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| **TECHNICAL SCIENCES TERM 2 WORKSHEET** |
| **ELECTRONIC PROPERTIES OF MATTER** |

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| 1.1 | Define the term *doping*. | (2) |

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| 1.2 | Silicon is listed as an intrinsic semiconductor. Justify this statement. | (2) |

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| 1.3 | A learner in a school laboratory adds boron to pure silicon to have a better conductor of electricity. |  |

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|  | 1.3.1 | Which type of semiconductor is manufactured by this learner during the process above? | (1) |

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|  | 1.3.2 | | A diode is a simple semiconductor device. How does a diode conduct electric current? | (1) |
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| 2.1 | Name the two mostly used semiconductor material | | | (2) |
|  |  | | |  |
| 2.2 | What is meant by tetravalent atom? | | | (2) |
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| 2.3 | Give one example of an industry were semiconductors are used. | | | (1) |
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| 2.4 | An intrinsic semiconductor silicon is doped with pentavalent phosphorus | | |  |
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|  | 2.4.1 | Name the type of semiconductor produced in the process above. | | (1) |
|  | 2.4.2 | What do you understand by the term intrinsic semiconductor? | | (2) |
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|  | 2.4.3 | Write down the particle represented by the letter X. | | (1) |
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| 3.1 | The diagram below represents a **p-n** junction diode. | | |  |
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|  | 3.1.1 | Draw a diagram showing a p-n junction diode connected to a battery so that the junction is forward biased. | | (2) |
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|  | 3.1.2 | Explain the working of p-n junction when it is in the forward biased mode. | | (3) |
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| 4.1 | Explain the difference between an **n-type** and a **p-type** semiconductor. | | | (4) |
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| 4.2 | Silicon is a well known semiconductor. | | |  |
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|  | 4.2.1 | Write down the number of valence electrons of silicon. | | (1) |
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|  | 4.2.2 | Write down the names and number of valence electrons of **two** elements that can be used to dope the silicon to create a **n-type** semiconductor. | | (2) |
|  |  |  | |  |
|  | 4.2.3 | Write down the names and number of valence electrons of **two** elements that can be used to dope the silicon create a **p-type** semiconductor. | | (2) |
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| **SOLUTIONS** | | |
| 1.1 | Doping is the process of adding impurities to intrinsic semiconductors. | (2) |
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| 1.2 | Silicon is a pure semiconductor as impurity atoms must be added to improve conductivity or a pure semiconductor which is undoped. | (2) |
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| 1.3.1 | P-type semiconductor  | (1) |
|  |  |  |
| 1.3.2 | A diode allows current flow in one direction only  | (1) |
|  |  |  |
| 2.1 | Silicon and Germanium | (2) |
|  |  |  |
| 2.2 | An atom with four valence electrons in its outermost shell (valence shell) | (2) |
|  |  |  |
| 2.3 | In the manufacturing of electronic components. | (1) |
|  |  |  |
| 2.4.1 | n-type | (1) |
|  |  |  |
| 2.4.2 | A pure semiconductor is called an intrinsic semiconductor. | (2) |
|  |  |  |
| 2.4.3 | An electron | (1) |
|  |  |  |
| 3.1.1 |  | (2) |
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| 3.1.2 | -the free electrons in the n-type material will be repelled by the negative terminal voltage supply. |  |

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|  | -the electrons will move and break through the junctions and start flowing towards the positive terminal and it seems as if the holes are moving towards negative terminal.  -the junction region becomes smaller and the break over voltage is overcome and the diode will begin to conduct. | (3) |
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| 4.1 | **n-type semiconductor**: Has been doped with a substance with more valence electrons than the semiconductor, providing free electrons.  **p-type semiconductor**: Has been doped with a substance with less valence electrons than the semiconductor, which leaves vacant spots, called holes. These holes are regarded as positive and can accept electrons. | (4) |
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| 4.2.1 | Silicon – 4 valence electrons | (1) |
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| 4.2.2 | Arsenic – 5 Valence electrons, Antimony- 5 valence electrons | (2) |
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| 4.2.3 | Gallium – 3 valence electrons,Boron – 3 valence electrons | (2) |
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