Name: _____

Class: _____

Due Date: _____

Physics Topic 1A Math – Fundamental and Derived Units

Part 1: State the seven fundamental units and their symbols. The solutions to this worksheet can be found on the YouTube channel Go Physics Go.

Quantity	Unit	Symbol
Length		
Mass		
Time		
Current		
Temperature		
Quantity		
Light intensity		

Part 2: Answer the following questions. The solutions to this worksheet can be found on the YouTube channel Go Physics Go.

1. What is the meaning and what are the fundamental units of *perimeter*?

2. What is the meaning, equation, and the fundamental units of *circumference*?

3. What is the meaning and what are the fundamental units of *area*?

4. What is the meaning and what are the fundamental units of *volume*?

5. Use the equation $\vec{v} = \frac{\Delta \vec{x}}{\Delta t}$ to solve for the fundamental units of *velocity*.

6. Use the equation $\vec{a} = \frac{\Delta \vec{v}}{\Delta t}$ to solve for the fundamental units of *acceleration*. The fundamental units of $\vec{v}$ have been solved for earlier.

7. What are the units of *force*? Use the equation $\sum \vec{F} = m\vec{a}$ to solve for the fundamental units of *force*. The fundamental units of $\vec{a}$ have been solved for earlier.

8. Use the equation $\vec{F}_{\mathrm{H}} = -k\Delta\vec{x}$ to solve for the fundamental units of the *spring constant k*. $\vec{F}_{\mathrm{H}}$ is the force on a spring and $\Delta\vec{x}$ is the displacement of a spring. The fundamental units of force has been solved for earlier.

9. Use the equation $F_{\mathrm{d}} = 6\pi\eta r v$ to solve for the fundamental units of the *fluid viscosity* η. F_{d} is the drag force on the object, r is the radius of the object, and v is the speed of the object. The fundamental units of force have been solved for earlier. The Greek letter "η" is pronounced "eta".

10. Use the equation $\vec{p} = m\vec{v}$ to solve for the fundamental units of *momentum* $\vec{p}$. The fundamental units of velocity has been solved for earlier.

11. What are the units of *energy*?

12. Use the equation $E_{\mathrm{k}} = \frac{1}{2}mv^2$ to solve for the fundamental units of *kinetic energy*. m is the mass of an object and v is the speed of an object.

13. Use the equation $E_{\mathrm{p}} = mg\Delta h$ to solve for the fundamental units of the *gravitational potential energy* near the surface of a planet. g is the acceleration of an object near to the surface of a planet and Δh is the height an object is raised. The fundamental units of acceleration has been solved for earlier.

14. What are the fundamental units of *energy*?

15. What are the units of *work*? Use the equation $W = Fs\cos\theta$ to solve for the fundamental units of *work W*. s is the displacement of an object and θ is the angle between F and s. The fundamental units of force has been solved for earlier.

16. What is the relationship between the fundamental units of *work* and *energy*?

17. What are the units of *power*? Use the equation $P = \frac{\text{Work}}{t}$ to solve for the fundamental units of *power P*. The fundamental units of work has been solved for earlier.

18. Use the equation $\tau = rF\sin\theta$ to solve for the fundamental units of *torque* τ. r has units of distance and F is the external force acting on an object. θ is the angle between r and F.

19. Use the equation $I = kMR^2$ to solve for the fundamental units of the *moment of inertia I*. k is a unitless constant which depends on the physical dimensions of the object, M is the mass of the object, and R has units of distance.

20. Use the equation $\Delta L = \tau\Delta t$ to solve for the fundamental units of *angular momentum L*. The fundamental units of τ has been solved for earlier.

21. Use the equation $L = I\omega$ to solve for the fundamental units of *angular speed* ω. The fundamental units of I and L has been solved for earlier.

22. Use the equation $\tau = I\alpha$ to solve for the fundamental units of *angular acceleration* α. The fundamental units of I and τ has been solved for earlier.

23. What is the equation and what are the fundamental units of *density* ρ?

24. Use the equation $\overline{E_{\text{k}}} = \frac{3}{2}k_{\text{B}}T$ to determine the fundamental units for the *Boltzmann's constant* k_{B}. $\overline{E_{\text{k}}}$ is the average kinetic energy of a gas and T is the temperature of a gas. The fundamental units of energy has been solved for earlier.

25. Use the equation $Q = mc\Delta T$ to determine the fundamental units for the *specific heat capacity* c. Q has the units of energy.

26. Use the equation $Q = mL_{\mathrm{f}}$ to determine the fundamental units for the *latent heat of fusion* L_{f}. Q has the units of energy.

27. Use the equation $\frac{\Delta Q}{\Delta t} = kA\frac{\Delta T}{\Delta x}$ to determine the fundamental units for the *thermal conductivity* k. The variable Q has the units of energy.

28. Use the equation $L = \sigma AT^4$ to solve for the fundamental units of the *Stefan-Boltzmann constant* σ. L is the luminosity of an object and has units of power, A is the surface area of an object, and T is the temperature of an object. The fundamental units of power has been solved for earlier.

29. Use the equation $b = \frac{L}{4\pi d^2}$ to solve for the fundamental units of the *apparent brightness* b. L is the *luminosity* of an object and has units of power. d is the distance from a light source. The fundamental units of power has been solved for earlier.

30. Use the equation $e = \frac{\frac{\mathrm{P}}{\mathrm{A}}}{\sigma T^4}$ to solve for the fundamental units of *emissivity* e. The fundamental units for the *Stefan-Boltzmann constant* σ has been solved for earlier.

31. *Specific energy* is defined as energy transferred per unit mass. Determine the fundamental units for *specific energy*.

32. *Energy density* is defined as energy transferred per unit volume. Determine the fundamental units for *energy density*.

33. What are the units of *pressure*? Use the equation $P = \frac{F}{A}$ to solve for the fundamental units of *pressure P*.

34. Use the equation $PV = nRT$ to solve for the fundamental units of the *ideal gas constant R*. P is the pressure exerted on an ideal gas, V is the occupied volume of an ideal gas, n is the number of moles of an ideal gas, and T is the temperature of an ideal gas.

35. Use the equation $S = \frac{\Delta Q}{\Delta T}$ to solve for the fundamental units of *entropy S*. Q has units of energy.

36. Use the equation $S = k_{\mathrm{B}} \ln \Omega$ to determine the fundamental units for the *Boltzmann's constant* k_{B}. The fundamental units for *entropy S* has been solved for earlier.

37. What are the units of *current I*? Use the equation $I = \frac{\Delta q}{\Delta t}$ to solve for the fundamental units of *current I*. Δq is the amount of charge passing through a closed loop.

38. Use the equation $I = \frac{\Delta q}{\Delta t}$ to solve for the fundamental units of *charge q*.

39. What are the units of *voltage*? Use the equation $V = W/q$ to solve for the fundamental units of *voltage V*. W is the work done on a charge and q is the amount of charge on an object.

40. What are the units for the *resistance* in a resistor R? Use the equation $V = IR$ to solve for the fundamental units of *resistance R*. The fundamental units of voltage V and current I have been solved for earlier.

41. What are the units for the *capacitance* in a capacitor C? Use the equation $Q = VC$ to solve for the fundamental units of *capacitance C*. The fundamental units of voltage V and charge Q have been solved for earlier.

42. What is the meaning and what are the fundamental units of *period T*?

43. What is the meaning and what are the fundamental units of *frequency f*?

44. What is the meaning and what are the fundamental units of *wavelength* λ?

45. *Intensity* is defined as power per unit area. What are the fundamental units of *intensity I*? The fundamental units of power have been solved for earlier.

46. Use the equation $F_{\text{gravity}} = \frac{Gm_1m_2}{r^2}$ to solve for the fundamental units of the *gravitational constant G*. m_1 and m_2 are the masses of each object and *r* is the distance between two masses.

47. Use the equation $V_{\text{g}} = \frac{Gm}{r}$ to solve for the fundamental units of the *gravitational potential* V_{g}. The fundamental units of the gravitational constant *G* has been solved for earlier.

48. Use the equation $F_e = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}$ to solve for the fundamental units of the *permittivity of free space* ε_0. F_e is the electric force on an object, q_1 and q_2 are the net charges of two objects , and *r* is the distance between two charged objects.

49. Use the equation $F_e = k\frac{q_1 q_2}{r^2}$ to solve for the fundamental units of the *Coulomb constant* k. F_e is the electric force on an object, q_1 and q_2 are the net charges of two objects, and *r* is the distance between two charged objects.

50. Use the equation $\vec{F}_e = q\vec{E}_{ext}$ to solve for the fundamental units of the *electric field E*.

51. Use the equation $V_e = \frac{kQ}{r}$ to solve for the fundamental units of the *electric potential* V_e. The fundamental units of the Coulomb constant *k* has been solved for earlier.

52. What are the units of *magnetic field* $\vec{B}$? Use the equation $\vec{F}_B = q\vec{v}\vec{B}_{ext}$ to solve for the fundamental units of the *magnetic field* $\vec{B}_{ext}$.

53. Use the equation $\frac{F}{L} = \mu_0\frac{I_1 I_2}{2\pi r}$ to solve for the fundamental units of the *permeability of free space* μ_0. F is the force between two wires, *L* has units of length, r is the distance between two wires, and I_1 and I_2 are the current passing through each wire. The fundamental units of these variables have been solved for earlier.

54. What are the units for the *magnetic flux* Φ? Use the equation $\Phi = BA\cos\theta$ to solve for the fundamental units for the *magnetic flux* Φ. B is the magnitude of the external magnetic field and A is the area of a closed loop. Their fundamental units have been solved for earlier.

55. Use the equation $E = hf$ to solve for the fundamental units of *Planck's constant* h. E is the energy of an electromagnetic wave and f is the frequency of an electromagnetic wave. Their fundamental units have been solved for earlier.

56. Use the equation $\lambda = \frac{h}{p}$ to solve for the fundamental units of the *de Broglie wavelength* λ. p is the momentum of an object and its fundamental units has been solved for earlier.