St John Baptist De La Salle Catholic School, Addis Ababa

Grade 10 Physics Final Examination

4th Quarter

January, 2022

Notes, and use of other aids is **NOT** allowed. Read all directions carefully and write your answers in the space provided. To receive full credit, you must show all of your work.

Useful Constants

- $\mathbf{e} = 1.6 \times 10^{-19}$C - elementary charge $\mathbf{m}_e = 9.11 \times 10^{-31}$kg - mass of an electron
- $\mathbf{m}_p = 1.673 \times 10^{-27}$kg - mass of a proton $\mu_0 = 4\pi \times 10^{-7} \frac{H}{m}$ - permeability of free space
- $\epsilon_0 = 8.85 \times 10^{-12} \frac{F}{m}$ - permitivitty of free space $\mathbf{G} = 6.672 \times 10^{-12} \frac{Nm^2}{kg^2}$ - gravitational constant
- $\mathbf{N}_A = 6.022 \times 10^{23} \frac{1}{mol}$ - Avogadro's number $\mathbf{a}_g = 10m/s^2$ - acceleration due to gravity

Name:_____ Roll Number:_____ Section:____Time Allowed: **1:45 hr**

Multiple Choice Questions

1. Which of the following changes to a parallel plate capacitor would not increase the energy stored in a capacitor at a fixed voltage?
   A. Increasing the area of the plates B. Increasing the dielectric constant C. Decreasing the charges on the plate D. Increasing the distance between the plates E. None of the above

2. An electron enters a region of uniform electric field of 4×10^3 V/m. What is the force on the electron?
   A. 8×10^{-16} N B. 6.4×10^{-16} N C. 8×10^{16} N D. 1.6×10^{-19} N E. None of the above

3. Which of the following is true about gravitational potential energy?
   A. It is positive because gravity and mass are positive B. It depends on the motion of the body C. It depends on the height above the ground where the body is D. It only depends on initial and final heights E. None of the above

4. What is the measure of the distribution of mass of a body in relation to its axis of rotation?
   A. Torque B. Angular Momentum C. Moment of Inertia D. Linear Momentum E. None of the above

5. A point charge Q_1 is at $x = 0$ and another point charge Q_2 is at $x = 4$. What is the relationship between these two point charges if the absolute potential due to these charges is 0 at $x = 8$?
   A. $Q_1 = 4Q_2$ B. $Q_1 = -2Q_2$ C. $Q_1 = -8Q_2$ D. $Q_1 = 4Q_2$ E. None of the above

6. The potential difference between the terminals of a battery when the battery is isolated is:
   A. Electric Force B. Terminal Voltage C. Electromotive Force D. Electrolytic Voltage

7. A simple circuit consists of a load resistor of 10Ω connected to a battery of 18V EMF. If the current through the circuit is 1.6A, what is the internal resistance of the battery?
   A. 1.25Ω B. 12.5Ω C. 10Ω D. 1.6Ω E. None of the above

8. The escape speed at the surface of some planet is twice that of the Earth's escape speed. What is the mass of the planet(M_p) in terms of Earth's mass(M_e)?
   A. $M_p = 0.5\ M_e$ B. $M_p = 2\ M_e$ C. $M_p = 4\ M_e$ D. $M_p = 8\ M_e$ E. None of the above

9. One electron-volt is the same as:
   A. 3.6 J B. 1.0 J C. 3.6×10^6 J D. 1.6×10^{-19} J

10. Electric companies usually list their billings in amounts of cents/KWh. For example, the British Power company EON bills consumers 7.3 cents/KWh. In this quantity, KWh is a unit of:
    A. Energy B. Power C. Current D. Voltage E. None of the above

11. A 2μF and 1μF capacitors are connected in parallel and a potential difference is applied across the combination. The 2μF capacitor has: A. half the charge of the 1μF capacitor B. twice the stored energy of the 1μF capacitor C. twice the potential difference of the 1μF capacitor D. half the stored energy of the 1μF capacitor E. None of the above

12. A tangent line to an equipotential surface and the electric field due to the same charge at any point must be:
A. Parallel B. Perpendicular C. Opposite in direction D. They don't have any relationship E. None of the above

13. Which of the following is true about resistivity and conductivity?
A. They are reciprocals of one another B. They are dimensionless quantities C. They have direct relationship D. They have the same SI units E. None of the above

14. If two, infinitely long parallel conducting wires carry the same current and the force per unit length on each wire is 2×10^{-7} N/m, the current in each wire is defined to be:
A. 1 Ampere B. 1 Coulomb C. 2×10^{-7} Coulomb D. 2×10^{-7} Ampere E. None of the above

15. The angular impulse experienced by a body is equivalent to the change in:
A. Mechanical energy B. Linear Momentum C. Angular Momentum D. Relativistic Kinetic Energy E. None of the above

16. A 9V battery is connected to a 2μF capacitor. How much electric energy can be stored in the capacitor?
A. 1.62×10^{-5} J B. 8.1×10^{-5} J C. 1.62×10^{-4} J D. 8.1×10^{-4} J E. None of the above

17. The two ends of a 4Ω resistor are connected to a 16V battery. What is the total power delivered by the battery to the circuit?
A. 4 W B. 16 W C. 32 W D. 64 W E. None of the above

18. Electric potential energy an energy of a charge possessed because it is in the:
A. region of other masses B. vacuum C. region of zero electric field D. region of other charges E. None of the above

19. Two resistors R_1 and R_2 are connected in series. If R_1=$2R_2$, which of the following is true?
A. V_1=$2V_2$ B. V_1=$\frac{1}{2}V_2$ C. I_1=$2I_2$ D. I_1=$\frac{1}{2}I_2$ E. None of the above

20. A 3A current is flowing through a Copper conductor ($n = 8.5 \times 10^{28} m^{-3}$) that has a cross sectional area of 1mm^2. What is the drift speed of the electrons in this conductor?
A. $2.205 \times 10^{4} m/s$ B. $2.205 \times 10^{-4} m/s$ C. $2.205 \times 10^{-8} m/s$ D. $2.205 \times 10^{-2} m/s$ E. None of the above

21. All conductors obey Ohm's Law.
A. True B. False C. None of the above

22. If the value of acceleration due to gravity on the surface of the Earth is **g**, what will its value be at a height equal to the radius of the Earth above the surface?

A. $\frac{\mathbf{g}}{8}$ B. $\frac{\mathbf{g}}{4}$ C. $\frac{\mathbf{g}}{2}$ D. **g** E. None of the above

23. What is the potential at a distance of 10m from a charge 0f -5.0C?
A. -4.45×10^{9} V B. $+4.45 \times 10^{9}$ V C. -4.45×10^{-9} V D. $-4.45 \times 10^{+9}$ V E. None of the above

24. There are two parallel parallel charged plates in some region. A positive charge of 1.0×10^{-4} C is on the negatively charged plate. If the potential on the positively charged plate is +10KV and the potential on the negatively charged plate is -10KV, how much work is required to move the charge from the negative plate to the positive plate?
A. 2.0 J B. 0.0 J C. 4.0 J D. 1.0 J E. None of the above

25. A charge of $Q_1 = 10 \times 10^{-9}$C is placed at the origin while another charge of $Q_2 = 10 \times 10^{-9}$C is placed at (0,6). What is the electric force on a third charge $Q_3 = -2.5 \times 10^{-8}$C if it is placed at (4,3) due to Q_1 and Q_2?
A. 1.08×10^{-7}N, positive Y direction B. 1.42×10^{-7}N, positive X direction C. 1.42×10^{-7}N, negative Y direction D. 9.00×10^{-7}N, positive Y direction E. None of the above

Conceptual & Proof Problems

26. What are the factors affecting the resistance of conductor? List each factor and explain the effects of changing the factors on the resistance.

27. Show that relation $R = \frac{\rho L}{A}$ follows from the macroscopic form of Ohm's Law($\implies V = IR$) and microscopic form($J = \sigma E$).

28. Consider a region in space where a uniform electric field points in the positive Y direction.

- What is the orientation of the equipotential surfaces?

- If you move in the negative Y direction, does electric potential decrease or increase?

29. Why are equipotential lines and surfaces perpendicular to the electric field lines?

Workout Problems

30. A capacitor in an RC circuit has a capacitance of 40μF while the resistor has a resistance of 20KΩ. If the capacitor is initially empty, answer the following questions: $(Q(t) = Q(1 - e^{-\frac{t}{\tau}}))$

- Calculate the amount of time it would take the charge in the capacitor to reach 63%.

- Calculate the amount of charge left when $\frac{2}{5}\tau$ amount of time has dissipated.

31. How far apart are two conducting plates that have an electric field strength of 6.40×10^3V/m between them, if one of the plates has a potential of -4.0KV and the other has a potential of 6.0KV?

32. On a planet whose radius is **2R**, the acceleration due to gravity at the surface of the planet is **g/3**. What is the mass of the planet in terms of Earth's mass if the radius of the Earth is R and the acceleration due to gravity at the surface of the Earth is **g**? $(g = \frac{GM}{R^2})$

Extra Credit Problem

33. Calculate the Schwarzschild radius of a hypothetical subatomic particle that has a mass of 700Gev/c^2. Explain why you think it whether that this particle can ever turn into a black hole or not?