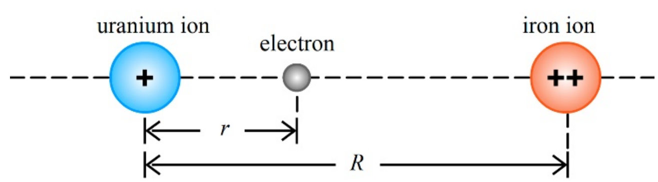
Exam-1 Phys-207UP Spring ‘21

1) *field from point charge; [9 pts.]* A charge of 3 μC is located at the origin. What is the x-component of the electric field at the point (x,y,z) = (4m,3m,0) produced by the charge?
   (A) 248 N/C
   (B) 372 N/C
   (C) 648 N/C +4
   (D) 864 N/C +9
   (E) 1080 N/C +5
   (F) 4320 N/C +2

2) *Force due to charged ions [9 pts.]* A singly ionized uranium ion (charge +e) and a double ionized iron ion (charge +2e) are held on the x-axis at a fixed distance of R apart. An electron is placed in between the two ions. Find the distance, r, from the uranium ion so that the net electric force on the electron vanishes
   (A) r = 0.16 R
   (B) r = 0.25 R
   (C) r = 0.33 R +3
   (D) r = 0.41 R +9
   (E) r =0.59 R +4
   (F) r = 0.67 R +3
   (G) r = 0.84 R



3) *charge enters E field [9 pts.]* A particle of charge -60 mC and mass 0.050 kg is moving at 20 m/s in the positive z-direction when entering a uniform electric field of unknown strength directed in the negative z-direction. After moving through the field for 10 cm the speed of the particle is found to 40 m/s. What is the strength of the electric field?
(A) 50 N/C +4
(B) 345 N/C
(C) 1600 N/C +3
(D) 5000 N/C +9
(E) 4330 N/C +2
(F) 11000 N/C

4) *point charge and closed surface [10 pts.]* A point charge is located at the origin, and a student places a closed surface area around it. Consider the following actions.
(i) Moving the charge to a different position within the surface.
(ii) Moving the charge outside the surface.
(iii) Bringing an additional charge into the vicinity but outside the surface.
(iv) Bringing an additional charge inside the surface.
(v) Bringing two additional charges of equal but opposite magnitude into the surface.
(vi) Contracting the surface area while keeping the charge inside.
Which two of the actions above will affect the net flux through the surface?

(A) (i) and (ii) +5
(B) (iii) and (iv) +5
(C) (v) and (vi)
(D) (i) and (v)
(E) (ii) and (iv) +10
(F) (iii) and (vi)

5) *flux through closed surface [9 pts.]* The electric flux through a closed surface area is found to be -3500 Nm^2/C. The net charge inside the surface is:
   (A) - 31 nC +9
   (B) - 520 nC +2
   (C) - 3.1 μC +4
   (D) 45 μC
   (E) 2.1 mC
   (F) 45 mC
   (G) - 2.1 C +2

6) *electric flux through plate [9 pts.]* Consider a uniform electric field with x-component E_x = 1.2 N/C and z-component E_z = 3.3 N/C. A person places a square plate (side length 0.5m) in the x-y-plane. Calculate the electric flux through the plate.
   (A) 0 +2
   (B) 0.30 Nm^2/C +4
   (C) 0.72 Nm^2/C
   (D) 0.83 Nm^2/C +9
   (E) 0.88 Nm^2/C +3
   (F) 2.6 Nm^2/C
   (G) 7.8 Nm^2/C

7) *Long wire; [9 pts.]* Consider an infinitely long (thin) wire with a charge per unit length of λ = Q/L. Use Gauss' law to determine the magnitude of the electric field for a distance r from the wire. The answer is
   (A) E = k λ / r +5
   (B) E = 2 k λ / r +9
   (C) E = k λ / r^2
   (D) E = 2 k λ / r^2 +4
   (E) E = k λ / 2 r^2
   (F) E = k λ^2 / r^3

8) *Electron in electric potential; [9 pts.]* An electron (charge -e) is at rest in a region of electric potential that varies as a function of position. When released it will move
   (A) into a region of lower potential +3
   (B) into a region of higher potential +9
   (C) along an equi-potential line
   (D) in the direction of the electric field +5

(E) in the direction perpendicular to the electric field
(F) not at all

9) *Hollow sphere; [9 pts.]* A very thin hollow sphere of radius R with uniformly distributed charge Q has an electric field of kQ/r^2 outside and zero inside. Determine the potential at the center of the sphere, normalizing the potential to be zero at infinity.
(A) kQ/R +9
(B) kQ/r +3
(C) 2 kQ /R +3
(D) 0
(E) 2kQ/r
(F) kQR/r^2
(G) $(3-r^3/R^3)$ kQ/R +3

10) *Charged particle vs. electric potential; [9 pts.]* A particle of charge 0.30 C and mass 0.050 kg is moving at a speed of 30 m/s at point A where the electric potential is V_A = 80 V. What is its speed when moving through point B where the potential is V_B = 120 V?
(A) 2.0 m/s
(B) 11 m/s
(C) 14 m/s +3
(D) 20 m/s +9
(E) 22m/s +4
(F) 37 m/s +5
(G) 44 m/s +2

11) *4 charges on a square; [9 pts.]* Four charges of equal magnitude, |q|, are placed on the corners of a square of side length a. The positive charges, q, are on one side and the negative charges, -q, are on the opposite side. The potential energy generated by assembling this configuration is
(A) $U = -2kq^2/a$ +3
(B) $U = -\sqrt{2}kq^2/a$ +9
(C) $U = -kq^2/a$ +1
(D) $U = -kq^2/\sqrt{2}a$ +3
(E) U = 0 +3
(F) $U = +kq^2/\sqrt{2}a$
(G) $U = +kq^2/a$
(H) $U = +k2q^2/a$ +1