

## Electromagnetic Theory II: Homework 16

Due: 6 April 2021

- 1 Griffiths, *Introduction to Electrodynamics*, 4ed, 10.12, page 448.

### 2 Fields produced by an infinite straight wire

An infinite straight wire carries a current

$$I = I_0 t / \tau$$

for  $t > 0$  and where  $I_0$  is a constant with units of current and  $\tau$  is a constant with units of time.

- a) Consider a point a distance  $s$  from the wire. Show that the potentials are

$$V = 0$$

$$\mathbf{A} = 0$$

for  $t < s/c$  and

$$V = 0$$

$$\mathbf{A} = \frac{\mu_0 I_0}{2\pi\tau} \left[ t \ln \left( \frac{ct + \sqrt{c^2 t^2 - s^2}}{s} \right) - \frac{\sqrt{c^2 t^2 - s^2}}{c} \right] \hat{\mathbf{z}}$$

for  $t \geq s/c$ .

- b) Determine the electric and magnetic field produced by the current for  $t \geq s/c$ . Use cylindrical coordinates.
- c) Determine the Poynting vector associated with these fields. In which direction is energy transported? At what speed is it transported?