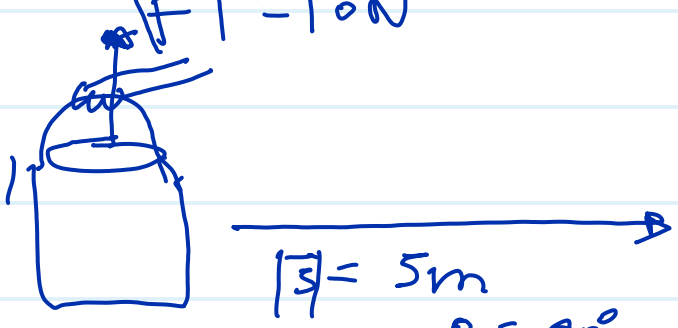
5.

5. A person is holding a bucket by applying a force of 10 N. He moves a horizontal distance of 5 m and then climbs up a vertical distance of 10 m. Find the total work done by him.

(1) 50 J (2) 150 J

(3) 100 J (4) 200 J

(i) $|\vec{F}| = 10N$

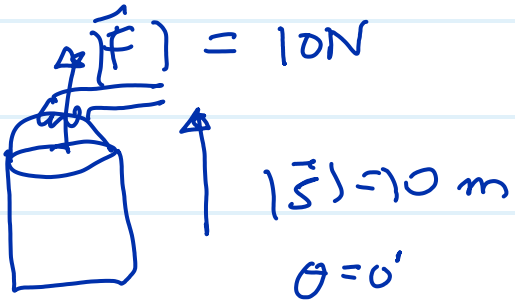


$|\vec{s}| = 5m$

$\theta = 90^\circ$

$W_1 = \vec{F} \cdot \vec{s} = 0\ J$

(ii) $|\vec{F}| = 10N$



$|\vec{s}| = 10\ m$

$\theta = 0^\circ$

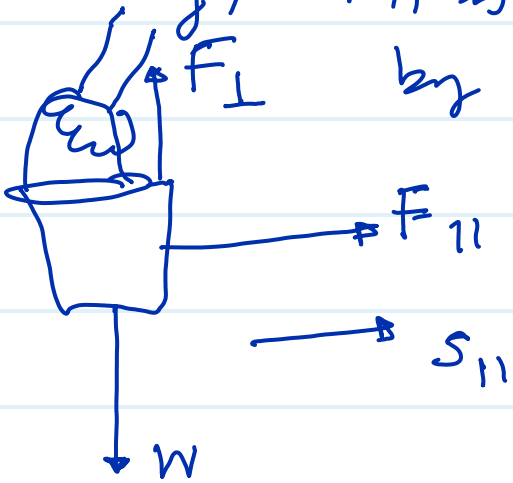
$W_2 = \vec{F} \cdot \vec{s} = 100J$

$W_{Total} = W_1 + W_2 = 100\ J$ (3) Ans

Notable: Carrying the bucket horizontally in reality does need force by the person.

In reality,

(i)



$F_{||}$ is the force exerted by the person in the horizontal direction.

$F_{||}$ → F parallel

We do not know the value of $F_{||}$.

So we assume that the person 'quasi-statically' moves horizontally

($\because$ i.e. $a_{||} \to 0 \Rightarrow F_{||} \to 0$)

and so $\vec{F}_{||} \cdot \vec{s}_{||} = 0$.

This is why we 'neglect' horizontal work done.

8. When a proton and an electron are brought close together then what happens to the potential energy of the system?

(1) Will increase (2) Becomes zero

(3) Remains same (4) Will decrease

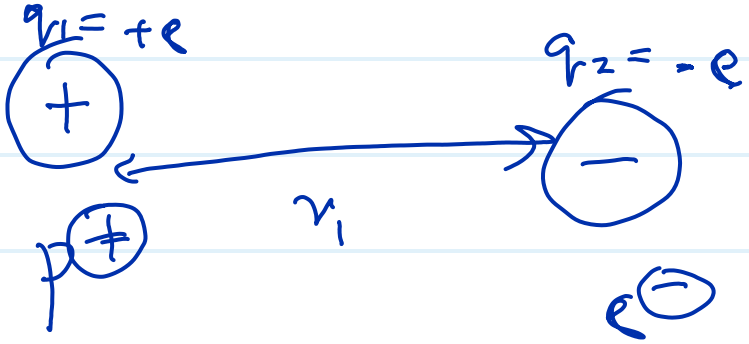
Welcome to Physics involving charged quantities!

Electrostatic charge formula is

$$|F| = \frac{kq_1q_2}{r^2}$$

(very much like gravitational force formula, but much much stronger)

q_1 and q_2 are the signed charges of the two particles.



where e is the magnitude of charge of each particle

$$F_{pe} = \frac{K(+e)(-e)}{r_1^2} = \frac{-ke^2}{r_1^2}$$

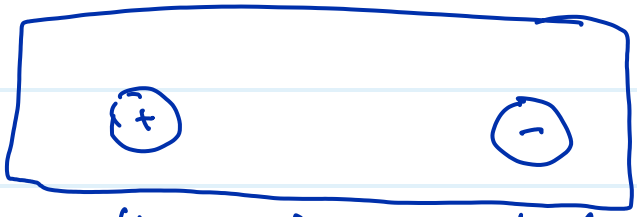
↓ Force on p⊕ due to e⊖

a -ve value ⇒ an attractive force. (towards e⊖)

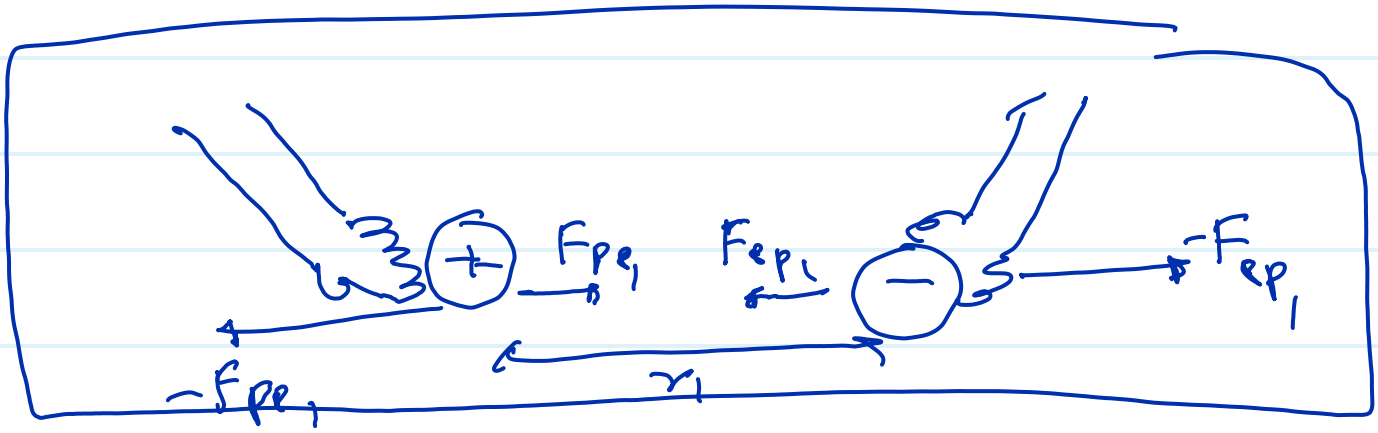
$$F_{ep} = \frac{K(-e)(+e)}{r_1^2} = \frac{-ke^2}{r_1^2}$$

(attracting towards the p⊕).

Thus we realize that



these two particles cannot stay suspended like this, and will quickly accelerate towards each other.



and that they have to be "held together" in place by some external force.

The closer the particle's distance ($r \downarrow$), the greater the restraining force, required.

So now, as per the question, if the particles are brought closer together, to a distance $r_2 < r_1$, then MORE external force will be required to restrain the particles at their new, reduced distance.

$\Rightarrow$ More energy injected into the system

$\Rightarrow$ System's Potential Energy ↑

(as KE → c, as the final state of the particles is again assumed to be at rest).

So (1) will increase Ans

should be the answer.

4

4. A gardener pushes a lawn roller through a distance of 20 m. If he applies a force of 20 kg wt in a direction inclined at 60° to the ground, find the work done by him. (g = 9.8 m/s^2)

(1) 400 J (2) 1960 J

(3) 250 J (4) 2514 J

Draw an FBD of the lawn roller, showing all forces acting on it.
What is the Normal Force acting on the lawn roller?