$PE = \frac{Kq_1 \cdot q_2}{r}$ Q.3 $F_e = \frac{Kqq}{r^2}$ $PE = \frac{kqq}{r}$ so $\frac{PE}{r} = F_e$ or $W = PE = Fd$ so $F = \frac{PE}{d}$

1. A 2μC charge and a 6μC charge are 3 mm apart.
   A. Calculate the electric potential energy between them.
   $PE = 9\times10^9 \cdot \frac{2\times10^{-6} \cdot 6\times10^{-6}}{.003m} = 36J$
   B. How much work was done to bring them together?
   36J Wdone = PE gained

2. Where is the reference point for potential energy for point charges? ∞
   Why? That's where Fe=0 + PE=0

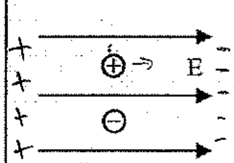
3. Two charges are 3 m apart and have 15 J of PE. Calculate the force between them.
   See Q.3 $\frac{15J}{3m} = 5N$

4. A 1.2μC charge and a −3μC charge have −4 joules of PE.
   A. What is the distance between the charges?
   $PE = \frac{Kq_1 \cdot q_2}{r}$ or $r = \frac{Kq_1 \cdot q_2}{PE} = \frac{9\times10^9 \cdot 1.2\times10^{-6} \cdot -3\times10^{-6}}{-4J}$ = .0081 m or 8.1 mm
   B. Why is the PE negative?
   opp. attract + it takes −W to keep them apart

5. A proton and an electron are near each other. To increase the potential energy of the system, should you move them closer together or farther apart? opp attract
   move them opposite the direct they want to go

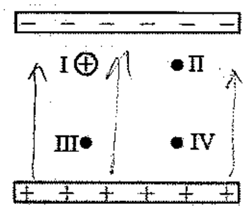
6. Two positive charges are near each other. If the distance between them is decreased, how does the potential energy between them change? PE↑ like compressing a spring

7. A + and − charge are at rest in an electric field, as shown.



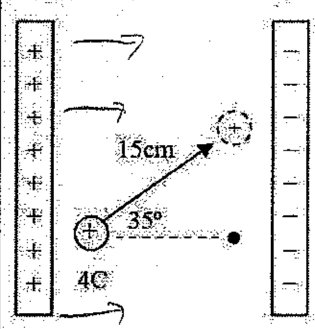
   A. Which way will the + move? → with E field
   B. When the + moves due to the field will it gain or lose PE? Lose PE
   C. Which way would you move the − to increase its PE? towards − side
   D. If + work is done on the − charge, which way did it move? right since it wants to move left

8. A + charge is between the charged plates of a capacitor.



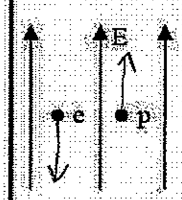
   A. Draw the direction of the electric field between the plates.
   B. Will the charge have more PE at point III or point IV? Same
   C. If moved to point III is its ΔPE + or −? + since it's moving opp it wants to
   D. How much work is required to move the charge to II? 0J no change in E field

9. The electric field strength is 2.5 N/C between the plates.



   A. Draw E between the plates.
   B. Is E + or −? to the R
   C. Is the charge gaining or losing PE? so neg Losing
   D. Calculate d. d must be parrele to E
   d = .15m cos 35° = .123m
   E. Calculate ΔPE.
   $\Delta PE = -Eqd = 2.5 N/C \cdot 4C \cdot .123m = -1.23J$

10. A proton and electron are placed into an electric field.



   A. Which has more charge? Same
   B. Which has more mass? proton
   C. Draw the direction each will move due to the field.
   D. Will the proton gain or lose PE?
   E. Will the electron gain or lose PE?
   F. What does the PE become? PE lost = KE gained
   G. After a long time which will be moving faster? electron
   H. Why? PE = KE = ½mv², same KE, less mass, so more V
   Same E field, same Fe, Proton more mass less accell

11. Three charges are placed as shown.

⊕ 4μC — 3 mm — ⊕ 3μC — 4 mm — ⊖ −2μC

PE = $K\frac{4\times10^{-6} \cdot 3\times10^{-6}}{.003}$ = 36J   PE = $\frac{K\,3\times10^{-6} \cdot -2\times10^{-6}}{.004m}$ = −13.5J

   A. Calculate PE between the 4μC and 3μC charges. 36J
   B. Calculate PE between the −2μC and 3μC charges. −13.5J
   C. Is energy a scalar or vector? Scaler
   D. Calculate the net PE of the middle charge.
   36J + −13.5J = 22.5J

12. The −2μC charge is then moved. Calculate the net potential energy of the 3μC charge in this configuration.

−2μC ⊖ (4 mm above the 3μC charge) −13.5J

⊕ 4μC — 3 mm — ⊕ 3μC   36J

as scalars direction doesn't matter, so moving one of the charge doesn't matter
22.5J