Chapter 18 Physics Review Name: KEY

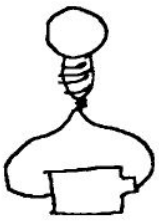
How many of the following are VECTORS?

1. Displacement
2. Velocity
3. Mass
4. Weight maybe?
5. Acceleration
6. Force
7. Inertia
8. Kinetic Energy
9. Potential Energy
10. Coefficient of Friction
11. Acceleration of Gravity
12. Work
13. Power
14. Time
15. Angle
16. Electric Field
17. Charge
18. Potential Difference

How many of the following diagrams will light up the light bulb?

A)

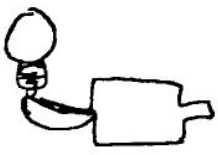
B)



C)

D)

E)



Sam

1. An alpha particle travels 5.00 cm in a uniform electric field of 6.00×10^2 N/C. Movement is in the same direction of the electric field. (Alpha particles are made of two protons and two neutrons.) What is the change in potential energy of the particle? Does it increase or decrease?

$$PE = -qEd$$
$$= -(2)(1.602\times10^{-19}\,C)(6.00\times10^{2}\,\tfrac{N}{C})(.05$$
$$= \boxed{-9.61\times10^{-18}\,J}$$

decrease

2. A parallel-plate capacitor holds 2.00×10^{3} μC of charge when a potential difference of 5.00×10^{3} V is applied between its plates.

What is the capacitor's capacity in units of farads and in units of nanofarads?

$$C = \frac{Q}{V} = \frac{2.00\times10^{-4}\,C}{5.00\times10^{2}\,V}$$
$$= \boxed{4\times10^{-7}\,F}$$
$$\boxed{400\ nF}$$

3. Electrons are accelerated in the picture tube of a television through a potential difference of 8.00×10^{3} V. What is the potential energy of each electron traveling through this tube?

$$PE = \tfrac{1}{2}Q\Delta V$$
$$= \tfrac{1}{2}(-1.60\times10^{-19})(8\times10^{3}\,V)$$
$$= \boxed{-6.4\times10^{-16}\,J}$$

4. In 1987, a chimney 275 m tall was razed in South Africa by a demolition team consisting of experts from the United States and Great Britain. Suppose there was an object with a 12.5 nC charge at the top of the chimney that fell to the ground after the demolition. What was the change in the electrical potential energy if Earth's electric field strength has a magnitude of 1.50 X 102 N/C and a downward direction?

$$PE = -qEd$$
$$= -(12.5\times10^{-9}C)(1.50\times10^{2})(275)$$
$$= \boxed{5.16\times10^{-4}J}$$

5. A Canadian company has developed a scanning device that can detect drugs beings smuggled. The scanner uses accelerated protons to generate gamma rays, which easily penetrate through most substances that are less than a few centimeters thick. At the heart of the scanner is a compact power supply that can produce an electric potential as large as 1.0 X 106 V. Find the value of a point charge q that would create an electric potential of 1.0 X 106 V at a distance of 12 cm.

Assume pt charge

$$V = \frac{K_c q}{r}$$

$$1.0\times10^{6}\,V = \frac{K_c\, 9}{.12}$$

$$q = \boxed{1.3\times10^{-5}C}$$

6. Tristan da Cunha, a remote island inhabited by a few hundred people, has an area of 98 km2. Suppose a .20 F capacitor with a plate area equal to 98 km2 is built. What is the plate separation in millimeters?

assume vacuum

$$\frac{98\,km^2}{1\,km^2}\left|\frac{1000^2\,m^2}{}\right. = 9.8\times10^{10}$$

$$.20F = \frac{(8.85\times10^{-12})(9.8\times10^{10})}{d}$$

$$d = \boxed{4.3m} \text{ or } \boxed{4,300mm}$$

7 Q1. What is the change in the electrical potential energy of a proton as it moves a distance of 2.0 cm in the direction of a uniform electric field with a strength of 328 V/m? What the sign of your answer.

$$PE = -qEd$$
$$= -(1.60\times10^{-19}\,C)(328\,\tfrac{V}{m})(.020\,m)$$
$$= \boxed{-1.1\times10^{-18}\,J}$$

8 Q2. An alpha particle (2 protons and 1 neutron) is released from rest in a uniform electric field with a magnitude of 4.0 X 10^3 N/C. If the change in electrical potential energy of the alpha particle is 5.34 nJ, what is the potential difference between the alpha particle's initial and final position?

$$\Delta V = \frac{\Delta PE}{q}$$
$$= \frac{5.34\times10^{-9}\,J}{2(1.60\times10^{-19}\,C)}$$
$$= \boxed{1.7\times10^{10}\,V}$$

9 Q3. A circular parallel-plate capacitor with a spacing of 7.0 mm is charged to produce a uniform electric field with a strength of 4.5 X 10^5 N/C. What plate radius is required if the stored charge is -2.4 μC?

$$C = \varepsilon_0 \frac{A}{d}$$

$$7.61905\times10^{-10}\,F = \frac{\varepsilon_0 A}{.007\,m}$$

$$A = .602637\,m^2 \quad (A=\pi r^2) \quad = \pi r^2 \quad r = \boxed{.44\,m}$$

(2) $$C = \frac{Q}{V} = \frac{-2.4\times10^{-6}\,C}{-3150\,V} = 7.61905\times10^{-10}\,F$$

(1) $$V = -Ed$$
$$= (-4.5\times10^5\,\tfrac{N}{C})(.007\,m)$$
$$= -3150\,V$$

10 14. An electron is displaced from a point 75 cm away from a proton to a point 130 cm away from the proton. What is the change in the electrical potential energy as a result of this movement?

$PE_f - PE_i$

$PE = K_C \frac{q_1 q_2}{r}$

$\Delta d = K_C \frac{(1.602\times10^{-19})^2}{.75} - K_C \frac{(1.602\times10^{-19})(1.602\times10^{-19})}{1.30}$

$= \boxed{1.3\times10^{-28}\ J}$

11 15. A parallel-plate capacitor has a charge of 7.5 μC when charged by a potential difference of 1.75 V. Find the capacitance.

$C = \frac{Q}{\Delta V}$

$= \frac{7.5\times10^{-6}C}{1.75\ V} = \boxed{4.3\times10^{-6}\ F}$

12 16. The capacitor in #13 was discharged and reconnected to a 6.0 V battery. How much potential energy is stored when this capacitor is connected to the second battery?

Shortcut $PE = \frac{1}{2}C\Delta V^2$

$C = \frac{Q}{\Delta V}$ new charge $C = \frac{Q}{\Delta V}$

$4.3\times10^{-6}\ F = \frac{Q}{6.0V}$

$Q = 2.6\times10^{-5}C$

$PE = \frac{1}{2}Q\Delta V$

$PE = \frac{1}{2}(2.6\times10^{-5}C)(6.0V)$

$= \boxed{7.7\times10^{-5}\ J}$