

**NAMIBIA UNIVERSITY  
OF SCIENCE AND TECHNOLOGY**

**FACULTY OF HEALTH, NATURAL RESOURCES AND APPLIED SCIENCES**

**SCHOOL OF HEALTH AND APPLIED SCIENCES**

**DEPARTMENT OF BIOLOGY, CHEMISTRY AND PHYSICS**

<b>QUALIFICATION: BACHELOR OF SCIENCE</b>	
<b>QUALIFICATION CODE: 07BOSC</b>	<b>LEVEL: 6</b>
<b>COURSE CODE: EAM601S</b>	<b>COURSE NAME: ELECTRICITY AND MAGNETISM</b>
<b>SESSION: JULY 2023</b>	<b>PAPER: THEORY</b>
<b>DURATION: 3 HOURS</b>	<b>MARKS: 100</b>

<b>SECOND OPPORTUNITY /SUPPLEMENTARY EXAMINATION PAPER</b>	
<b>EXAMINER (S)</b>	PROF MUNAWAR KARIM
<b>MODERATOR:</b>	DR VAINO INDONGO

<b>INSTRUCTIONS</b>
<ol style="list-style-type: none"><li>1. Write all your answers in the answer booklet provided.</li><li>2. Read the whole question before answering.</li><li>3. Begin each question on a new page.</li></ol>

**PERMISSIBLE MATERIALS**

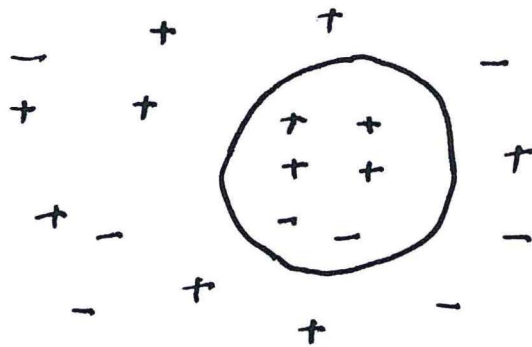
Scientific Calculator

THIS PAPER CONSISTS OF 4 PAGES INCLUDING THIS FRONT PAGE.

Electricity and Magnetism Final Examination June 2023

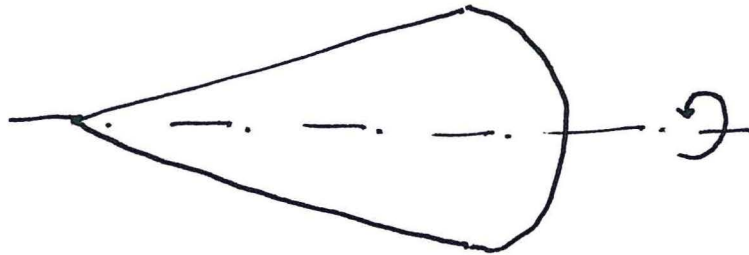
Supplemental examination

- 1) In the diagram below there is a collection of charges. + means +q and - means -q. What is the flux through the surface of the sphere? Recall flux  $\Phi_E = \oint \vec{E} \cdot \vec{da}$ . (20 points)



- 2) Given a uniformly charged cylinder of radius  $R$ , length  $l$  and charge  $Q$ : (10 points)
- a) Calculate the  $E$ -field inside the cylinder (3 points)
  - b) Calculate the  $E$ -field outside the cylinder (3 points)
  - c) Draw a graph of the  $E$ -field both inside and outside the cylinder (2 points)
  - d) Identify points where the field is maximum and minimum. There is more than one point where the field is minimum. (2 points)
- 3) Electric potential and electric field are related by  $E = -dV/dr$ . The field is strongest where the potential changes most rapidly. In the diagram below the metal object is charged to a potential  $V$ . Identify the point (10 points)

(2)



### 3-D OBJECT

- a) Where the field is maximum. (4 points)
- b) Where the field is minimum. (4 points)
- c) Where the field has an intermediate value. (2 points)
- 3) You are required to measure an unknown current  $I$ . (20 points)
- a) Set up a force balance with two anti-parallel currents each carrying a current  $I$  and of length  $l$ . A mass  $m$  is placed on the top current carrying conductor so that its weight balances the repulsive force between the currents. (10 points)
- b) Draw a free-body diagram depicting equilibrium between the weight of the mass and the force between the two currents. Using Newton's Second law write a vector equation depicting equilibrium. At equilibrium the center-to-center distance is  $r = 5\text{mm}$ . (5 points)
- c) From the force calculate the unknown current  $I$  in terms of  $l, m$  and  $g$ . Let  $l = 0.1\text{m}, m = 1.63 \times 10^{-3} \text{ kg}, \mu_0 = 4\pi \times 10^{-7} \text{ H/m}, g = 9.80 \text{ m/s}^2$ .  
Use  $F = (\mu_0/4\pi)I^2l^2/(r)^2$ . (5 points)

(3)

- 4) Two charges  $q_1 = 2nC$  and  $q_2 = +0.25nC$  are located on the x-axis separated by 0.3m. A third charge  $q_3 = -0.5nC$  is also placed on the x-axis. (20 points)
- a) Set up the equation for the forces acting on  $q_3$  due to  $q_1$  and  $q_2$ . (10 points)
- b) Find the locations (two solutions) on the x-axis where the force on  $q_3 = 0$ . (10 points)
- 5) A hollow cylindrical conductor of inner radius  $r_1 = 0.03m$  and outer radius  $r_2 = 0.05m$  carries a current  $I = 10A$  along its axis. (20 points)
- a) Using Ampere's law calculate the B-field in the hollow part of the conductor. (5 points)
- b) The B-field outside the conductor. Show the direction of the B-field. (5 points)
- c) The B-field in the solid part of the conductor. Use  $\mu_0 = 4\pi \times 10^{-7}H/m$ . (10 points)

