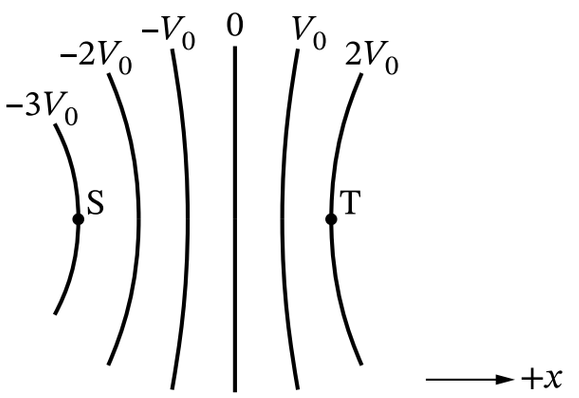
Question 4

4. Equipotential lines for a region with an electric field are shown.



A small sphere (not shown) with positive charge $+Q$ has initial speed v_S in the +*x*-direction and kinetic energy K_S when the sphere is at Point S. The sphere moves to Point T. The force from the electric field is the only force that is exerted on the sphere as the sphere moves between Points S and T.

The sphere has final speed v_T and kinetic energy K_T when the sphere is at Point T.

Part A

Indicate whether v_T is greater than, less than, or equal to v_S. Include one of the following relationships in your response.

- $v_T > v_S$
- $v_T < v_S$
- $v_T = v_S$

Justify your answer. Your justification may include expressions/equations but must include conceptual reasoning beyond algebraic solutions.

Part B

Derive an expression for K_T in terms of V_0, Q, K_S, and physical constants, as appropriate. Begin your derivation by writing a fundamental physics principle or an equation from the reference information.

Part C

A new, small sphere of the same mass as the original sphere but with negative charge $-Q$ has the same initial speed v_S as the original sphere in the +*x*-direction when the sphere is at Point S. The force from the electric field is the only force that is exerted on the new sphere as the new sphere moves between Points S and T. The new sphere has kinetic energy K_{new} when the new sphere is at Point T.

Indicate whether K_{new} is greater than, less than, or equal to K_T. Include one of the following relationships in your response.

- $K_{new} > K_T$
- $K_{new} < K_T$
- $K_{new} = K_T$

Briefly **justify** your answer by referencing your derivation in part B.

STOP

END OF EXAM