# Electrostatic lens (10 points)

## Part A. Electrostatic potential on the axis of the ring (1 point)

**A.1** (0.3 pt)

$\Phi(z) =$

**A.2** (0.4 pt)

$\Phi(z) \approx$

**A.3** (0.2 pt)

$F(z) =$

Circle the right answer: $q < 0$ *or* $q > 0$.

**A.4** (0.1 pt)

$\omega =$

## Part B. Electrostatic potential in the plane of the ring (1.7 points)

**B.1** (1.5 pt)

$\beta =$

**B.2** (0.2 pt)

$F(r) =$

Circle the right answer: $q < 0$ *or* $q > 0$.

## Part C. The focal length of the idealized electrostatic lens: instantaneous charging (2.3 points)

**C.1** (1.3 pt)

$f =$

**C.2** (0.8 pt)

$c$ =

**C.3** (0.2 pt)
Circle the right answer. The equation of the thin optical lens is: valid *or* not valid.

## Part D. The ring as a capacitor (3 points)

**D.1** (2.0 pt)

$C$ =

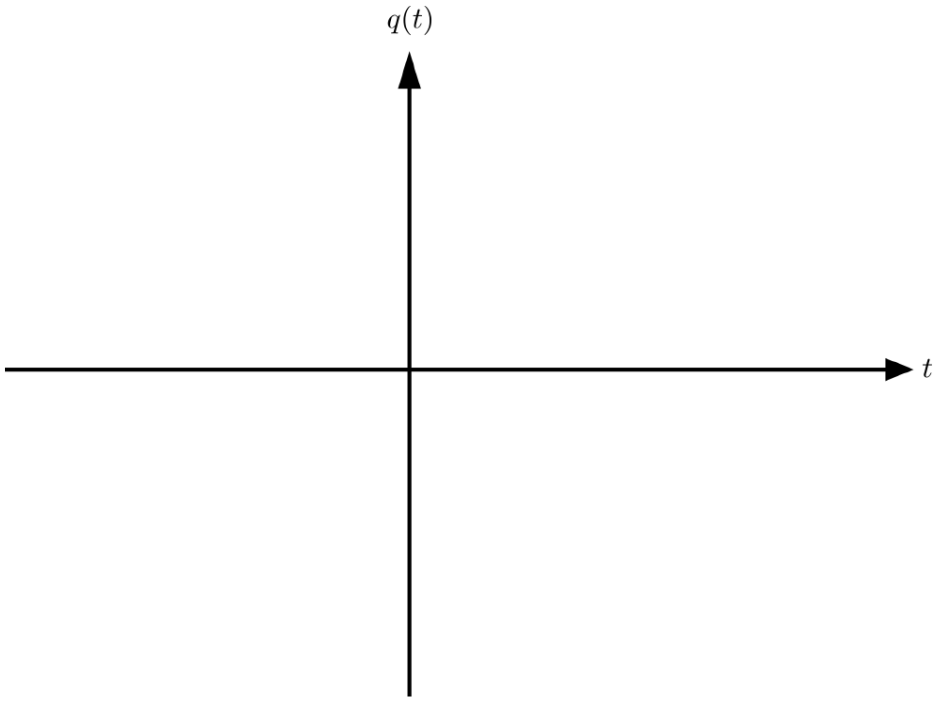
**D.2** (1.0 pt)

For $-\frac{d}{2v} < t < \frac{d}{2v}$, $q(t) =$

For $t > \frac{d}{2v}$, $q(t) =$

$q_0 =$

Charge on the ring as a function of time:




## Part E. Focal length of a more realistic lens: non-instantaneous charging (2 points)

**E.1** (1.7 pt)

$f =$

**E.2** (0.3 pt)

$q_{\text{eff}} =$