OL Academy

# PHYCS102: General Physics II

# Final Exam Revision

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# Outline

- Past exams questions

**1-** A charged particle (charge = $+\boldsymbol{2e}$) is sent at high speed toward a gold nucleus (charge = $+\boldsymbol{76e}$). What is the magnitude of the electrical force (in $\boldsymbol{N}$) acting on the particle when it is $\boldsymbol{2.0 \times 10^{-14}\, m}$ from the gold nucleus?

(a) 91
(b) 90.50
(c) 89.86
(d) 88.70
(e) 87.55

**2-** A rod of length $\boldsymbol{l}$ located along the **x-axis** has a total charge $\boldsymbol{Q}$ and a uniform linear charge density $\boldsymbol{\lambda}$. Which integral correctly describes the electric potential at point **P** located on the **y-axis**, as shown in the figure.

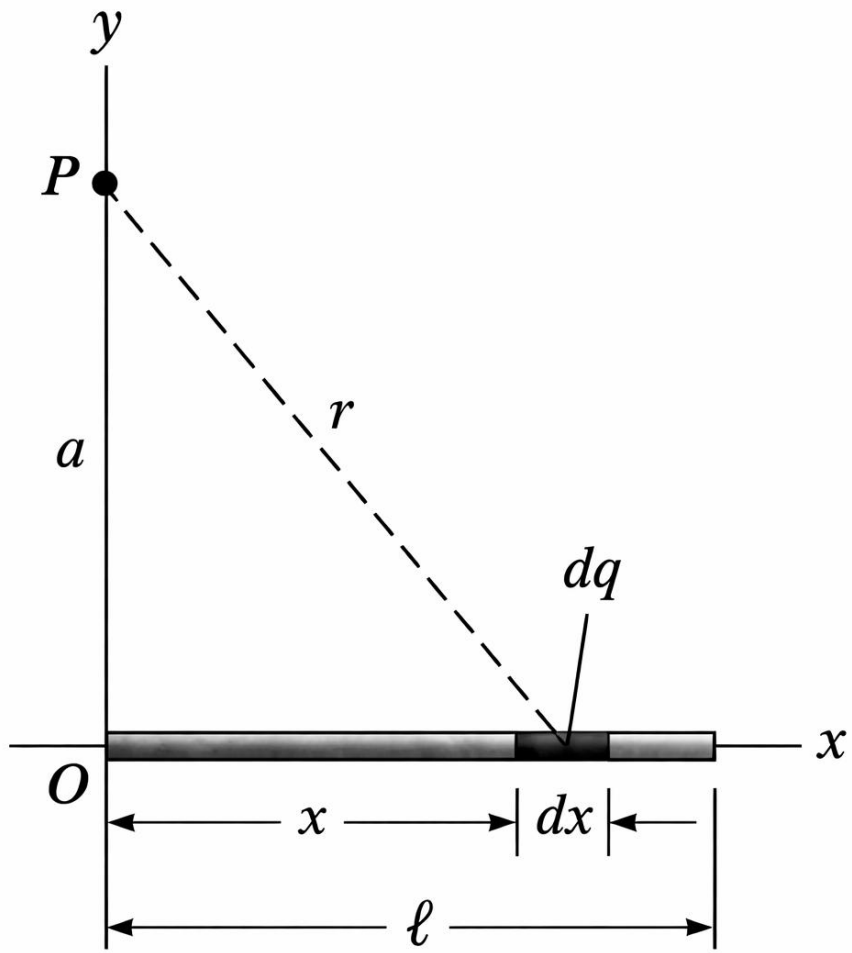
(a) $\int_0^l k \frac{\lambda\, x\, dx}{\sqrt{a^2+x^2}}$

(b) $\int_0^l k \frac{\lambda\, dx}{\sqrt{a^2+x^2}}$

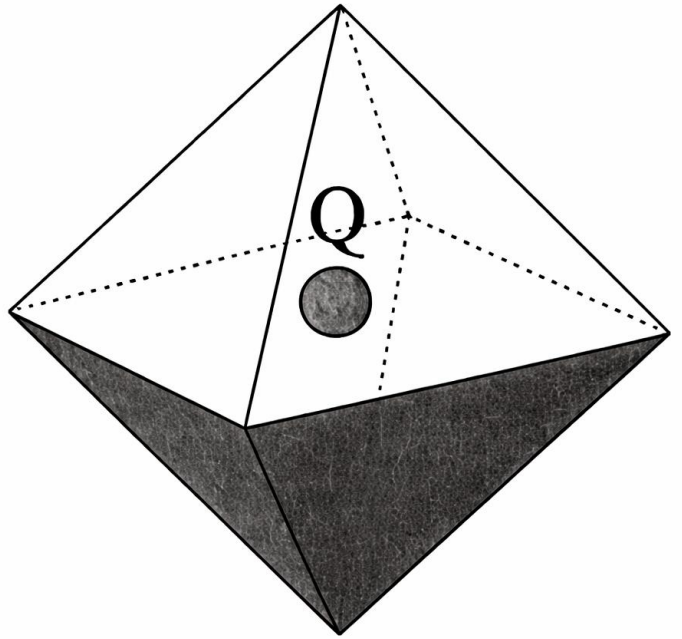
(c) $\int_0^l k \frac{\lambda\, dx}{a^2+x^2}$

(d) $\int_0^l k \frac{\lambda\, dx}{(a^2+x^2)^2}$

(e) $\int_0^l k \frac{\lambda\, x\, dx}{a^2+x^2}$



**3-** A double-pyramid has a square base of side $\boldsymbol{a}$, and **8 faces** which are equilateral triangles. A charge $\boldsymbol{Q}$ is placed at the center of the base of the pyramid. What is the net flux of the electric field emerging from **one of the triangular faces** of the pyramid?




(a) $\frac{Qa^2}{\varepsilon_0}$

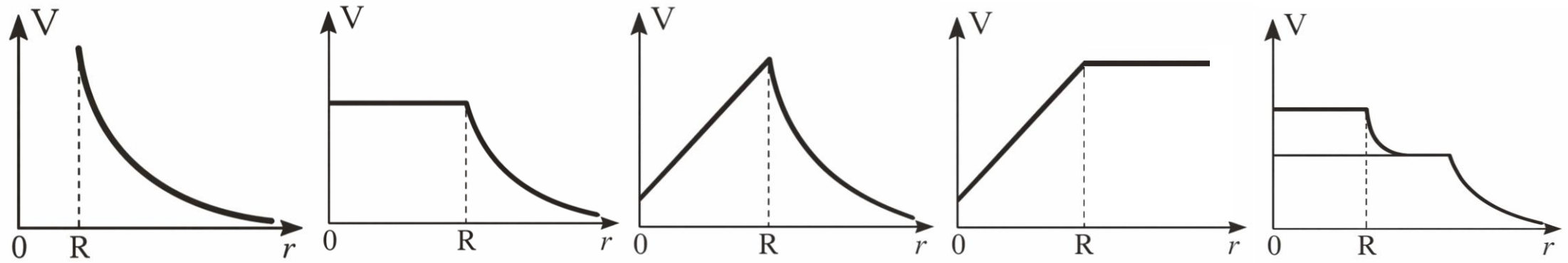
(b) $\frac{Q}{8\varepsilon_0}$

(c) $\frac{Q}{4\varepsilon_0}$

(d) $\frac{Q}{6\varepsilon_0}$

(e) $\frac{Qa^2}{2\varepsilon_0}$

**4-** A conducting charged solid sphere of radius $\boldsymbol{R}$ has a total charge $\boldsymbol{Q}$. The correct variation of electric potential $\boldsymbol{V}$ with the radial distance $\boldsymbol{r}$ is:




(a) (b) (c) (d) (e)

**5-** A copper wire has a cross-sectional area of $\mathbf{3.31 \times 10^{-6}\, m^2}$. If it carries a constant current of $\mathbf{10\, A}$, with an electron density of $\mathbf{8.46 \times 10^{28}\, electrons/m^3}$, then what is the **drift speed of the electrons** in the wire (in $\mu\boldsymbol{m/s}$)?

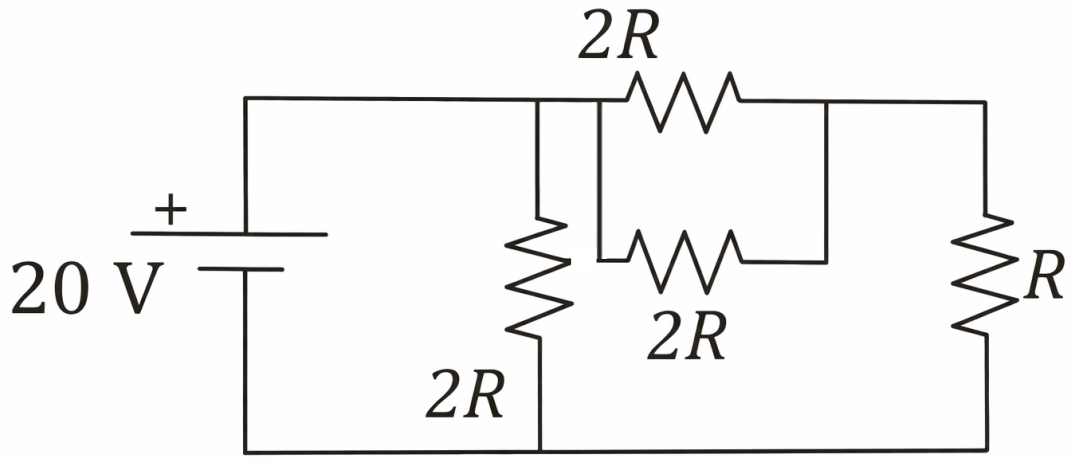
(a) 223
(b) 105
(c) 79
(d) 59
(e) 38

**6-** According to the table shown, which metal is the **worst in terms of electric conductivity**?

| **Metal** | Copper | Gold | Aluminum | Iron | Platinum |
|---|---|---|---|---|---|
| **Resistivity** $(\times \mathbf{10^{-8}}\ \boldsymbol{\Omega \cdot m})$ | 1.7 | 2.44 | 2.82 | 10 | 11 |
| | (a) | (b) | (c) | (d) | (e) |

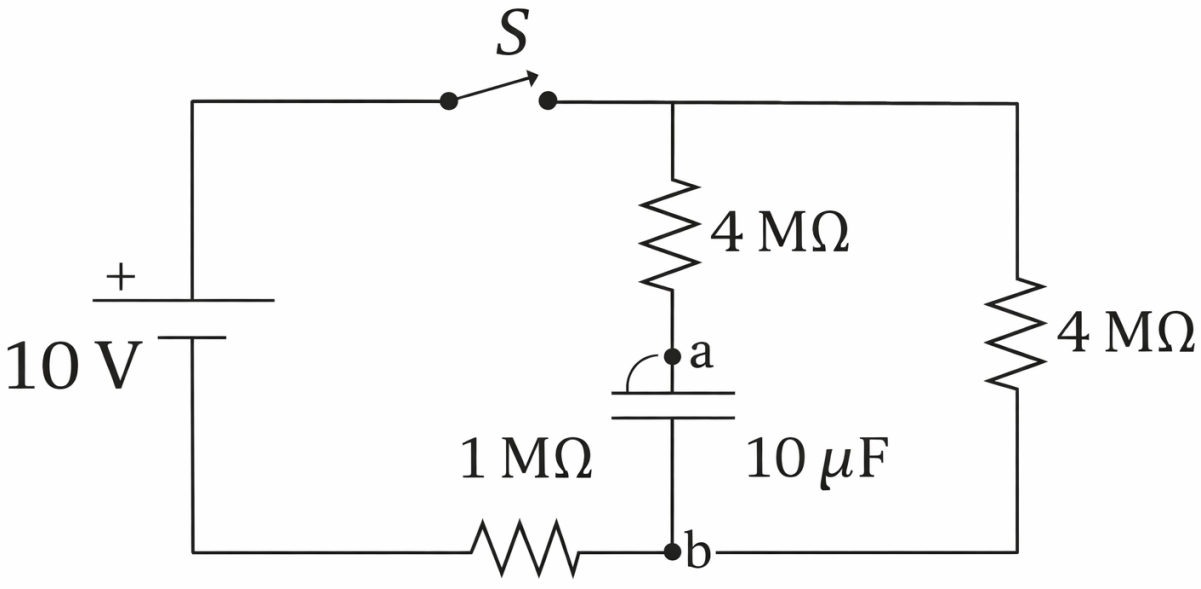
**7-** Find the **total power (in $W$)** delivered by the battery in the following circuit, $\boldsymbol{R = 16\ \Omega}$.

(a) 40
(b) 25
(c) 22.5
(d) 20
(e) 16



**8-** In the circuit shown, switch **S** has been closed for a long time. If the emf $\boldsymbol{\varepsilon = 10\,V}$, then the value of the **energy stored in the capacitor** (in $\mu\boldsymbol{J}$) is:

(a) 320
(b) 365.4
(c) 387.2
(d) 460.8
(e) 540.8



**9-** A charged particle of charge $+\boldsymbol{q}$ moves in a circular path of radius $\boldsymbol{r}$ in a constant magnetic field of strength $\boldsymbol{B}$. If the magnetic field strength is increased to $\boldsymbol{3B}$, the new radius of the circular path that this charge will take is:

(a) $2r$
(b) $3r$
(c) $r/2$
(d) $r/3$
(e) $r$

**10-** In the circuit shown, the **net magnetic field at point P** is:

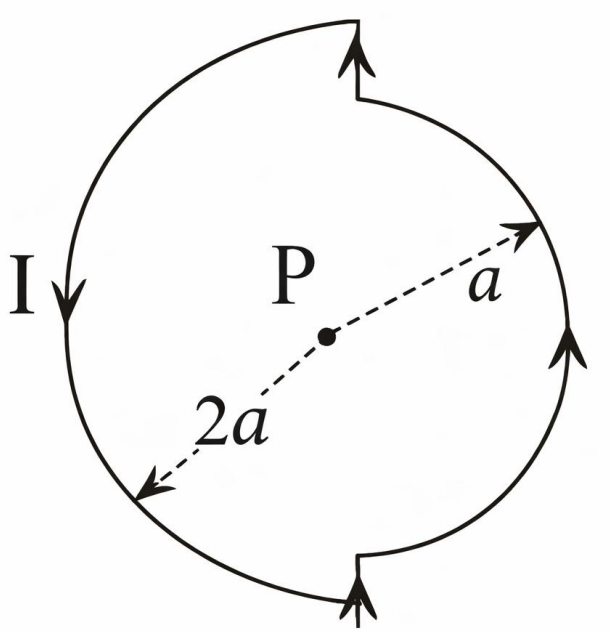
(a) $\frac{3\mu_0 I}{8a}\odot$

(b) $\frac{\mu_0 I}{4a}\otimes$

(c) $\frac{\mu_0 I}{4a}\odot$

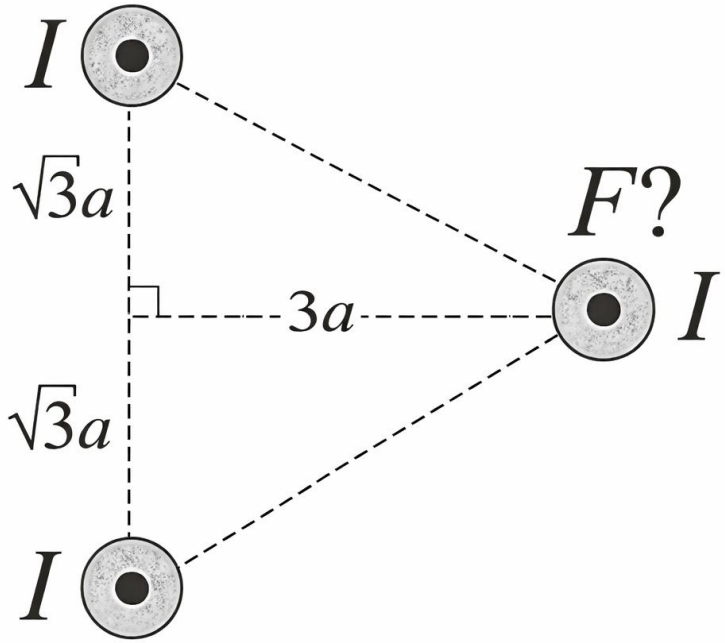
(d) $\frac{3\mu_0 I}{8a}\otimes$

(e) $\frac{\mu_0 I}{8a}\odot$



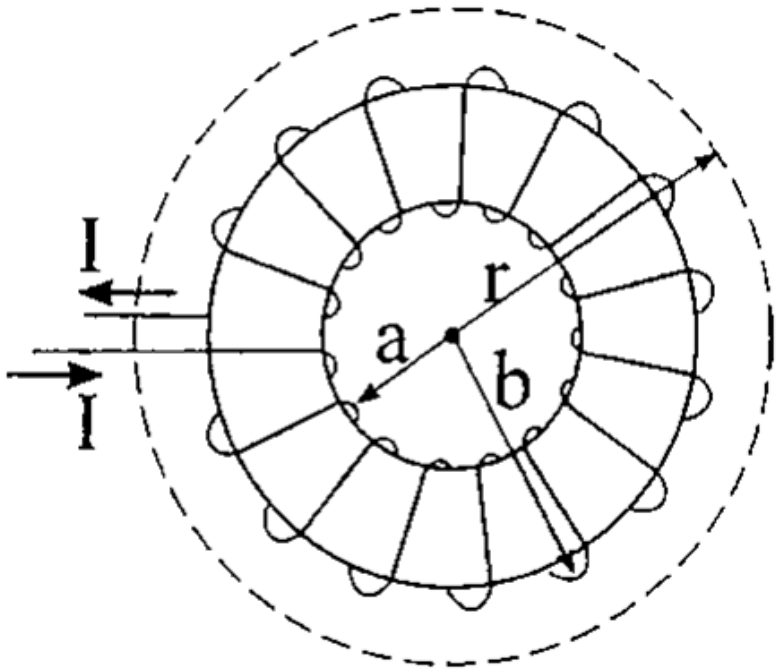
**11-** Three identical long, parallel conductors each carry a current of $\boldsymbol{I = 5\,A}$. The figure shown is an end view of the conductors, with each current coming **out of the page**. Taking the length of the conductors $\boldsymbol{l = 2\,m}$ and $\boldsymbol{a = 1.00\,cm}$, determine the **magnitude of the net force** acting on the conductor at the right.

(a) 5
(b) 20
(c) 32
(d) 45
(e) 80



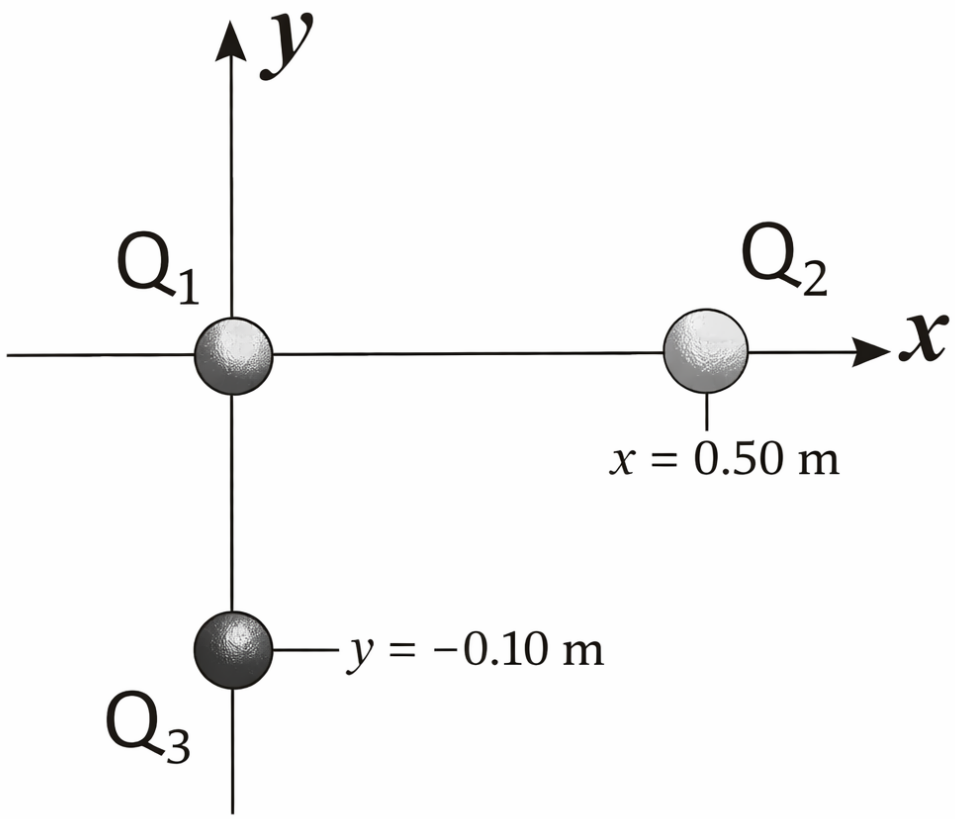
**12-** A toroid has an **inner radius** $a = 9\,cm$ and an **outer radius** $b = 11\,cm$, as shown in the figure. If the toroid consists of $\boldsymbol{100\ turns}$ and carries a current of $\boldsymbol{4\ A}$, then the **magnetic field** (in $\mu T$) at the position $r = 13\,cm$ from its center is:

(a) $400$
(b) $200$
(c) $Zero$
(d) $600$
(e) $None\ of\ the\ above$



**Problem 1:**

Three electric charges, $\boldsymbol{Q_1 = 5\,nC}$, $\boldsymbol{Q_2 = 6\,nC}$, and $\boldsymbol{Q_3 = -3\,nC}$, are arranged as shown in the figure.




Answer the following questions.

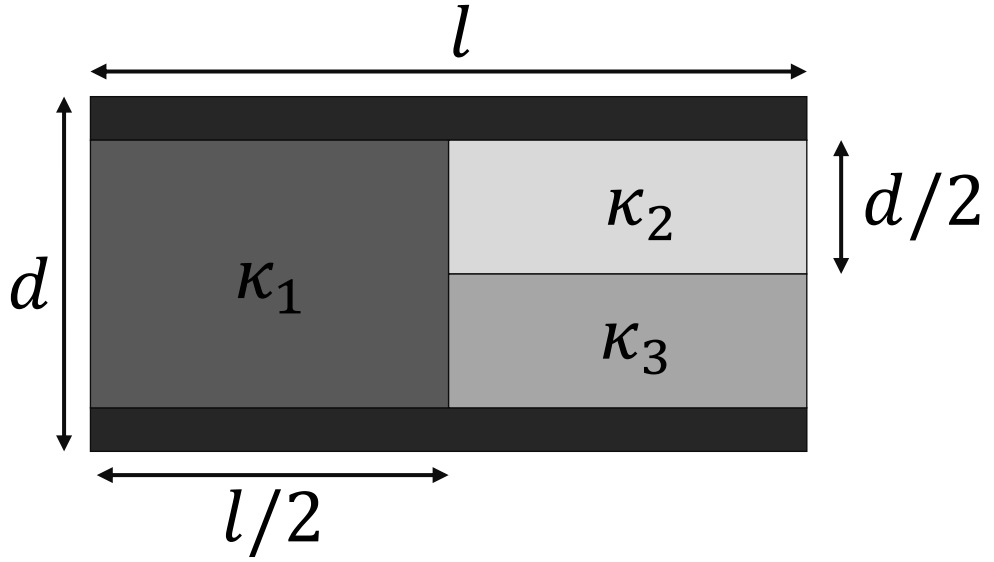
**Q1:** Find the electrostatic force vector on $\boldsymbol{Q_3}$?

**Q2:** Calculate the electric energy of the system.

**Q3:** Calculate the electric potential at the position **(0.5 m, –0.1 m)**.

**Problem 2:**

A parallel-plate capacitor is constructed by filling the space between two square plates with blocks of three dielectric materials, as shown in the figure. Using the values $A = 1.00\ cm^2$, $d = 4.00\ mm$, $\kappa_1 = 4.0$, $\kappa_2 = 6.0$, and $\kappa_3 = 2.0$, answer the following questions:



**Q1:** Find the capacitance of each capacitor after adding the dielectrics, as shown in the figure.

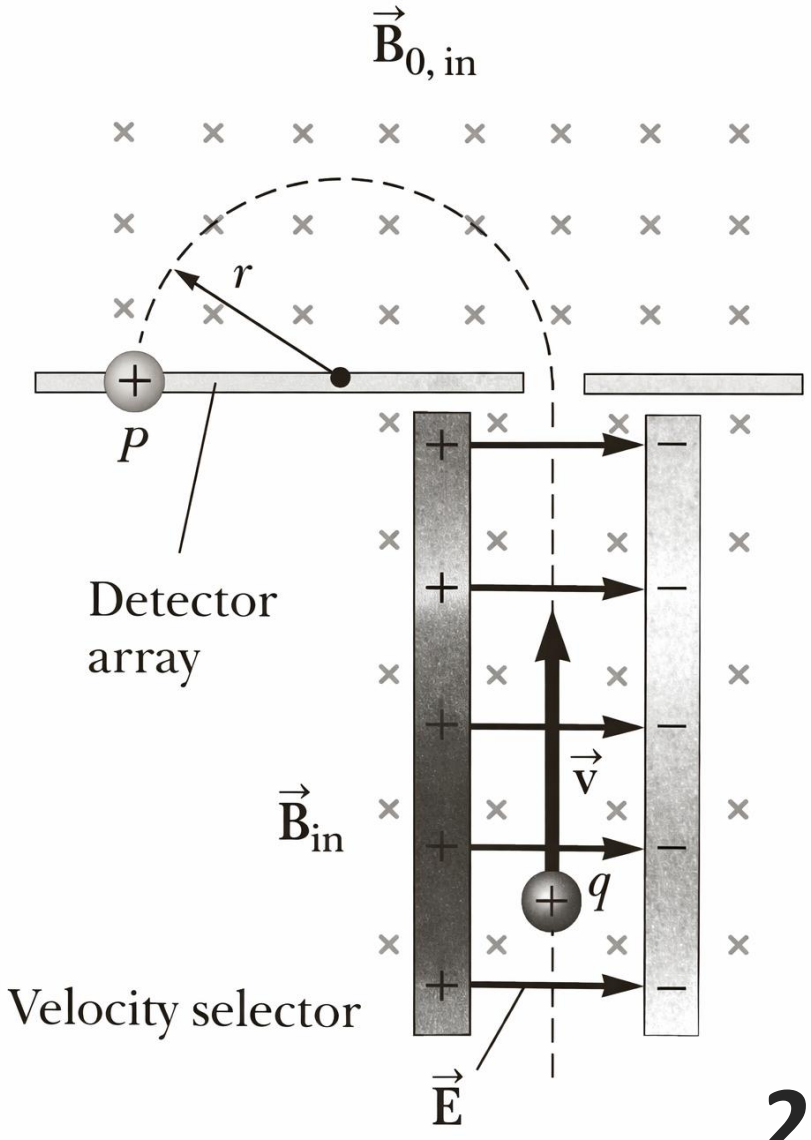
**Q2:** Calculate the equivalent capacitance of the constructed capacitor.

**Q3:** Assuming the constructed capacitor has a capacitance of $\mathbf{150}\ \boldsymbol{pF}$, and a voltage of $\mathbf{20}\ \boldsymbol{V}$ is applied across it, determine the **maximum energy** that can be stored.

**Problem 3: (4 points)**

Consider the mass spectrometer shown schematically in the figure. The magnitude of the electric field between the plates of the velocity selector is $E = 2500\ \mathrm{V/m}$, and the magnetic field in both the velocity selector and the deflection chamber has a magnitude of $B_{in} = B_{0,in} = 0.0350\ T$.

Answer the following questions:



**Q1:** Find the optimal speed of the entering charged particle in the velocity selector chamber?

**Q2:** Determine the kinetic energy of the charged particle.

**Q3:** Calculate the radius $\boldsymbol{r}$ of the path for a **singly charged ion** having a mass $m = 2.18 \times 10^{-26}\ kg$ and exiting the chamber at a speed of $\boldsymbol{70\ km/s}$.

**Q4:** Find the ratio $\boldsymbol{q/m}$ of the particle?

بالتوفيق والنجاح

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