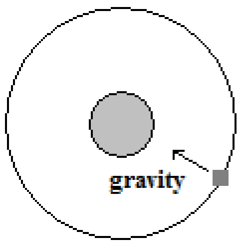
2018 AP Physics 1 Free Response answers

1.a.



1b.i.

$F_G = F_C$

$\frac{GM_E m}{R^2} = \frac{mv^2}{R}$

$v^2 = \frac{GM_E}{R} = (\frac{2\pi R}{T})^2 = \frac{4\pi^2 R^2}{T^2}$

$T = \sqrt{\frac{4\pi^2 R^3}{GM_E}}$

1.b.ii.

Equal to. In the derivation above, the mass of the satellite is not in the final result for period, so it does not affect the value.

1.c.

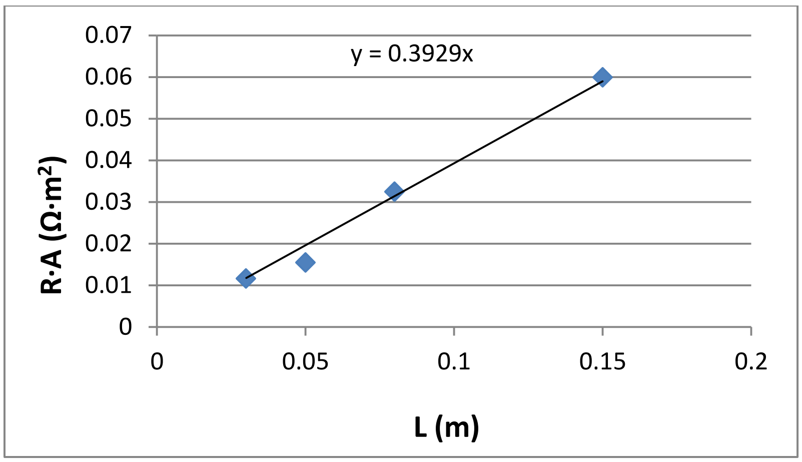
Less than. In the intermediate step of the derivation above, $v^2 = \frac{GM_E}{R}$. As R increases, v decreases.

2.a.i.

Vertical Axis: R·A Horizontal Axis: L

2.a.ii.

Dough cylinder	A (m^2)	L (m)	ΔV (V)	R (Ω)	R·A (Ω·m^2)
1	0.00049	0.03	1.02	23.6	0.011564
2	0.00049	0.05	2.34	31.5	0.015435
3	0.00053	0.08	3.58	61.2	0.032436
4	0.00057	0.15	6.21	105	0.05985



2.a.iii.

ρ = slope = 0.39 Ω·m

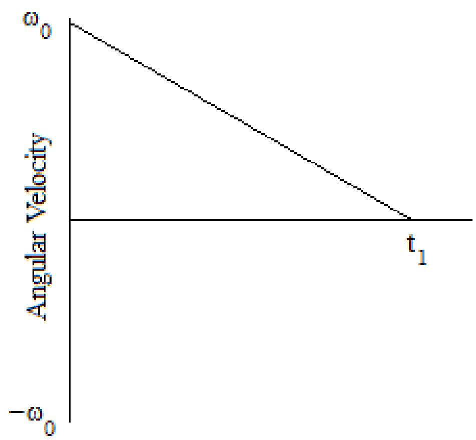
2.b.

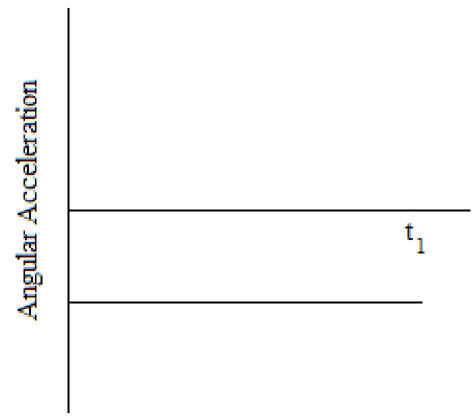
No. The relationship R = $\frac{\rho L}{A}$ is independent of the geometric shape of the resistor.

2.c.

Cap the ends of a conductive cylinder with foil which is then soldered to wire leads. Coat the remainder of the cylinder with non-conductive rubber cement to make it waterproof. Connect the cylinder with a power supply and ammeter in series and then place the cylinder in a water bath on a hot plate with a thermometer in the bath. Turn-on the power supply, ammeter, and hot plate. Collect ammeter readings at temperatures of 30 through 90 degrees Celsius in intervals of 5 degrees. If the graph of current versus temperature is horizontal, the resistance is independent of the temperature.

3.a.i.ii.





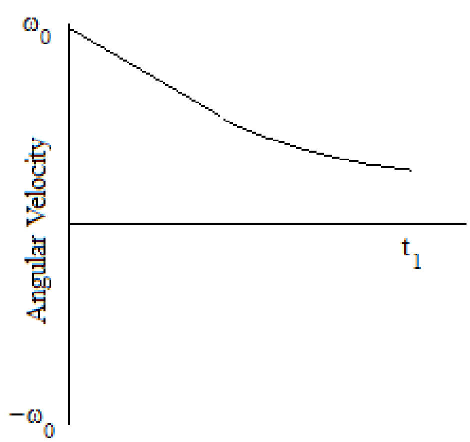
3.b.

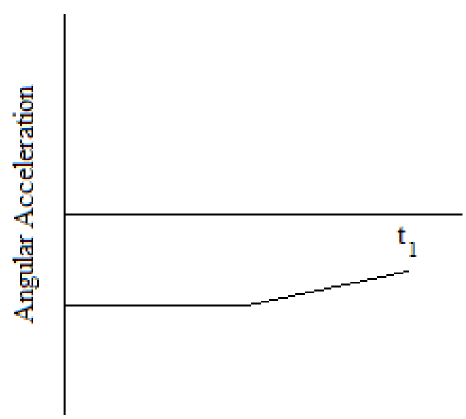
$\tau = I \cdot \alpha$

$-\tau_0 = I \cdot \frac{0 - \omega_0}{t_1}$

$I = \frac{\tau_0 \cdot t_1}{\omega_0}$

3.c.i.ii.

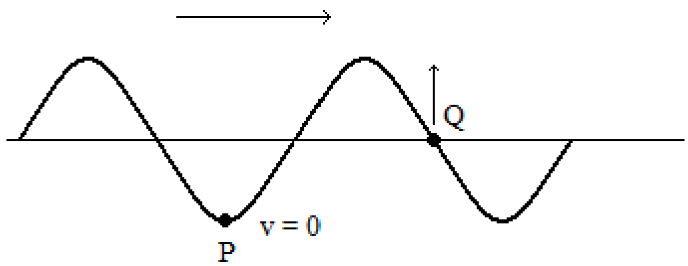




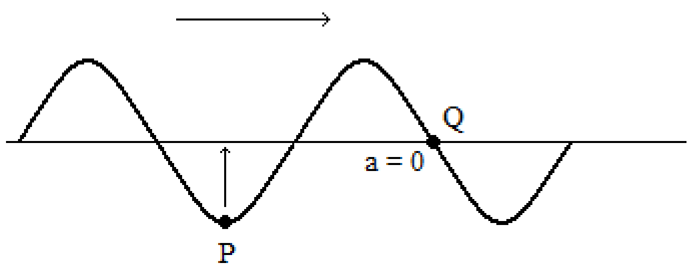
3.d.

Equation (2). The second equation shows that, as t increases, τ decreases, in agreement with the graph and description. The first equation shows that, as t increases, τ increases, which does not agree with the graph and description.

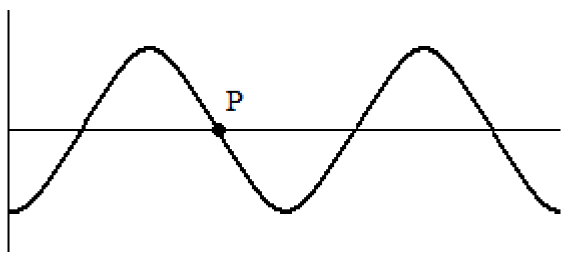
4.a.i.



4.a.ii.



4.b.i.ii.



4.c.

32cm

5.a.

$\frac{T_{PQ}}{T_P} = \sqrt{3}$

5.b.

$A_{PQ} < A_P$

In the collision between the two blocks, momentum is conserved. Therefore, if the mass of the moving system triples, the velocity of the moving system is cut into one-third. The kinetic energy of the system is then one-third what it is before the collision. At equilibrium, the oscillating system's energy is entirely kinetic, so the total energy of the system has also reduced to one-third the pre-collision value. At maximum displacement, the kinetic energy is zero, so this reduced total energy requires a reduced spring energy. By the equation $U = \frac{1}{2}kx^2$, a lesser energy implies a lesser amplitude.