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
$\epsilon_\circ$	=	8.85×10^{-12} C^2/(N m^2)	$\mu_\circ$	=	$4\pi \times 10^{-7}$ T m/A
e	=	1.602×10^{-19} C	h	=	6.626×10^{-34} J s
m_p	=	1.67×10^{-27} kg	m_e	=	9.11×10^{-31} kg
1 eV	=	1.602×10^{-19} J	1 T	=	10^4 G
1 min	=	60 s	1 hr	=	3600 s
1 mA	=	10^{-3} A	1 micro (μ)	=	10^{-6}

Useful Formulae

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

C (circle) $= 2\pi r$

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

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

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

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

$\tan\theta = \sin\theta/\cos\theta =$ (opposite)/(adjacent)

$\sum \vec{F} = m\vec{a}$

$\mathrm{KE} = \frac{1}{2}mv^2$

$\mathrm{PE}_s = \frac{1}{2}kx^2$

$C = Q/\Delta V$

$\tau = RC$

$R = \rho L/A$

$R = \Delta V/I$

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

$I = \Delta Q/\Delta t$

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

$F = qvB\sin\theta$

$F = BI\ell\sin\theta$

$B = \mu_\circ nI$

$r = mv/qB$

$n = N/\ell$

$\tau = L/R$

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

$\Phi_B = BA\cos\theta$

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

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

Physics 2020-002

Name: _____

Exam 2B – 27 February 2017

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

1. A proton ($q = +e$) moves out of the page toward you in a magnetic field that points to the right of the page. What direction does the magnetic force on this particle point?

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

d) toward the page bottom e) into the page

2. Consider an RL circuit which has a resistance of 368 Ω. If the time constant of this circuit is 1.78 s, what is the inductance of the inductor in this circuit?

a) 0.144 H b) 655 H c) 20.7 H d) 4.84×10^{-3} H e) 207 H

3. A proton ($q = +e$) moves at 5.67×10^5 m/s in a perpendicular direction with respect to an external B-field. If this electron experiences a magnetic force of 1.52×10^{-12} N, what is the strength of this magnetic field?

a) 3.29 mT b) 0.862 μT c) 50.0 μT d) 16.7 T e) 569 mT

4. A battery has an emf of 50 V and delivers a current of 3.0 A with an internal resistance of 10 Ω. What is the potential difference across this battery?

a) 5.0 V b) 10 V c) 40 V d) 20 V e) 50 V

5. Two resistors are in series with a 36.0 V battery. If one resistor has 4 times the resistance of the other resistor and the equivalent resistance of this circuit is 520 Ω, what is the resistance of the weaker (*i.e.*, smaller) resistor?

a) 104 Ω b) 130 Ω c) 14.4 Ω d) 7.20 Ω e) 9.00 Ω

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

6. Which of the following best describes what inductance measures?

a) The opposition to the current in a circuit.

b) The amount of resistance in a circuit.

c) The opposition to the rate of change of current in a circuit.

d) The amount of emf supplied to a circuit.

e) The speed at which light travels.

7. Producing a current by moving a metal bar through a B-field is sometimes called

a) Henry's law b) the loop rule c) Ampere's law

d) motional emf e) self inductance

8. After a switch is closed in a circuit, the current produces its own magnetic flux through the loop of the circuit. This effect is called

a) self-inductance b) forced vibration c) ferromagnetism

d) Doppler effect e) piezoelectric effect

9. A $\mathrm{Wb/m^2}$ is also known as a

a) V b) T c) N/A d) G e) A

10. Which of the following devices convert mechanical energy to electrical energy?

a) motor b) galvanometer c) transporter

d) generator e) compass

11. 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

12. Which of the following do capacitors and inductors have in common?

a) Both block the flow of current.

b) Both can produce alpha particles.

c) Both produce a strong magnetic field.

d) Both can temporarily store energy.

e) None of these.

13. The SI unit for magnetic flux is called the

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

14. The equation $\mathcal{E} = -N\Delta\Phi_B/\Delta t$ is known as

a) Tesla's Law of magnetic flux

b) Henry's Law of self inductance

c) Coulomb's Law

d) Ampere's Circuit Law

e) Faraday's Law of magnetic induction

15. Rocks found in nature that can repel or attract each other without touching are called

a) solenoids b) magma c) loadstones

d) diamonds e) meteorites

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

16. A proton ($q = +e$, $m = m_p$) is moving in a circular path of circumference 235 m in a 0.0256 T magnetic field. (a) What is the velocity of this proton? (b) What is the kinetic energy of this proton? (**Show all work!!!**)

17. A solenoid contains 98.0 turns of wire over a length of 56.8 cm. It produces an internal magnetic field of 2.34 gauss. (a) What is the current flowing through the coiled wire of this solenoid? (b) If this solenoid has a diameter of 23.6 cm and the B-field is uniform inside this solenoid, what is the magnetic flux through one of the turns inside this solenoid? (*Hint:* Angle θ is zero here. **Show all work!**)

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

18. A circuit has a battery, a resistor, a capacitor, and a switch. The time constant of this circuit is 3.12 s. If the resistor has a current of 420 mA and a potential drop of 12.0 V sometime after the switch is closed, what is the capacitance of the capacitor? (**Show all work!**)