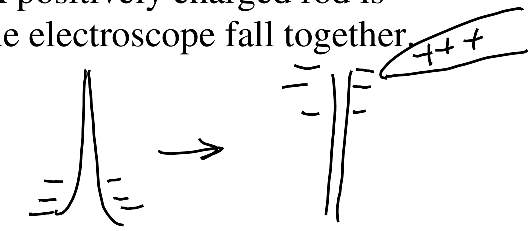
→ charged initially

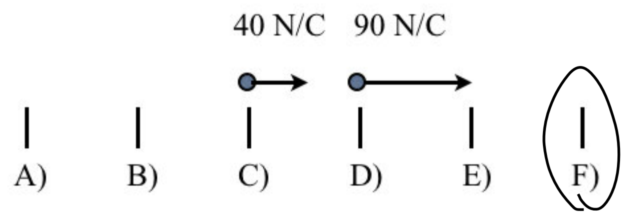
**Question 7:** The leaves of an electroscope are initially apart. A positively charged rod is brought near to the top of the electroscope and the leaves of the electroscope fall together.



A) The electroscope must be negatively charged.
B) The electroscope isn't charged at all.
C) The electroscope must be positively charged.
D) It's impossible to determine if it's positively or negatively charged.

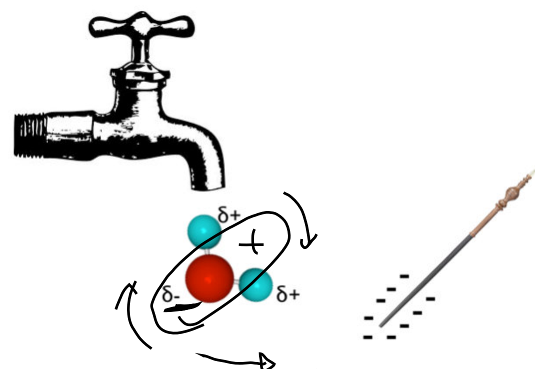
**Question 8:** The electric field from a point charge is shown at two points along the x-axis. At what position does the charge rest?

$\vec{E} = \frac{kQ}{r^2}\hat{r}$




Have ratio $\frac{9}{4}$ for E, so $\frac{2}{3}$ for r

**Question 9:** A water molecule falls from a tap near a charged wand. What happens to the water molecule at the instant shown in the figure?

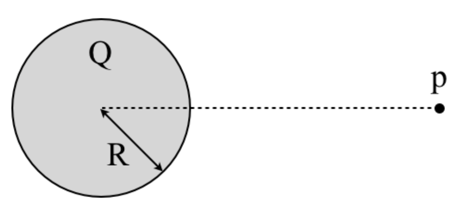



A) It rotates counter-clockwise and moves towards the wand.
B) It rotates clockwise and moves towards the wand.
C) It rotates counter-clockwise and moves away from the wand.
D) It rotates clockwise and moves away from the wand.
E) It doesn't rotate and it moves away from the wand.
F) It doesn't rotate and it moves towards the wand.

Dipole

**Question 10:** The diagram below shows a charged spherical conductor of radius R. The radius of the sphere is doubled to 2R and the charge is halved to Q/2. What is the ratio of the electric field at point p after the change compared with before the change $E_{after}/E_{before}$?

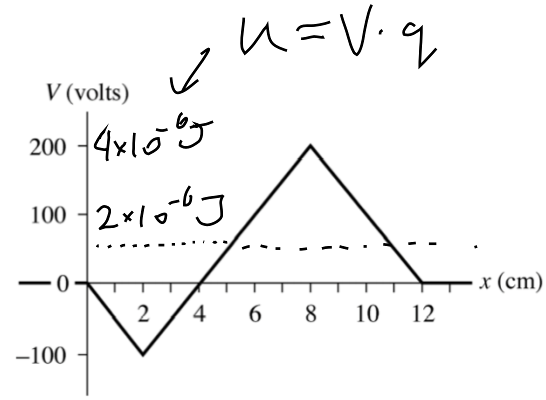
A) 2
B) 1
C) 1/2
D) 1/4
E) 1/8




R is irrelevant

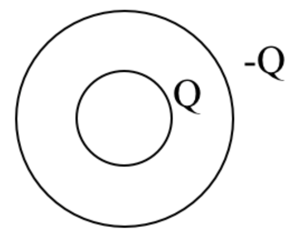
E prop. to. charge (Gauss)

**Question 11:** The graph shows electric potential along the x-axis. A 20 nC particle is shot from the left (x<0) with $10^{-6}$ J of kinetic energy. The particle will turn around at

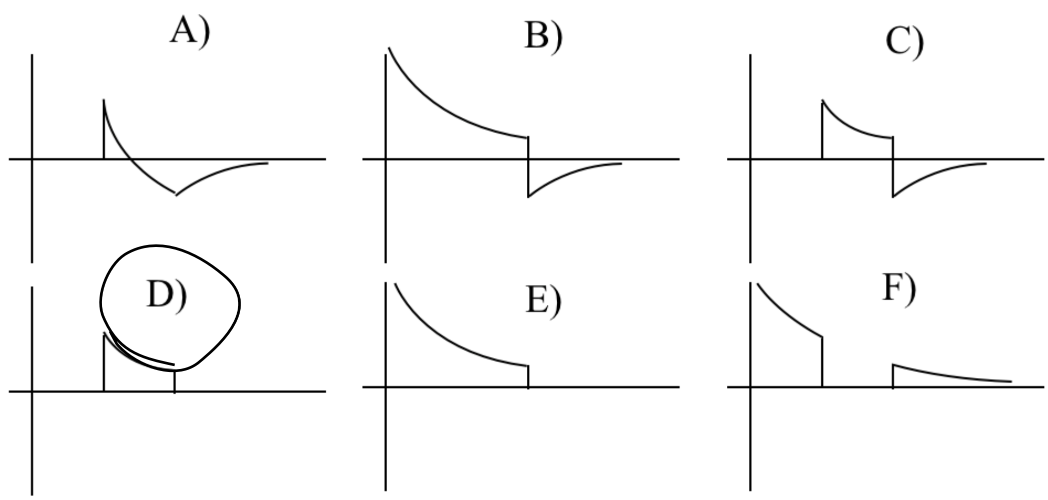



A) 11 cm
B) 10cm
C) 8 cm
D) 5 cm
E) 2 cm
F) 1 cm
G) no turning point

**Question 12:** The diagram to the right shows two thin charged spherical shells. The inner shell has a charge Q and the outer shell has a charge –Q.

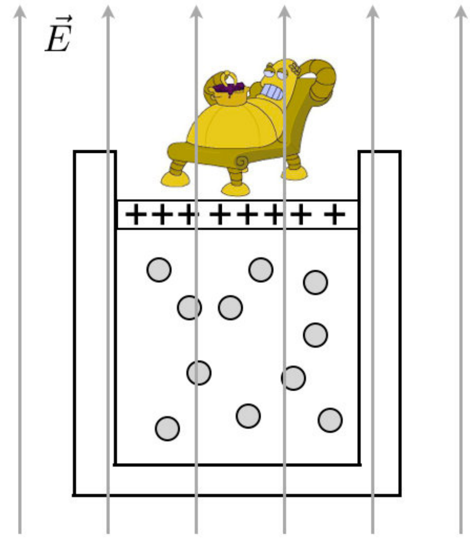



Which plot below best describes the outward electric field as a function of radius in this situation?



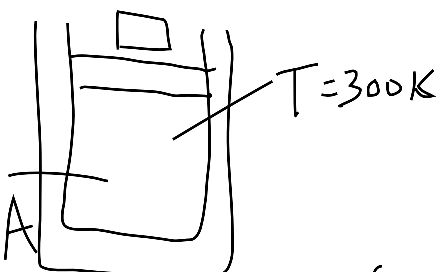
Hedonism-bot will only sit on a platform suspended by pure oxygen. Hedonism-bot has one problem, though. When the temperature outside changes, the gas expands and contracts, which moves the platform up and down and drives Hedonism-bot crazy.

To fix the problem, Hedonism-bot has charged the platform with 1 Coulomb and installed a machine that can generate a uniform electric field of any strength that can point either up or down. When the temperature changes, the electric field will change, thus keeping the platform at a constant height.




If the electric field is initially zero and the temperature drops by 1 degree Kelvin, what will the final value of the electric field need to be?

Possibly useful info: When the temperature is 300 K the platform is 10 m above the bottom of the container. Hedonism-bot has a mass of 1000 kg, and the area of the platform is 5m$^2$. The ambient air pressure is 100kPa.




$P \cdot A = P_{atm} A + M_{h\text{-}b} \cdot g$

Using $PV = nRT$, we find that when the temperature drops by 1K, if V stays constant, then

$$\Delta P = \frac{nR\Delta T}{V}$$

The upward force on the platform thus decreases by $\Delta F = \Delta P \cdot A = \frac{nR\Delta T}{V} \cdot A = P \cdot A \cdot \frac{\Delta T}{T}$

To compensate, we thus need an upward $\vec{E}$ with $Eq = PA\frac{\Delta T}{T}$

$$\Rightarrow E = \frac{1}{q} \cdot \frac{\Delta T}{T}\left(P_{atm} A + M_{h\text{-}b}\, g\right)$$