Cathkin High School

Physics Department

CfE Higher

Unit 3 Electricity

Learning Outcomes

Name……………………………………………… Class……………………

✓	**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**

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.		✗ ? ✓
2. State that a.c. current and voltage can be measured using an oscilloscope.		✗ ? ✓
3. Describe how to measure the frequency and peak voltage of an alternating supply using an oscilloscope.		✗ ? ✓
4. State that the r.m.s. voltage is equivalent to a d.c. voltage that produces the same power.		✗ ? ✓
5. State the relationship between peak and r.m.s. values for a sinusoidally varying voltage and current.		✗ ? ✓
6. Carry out calculations involving peak and r.m.s. values of voltage and current.		✗ ? ✓

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.		✗ ? ✓
8. State the relationship $V = E_w/Q$.		✗ ? ✓
9. Carry out calculations involving the relationship between energy, voltage and charge.		✗ ? ✓
10. State that the energy transformed from an external source to the circuit is known as the electromotive force (e.m.f.).		✗ ? ✓
11. Give examples of sources of e.m.f.		✗ ? ✓
12. State that the energy transformed into another form of energy by a circuit component is known as the potential difference (p.d.).		✗ ? ✓
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.		✗ ? ✓
15. Carry out calculations involving potential differences and resistances in potential dividers using the potential divider equation and Ohm's law.		✗ ? ✓

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.		✗ ? ✓
17. Describe the principles of a method for measuring the e.m.f. and internal resistance of a source		✗ ? ✓
18. Explain why the e.m.f. of a source is equal to the open circuit p.d. across the terminals of a source.		✗ ? ✓
19. State that the closed circuit p.d. across the terminals of a source is equal to the t.p.d.		✗ ? ✓
20. State that the e.m.f. of a cell is equal to the sum of the t.p.d. and the lost volts.		✗ ? ✓
21. Carry out calculations involving the relationship between the e.m.f., t.p.d. and lost volts.		✗ ? ✓
22. Describe two methods of measuring e.m.f. and internal resistance by graphical methods.		✗ ? ✓
23. State the R = r for maximum transfer of energy between a source and a load.		✗ ? ✓

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.		✗ ? ✓
25. State that a simple capacitor consists of two parallel conducting plates separated by an air gap.		✗ ? ✓
26. Describe the circuit symbol for a capacitor.		✗ ? ✓
27. State that the charge Q stored on a capacitor is directly proportional to the p.d. V across it.		✗ ? ✓
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.		✗ ? ✓
29. State that capacitance is defined as the gradient of the charge against p.d. graph or the ratio of charge to p.d.		✗ ? ✓
30. State that the unit of capacitance is the farad and that one farad is one coulomb per volt.		✗ ? ✓
31. Carry out calculations involving the relationship between charge, capacitance and p.d.		✗ ? ✓
32. Explain why work must be done to charge a capacitor.		✗ ? ✓

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.		✗ ? ✓
34. State that the energy stored in a capacitor is given by ½ (charge × p.d.) and equivalent expressions.		✗ ? ✓
35. Carry out calculations using the relationship between energy, charge and p.d. or alternative expressions.		✗ ? ✓
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.		✗ ? ✓
37. Carry out calculations involving voltage and current in CR circuits.		✗ ? ✓

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.		✗ ? ✓
2. Give examples of conductors, semiconductors and insulators.		✗ ? ✓
3. State that the different electrical properties of conductors, semiconductors and insulators can be explained by Band Theory.		✗ ? ✓
4. State that in isolated atoms, the permitted energy levels consist of a series of sharply defined states.		✗ ? ✓
5. State that in solids, the permitted energy levels associated with each state of the isolated atom forms a continuous band.		✗ ? ✓
6. State that the two highest bands are known as the valence band and the conduction band, respectively.		✗ ? ✓
7. State that the valence band contains electrons that can be considered to be bound to the atom.		✗ ? ✓
8. State that the valence band is full in insulators and semiconductors.		✗ ? ✓
9. State that the conduction band contains electrons that are free to move.		✗ ? ✓
10. State that the conduction band is empty in insulators and semiconductors, but partially filled in conductors.		✗ ? ✓

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.		✗ ? ✓
12. State that there is an energy gap between the valence and conduction bands in insulators and semiconductors.		✗ ? ✓
13. State that an electron can absorb energy to move between the valence band and the conduction band.		✗ ? ✓
14. State that in insulators, the energy gap is normally too large for electrons to jump to the conduction band.		✗ ? ✓
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.		✗ ? ✓

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).		✗ ? ✓
17. State that in pure semiconductors there are very few electrons available to conduct which makes the resistance very large.		✗ ? ✓
18. State that in pure semiconductors more free electrons become available at higher temperatures, therefore the conductivity increases and the resistance decreases.		✗ ? ✓
19. State that these pure semiconductors are known as **intrinsic** semiconductors.		✗ ? ✓
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.		✗ ? ✓
21. State that doped semiconductors now have a majority charge carrier present and are known as **extrinsic** semiconductors.		✗ ? ✓
22. State that group V doping agents result in n-type extrinsic semiconductors, which contain extra electrons.		✗ ? ✓
23. State that group III doping agents result in p-type extrinsic semiconductors, which contain extra holes.		✗ ? ✓

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.		✗ ? ✓

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.		✗ ? ✓
26. State that the majority charge carriers diffuse towards the junction and electrons and holes combine to form ions.		✗ ? ✓
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.		✗ ? ✓
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**.		✗ ? ✓
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.		✗ ? ✓
30. State that when the terminals are reversed, the junction is **reverse biased** and cannot conduct.		✗ ? ✓

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.		✗ ? ✓
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.		✗ ? ✓
33. State that the frequency of the emitted photons increases as the size of the energy gap between the conduction and valence bands increases.		✗ ? ✓
34. State the relationship $E = hf$.		✗ ? ✓
35. Carry out calculations involving the relationships between E, *h*, *f* and λ.		✗ ? ✓
36. State that in photovoltaic cells, absorbed photons can create electron-hole pairs to produce a potential difference.		✗ ? ✓