

**UNIVERSITY OF FORT HARE**

**MATERIALS CHEMISTRY 1  
(PAC 227)**

**MAIN EXAMINATIONS**

**NOVEMBER 2018**

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**Time: 3 HOURS**

**Subject: PAC 227**

**Marks: 100**

**This paper consists of 4 pages including the cover page**

**Internal Examiners**

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**INSTRUCTIONS**

**ANSWER BOTH QUESTIONS  
THE PERIODIC TABLE OF ELEMENTS IS ATTACHED**

## QUESTION 1

1. Which TWO factors determine the number of electrons that can make the thermal transition from the valence band to the conduction band of a semiconductor? (4)
  2. Explain electricity conduction in metals using the metallic bonding model. (4)
  3. Is the electrical resistivity of pure copper expected to increase or decrease when:
    - (a) a sample of pure copper is deformed?
    - (b) relatively very small quantities of nickel are added to the pure copper?
    - (c) the temperature of the pure copper is lowered? (6)
  4. Explain conductivity in p-type semiconductors using the band model. (7)
  5. Explain how temperature affects the conductivity of (a) metals, (b) insulators (6)
  6. Draw 3 separate diagrams showing magnetic moments in:
    - (a) a paramagnetic substance for  $H = 0$ ;
    - (b) a diamagnetic material when an external field is applied,
    - (c) a ferromagnetic substance for  $H = 0$ . (9)
  7. Draw graphs showing:
    - (a) saturation magnetization as a function of temperature for a ferromagnetic metal and indicate the Curie temperature (4)
    - (b) a complete hysteresis loop from  $H = 0$  to the first, second, and back to the first saturation points. Indicate the saturation points and label/name all the points on the vertical and horizontal axes. (6)
    - (c) the temperature dependence of resistivity of a superconductor and label the temperatures at which the material behaves like a superconductor and where it is like any normal metal. (4)
- {50}

## QUESTION 2

- 1 (a) Differentiate between transparent, translucent, and opaque materials. (6)
- (b) Explain opacity and transparency from the perspective of light scattering and crystallinity in aluminium oxide. (4)

2. Light is considered to have a wave nature and a particle nature. Explain this fact. (4)
3. Explain the origin of the silvery appearance of most metal substances. Include a diagram in your explanation. (6)
4. Sapphire has a wide energy band gap and appears colourless. Addition of 0.5% to 2% chromium ions causes the sapphire to appear deep red. Explain this observation. (6)
- 5(a) Define intercalation compounds. (2)
- (b) List 5 practical uses of intercalation compounds. (10)
- 6(a) Define biogenic compounds. (2)
- (b) List 5 practical uses of biogenic materials. (10)
- {50}

\*\*\*\*\* END \*\*\*\*\*

