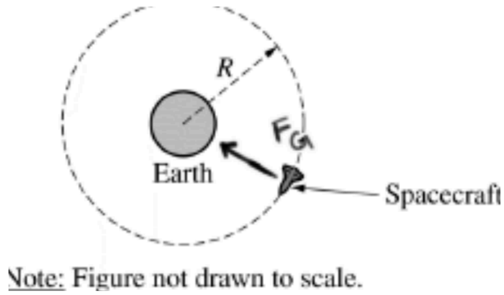
1. A.



B.

I.

Get velocity of spacecraft: $v = \frac{2\pi r}{T}$

Get centripetal force on spacecraft: $F = ma_R = m\frac{v^2}{r}$

Solve for velocity using centripetal force: $v = \sqrt{\frac{Fr}{m}}$

Substitute velocity: $\sqrt{\frac{Fr}{m}} = \frac{2\pi r}{T}$

Solve for period: $T = \frac{2\pi r}{\sqrt{\frac{Fr}{m}}}$

Gravity equation: $F = g\frac{M_E m}{R^2}$

Substitute force with gravity equation: $T = \frac{2\pi R}{\sqrt{\frac{g\frac{M_E m}{R^2}R}{m}}}$

Simplify: $T = \frac{2\pi R}{\sqrt{\frac{gM_E}{R}}}$

II.

Equal to. m is not in the equation in the previous part, therefore it has no effect

C.

Velocity is equal to $\frac{2\pi r}{T}$, if radius increases then velocity will also increase

2. A.

I.

$y = mx$

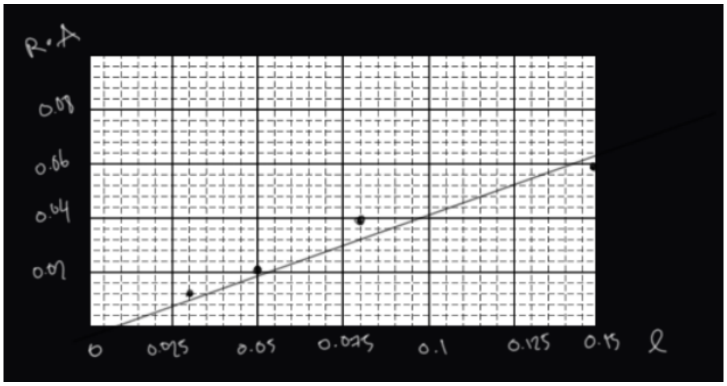
$R = \frac{\rho L}{A}$

$RA = \rho L$

Vertical: $R \times A$

Horizontal: L

II.



III. Slope: $\frac{2}{5}$

The resistance of the dough is around $0.4\Omega \times m$

B.

No. The resistivity of the dough itself will not change. The wire resistivity changes because of the cross-sectional area.

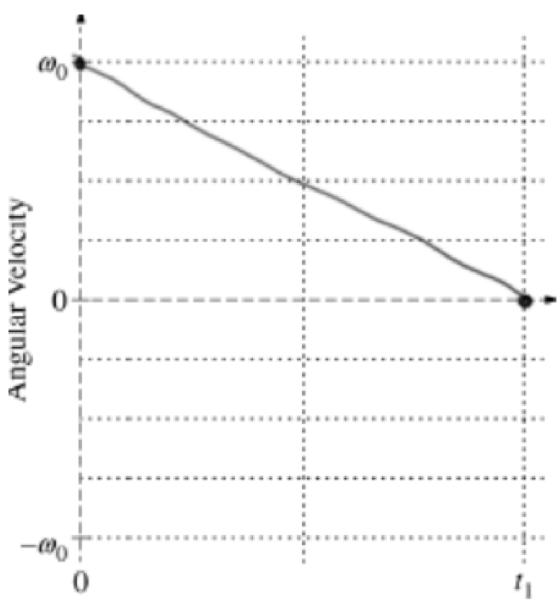
C.

You will need a thermometer, meter stick or calipers, controllable temperature surface, a constant power source, and a light.

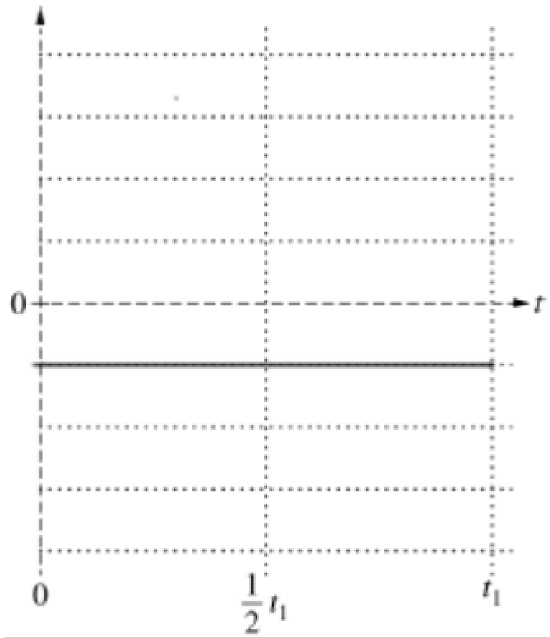
First, create multiple different wires, with the same cross-sectional areas and lengths. Then heat/cool the wires to a certain temperature and record the temperature. With the heated/cooled wire, form a circuit with the power source and light bulb. Compare the light brightness with the rest of the wires. The brighter the light, the lower the resistance of the dough. The dimmer the light, the higher the resistance.

3. A.

I.



II.



B.

Angular Acceleration and substitute: $\alpha = \frac{\Delta\omega}{\Delta t} = -\frac{\omega_0}{t_1}$

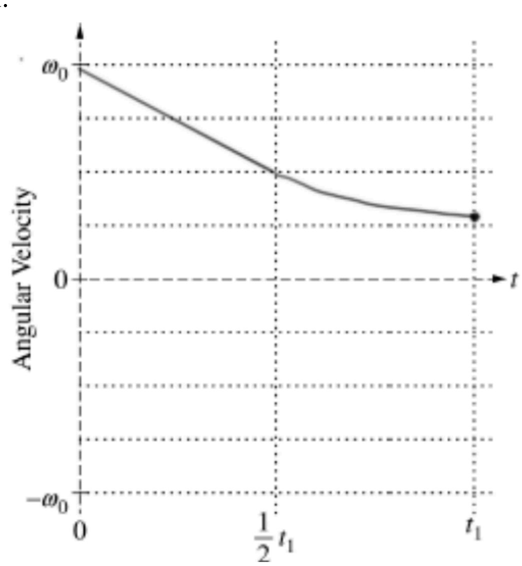
Net torque equation: $\Sigma\tau = I\alpha$

Solve for moment of inertia: $I = \frac{\Sigma\tau}{\alpha}$

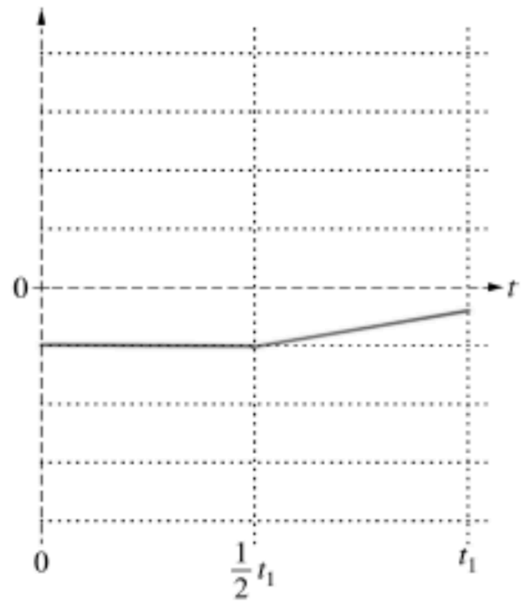
Substitute: $I = \frac{\tau_0}{-\frac{\omega_0}{t_1}} = -\frac{t_1\tau_0}{\omega_0}$

C.

I.



II.

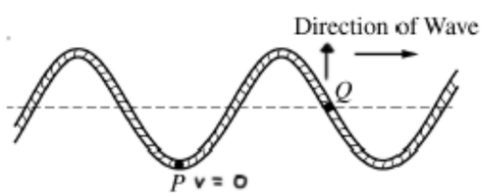


D.

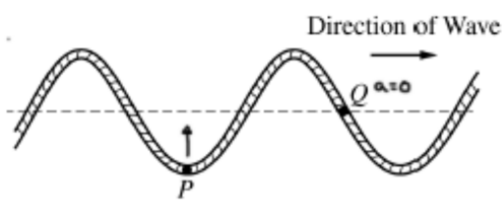
Equation 2 better represents the torque because equation 2 contains $t + \frac{1}{2}t_1$, which means the time after the $\frac{1}{2}$point. Equation 1 on the other hand, has $t - \frac{1}{2}t_1$, which represents the time before the $\frac{1}{2}$point.

4. A.

I.



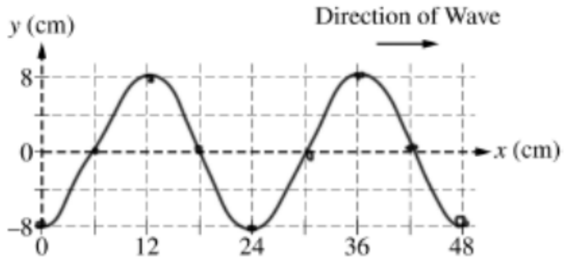
II.



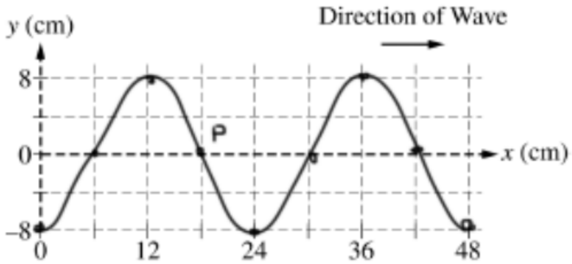
B.

I.

When $t = T/4$, the wave will be transformed towards the right by 1 unit



II.



C.

$(8cm \times 2cm) \times 2cm = 32cm$

5. A.

$T = 2\pi\sqrt{\frac{m}{k}}$

$T_{PQ} = 2\pi\sqrt{\frac{3m}{k}}$

$T_P = 2\pi\sqrt{\frac{m}{k}}$

$\frac{T_{PQ}}{T_P} = \frac{2\pi\sqrt{\frac{3m}{k}}}{2\pi\sqrt{\frac{m}{k}}} = \frac{2\pi\sqrt{\frac{m}{k}}\times\sqrt{3}}{2\pi\sqrt{\frac{m}{k}}} = \sqrt{3}$

B.

Equal. This is because the total system energy remains constant once the block is dropped. Therefore, using $W = \frac{1}{2}kA^2$, $k$and Aremain constant