
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| 17. State that in pure semiconductors there are very few electrons available to conduct which makes the  resistance very large. |  | 🗶 ? ✓ |
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| 18. State that in pure semiconductors more free electrons become available at higher temperatures, therefore the conductivity increases and the resistance  decreases. |  | 🗶 ? ✓ |
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| 19. State that these pure semiconductors are known as **intrinsic** semiconductors. |  | 🗶 ? ✓ |
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| 20. State that the addition of impurity atoms to a pure  semiconductor (a process called doping) increases its  conductivity by adding either extra electrons or holes  to the lattice. |  | 🗶 ? ✓ |
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| 21. State that doped semiconductors now have a  majority charge carrier present and are known as  **extrinsic** semiconductors. |  | 🗶 ? ✓ |
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| 22. State that group V doping agents result in n-type  extrinsic semiconductors, which contain extra  electrons.  |  | 🗶 ? ✓ |
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| 23. State that group III doping agents result in p-type  extrinsic semiconductors, which contain extra holes.  |  | 🗶 ? ✓ |
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| 24. Explain how doping can form an n-type semiconductor in which the majority of the charge carriers are negative, or a p-type semiconductor in which the majority of the charge  carriers are positive. |  | 🗶 ? ✓ |
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| **Section 2 Electrons at work****p – n junctions** | **Covered** **(✓)** | **How well can you do this?****🗶 ? ✓** |
| 25. State that the interface between p-type and n-type  material is called the p–n junction and it functions as a  diode. |  |  🗶 ? ✓ |
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| 26. State that the majority charge carriers diffuse towards the junction and electrons and holes combine to form ions. |  | 🗶 ? ✓ |
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| 27. State that this results in a depletion zone across the p–n  junction where the density of charge carriers is low, with positive ions on the n-type side and negative ions on the  p-type side. |  | 🗶 ? ✓ |
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| 28. State that when the p-type material is connected to the  positive terminal of a supply and the n-type to the negative terminal, then the junction is **forward biased**. |  | 🗶 ? ✓ |
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| 29. State that if the potential difference across the junction is  sufficient to force electrons to cross the depletion zone, then the junction will conduct. |  | 🗶 ? ✓ |
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| 30. State that when the terminals are reversed, the junction is  **reverse biased** and cannot conduct. |  | 🗶 ? ✓ |
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| **Section 2 Electrons at work****p – n junctions (continued)** | **Covered** **(✓)** | **How well can you do this?****🗶 ? ✓** |
| 31. Describe the movement of the charge carriers in a  forward/ reverse-biased p-n junction diode. |  |  🗶 ? ✓ |
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| 32. State that in a light emitting diode a large forward bias is  applied to the p-n junction enabling positive and negative  charge carriers to recombine, thereby producing photons of light. |  | 🗶 ? ✓ |
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| 33. State that the frequency of the emitted photons increases as the size of the energy gap between the conduction and  valence bands increases. |  | 🗶 ? ✓ |
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| 34. State the relationship E = *h f*. |  | 🗶 ? ✓ |
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| 35. Carry out calculations involving the relationships between  E, *h*, *f* and λ. |  | 🗶 ? ✓ |
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| 36. State that in photovoltaic cells, absorbed photons can create electron-hole pairs to produce a potential  difference. |  |  🗶 ? ✓ |
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