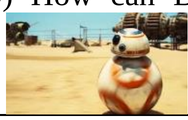
Name:

ME 6710, Final Exam

August 4, 2017

Rules: This is a self-proctored exam. You have a maximum of 3 hours to spend on the exam. Once you have started the exam, you can take breaks as needed (not counting toward 3 hours), but you cannot take additional study time outside the 3 hours. Exam is open book, notes, course material. Contact me directly if you have questions, 931-267-2669. Thanks and good luck!

 # 1: (10%) Matching:

	Match	
1) Number of generalized coordinates needed to describe the motion of a particle in space		a)diagonal **I**
2) Kinetic Energy		b)$\int(x^2+y^2)dm$
3) Potential energy		c) 3
4) moment of inertia		d) ½*m*$\mathbf{v}^T\mathbf{v}$
5) T-V		e)$-\int(xy)dm$
6) principal inertia		f) L
7) product of inertia		g) m*g*h
8) Best speech in the history of speeches given by a president to boy scout jamboree		h) Pres. Trump's speech to boy scout jamboree
9) (True or False) Lagrange's equations eliminate all workless, constraint forces		
10) How can BB-8 travel through the sand without getting stuck? 		

#2 – 10%

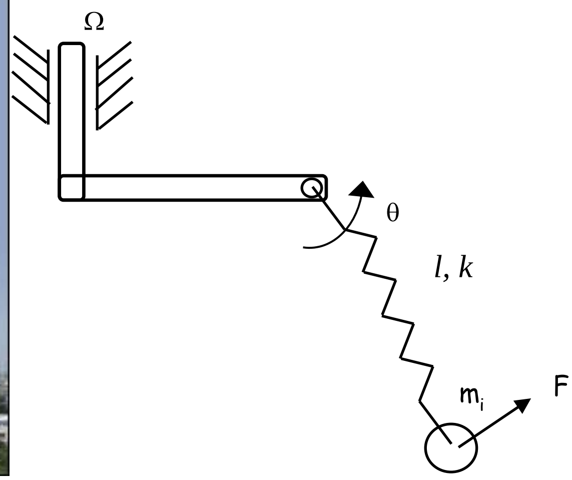
2 a) Name of Ordinary differential equation solver in matlab?

2b) Name of Method that eliminates workless constraints

2c) Name of method that incorporates accelerations as inertial forces into virtual work

2d) method that extends 2c into an energy-based method (most common analytical dynamics approach used)

#2) (40%) Kevin continues to create a ruckus at amusement parks. Here is Kevin shown as a lumped mass in the schematic on a spinning ride with an elastic supporting cable. Kevin is holding a water pistol shooting out at the crowd. Assume the water pistol creates a force F directed as shown on the figure (fixed perpendicular to *l* in his frame of reference). Using Lagrange's method to , solve the equations of motion assuming the tower is rotating at a constant speed Ω = phi_dot and F is constant. Show all work.



#4) (40%) **Dynamic analysis of a Trebuchet:** Given the trebuchet shown in the figure and model below, construct the equations of motion and any other equations needed for integration. Use Lagrange's methods. Assume that the system mass is lumped in two spots, one at i and one at P. Use the generalized coordinate set $\mathbf{q}=\{r_2,\theta_3\}^T$ and the method of Lagrange multipliers to incorporate the loop closure constraint (note that this is a 1 dof system). Briefly describe the process to perform numerical simulation in Matlab. Show all you work.