Unit 4 - Week 2

Assignment 2

The due date for submitting this assignment has passed.
As per our records you have not submitted this assignment.

Due on 2020-02-12, 23:59 IST.

1) 1. Four particles, each with charge q, are placed at corners of a square. Another charge Q of opposite sign is placed at centre of the square such that the total force on each four particles is zero. Which of the following relation is correct regarding charges Q and q? *2 points*

- q=0.96Q
- Q=0.96q
- q=0.76Q
- Q=0.76q

No, the answer is incorrect.
Score: 0
Accepted Answers:
Q=0.96q

2) Consider a spherical charge distribution which has constant charge density ρ from $r = 0$ to $r = a$ and is zero beyond. Choose the correct pattern of electric field from the following for r less than 'a' and for r greater than 'a' respectively *2 points*

- $\frac{1}{4\pi\epsilon_0}\frac{\rho}{r^2}; \frac{1}{4\pi\epsilon_0}\frac{\rho}{a^2}$
- $\frac{1}{\epsilon_0}\frac{\rho}{r}; \frac{1}{4\pi\epsilon_0}\frac{\rho}{a}$
- $\frac{4}{\epsilon_0}\frac{\rho}{3r^2}; \frac{4}{\epsilon_0}\frac{\rho}{3a^2}$
- $\frac{\rho r}{3\epsilon_0}; \frac{a^3}{3\epsilon_0}\frac{\rho}{r^2}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\frac{\rho r}{3\epsilon_0}; \frac{a^3}{3\epsilon_0}\frac{\rho}{r^2}$

3) The capacitance of two concentric metal shells, with radii a and b (where, a < b) is *2 points*

- $C = 4\pi\epsilon_0\frac{ab}{b-a}$
- $C = 4\pi\epsilon_0\frac{ab}{b+a}$
- $C = 4\pi\epsilon_0\frac{a^2b^2}{b^2-a^2}$
- $C = 4\pi\epsilon_0\frac{a^2b^2}{b^2+a^2}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$C = 4\pi\epsilon_0\frac{ab}{b-a}$

4) If the plates of a parallel plate capacitor move closer together by a distance 'Δ', what will be the magnitude work done in terms of the field 'E' and area of the plates 'A'. *1 point*

- $\frac{\epsilon_0 E^2 A^2 \Delta^2}{2}$
- $\frac{\epsilon_0 E^2 A\Delta}{2}$
- $\frac{\epsilon_0 E^2 \Delta^4}{2A}$
- $\frac{\epsilon_0 E^2 A}{2\Delta}$

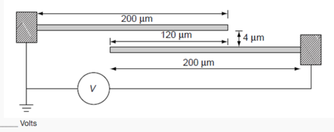
No, the answer is incorrect.
Score: 0
Accepted Answers:
$\frac{\epsilon_0 E^2 A\Delta}{2}$

5) Choose the correct option in case of parallel plate capacitor with overlapping distance of 'x' : *1 point*
i. $F_N = \frac{bx\epsilon_0 V^2}{2d^2}$; $F_T = \frac{b\epsilon_0 V^2}{2d}$ where F_N and F_T are the normal and transverse forces respectively.
ii. If $x \gg d$, $F_T \gg F_N$.

- a. Only I is correct
- b. Only ii is correct
- c. Both I and ii are correct
- None of the above is correct

No, the answer is incorrect.
Score: 0
Accepted Answers:
a. Only I is correct

6) Figure below shows two polysilicon beams of length 200 μm, width 2 μm and out of plane thickness 10 μm separated by an in-plane gap of 4 μm. The beams overlap, as shown in the figure, over a length of 120 μm. Assume that the Young's modulus is 155 Gpa. What is the pull-in voltage for this pair of beams *5 points*



Voltage = _____ Volts

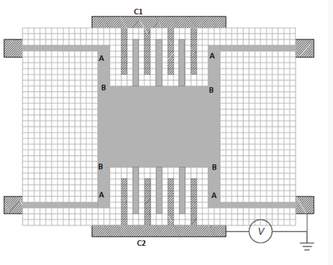
No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 17,20

7) The electric energy density of a parallel plate capacitor (plate area A, gap between the plates d), if the electric field inside is E, is *1 point*

- $\frac{1}{2}\epsilon_0 E$
- $\frac{1}{2}\epsilon_0 E^2$
- $\frac{1}{4}\epsilon_0 E^2$
- $\frac{1}{2}\epsilon_0 E^3$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\frac{1}{2}\epsilon_0 E^2$

8) The schematic of an in-plane accelerometer with a crab-leg suspension is shown below. Assume it is made of silicon whose Young's modulus is 169 GPa. The thickness everywhere is 25 μm. Each square in grid has a size 5 μm × 5 μm. In order to perform a self-test, how much voltage needs to be applied to get a displacement of 5 nm? (Deflection of beams AB is negligible and the top fixed comp C1 is not connected to circuit) *4 points*



Voltage = _____ V

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 500,580

9) Which of the following processes will not avoid stiction? *1 point*

- Fabricating a stiff cantilever
- Using wider beam instead of narrow beam
- Using methanol for washing instead of water
- Making narrow dimples at the tip of cantilever
- Super-critical drying

No, the answer is incorrect.
Score: 0
Accepted Answers:
Using wider beam instead of narrow beam

10) Which of the following should not be used for either sublimation or super-critical drying? *1 point*

- Liquid CO_2
- P-dichlorobenzene
- Liquid t-butylalchohol
- DI water

No, the answer is incorrect.
Score: 0
Accepted Answers:
DI water