YTU Physics Department 2024-2025 Spring Semester			
FIZ1002 Physics-2 Mid Term-2			
Question Sheet	**AAAAAA**	**07.05.2025 18.30-20.10**	**100 m**

Name	
Surname	
Student No	
Group/Saloon	
Signature	

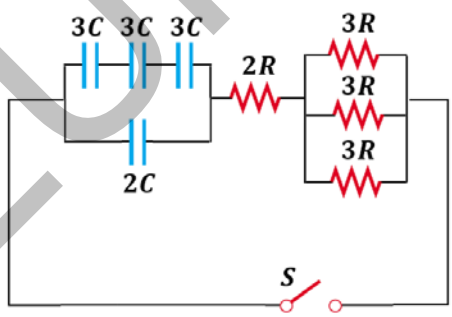
The 9th article of Student Disciplinary Regulations of YÖK Law No.2547 states "**Cheating or helping to cheat or attempt to cheat in exams**" de facto perpetrators take **one or two semesters suspension** penalty. Students are NOT permitted to bring **calculators, mobile phones, smart watches** and/or any other unauthorized **electronic devices** into the exam room.

θ	0^0	30^0	37^0	45^0	53^0	60^0	90^0
sin	0	1/2	3/5	$\sqrt{2}/2$	4/5	$\sqrt{3}/2$	1
cos	1	$\sqrt{3}/2$	4/5	$\sqrt{2}/2$	3/5	1/2	0

$q = 1.6\,10^{-19}C; k = 1/(4\pi\varepsilon_0) \cong 9\,10^9 \frac{Nm^2}{C^2}; \varepsilon_0 \cong 9\,10^{-12}\frac{F}{m}; \pi = 3; ln\left(\frac{1}{2}\right) = -0.69, e^{-0.69} = 2;\ \mu_0 = 12\,10^{-7} Tm/A$

$\vec{F}=k\frac{q_1q_2}{r^2}\hat{r}; \vec{E}=k\frac{q}{r^2}\hat{r}; \Phi_E = \oint \vec{E}\cdot d\vec{A} = \frac{q_{ic}}{\varepsilon_0}; V=k\frac{q}{r}; V_B - V_A = -\int_A^B \vec{E}.d\vec{l}; \tau = RC; V = IR; I = \frac{dq}{dt}; I(t) = I_0\left(1-e^{-t/\tau}\right);$
$q(t) = Q_0\,e^{-t/\tau}; I(t) = I_0\,e^{-t/\tau}; q(t) = Q_0\left(1-e^{-t/\tau}\right); P = IV = I^2R; R = \rho\frac{l}{A}; J = \frac{I}{A}; \sigma = \frac{1}{\rho}; \vec{J} = \sigma\vec{E}; I = nqAv_d;$
$\vec{F}_B = q\vec{v}\times\vec{B}; \vec{F}_r = m\vec{a}_r; a_r = \frac{v^2}{r}; \vec{F}_B = I\vec{l}\times\vec{B}; \vec{F} = q\vec{E} + q\vec{v}\times\vec{B}; \vec{\tau} = \vec{\mu}\times\vec{B}; U = -\vec{\mu}.\vec{B}; d\vec{B} = \frac{\mu_0 I}{4\pi}\frac{d\vec{s}\times\hat{r}}{r^2};$
$\Phi_B = \int \vec{B}\cdot d\vec{A}; B = \mu_0\frac{N}{l}I = \mu_0 nI; \oint \vec{B}\cdot d\vec{l} = \mu_0(I + I_d); I_d = \varepsilon_0\frac{d\Phi_E}{dt}; \vec{\mu} = I\vec{A}; \varepsilon = \oint \vec{E}\cdot d\vec{l} = -\frac{d\Phi_B}{dt}$

Questions 1-3) Four capacitors and four resistors, with $C = 10\ \mu F$ and $R = 1\ M\Omega$, form the RC circuit shown. Initially, the total charge on the capacitors is 600 μC. The switch S is closed at t = 0, and the capacitors begin to discharge.



1. What is the time constant of the circuit in seconds?

A) 90 B) 150 C) 30 D) 10 E) 100

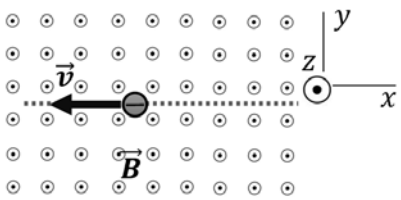
2. How long does it take for the total charge on the capacitors to decrease by half?

A) 103.5 B) 62.1 C) 69 D) 45 E) 20.7

3. What is the current in the circuit in microamperes when the charge has dropped to half of its initial value?

A) 13/5 B) 30 C) 10/3 D) 20 E) 10

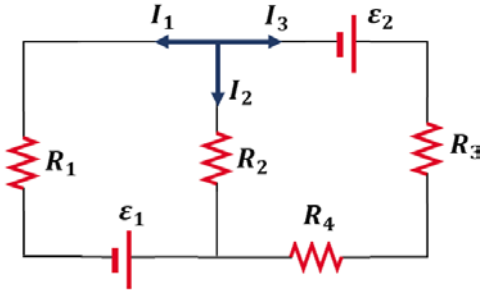
4. An electron moves to the left across the page with a constant velocity $\vec{v}$, passing through a uniform magnetic field $\vec{B}$ directed into the page. What should be the direction of an applied electric field to ensure the electron continues moving in a straight line?



A) $\hat{j}$ B) $-\hat{\imath}$ C) $\hat{k}$ D) $\hat{\imath}$ E) $-\hat{j}$

Questions 5-6) The circuit shown consists of $R_1 = R_3 = 1\Omega, R_2 = R_4 = 2\Omega, \varepsilon_1 = 5\,V, \varepsilon_2 = 10\,V$

5. Which of the following gives the correct values of currents $(I_1; I_2; I_3)$ in Amperes?



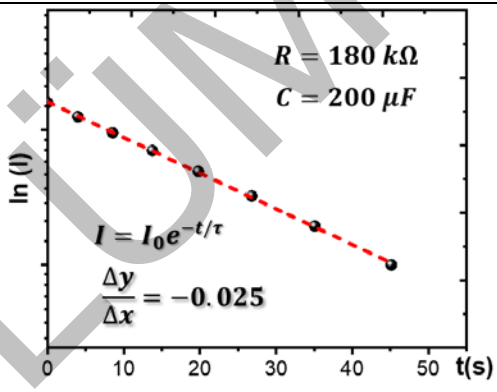
A) $-\frac{5}{11}; -\frac{20}{11}; \frac{25}{11}$ B) $\frac{5}{11}; -\frac{25}{11}; \frac{20}{11}$

C) $\frac{25}{11}; -\frac{5}{11}; -\frac{20}{11}$ D) $\frac{15}{11}; -\frac{25}{11}; \frac{10}{11}$ E) $\frac{20}{11}; -\frac{25}{11}; \frac{5}{11}$

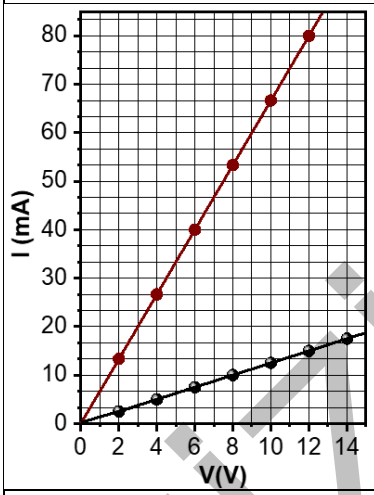
6. What is the ratio of the power dissipated in R_1 to that in R_3 (P_{R1}/P_{R3})?

A) 45/2 B) 16/125 C) 4/9 D) 25/2 E) 1/16

7. An RC circuit used in a capacitor charging experiment; experimental information, current-time graph, and the slope of the graph is given as shown. Which of the following statements is correct?



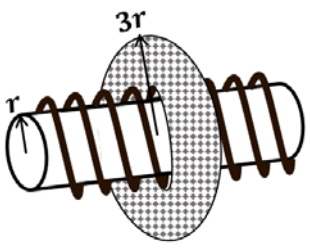
A) The theoretical time constant of the circuit is 9 s.
B) The relative error in the experiment is 0.2.
C) If 2R and C/4 are used the time constant doubles.
D) The absolute error in the experiment is 4 s.
E) The current through the circuit is determined by the $V_{Capacitor}/R$



8. Two unknown resistors were connected both in series and in parallel, and their current-voltage characteristics were measured. Based on the $I = f(V)$ graphs provided, which pair of resistors was used in the experiment?

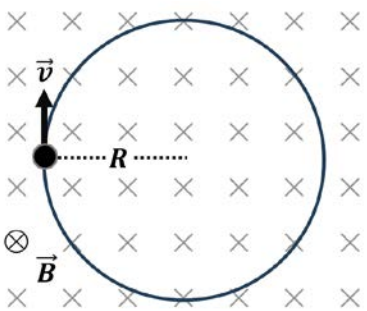
A) 300 Ω, 500 Ω
B) 600 Ω, 1200 Ω
C) 200 Ω, 600 Ω
D) 150 Ω, 800 Ω
E) 400 Ω, 600 Ω

9. A cylindrical solenoid with a radius of $r = 1\ cm$ and a length of 15 cm has 900 turns. If a current of 1 A flows through the solenoid, what is the magnetic flux in Wb through a disk of radius 3 cm placed perpendicular to the solenoid's axis?



A) $6.48\ 10^{-6}$ B) $19.4\ 10^{-6}$ C) $7.2\ 10^{-6}$ D) $2.16\ 10^{-6}$ E) $2.82\ 10^{-6}$

Questions 10-11) An experiment observing the motion of a charged particle, the particle moves in a clockwise circular path within a uniform magnetic field that is directed into the page as shown. If the period of the particle's motion is $4\ 10^{-7} s$ and the magnetic field in the experimental setup is $0.5\ T$.



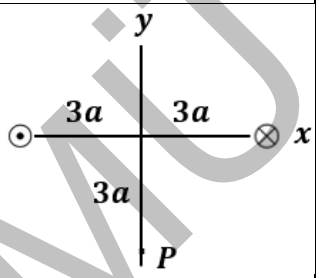
10. What is the particle's charge-to-mass ratio (q/m) in units of C/kg?

A) $2\ 10^7$ B) $-3\ 10^7$ C) $3\ 10^7$ D) $6\ 10^7$ E) $-2\ 10^7$

11. If the radius of the particle's orbit is $0.2\ m$, what is its speed in SI units?

A) $1\ 10^6$ B) $3\ 10^6$ C) $2\ 10^6$ D) $6\ 10^6$ E) $4\ 10^6$

Questions 12-13) Two infinitely long wires carrying current I in opposite directions are placed perpendicular to the $xy-$ plane as shown.



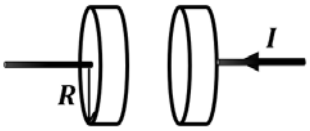
12. What is the net magnetic field vector at point P, in T?

A) $\frac{\mu_0 I}{18a}\hat{\jmath}$ B) $-\frac{\mu_0 I}{9a}\hat{\jmath}$ C) $\frac{\mu_0 I}{9a}\hat{\jmath}$ D) $\frac{\mu_0 I}{18a}\hat{\imath}$ E) $-\frac{\mu_0 I}{27a}\hat{\imath}$

13. If a particle with charge $+q$ passes through P with a velocity $\vec{v} = v(3\hat{\imath} - 4\hat{k})$ what is the magnetic force on the charge, expressed in terms of "$(vq\mu_0 I)/a$" ?

A) $\left(-\frac{4}{9}\hat{\imath} + \frac{1}{6}\hat{k}\right)$ B) $\left(\frac{2}{9}\hat{\imath} + \frac{1}{12}\hat{k}\right)$ C) $\left(\frac{2}{9}\hat{\imath} - \frac{1}{6}\hat{k}\right)$ D) $\left(-\frac{2}{9}\hat{\imath} + \frac{1}{6}\hat{k}\right)$ E) $\left(\frac{2}{9}\hat{\imath} + \frac{1}{6}\hat{k}\right)$

Questions 14-15)
A parallel plate capacitor with air between the plates has circular plates of radius 4 cm. At a certain moment, the current in the connecting wire is 0.48 A. Assume vacuum permittivity and permeability are given as ε_0 and μ_0.



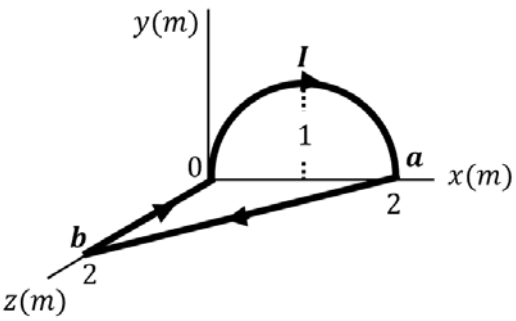
14. What is the displacement current density between the plates in A/m^2?

A) $4\ 10^2$ B) 10^2 C) 10^4 D) $4\ 10^3$ E) $2.5\ 10^3$

15. What is the magnetic field induced at a distance of 1 cm from the axis between the plates in T?

A) $6\ 10^{-7}$ B) $24\ 10^{-7}$ C) $12\ 10^{-7}$ D) $2\ 10^{-7}$ E) $3\ 10^{-7}$

Questions 16-18) A closed current loop carrying $I = 2\ A$ is placed in a magnetic field $\vec{B} = 2\hat{\imath} - 3\hat{\jmath} + \hat{k}\ (T)$. Neglect the magnetic field produced by the loop itself.



16. What is the magnetic dipole moment vector of the loop in Am^2?

A) $4\hat{\jmath} + 3\hat{k}$ B) $8\hat{\jmath} + 6\hat{k}$ C) $-4\hat{\jmath} + 12\hat{k}$
D) $-8\hat{\jmath} + 6\hat{k}$ E) $-4\hat{\jmath} - 3\hat{k}$

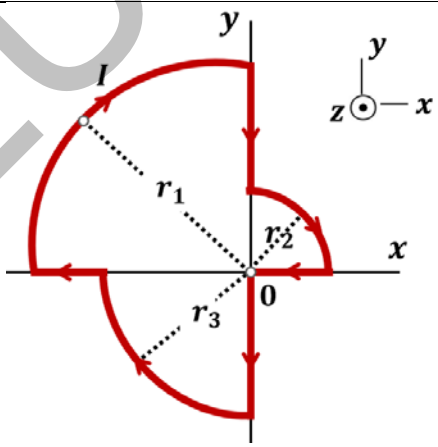
17. What is the torque acting on the current loop in Nm?

A) $26\hat{\imath} - 12\hat{\jmath} - 16\hat{k}$ B) $10\hat{\imath} - 12\hat{\jmath} - 16\hat{k}$ C) $13\hat{\imath} + 6\hat{\jmath} - 8\hat{k}$ D) $10\hat{\imath} + 12\hat{\jmath} + 16\hat{k}$ E) $-13\hat{\imath} - 6\hat{\jmath} + 8\hat{k}$

18. What is the magnetic force vector acting on the $a - b$ segment of the wire in N?

A) $12(\hat{\imath} + \hat{k})$
B) $12(\hat{\imath} + \hat{\jmath} + \hat{k})$
C) $2(3\hat{\imath} - 3\hat{\jmath} - 2\hat{k})$
D) $12(\hat{\imath} - \hat{k})$
E) $6\hat{\imath} - 12\hat{\jmath} - 6\hat{k}$

Questions 19-20)
The current-carrying wire shown is composed of three quarter-circles with different radii and straight segments. The current is steady at 4 A, with; $r_1 = 6\ cm$, $r_2 = 2.5\ cm$ and $r_3 = 5\ cm$.



19. What is the magnetic field at the origin due to the quarter-circle of radius r_1, in T?

A) $-7.5\ 10^{-6}\ \hat{k}$
B) $12\ 10^{-6}\ \hat{k}$
C) $-10\ 10^{-6}\ \hat{k}$
D) $-32\ 10^{-6}\ \hat{k}$
E) $18\ 10^{-6}\ \hat{k}$

20. What is the total magnetic field vector at the origin in T?

A) $22\ 10^{-6}\ \hat{k}$ B) $46\ 10^{-6}\hat{k}$ C) $-46\ 10^{-6}\ \hat{k}$ D) $-36\ 10^{-6}\ \hat{k}$ E) $36\ 10^{-6}\ \hat{k}$