

PHYSICS

12TH CLASS

Corona Effect

P-27

Van De Graaff Generator

All in One



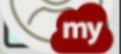
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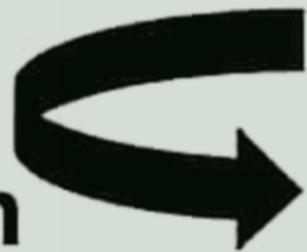
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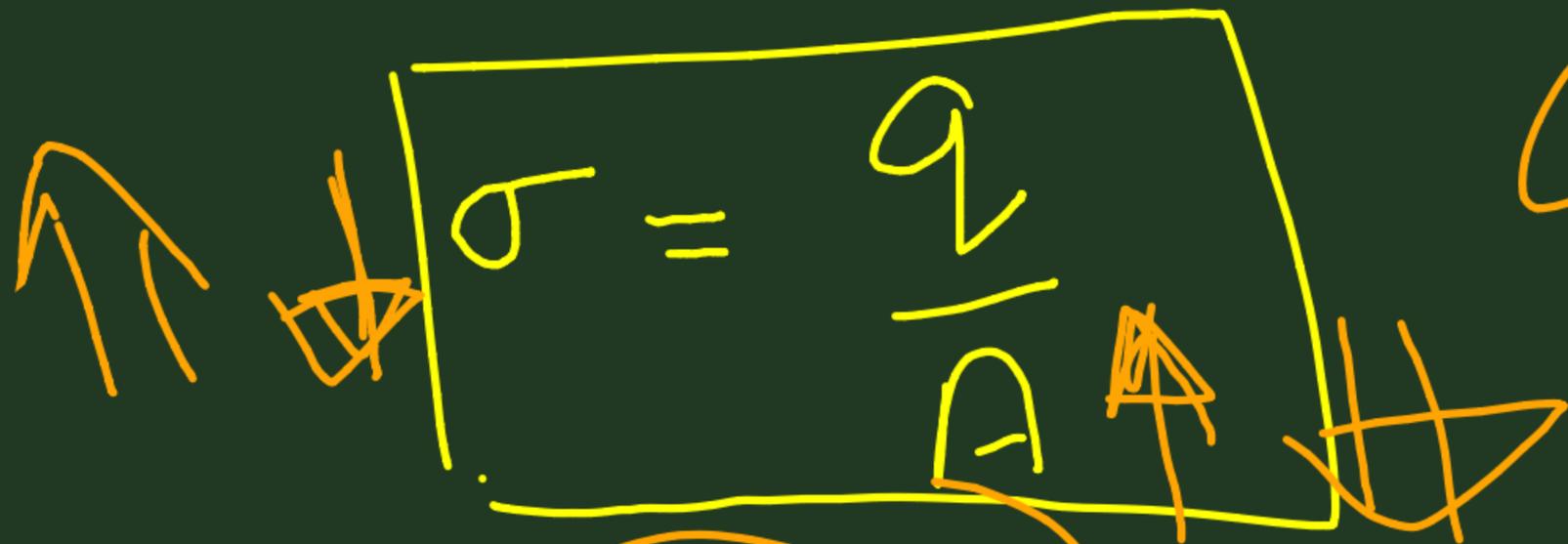
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7 June: World Food Safety Day

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8 June: World Brain Tumour Day

8 June: World Oceans Day



capacitor
discharging



leak

Corona Discharge:

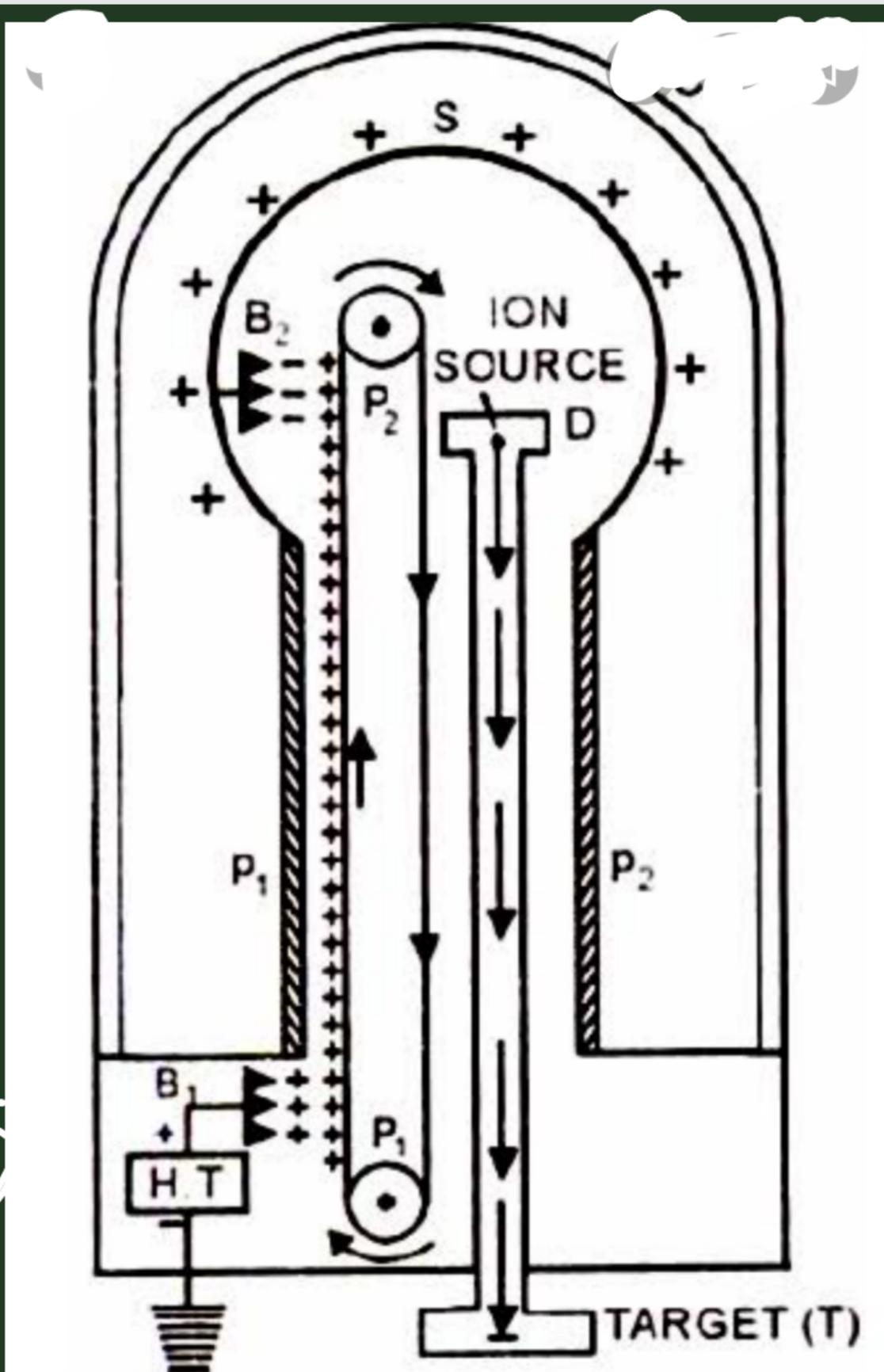
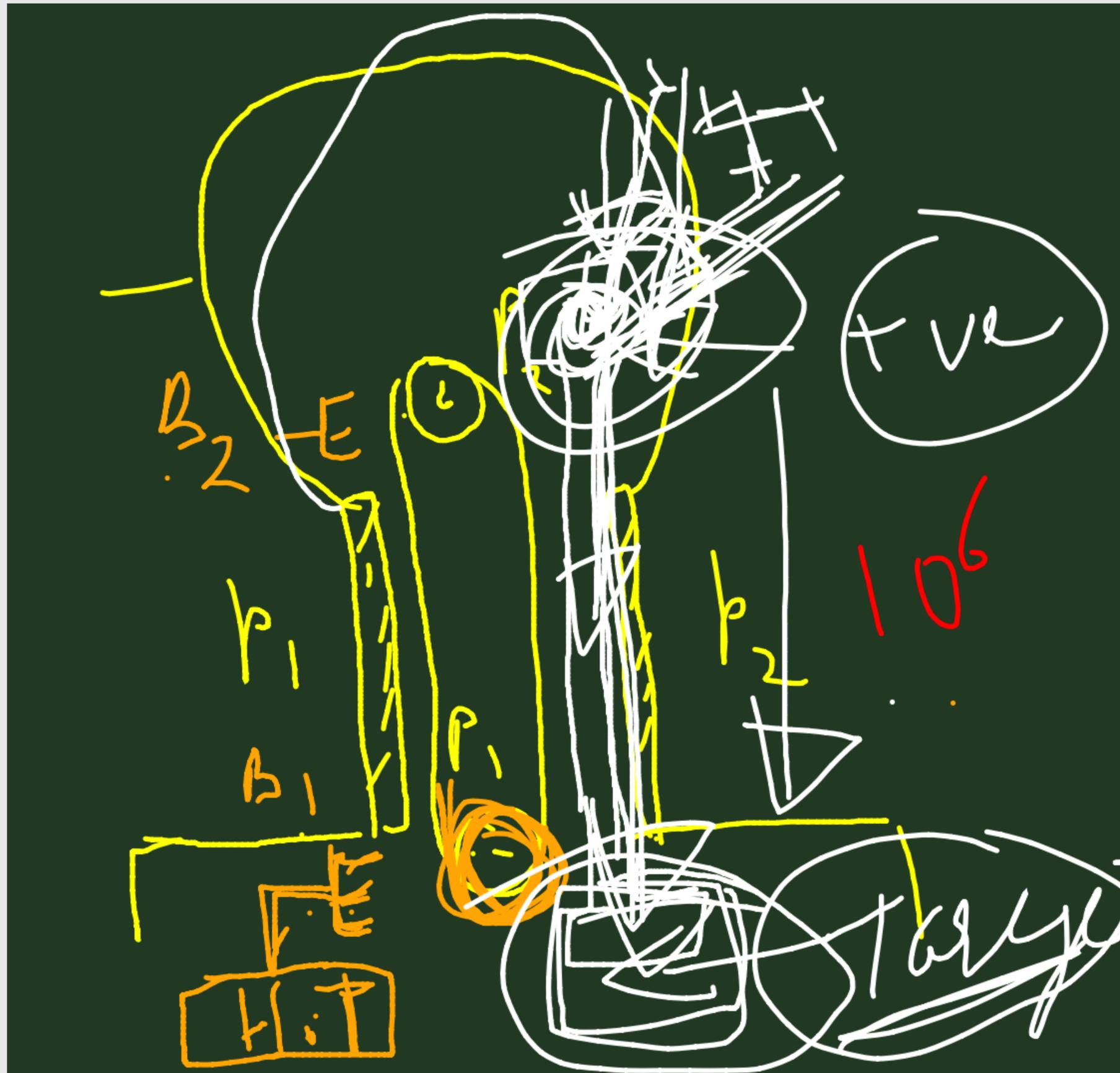
Electric wind set up ~~which takes~~ which takes away the charge continuously from the pointed ends of the conductor.

This process is called corona discharge / corona effect.



Van de graaff generator: it is device used for building up high potential difference of order 10^6 V by applying small potential.

- **Principle:** It is based on two principles:
- **1. Corona discharge.**
- **2.** The property that charge given to hollow conductor is transferred to outer surface and is distributed uniformly over it.



$$\Phi = CV$$

$$V = \frac{\Phi}{C}$$

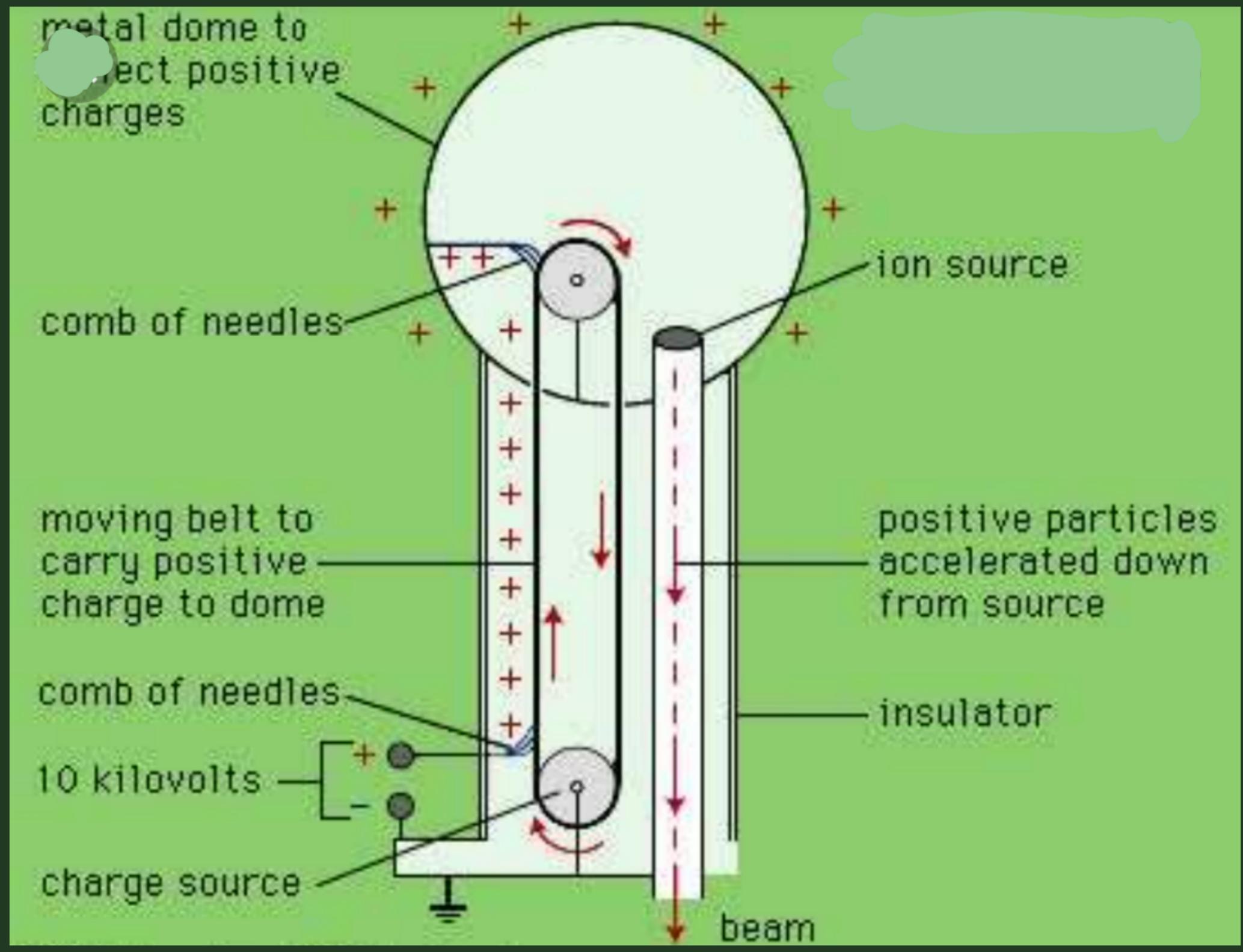
$$C = 4\pi \epsilon_0 R$$

$$V = \frac{\Phi}{4\pi \epsilon_0 R}$$

Construction:

Van de Graaff generator consists of a large hollow metallic sphere S mounted on pulleys P_1 and P_2 . The pulley P_1 is run by a motor. Two sharp combs B_1 and B_2 are fixed near the pulleys P_1 and P_2 respectively touching the belt. Comb B_1 is called spray comb, while comb B_2 is called collecting comb.

The positive ions to be accelerated are produced in a discharge tube D. The ion source lies at the head of the tube in the sphere. Target is at the other end of the tube is earthed. The whole assembly is enclosed in a chamber filled with nitrogen or methane at high pressure.



Working

The spray comb B_1 is given a positive potential of range 104 V with respect to earth using high tension source. Due to the positive charge on the comb B_1 electric wind is set and it sprays positive charge on the belt. As the belt moves and reaches the top of pulley P_1 the negative charge is induced on sharp ends of collecting comb B_2 . The equal positive charge is induced on the far end of comb B_2 . Now, the far end of B_2 and the sphere are connected.

This positive charge on the far side of B_2 moves immediately to the outer surface of the sphere. Due to discharging action of sharp edges of comb B_2 negative electric winds are set and it discharges negative charge on the belt. Thus the positive charge on the belt is neutralized. This is repeated continuously. Thus positive charge gets accumulated on the outer surface of the sphere "S".

Now the capacity of the spherical conductor is given by

$$C = 4\pi\epsilon_0 r k$$
$$V = \frac{Q}{C} = \frac{Q}{4\pi\epsilon_0 k r}$$

$k \rightarrow$ dielectric constant

$3 \times 10^6 \text{ V/m} \rightarrow$ dielectric constant air

Hence the potential of the sphere goes on increasing with the increase in the charge.

The breakdown voltage for air is $3 \times 10^6 \text{ V/m}$. beyond which air around the sphere is ionized and leakage takes place. This leakage is minimized by enclosing the assembly in a chamber filled with nitrogen or methane at high pressure.

Projectiles like protons, deuterons, etc. can be generated in a discharge tube D and are accelerated in a downward direction along the length of the tube. This accelerated projectile hit

This accelerated projectile hit the target with large kinetic energy and bring about artificial transmutation.

Uses of Van De Graaff Generator:

- . It is used to create high potential of a range of few million volts.
- It is used to accelerate projectiles like protons, deuterons, etc. which hit the target with large kinetic energy and bring about artificial transmutation.
- It is used to study collision experiments in physics
- Such beams are used for the treatment of cancer.

Thank you

TVM
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