YTU Physics Department 2025-2026 Spring Semester			
FIZ1002 Physics-2 Final			
Question Sheet	**A**	**18.06.2026 11.00-13.00**	**100 min**

Name		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.
Surname		
Student No		
Group/Saloon		
Signature		

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

$k = \frac{1}{4\pi\varepsilon_0} \cong 9\ 10^9 \frac{Nm^2}{C^2}$; $\varepsilon_0 \cong 9 \frac{10^{-12}F}{m}$; $e^{0.69} = 2$; $\mu_0 = 12 \frac{10^{-7}Tm}{A}$

$q = 1.6\ 10^{-19}C$; $ln\left(\frac{1}{2}\right) = -0.69$; $g = 10 \frac{m}{s^2}, \pi = 3$

$\vec{E} = k\int \frac{dq}{r^2}\hat{r}$; $V = k\int \frac{dq}{r}$; $\Delta U = q\Delta V$; $\lambda = \frac{Q}{L} = \frac{dq}{dl}$; $\sigma = \frac{Q}{A} = \frac{dq}{dA}$; $\rho = \frac{Q}{V} = \frac{dq}{dV}$; $\phi_E = \int \vec{E}.d\vec{A}$; $V_B - V_A = -\int_A^B \vec{E}.d\vec{l}$; $\oint \vec{E}.d\vec{A} = \frac{Q_{in}}{\varepsilon_0}$;

$|\Delta V| = Ed$; $E_y = \frac{\sigma}{2\varepsilon_0}$; $E_i = \frac{\sigma}{\varepsilon_0}$; $p = aq$; $\vec{\tau} = \vec{p} \times \vec{E}$; $U = -\vec{p}.\vec{E}$; $C = \frac{|Q|}{|\Delta V|}$; $C = \frac{\varepsilon_0 A}{d}$; $U = \frac{1}{2}CV^2$; $\frac{1}{C_{eq}} = \sum_i \frac{1}{C_i}$; $C_{eq} = \sum_i C_i$; $C = \kappa C_0$

$V = \frac{V_0}{\kappa}$; $E = \frac{E_0}{\kappa}$; $U = \frac{U_0}{\kappa}$; $W = \int \vec{F}.d\vec{r}$; $W = -\Delta U$; $I = \frac{dq}{dt}$; $I = nqv_dA$; $R = \rho\frac{\ell}{A}$; $\vec{J} = \sigma\vec{E}$; $R = \frac{\Delta V}{I}$; $\sigma = \frac{1}{\rho}$; $J = \frac{I}{A}$; $\tau = RC$; $V = IR$; $I = \frac{dq}{dt}$

$I(t) = I_0\left(1 - e^{-t/\tau}\right)$; $q(t) = Q_0 e^{-t/\tau}$; $I(t) = I_0 e^{-t/\tau}$; $q(t) = Q_0\left(1 - e^{-t/\tau}\right)$; $P = IV = I^2R$; $\vec{F}_B = q\vec{v} \times \vec{B}$; $\vec{F}_B = I\vec{l} \times \vec{B}$; $\vec{\tau} = \vec{\mu} \times \vec{B}$

$\vec{F} = q\vec{E} + q\vec{v} \times \vec{B}$; $U = -\vec{\mu}.\vec{B}$; $d\vec{B} = \frac{\mu_0 I}{4\pi}\frac{d\vec{s}\times\hat{r}}{r^2}$; $\Phi_B = \int \vec{B}\cdot d\vec{A}$; $B = \mu_0 \frac{N}{l} I = \mu_0 nI$; $\oint \vec{B}\cdot d\vec{l} = \mu_0(I + I_d)$; $I_d = \varepsilon_0 \frac{d\phi_E}{dt}$; $\vec{\mu} = I\vec{A}$; $B = \mu_0 nI$

$\varepsilon = \oint \vec{E}\cdot d\vec{l} = -\frac{d\phi_B}{dt}$; $\varepsilon_L = -N\frac{d\Phi_B}{dt} = -L\frac{dI}{dt}$; $I_{rms} = \frac{I_{max}}{\sqrt{2}}$; $\Delta V_{rms} = \frac{\Delta V_{max}}{\sqrt{2}}$; $X_L = Lw$; $X_C = \frac{1}{Cw}$; $tg\phi = \left(\frac{X_L - X_C}{R}\right)$; $I_{max} = \frac{\Delta V_{max}}{Z}$

$w = \frac{1}{\sqrt{LC}}$; $Z = \sqrt{R^2 + (X_L - X_C)^2}$; $< p > = I_{rms}\Delta V_{rms}\cos(\phi)$; $\Delta v_R = \Delta V_R \sin(wt)$; $\Delta v_C = \Delta V_C \sin\left(wt - \frac{\pi}{2}\right)$; $\Delta v_L = \Delta V_L \sin\left(wt + \frac{\pi}{2}\right)$

$\Delta V_L = I_{max}X_L$; $\Delta V_C = I_{max}X_C$; $\Delta V_R = I_{max}R$; $\omega_0 = \frac{1}{\sqrt{LC}}$; $\tau = \frac{L}{R}$; $I = \frac{\varepsilon}{R}\left(1 - e^{-\frac{R}{L}t}\right)$; $I = \frac{\varepsilon}{R}e^{-\frac{t}{\tau}}$; $U_L = \frac{1}{2}LI^2$; $u_B = \frac{1}{2}\left(\frac{B^2}{\mu_0}\right)$; $M_{12} = N_2\frac{\Phi_{12}}{I_1}$

$\varepsilon_1 = -M\frac{dI_2}{dt}$; $\varepsilon_2 = -M\frac{dI_1}{dt}$; $U_C = \frac{Q^2}{2C}$; $Q = Q_{max}\cos(\omega t + \varphi)$; $I_{max} = \omega Q_{max}$; $\varepsilon_{ind} = -Bl\frac{dx}{dt} = -Blv$; $P = F_{app}v$; $\Delta V_2 = \frac{N_2}{N_1}\Delta V_1$

1. A conducting bar of length L rotates with a constant angular speed ω about a pivot at one end. A uniform magnetic field B is directed perpendicular to the plane of rotation. Find the motional emk induced between the ends of the bar?

A) ωBL B) $2\omega BL$ C) ωBL^2 D) $\frac{1}{2}\omega BL^2$ E) 0

2) The number of turns in a solenoid is doubled, and its length is halved. How does its magnetic field change?

A) it triples. B) it is halved. C) it quadruples. D) it doubles. E) it remains unchanged.

Q(3-4). A long solenoid of radius R has n turns of wire per unit length and carries a time-varying current that varies sinusoidal as $I = I_{max}\cos\omega t$, where I_{max} is the maximum current and ω is the angular frequency of the alternating current source.

3) Determine the magnitude of the induced electric field outside the solenoid at a distance $r > R$ from its long central axis?

A) $\frac{\mu_0\ n\omega R^2}{2} I_{max}\sin(\omega t)$ B) $\frac{\mu_0\ n\omega R^2}{2r} I_{max}\sin(\omega t)$ C) $\frac{\mu_0\ nR^2}{r} I_{max}\omega\sin(\omega t)$

D) $\frac{\mu_0\ n\omega R^2}{2r^2} I_{max}\sin(\omega t)$ E) $\frac{\mu_0\ nR}{2r} I_{max}\omega\sin(\omega t)$

4) What is the magnitude of the induced electric field inside the solenoid, a distance r from its axis?

A) $\frac{\mu_0\ nr}{2} I_{max}\omega \sin(\omega t)$ B) $\frac{\mu_0\ nR^2}{2r^2} I_{max}\omega \sin(\omega t)$ C) $\frac{\mu_0\ nR^2}{4r} I_{max}\omega \sin(\omega t)$
D) $\frac{\mu_0\ nr^2}{2} I_{max}\omega \sin(\omega t)$ E) $\frac{\mu_0\ nr}{4} I_{max}\omega \sin(\omega t)$

Q(5-6) The charge density of a spherical distribution is given as $\rho = \rho_0 \frac{r}{R}$ where R is the radius and r is the position with respect to the origin of the sphere.

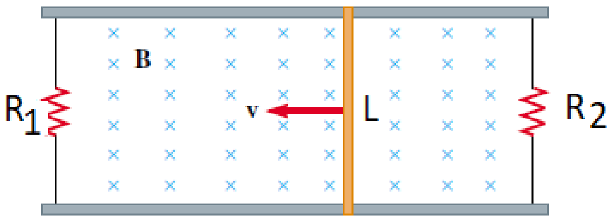
5) What is the total charge of the sphere?

A) $\pi\rho_0 R^2$ B) $4\pi\rho_0 R^3$ C) $2\pi\rho_0 R^3$ D) $\frac{1}{4}\pi\rho_0 R^3$ E) $\pi\rho_0 R^3$

6). What is the magnitude of the electric field of this charge distribution at $r = \frac{R}{2}$?

A) $\frac{\rho_0}{16\varepsilon_0} R$ B) $\frac{\rho_0}{32\varepsilon_0} R$ C) $\frac{\rho_0}{4\varepsilon_0} R$ D) $\frac{\rho_0}{64\varepsilon_0} R$ E) $\frac{\rho_0}{8\varepsilon_0} R$

Q(7-9) A conducting rod of length L is free to slide on two parallel conducting bars as shown. Two resistors $R_1 = 2R$ and $R_2 = R$ are connected across the ends of the bars to form a loop. A constant magnetic field B is directed perpendicularly into the page. An external agent pulls the rod to the left with a constant speed of v. Find



7) The ratio of the magnitude of currents in R_1 and R_2 resistors respectively, $\frac{I_1}{I_2}$=?

A) 4 B) 2 C) ¼ D) ½ E) 1

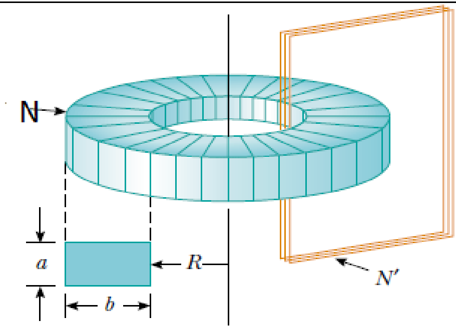
8) The magnitude and direction of the current passing through the conducting rod.

A) $\frac{3vLB}{2R}$, ↑ B) $\frac{3vLB}{R}$, ↑ C) $\frac{3vLB}{2R}$, ↓ D) $\frac{vLB}{2R}$, ↓ E) $\frac{vLB}{2R}$, ↑

9) The magnitude of the applied force that is needed to move the rod with this constant velocity.

A) $\frac{vL^2 B^2}{R}$ B) $\frac{3vL^2 B^2}{2R}$ C) $\frac{vL^2 B^2}{2R}$ D) $\frac{vL^2 B^2}{4R}$ E) $\frac{2vL^2 B^2}{3R}$

Q(10-12) A toroid having a rectangular cros section with sides a and b and inner radius R consists of N turns of wire that carries a direct current I. A coil that consists of N' turns of wire links with the toroid, as in the Figure.



10) Determine the emk induced in the coil.

A) $\frac{N\mu_0}{2\pi} a ln(1+\frac{b}{R})$ B) $\frac{N\mu_0}{2\pi} a$ C) $\frac{N\mu_0}{2\pi} I$ D) $\frac{N\mu_0}{2\pi} aI$ E) 0

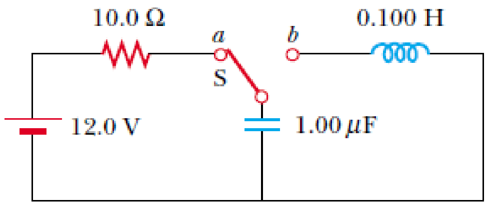
11) Calculate the magnetic field inside the toroid.

A) $\frac{\mu_0 IN}{4\pi r}$ B) $\frac{\mu_0 IN}{6\pi r}$ C) $\frac{\mu_0 IN}{2\pi(R+b)}$ D) $\frac{\mu_0 IN}{\pi(R+b)}$ E) $\frac{\mu_0 IN}{2\pi r}$

12) Calculate the inductance of the toroid.

A) $\frac{N^2\mu_0 a}{2\pi} ln(\frac{b+R}{R})$ B) $\frac{N\mu_0 a}{2\pi} ln(\frac{b+R}{2R})$ C) $\frac{N^2\mu_0 a}{\pi} ln(\frac{b+R}{R})$ D) $\frac{N^2\mu_0 a}{2\pi} ln(\frac{b+2R}{2R})$ E) $\frac{N\mu_0 a}{4\pi} ln(\frac{b+R}{R})$

Q(13-15) The switch in the Figure is connected to point *a* for a long time. After the switch is thrown to point *b* at t=0, what are



13) The angular frequency of oscillation of the *LC* circuit in unite krad/s?

A) 10 B) 12 C) $\sqrt{12}$ D) $\sqrt{10}$ E) $\sqrt{20}$

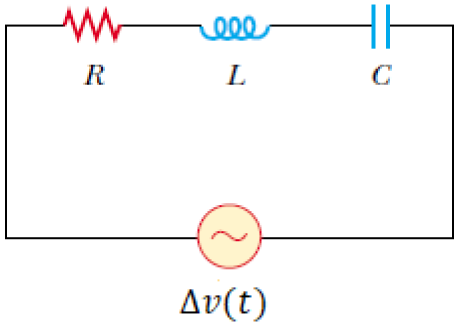
14) The charge on the capacitor in unite μC respectively at time t?

A) $12Sin(1000\sqrt{10}\,t)$ B) $1.2Sin(1000\sqrt{10}\,t)$ C) $12cos(1000\sqrt{10}\,t)$ D) $12Sin(10\,t)$ E) $120\cos(\sqrt{10}t)$

15) The total energy in unite μJ the circuit possesses at t =3.00 s?

A) 54 B) 72 C) 144 D) 49 E) 84

Q(16-18) A sinusoidal voltage $\Delta v = (40.0V)\sin(100t)$ is applied to a series RLC circuit with L = 60 mH, C =100.0 µF, and R= 50.0 Ω.



16) What is the impedance of the circuit?

A) $\sqrt{11736}$ B) $\sqrt{11336}$ C) $\sqrt{12986}$ D) $\sqrt{14986}$ E) $\sqrt{8986}$

17) What is the maximum current?

A) $\frac{40}{\sqrt{11336}}$ B) $\frac{40}{\sqrt{11986}}$ C) $\frac{40}{\sqrt{12986}}$ D) $\frac{40}{\sqrt{14986}}$ E) $\frac{20}{\sqrt{11986}}$

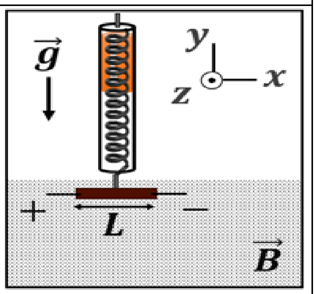
18) What is the phase angle between the current and the applied voltage?

A) $tan^{-1}(\frac{-6}{5})$ B) $tan^{-1}(\frac{-9.4}{5})$ C) $tan^{-1}(\frac{-12.6}{5})$ D) $tan^{-1}(\frac{-6.6}{5})$ E) $tan^{-1}(\frac{-11.6}{5})$

19) **Laboratory Question** To determine $\frac{e}{m}$ ratio, electrons are accelerated by an accelerating voltage V and enter a magnetic field B created by Helmholtz coils at right angles to the direction of motion. The ratio is determined from the accelerating voltage, the magnetic field strength and the radius of the electron orbit. Based on this information, Which of the following is wrong?

A) If the current in Helmholtz coils are increased, the magnitude of B increases
B) If the currents direction in the coils are reversed, the bending direction of electron are also reversed.
C) To determine the e/m ratio, the current in the coils must flow counterclockwise.
D) The magnitude of V is proportional to the kinetic energy of the beam.
E) The magnitude of V affects the radius of the electron trajectory.

20) **Laboratory Question** A conducting rod of length **L = 15 cm** is placed perpendicular to a uniform magnetic field **B = 0.5 $\hat{k}$ T** located in the shaded region of the **xy-plane**. The conducting rod is vertically attached to the end of a dynamometer and is connected horizontally to a battery and an ammeter through massless wires. A constant current of magnitude I flows through the conducting rod, whose mass is neglected. According to the analysis carried out by a researcher using this experimental setup, in which the current flows from left to right, which of the following statements is **incorrect?**



A) The conducting rod moves downward.
B) If a current of 2 A passes through the wire, the magnitude of the magnetic force acting on the wire is 0.15 N.
C) If both the direction of the magnetic field and the direction of the current are reversed, the direction of the force acting on the wire does not change.
D) If the length of the conducting rod is increased, the magnitude of the magnetic force does not change.
E) If the magnitude of the magnetic field is doubled, the magnitude of the magnetic force also doubles.