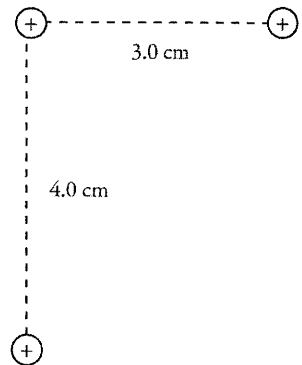


科目：普通物理

系所組：物理組 (物理學系)

1. (10 pts) Consider the group of three $+2.4 \text{ nC}$ point charges shown in the figure. What is the electric potential energy of this system of charges relative to infinity?

$$(k = 1/4\pi\epsilon_0 = 8.99 \times 10^9 \text{ N} \cdot \text{m}^2/\text{C}^2)$$



2. (20 pts) A particle oscillates with simple harmonic motion along the x axis. Its position varies with time according to the equation:

$$x = 5.0 \text{ m} \sin\left(\frac{\pi}{2}t + \frac{\pi}{6}\right), \quad \text{where } t \text{ is in seconds.}$$

- (a) Determine the amplitude, frequency, and period of the motion.
 (b) Calculate the velocity and acceleration of the particle at any time t .
 (c) What are the position and the velocity of the particle at time $t = 0$?
 (d) At what time is the particle's potential energy equal to its kinetic energy?
3. (20 pts) A 2.0-m-long rod has density λ in kilograms per meter of length described by $\lambda = a + bx$, where $a = 1.0 \text{ kg/m}$, $b = 1.0 \text{ kg/m}^2$, and x is the distance from the left end of the rod. The rod rests horizontally with each end supported by scale. What do the two scales read?
4. (15 pts) The Yukawa potential energy function for the interactions of neutrons and protons in a nucleus is given as:

$$U(r) = -\left(\frac{r_0}{r}\right)U_0 \cdot e^{-\frac{r}{r_0}}.$$

Compute the value of the force at $r = r_0$, and $r = 3r_0$. [Hint: calculate the force function first]

Take $U_0 = 5 \times 10^{-12} \text{ J}$ and $r_0 = 1.5 \times 10^{-15} \text{ m}$, $e^{-1} \approx 0.368$, $e^{-3} \approx 0.0498$.

5. (15 pts) A camera lens has a focal length of 0.1 m. (a) If the camera is focused on a child 2 m from the lens, what is the distance from the lens to the film? (b) If the child has a height of 1 m, how tall is the image on the film?
6. (20 pts) Write down the major contributions to our knowledge of nature from the following physicists.
 (a) Sadi Carnot; (b) Michael Faraday; (c) Leon Foucault; (d) Robert Hooke.

- ※ 注意：1. 考生須在「彌封答案卷」上作答。
 2. 本試題紙空白部份可當稿紙使用。
 3. 考生於作答時，請勿使用計算機。