

|                     | SONANNESBORG                                      |
|---------------------|---|
| PROGRAM             | : BACHELOR OF ENGINEERING TECH. (BEngTech)        |
|                     | ENGINEERING METALLURGY / EXTRACTIVE<br>METALLURGY |
| <u>SUBJECT</u>      | : FUNDAMENTALS OF METALLURGY B1                   |
|                     | PHYSICAL METALLURGY (PAPER1)                      |
| <u>CODE</u>         | : METMTB1   |
| DATE                | SUPPLEMENTARY EXAMINATION                         |
|                     | JANUARY 2020                                      |
| <b>DURATION</b>     | : (2 HOURS)                                       |
| <u>WEIGHT</u>       | : 40: 60  |
| TOTAL MARKS         | : 100   |
| FULL MARKS          | : 100   |
| <b>EXAMINER</b>     | : Ms G.P APHANE                                   |
| <b>MODERATOR</b>    | : Mr LG JUGANAN                                   |
| NUMBER OF PAGES     | : 4 PAGES IN TOTAL                                |
|                     |   |
| <b>INSTRUCTIONS</b> | : ALL THE ANSWERS MUST BE COMPLETED IN THE        |
|                     | EXAM SCRIPTS AND QUESTION PAPERS MUST BE          |
|                     | HANDED IN.  |
|                     |   |
| REQUIREMENTS        | : 1 POCKET CALCULATOR                             |
|                     | NO CORRECTION FLUID SHALL BE USED                 |

# ALL WORK SHALL BE HANDED IN.

#### **INSTRUCTIONS TO CANDIDATES:**

PLEASE ANSWER ALL THE QUESTIONS

# Question1

1.1 Differentiate between the following:

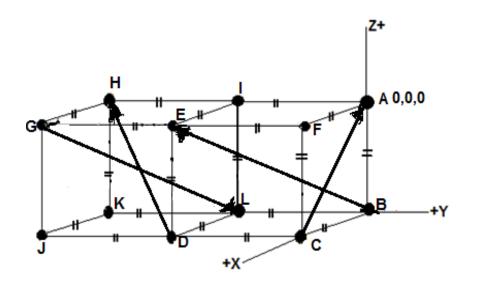
| a. Frenkel and Schotkky defects                           | (4)  |
|---|------|
| b. Microstructure and macrostructure                      | (4)  |
| c. Atomic mass and atomic weight                          | (4)  |
| d. Edge and screw dislocations                            | (4)  |
| 1.2 Name and explain three types of van der Waals forces. | (6)  |
|   | [22] |

## Question 2

| 2.1 Referring from the periodic table, write the electron configuration and the valence |      |  |  |  |
|---|------|--|--|--|
| electrons of potassium and bromine.   | (8)  |  |  |  |
| 2.2 State the functional classification of materials (there are eight of them) and      |      |  |  |  |
| include one example for each.   | (16) |  |  |  |
|   | [24] |  |  |  |

# Question 3

3.1 Determine the coordinates for each point from B to L with A as the origin and the miller indices of GL, CA, DH and EB (11+8)



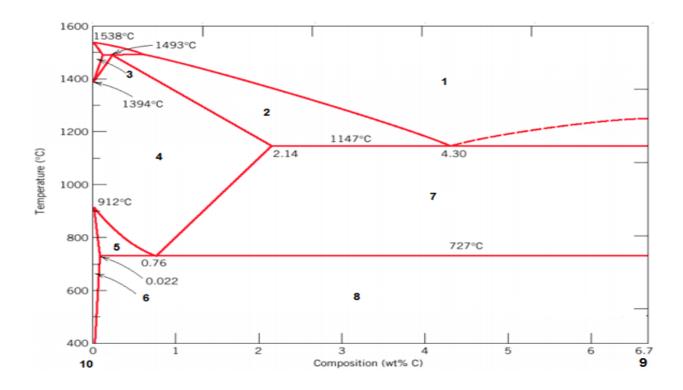
[19]

#### Question 4

| 4.1 The Iron (Fe) has a BCC structure with the atomic radius of 0.124nm. Deter  | rmine       |
|---|-------------|
| the lattice parameter.  | (3)         |
| 4.2 State Pauli's exclusion principle.  | (2)         |
| 4.3 The lattice parameter of BCC caesium is 6.13 Å. Calculate the density of caesium.   | (5)         |
| 4.4 Calculate the radius of an iridium atom, given that Ir has an FCC crystal structure, a density of 22.4g/cm <sup>3</sup> . | (5)<br>[15] |

## Question 5

5.1 Referring to the iron-iron carbide diagram below, label the phases that are present from 1 to 10. [20]



TOTAL [100]

1 nanometer (nm) =  $10^{-9}$  m =  $10^{-7}$  cm = 10 Å 1 angstrom (Å) = 0.1 nm =  $10^{-10}$  m =  $10^{-8}$  cm

|  | 7   | 6                   | сл                                   |                                   | ω                       | 2   | -                     |                              |
|--|---|---------------------|--------------------------------------|-----------------------------------|-------------------------|---|-----------------------|------------------------------|
|  | 132.90045<br>87<br>Francium<br>(223)  | Cs Cs               | 37<br>Rb<br>Rubidium<br>85.4678      | 19<br>R<br>Potassium<br>39 0983   | Na<br>Sodum<br>22 98977 | 3<br>Lithium<br>6.941                     | Hydrogen<br>1,00794   | IA IA                        |
|  | 137.327<br>88<br>Radium<br>Radium<br>(226)  | Ch                  | 38<br>Sr<br>Strontum<br>87.62        | 20<br>Ca<br>Catolum<br>40.078     | Magreesum               | 4<br>Beyllum<br>9.01218                   | IIA                   |                              |
|  |   |                     | 39<br>Yatium<br>88.50585             | 21<br>Sc<br>Scandium<br>44 95591  | IIIA                    |   |                       |                              |
| 57<br>La<br>Landhanum<br>138.9065<br>89<br>89<br>Actinium<br>(227)         | 178.40<br>104<br>Rf<br>Rutrestoctum<br>(261)  | Hf                  | 40<br>Zr<br>Zeconium<br>91 224       | 22<br>Ti<br>Titanium<br>47.867    | IVA                     |   |                       | Peri                         |
| 58<br>Cee<br>Ceeum<br>140,116<br>90<br>7h<br>Thorium<br>232,0391           | 105<br>Db<br>Dubonium<br>(262)  | <sup>73</sup><br>Ta | A1<br>Nictium<br>92 50638            | 23<br>V<br>Vanadium<br>50.9415    | VA                      | Liquids<br>Gases<br>Artificial            | Solids                | iodi                         |
| 59<br>Pr<br>140.80765<br>91<br>Protactinium<br>231.03588                   | 106<br>Sg<br>Seatoorgum<br>(203)  | ¥                   | 42<br>Mo<br>Molytedenum<br>95.94     | 24<br>Cr<br>Chromium<br>51.9961   | VIA                     | Liquids<br>Gases<br>Artificially Prepared |                       | с Та                         |
| 60<br>Neodymium<br>144 24<br>92<br>Uranium<br>238 0289                     | 107<br>107<br>Bh<br>Bahrium<br>(264)  | 75<br>Re            | 43<br>Tc<br>Technelium               | 25<br>Mn<br>Manganese<br>54 90805 | VIIA                    | đ   | Atomic                | Periodic Table of the Elemer |
| 61<br>Promethiam<br>(145)<br>93<br>Np<br>Neptunam<br>(237)                 | 100 23<br>100 23                            | 0S                  | 44<br>Ru<br>Ruthernium<br>101.07     | 26<br>Fe<br>Iron<br>55.845        |                         | Symbol                                    | Atomic Number         | of th                        |
| 62<br>Sm<br>Samarium<br>150.39<br>94<br>94<br>Pudonium<br>(244)            | 109<br>Mt<br>Methorium<br>(208)   | ۳<br>ار             | 45<br>Rh<br>Rhodiam<br>102.90550     | 27<br>Co<br>Cobait<br>58 50320    | VIIIA                   | Hydrogen<br>1.0079 -                      | 26                    | Ie E                         |
| 63<br>Europium<br>151.964<br>95<br>Americium<br>(243)                      | 196.078<br>196.078<br>10<br>110<br>11<br>10<br>11<br>10<br>11<br>10<br>11<br>10<br>11<br>10<br>11<br>10<br>11<br>10<br>11<br>10<br>11<br>10<br>11<br>10<br>11<br>10<br>11<br>10<br>11<br>10<br>11<br>10<br>11<br>10<br>11<br>10<br>11<br>10<br>11<br>10<br>10 | 78<br>Pt            | 46<br>Pd<br>Palladium<br>105.42      | 28<br>Nickel<br>Nickel<br>S8 6934 |                         | 4   | -                     | lemo                         |
| 64<br>Gd<br>Gd<br>Gadolinium<br>157.25<br>96<br>Com<br>Cuitum<br>(247)     | 196.90055<br>111<br>Unununium<br>(272)  | Au                  | A7<br>Ag<br>Saver                    | 29<br>Cu<br>Copper<br>S3.546      | 8                       | Atomic Weight                             |                       | ents                         |
| 65<br>Tb<br>Terbum<br>158 92534<br>97<br>97<br>BK<br>Bekellum<br>(247)     |   | BH                  | 48<br>Cd<br>Cadmium<br>112.411       | 30<br>Zn<br><sup>Znc</sup>        | B                       |   |                       |                              |
| 66<br>Dy<br>Dysprotum<br>102.50<br>98<br>Cf<br>Californium<br>(251)        | Thallum<br>204.3633   | <b>L</b>            | 49<br>In<br>Indiam<br>114.818        | 31<br>Ga<br>Gallum<br>69.723      | Auminum<br>28 98154     | 5<br>Boron<br>10.811                      | IIB                   |                              |
| 67<br>HO<br>Hotmium<br>164 9002<br>99<br><b>PS</b><br>Einsteentum<br>(252) | 207.2   | 82<br>Pb            | 50<br>Sn<br><sup>Te</sup><br>118.710 | 32<br>Ge<br>Germanium<br>72.61    | Silcon<br>28.0855       | G<br>Canton<br>12.0107                    | IVB                   |                              |
| 68<br>Ercium<br>167.28<br>100<br>Femium<br>(257)                           | 208.98038   | Bi                  | 51<br>Sb<br>Antimony<br>121.760      | 33<br>AS<br>Ansenic<br>74.92160   | Phosphorus<br>30.97376  | 7<br>N<br>Nitrogen<br>14.00674            | VB                    |                              |
| 69<br>Tm<br>Thulium<br>168, 93421<br>101<br>Mendelevium<br>(256)           | (209)   | Po                  | 52<br>Tellurium<br>127.60            | 34<br>Se<br>Selenium<br>78.96     | Suthar<br>32.006        | 8<br>Ouygen<br>15, 9994                   | VIB                   |                              |
| 70<br>Yb<br>Yberbian<br>173.04<br>102<br>Nobelian<br>(259)                 | (210)   |                     | 53                                   | 35<br>Br<br>Bromine<br>79.904     | Chlorine<br>35 4527     | 9<br>Fucrine<br>18.99840                  | VIIB                  | _                            |
| 71<br>Lutetum<br>174.087<br>103<br>Ln<br>Lawrencium<br>(262)               | (222)   | Rn                  | 54<br>Xenon<br>131 20                | 36<br>Kr<br>Krypton<br>83.80      | Argon<br>39 548         | Neon<br>20.1797                           | 2<br>Heium<br>4 00280 | <b>≤</b>                     |