1. A toddler goes on a rampage and starts pushing its toy box. The toy box has a mass of 5.0 kg. The coefficient of static friction is 0.6 and a coefficient of kinetic friction 0.5.
   a. The toddler pushes the box with a force of 20.0 N. Quantify all the forces on the toy box and the toy box's acceleration. After 3 seconds how far has the box moved? [3]

   b. If the toddler pushes the box with a force of 29.4 N. What are the forces and acceleration now? After 3 seconds how far has the box moved? [3]

   c. If the toddler pushes the box with a force of 34 N with a massive prolonged scream. What are the forces and acceleration now? After 3 seconds how far has the box moved? [3]

2. The caregivers of the toddler notice the aggressive behaviour it is exhibiting and decide to take it to a playground. At the playground they decide to tire the toddler out on the swings. The toddler has a mass of 11.0 kg and the length of the cable is 1.8 m.
   a. What frequency should the caregivers push the toddler at, so it has the most fun? [2]

   b. If the caregivers put a total of 13 J into the system what is the amplitude, maximum velocity and maximum acceleration of the toddler? [4]

   c. If the toddler has just interacted with their caregivers at one extreme of their arc, where are they, with what speed and acceleration after 1.2 seconds? [3]

3. Terrifying their caregivers, the toddler jumps out of the swing at the peak of its travel away from them. The mortified and scared caregivers watch on as the toddler launches into a perfect somersault. The toddler leaves the swing with a total energy of 600 J, if the toddler is moving at a horizontal speed of 8.0 ms^{-1} and climbs to a height of 1.8 m from an initial height of 0.6 m.
   a. What energy is remaining for the toddler to tuck into a ball and rotate? [3]

   b. How far does the toddler travel? [4]

   c. If the toddler has an angular inertia of 1.1 kgm^2 while tucked into a ball, what angular velocity does the toddler reach? [3]

   d. Describe and explain how the toddler's angular velocity changes as the toddler straightens out and sticks a perfect landing? [3] What do the caregivers feel? [0]

4. The caregivers look around to see if anyone else saw their amazing child/ their bad caregiving. Relived that there are no witnesses but sad that it was not caught on film, they try to go to play it safe by changing equipment to the seesaw. One of the caregivers places the toddler at one end of the 3-meter-long seesaw while the other caregiver who is 70 kg sits at the other end. The 70 kg caregiver butt scoots from their end of the seesaw forward at 1 ms^{-1}. (remembering the toddler's mass is 11.0 kg)
   a. How long until the seesaw is balanced? [2]

   b. The other caregiver, who is 58 kg, joins the toddler forcing the 70 kg caregiver to butt scoot backwards until the seesaw is balance. If the 70 kg caregiver pushes up with a force of 45N, with what magnitude will the toddler accelerate and what assumptions did you make? (the mass of the seesaw is 30 kg, inertia of a rod rotating around its centre is $I = \frac{1}{12}ml^2$) [7]

5. The seesaw goes down well after a slow start and they move on to a merry-go-round. As they spin the merry-go-round at a slow speed, the toddler toddles in a straight-line from the rim of the merry-go-round to the centre of the merry-go-round. Describe and explain what happens to the **angular velocity** of the merry-go-round, the **momentum** of the system and the **energy** of the system? [10]

6. After having no incidents on the merry-go-round, the family moves onto the slide. The 70kg caregiver goes down first to attempt to dry the slide for the toddler but stops in the middle. As the other caregiver and the toddler are already sliding down at 4 ms^{-1}, the family collide and move together at what speed? [2]

7. The toddler loves to be spun around in a circle such that it is spinning at 1.2 Hz (s^{-1}). Assume the toddler can be treated as a point source 1 meter away from the caregiver and that the toddler and the arms are elevated at 45° from the horizontal. What force must the caregiver pull the toddler towards themselves, to get that frequency of motion? [8]