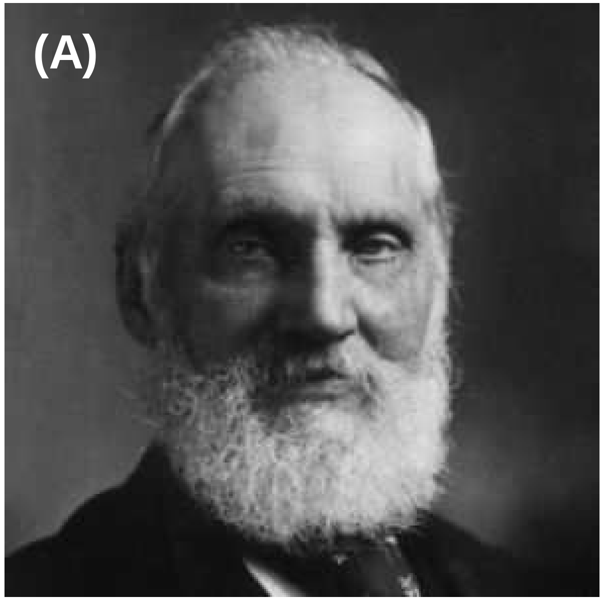
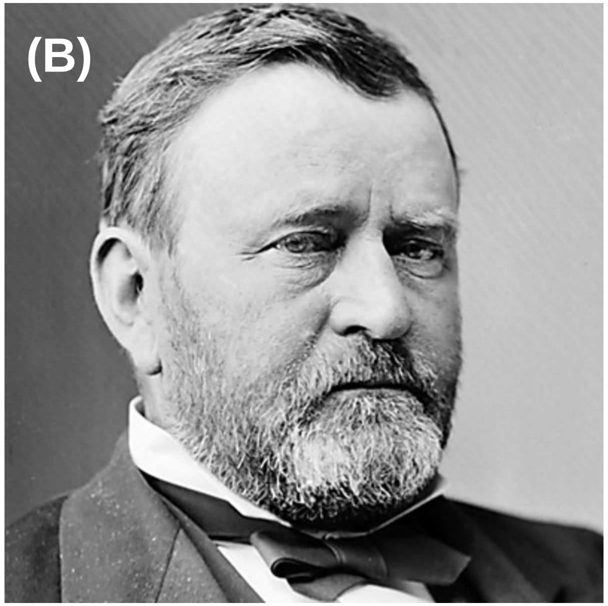
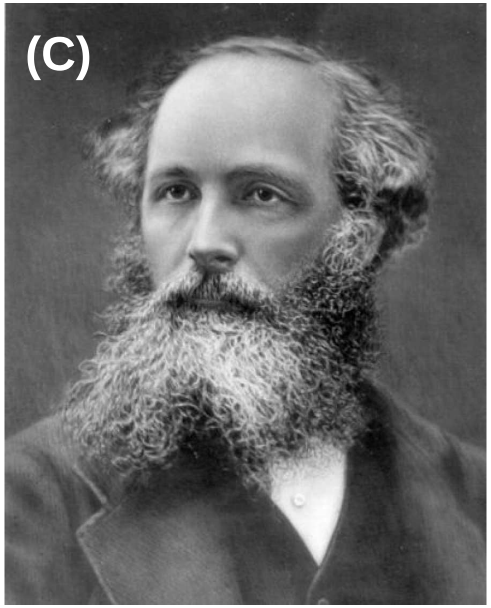
Which of these pictures shows James Clerk Maxwell ?



William Thomson
(Lord Kelvin)



Ulysses S. Grant



James Clerk Maxwell

Homeworks

- HW1 will be online at noon on D2L

- Answers for questions in first part to be submitted via D2L

    Multiple-Choice question
    Answer in numerical form with units!
    Essay questions

    credit for correctness or for participation

- Long answer question (with tutorial) to be submitted in wooden box in Physics Help Room

Homeworks

Elements for grading essay and long answer questions

1. **Identifying the physical principles or "key ideas" (expressed in words) that apply to the problem and your strategy for approaching the problem**

2. **Explaining (in words) the reasoning that goes along with the equations/math you are doing**

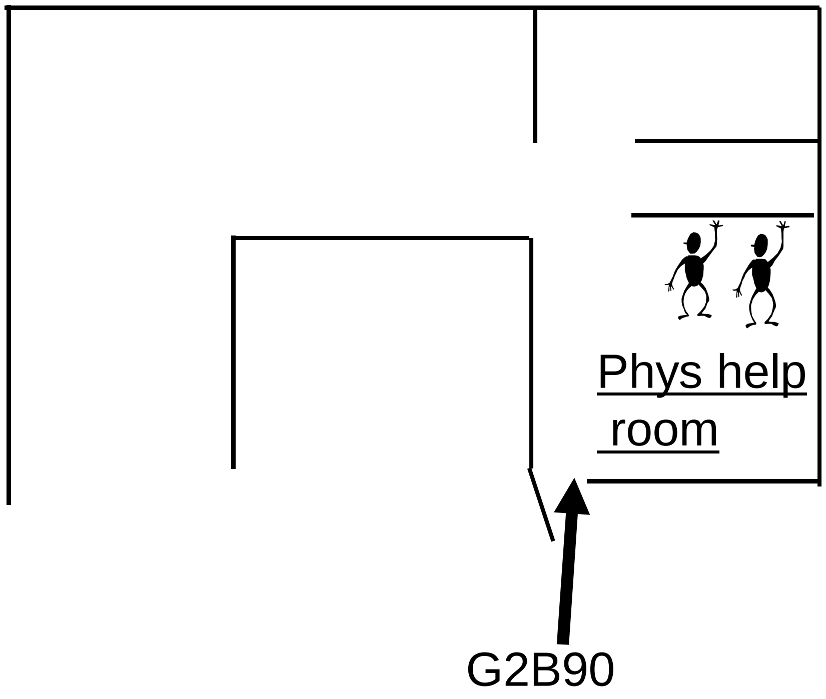
3. **Showing the details of your solution (equations/math)**

4. **Clarity of solution**

Team is here to help

Problem solving sessions:

Best education is one-on-one examination of thinking with feedback.
Main learning time!



Regular Weekly Hours:
(start next week)

Mo: 11-12 (after class)

Tues: 2-5

Wed: 11-12 (after class)
2-5

Thurs: 2-5

Homework is *hard*, but ok. You will learn a lot when working together.
We coach, help you to interact – but will **not** *give or check answers*

And God said

$$\nabla \cdot \vec{E} = \frac{\rho}{\varepsilon_0}$$

$$\nabla \cdot \vec{B} = 0$$

$$\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$$

$$\nabla \times \vec{B} = \mu_0 \vec{J} + \frac{1}{c^2}\frac{\partial \vec{E}}{\partial t}$$

and there was light.

How do you generate light (EM wave)?

(A) Stationary charges

(B) Charges moving at a constant velocity

(C) Accelerating charges

(D) B and C are correct

(E) A, B and C are correct

Maxwell equations

$$\nabla \cdot \mathbf{E} = \frac{\rho}{\varepsilon_0} \qquad \nabla \cdot \mathbf{B} = 0$$

$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t} \qquad \nabla \times \mathbf{B} = \mu_0 \mathbf{J} + \mu_0 \varepsilon_0 \frac{\partial \mathbf{E}}{\partial t}$$

$$\oint \mathbf{E} \cdot d\mathbf{A} = \frac{Q_{encl}}{\varepsilon_0} \qquad \oint \mathbf{B} \cdot d\mathbf{A} = 0$$

$$\oint \mathbf{E} \cdot d\mathbf{L} = -\frac{d\Phi_B}{dt} \qquad \oint \mathbf{B} \cdot d\mathbf{L} = \mu_0 I_{encl} + \mu_0 \varepsilon_0 \frac{d\Phi_E}{dt}$$

Wave equation

$$\nabla \cdot \mathbf{E} = \frac{\rho}{\varepsilon_0}$$

$$\nabla \cdot \mathbf{B} = 0$$

$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$$

$$\nabla \times \mathbf{B} = \mu_0 \mathbf{J} + \mu_0 \varepsilon_0 \frac{\partial \mathbf{E}}{\partial t}$$

$\Rightarrow$ $$\nabla^2 \mathbf{E} = \frac{1}{c^2} \frac{\partial^2 \mathbf{E}}{\partial t^2}$$ (in 3D)

$$\frac{\partial^2 \mathbf{E}}{\partial x^2} = \frac{1}{c^2} \frac{\partial^2 \mathbf{E}}{\partial t^2}$$ (in 1D)

<u>in HW: </u>Show that $\mathbf{E}(x,t) = \mathbf{E}_0 \cos(ax + bt)$ is a solution

Traveling sinusoidal wave

Consider an electromagnetic wave given by the following electric field:

$$E(x,t) = E_0 \sin\left(2\pi\frac{x}{\lambda} - 2\pi\frac{t}{T}\right)$$

The wave is moving in …

(A) positive x-direction

(B) negative x-direction

Traveling sinusoidal wave

Consider an electromagnetic wave given by the following electric field (v>0):

$$E(x,t) = E_0 \sin\left(2\pi \frac{x - vt}{\lambda}\right)$$

The wave is moving in …

(A) positive x-direction

(B) negative x-direction