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QUESTION WORKBOOK

Electric potential

Electric fields · Year 13

AQA 3.7.3.3 · CIE 18.5.1, 18.5.2, 18.5.3, 18.5.4
OCR A 6.2.4(a), 6.2.4(b), 6.2.4(c), 6.2.4(d), 6.2.4(e)

19 questions · 51 marks

NAVY SCREEN EDITION

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SECTION A · Warm-up

A1 Define the absolute electric potential at a point in an electric field. [2]

A2 Calculate the electric potential at a distance of 0.10 m from a point charge of 5.0×10^{-9} C.
$k = 8.99 \times 10^{9}$ N m^2 C^{-2} [2]

A3 Describe the equipotential surfaces around an isolated point charge and state how they are related to the electric field lines. [2]

A4 A charge of 5.0 μC is moved 0.40 m along an equipotential surface. State the work done on the charge. [1]

A5 The electric potential at a distance r from a point charge is 800 V. State the potential at a distance 2r, and at a distance 4r, from the charge. [2]

A6 State what a potential difference of one volt means, in terms of energy and charge. [1]

SECTION B · Standard

B1 Calculate the electric potential at a distance of 0.20 m from a point charge of -3.0×10^{-9} C. [2]

B2 A charge of $+2.0 \times 10^{-9}$ C is moved from a point 0.30 m from a fixed point charge of 5.0×10^{-9} C to a point 0.10 m from it. Calculate the potential difference between the two points and the work done on the charge. [4]

B3 In a uniform electric field the potential changes by 200 V over a distance of 0.050 m along a field line. Calculate the electric field strength. [2]

B4 Two point charges, each of +4.0 μC, are placed so that each is 0.20 m from a point P. Determine the total electric potential at P. [3]

B5 Determine the distance from a point charge of +12 nC at which the electric potential is 450 V.
$k = 8.99 \times 10^{9}$ N m^{2} C^{-2} [3]

B6 In a vacuum tube, an electron moves from a point at a potential of +150 V to a point at a potential of +650 V. Calculate the kinetic energy the electron gains, in J and in eV.
$e = 1.60 \times 10^{-19}$ C [3]

B7 A small charge is moved from point X to point Y in the field of a fixed point charge, once along a straight line and once along a much longer curved path. State and explain how the work done in the two cases compares. [2]

SECTION C · Stretch

C1 A charge of +5.0 μC is placed at a point where the electric potential is 2000 V. Calculate the electric potential energy of the charge and state the work done in bringing it to this point from infinity. [3]

C2 A +6.0 μC charge and a −6.0 μC charge are placed so that each is 0.30 m from a point P. Calculate the total electric potential at P and explain your result. [4]

C3 Explain how the electric field strength at a point can be found from a graph of electric potential against distance. [3]

C4 A charge of +8.0 nC is fixed at point A and a charge of −2.0 nC is fixed at point B, 0.50 m from A. Determine the distance from A of the point on the line between the charges at which the total electric potential is zero. [4]

C5 Two protons are held 1.0×10^{-12} m apart in a vacuum. One is kept fixed and the other is released from rest. Calculate the speed of the released proton when it is very far from the fixed one. Assume that only the electrostatic force acts.
$k = 8.99 \times 10^{9}$ N m^2 C^{-2}, $e = 1.60 \times 10^{-19}$ C, $m_p = 1.67 \times 10^{-27}$ kg [5]

C6 A bird perches with both feet on a single bare overhead cable at a potential of 25 kV. Suggest why the bird is unharmed. [3]