PHYS 223 University Physics III	TRADES	98
Exam 5 April 19, 2023		ac ac
Name T.C. DALY		90
1. A motor connected to a 120 V rms ac line is equivalent to a	15 $\Omega$ resistance and a	$2.0 \Omega$ indu

- A motor connected to a 120 V rms ac line is equivalent to a 15 Ω resistance and a 2.0 Ω inductive reactance in series. Calculate
  - a. the impedance of the motor \_\_\_\_\_\_\_
  - b. and the average rate at which energy is supplied to the motor.



 $3j^{2}z^{2}$   $Z = 15 + 2j^{2}$  $= \sqrt{15^{2} + 4} \sqrt{4an^{2}(\frac{2}{15})}$ 2= 15.13 23.810



## PHYS 223 University Physics III Exam 5

- 2. A metal rod is forced to move with constant velocity V along two parallel metal rails, connected by a resistor as shown in Fig. 2.. A magnetic field of magnitude B = 0.450 T points into the paper.
  - a. If the rails are separated by L = 1.20 m and the speed of the rod is 55.0 cm/s, what emf is generated?
  - b. if the resistance has a value of 20.0  $\Omega$  and the rails and the rod have neglible resistance, what is the current in the rod?

E: Fe BL HE BLN

a) Z= 0.45 × 1.2× 0.55 = 0,297 V

6) I = = = = = 0,297 = 14,85 mA

() F= ILXB = ILB= 0,014854 1,24 0,45

F= 0.00802 N= 8.02 MN

Space the Flux is increasing mits the page, a current is induced to produce

a flor out of the page. I is up through

BINTS the Pase

AILUP IL + B is Totte Left

the Applied Force

COUNTERS This For

X

X

X

X

L = 1.20 m

X

X

X

Х

X

X

14. 85 MA

Figure 2

X

X

X

B

S.OZMN

AREA= LX

X

X

 $R \gtrsim$ 

X

X

X

- c. What force is required to maintain the constant speed?

Q= BLY

the rod.

## **Problem 4 Solution**

Write Maxwell's four equations,

- 1. What is each equation called?
- 2. Write each equation in English words,
- 3. and in integral form

1.

- a. Gauss' Law
- b. The electric flux through a closed surface is equal to the charge enclosed within the surface divided by the permittivity of free space.

$$\oint E \cdot ds = \frac{1}{\epsilon_o} \int \rho dv$$

2.

c.

c.

- a. Gauss' Law for magnetic fields
- b. The magnetic flux through a closed surface is equal to zero

$$\oint B \cdot ds = 0$$

3.

- a. Faraday's Law
- b. The emf induced in a closed loop is equal to the negative of the rate of change of the magnetic flux passing through the loop.

$$\oint E \cdot dl = -\frac{\partial}{\partial t} \int B \cdot ds$$

4.

- a. Ampere's Law
- b. The integral of the magnetic field around a closed loop is equal to the current flowing through the loop and the displacement current flowing through the loop multiplied by the permeability of free space.

$$\oint B \cdot dl = \mu_o \int \left( J + \epsilon_o \frac{\partial E}{\partial t} \right) \cdot ds$$

## **Physical Constants**

Constant	Symbol	Magnitude
Avogadro's Number	N <sub>A</sub>	6.022 x 10 <sup>23</sup> molecules/mole
Boltzmann's constant	k	1.38 x 10 <sup>-23</sup> J/K = 8.62 x 10 <sup>-5</sup> eV/K
Stefan-Boltzmann constant	σ	5.67x10 <sup>-8</sup> J/(s*m <sup>2</sup> *K <sup>4</sup> )
Electronic charge	q	1.6 x 10 <sup>-19</sup> C
Electronvolt	eV	1.6 x 10 <sup>-19</sup> J
Planks constant	h	6.625 x 10 <sup>-34</sup> J-s
Thermal voltage, kT, at 300 <sup>o</sup> K	Vt	25.8 mV
Velocity of light	С	3 x 10 <sup>8</sup> m/s
Permeability of free space	u <sub>o</sub>	1.257 x 10 <sup>-6</sup> H/m
Permittivity of free space	<sup>3</sup> ع	8.854 x 10 <sup>-12</sup> F/m
Electron mass	m <sub>e</sub>	9.1 x 10 <sup>-31</sup> kg
Proton mass	m <sub>p</sub>	1.673 x 10 <sup>-27</sup> kg

## Atomic Masses

Element	Symbol	Atomic Mass	Atomic Number
Hydrogen	H	1.00794 u	1
Helium	He	4.00260 u	2
Lithium	Li	6.941 u	3
Beryllium	Be	9.0122 u	4
Boron	В	10.811 u	5
Carbon	С	12.0107 u	6
Nitrogen	N	14.0067 u	7
Oxygen	0	15.9994 u	8
Fluorine	F	18.9984 u	9
Neon	N	20.1797 u	10
Sodium	Na	22.9897 u	11
Magnesium	Mg	24.305 u	12
Aluminum	Al	26.9815 u	13
Silicon	Si	28.0855 u	14
Phosphorus	Р	30.9738 u	15