Physics 2020 Exam 2 Constants and Formulae

Useful Constants

k_e	=	8.99×10^9 N m^2/C^2	c	=	3.00×10^8 m/s
$\mu_\circ$	=	$4\pi \times 10^{-7}$ T m/A	e	=	1.602×10^{-19} C
m_e	=	9.110×10^{-31} kg	m_p	=	1.672×10^{-27} kg
$\epsilon_\circ$	=	8.85×10^{-12} C^2/(N m^2)	g	=	9.80 m/s^2
1 eV	=	1.602×10^{-19} J	1 T	=	10^4 G
1 km	=	10^3 m	1 hr	=	3600 s
1 day	=	8.64×10^4 s	1 yr	=	365.242 days
1 milli (m)	=	10^{-3}	1 micro (μ)	=	10^{-6}

Useful Formulae

C (circle) $= 2\pi r$

D (circle) $= 2r$

A (circle) $= \pi r^2 = \pi D^2/4$

V (sphere) $= \frac{4}{3}\pi r^3$

A (sphere) $= 4\pi r^2$

V (rectangular box) $= L \cdot W \cdot H$

$\sin\theta =$ (opposite)/(hypotenuse)

$r^2 = x^2 + y^2$

$\cos\theta =$ (adjacent)/(hypotenuse)

$1 = \cos^2\theta + \sin^2\theta$

$\tan\theta =$ (opposite)/(hypotenuse)

$\tan\theta = \sin\theta/\cos\theta$

$v^2 = v_\circ^2 + 2a(x - x_\circ)$

$v = v_\circ + a(t - t_\circ)$

$x = x_\circ + v_\circ(t - t_\circ) + \frac{1}{2}a(t - t_\circ)^2$

$R = |\vec{R}| = \sqrt{R_x^2 + R_y^2}$

$R_x = R\cos\theta$

$R_y = R\sin\theta$

Useful Formulae (continued)

$F_g = \vec{w} = m\vec{g}$

$W = (F\cos\theta)s = \Delta(\text{KE})$

$\text{KE} \equiv \frac{1}{2}mv^2$

$\text{PE}_g = mgy$

$\text{KE}_i + \text{PE}_i = \text{KE}_f + \text{PE}_f$

$\vec{p} \equiv m\vec{v}$

$F_e = k_e|q_1||q_2|/r_{12}^2$

$\vec{E} = \vec{F}_e/q$

$\mathcal{P} = W/\Delta t = I\ \Delta V = I^2R = (\Delta V)^2/R$

$W = \Delta\text{PE} = q\,\Delta V = q\,E\,d$

$I = \Delta Q/\Delta t$

$R = \Delta V/I$

$C = Q/\Delta V$

$C = \epsilon_\circ A/d$

$U = Q^2/(2C) = \frac{1}{2}C(\Delta V)^2 = \frac{1}{2}Q(\Delta V)$

$V = k_e q/r$

$R_{eq} = \sum R_i$ (series)

$1/R_{eq} = \sum(1/R_i)$ (parallel)

$I_1 = I_2 = I_i = I$ (series resistors)

$\Delta V = \sum \Delta V_i$ (series resistors)

$\Delta V_1 = \Delta V_2 = \Delta V_i = \Delta V$ (parallel)

$I = \sum I_i$ (parallel resistors)

$\Delta V = \mathcal{E} - Ir$

$q = Q\left(1 - e^{-t/RC}\right)$ (charging)

$\tau = RC$

$q = Qe^{-t/RC}$ (discharging)

$F = qvB\sin\theta$

$F = BI\ell\sin\theta$

$r = mv/qB$

$B = \mu_\circ I/(2\pi r)$

$\sum B_\parallel \Delta\ell = \mu_\circ I$

$\Phi_B = BA\cos\theta$

$\mathcal{E} = -N\Delta\Phi_B/\Delta t = -L\Delta I/\Delta t$

$\Delta V = \mathcal{E} = E\ell = B\ell v$

$L = \mu_\circ N^2 A/\ell = \mu_\circ n^2 A\ell = \mu_\circ n^2 V$

$I = |\mathcal{E}|/R = (B\ell v)/R$

Physics 2020-002

Name: _____

Exam 2A – 1 March 2010

.

Part A: Hard Multiple Choice (10 points total, 2 points each, Circle Best Answer).

1. A proton moves directly into the page away from you and an accompanying magnetic field points to the bottom of the page. What direction does the magnetic force point?

a) out of the page b) toward the left c) into the page

d) toward the right e) toward the page top

2. Fully charged capacitor in an RC circuit is allowed to discharge. If the capacitor reaches one-quarter charge in 4.24 s, what is the time constant of this circuit?

a) 12.4 s b) 8.88 s c) 3.06 s d) 4.24 s e) 0.555 s

3. A 342 m long wire carrying a current of 2.88 A is embedded in a 23.9 mT magnetic field such that it experiences a maximum force from the magnetic field. What is the magnitude of this maximum force?

a) 3.29 N b) 68.8 N c) 4.97 N d) 985 N e) 23.5 N

4. A battery has an emf of 2.40 V. If this battery produces a voltage of 2.22 V when a current of 0.122 A is being drawn from it, what is the internal resistance of this battery?

a) 19.7 Ω b) 0.122 Ω c) 2.40 Ω d) 18.2 Ω e) 1.48 Ω

5. A current of 2.88 A is flowing through a straight wire. What is the strength of the magnetic field at a distance of 50.0 cm from the wire?

a) 15.3 mT b) 24.0 T c) 1.15 μT d) 3.20 mT e) 30.5 mT

Part B: Easy Multiple Choice (10 points total, 1 point each, Circle Best Answer).

6. Why should a third "grounding" wire be used in the power cords of all electric devices?

a) In order to ensure the polarity of the plug.

b) To allow negative voltages to be "realized" by the device.

c) To supply the electrons for the device.

d) To prevent a short circuit.

e) To increase the profits of electric companies.

7. A coiled wire carrying current is called a

a) spectrograph b) solenoid c) magnetometer

d) galvanometer e) seismograph

8. Counting the number of field lines that cross a surface area is called the

a) inductance b) polarity c) flux

d) motional emf e) induced emf

9. Which characteristic of the Earth lead to the discovery of the flipping of the Earth's magnetic field?

a) length of day b) length of year c) axis precession

d) continental drift e) compass drift

10. Whereas Kirchhoff's junction rule is the conservation of charge, his loop rule is conservation of

a) force b) energy c) momentum d) mass e) none of these

11. Which of the following equations is the basis behind the operation of audio speakers?

a) $P = \rho kT/(\mu m_H)$ b) $E = m\,c^2$ c) $F = B\,I\,\ell\,\sin\theta$

d) $\overline{F}\,\Delta t = \Delta p$ e) $\mathcal{E} = N\,B\,A\,\omega\,\sin\omega t$

12. The first hint of the existence of magnetism came from the discovery of

a) basalt rocks b) loadstones c) meteorites

d) lightning e) limestones

13. Who discovered the phenomenon of self-induction?

a) Franklin b) Lenz c) Henry d) Oersted e) Coulomb

14. The SI unit for magnetic field flux is called the

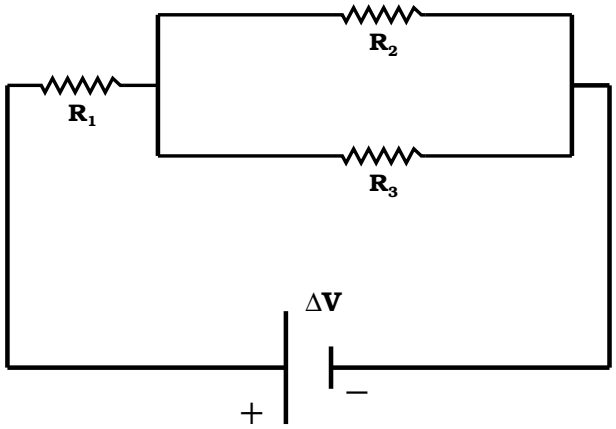
a) volt b) ohm c) ampere d) weber e) tesla

15. When the sum of spins of electrons contained in matter add up to a non-zero value, such material is called

a) ohmic b) ferromagnetic c) ampic d) voltic e) neutral

Part C: Problems (20 points total, 10 points each).

16. The circuit in this diagram has a 24.0 V battery and three resistors with $R_1 = 32.0\ \Omega$, $R_2 = 24.0\ \Omega$, and $R_3 = 48.0\ \Omega$. (a) Calculate the equivalent resistance of this circuit. (Don't forget to show your diagram for each step.) (b) What is the current flowing though R_1? (c) What is the potential drop across R_3? (**Show all work!!!**)



17. A 15.2 MeV cosmic ray positively charged ion has a mass of 3.45×10^{-26} kg moves in a circular orbit whose orbital plane is perpendicular to a uniform 2.88×10^{-8} T magnetic field. (a) If the radius of this circular orbit is 9890 km, what is the charge on this cosmic ray ion? (b) Approximately how many electrons would this ion be deficit, that is how many extra electrons would this ion need to make it a neutral particle? (**Show all work!!!**)

Extra Credit Problem (5 points, do this only if you have time).

18. Assume that a lightning bolt can be represented a by long straight line of current. If 22.0 C of charge passes by in a time of 2.00×10^{-3} seconds, what is the magnitude of the magnetic field at a distance of 50.0 meters from the bolt? (**Show all work!**)