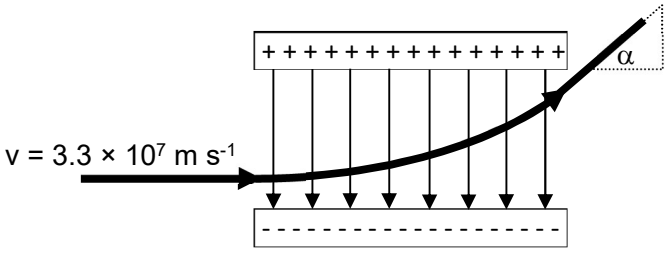
Review paper

Q1. An electron gun creates a beam of electrons moving horizontally with a speed of 3.3×10^7 m s^{-1}. The electrons enter two parallel electrodes of length 2.0 cm, where the electric field is $E = 5.0 \times 10^4$ N C^{-1} downwards. In which direction and by what angle is the electron beam deflected by the electrodes?



Q2. A straight 2.00-m, 150-g wire carries a current in a region where the earth's magnetic field is horizontal with a magnitude of 0.55 gauss. (a) What is the minimum value of the current in this wire so that its weight is completely supported by the magnetic force due to earth's field (assuming no forces other than gravity acts on it)? Does it seem likely that such a wire could support this kind of current? (b) Show how the wire would have to be oriented relative to the earth's magnetic field to be supported in this way.

Q3. A positive charge q is fixed at the point x = 0, y = 0. A negative charge -2q is fixed at the point x = a and y = 0. (a) Show the positions of the charges in a diagram. (b) Derive an expression for the potential V at points on the x-axis as a function of the coordinate x (take V to be zero at an infinite distance from the charges).(c) At which positions on the x-axis is V = 0?

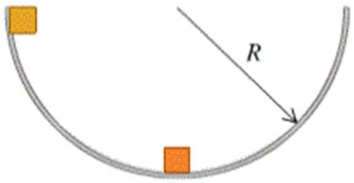
Q4. Three point charges are arranged along the x-axis. Charge $q_1 = +3.00$ μC is at the origin and charge $q_2 = -5.00$ μC is at x = 0.200 m. There is a third charge $q_3 = -8.00$ μC located on the x-axis. Where is q_3 located so that the net force on q_1 is 7.00 N in the negative x direction?

Q5. A ice block of mass 10 kg floating in a river is pushed through a displacement **d** given by **d** = (20 m) **i** – (16 m) **j** along a straight embankment by rushing water, which exerts a force **F** = (210 N) **i** – (150 N) **j** on the block.
(a) How much work does the force do on the block during the displacement?
(b) What is the magnitude of the final velocity of the block if it was initially at rest?

Q6. An object of mass 2.4 kg moves up a plane that is inclined at 37.0^0 to the ground. If the initial speed of the object is 3.8 m/s and the coefficient of kinetic friction between the object and the plane is 3/10, how far does the object travel before it stops?

Q7. A force of 30 N is applied to a body of mass 10 kg which was originally at rest. If the object moved 24 m in the same direction as the force, calculate. i) the work done on the body and its final kinetic energy, ii) the final velocity of the body, iii) the rate of work done by the force.

Q8. Two identical masses m_1 and m_2 are placed in a smooth hemispherical bowl of radius R at the top and bottom, respectively, as shown. The mass m_1 is released from rest and collides with m_2 at a certain velocity. The masses stick together when they collide and move together at half the original speed that m_1 had just before the collision. How high above the bottom of the bowl will the masses go after colliding? You can ignore friction between the masses and the surface of the bowl.



Q9. A singly charged Lithium ion has a mass 1.16×10^{-26} kg. It is accelerated through a potential difference of 220 V and then enters a magnetic field with magnitude 0.723 T perpendicular to the path of the ion. What is the radius of the ion's path in the magnetic field?

Q10. Singly ionized atoms are accelerated and then passed through a velocity selector consisting of perpendicular electric and magnetic fields. The electric field is 155 V/m and the magnetic field is 0.0315 T. The ions next enter a uniform magnetic field of magnitude 0.0175 T that is oriented perpendicular to their velocity. (a) How fast are the ions moving when they emerge from the velocity selector? (b) If the radius of the path of the ions in the second magnetic field is 17.5 cm, what is their mass?