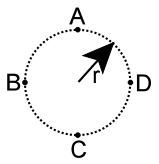
PART A: MULTIPLE CHOICE (10 MARKS)

Choose the best response in each case.

1. A boy pushing a 20 kg lawn mower exerts a force of 100 N along the handle. The handle is elevated 37° to the horizontal. The component of the applied force that pushes the lawn mower forward is closest to:
   (a) 200 N (b) 100 N
   (c) 80 N (d) 60 N

Use the following diagram to answer questions 2 & 3. An object attached to a string is rotated in a vertical circle of radius r with a constant speed v.



2. At what point in the object's flight path does the maximum tension in the string occur?
   (a) A (b) B
   (c) C (d) D

3. If the radius is maintained at r, but the speed of rotation is changed to 4v, by what factor will the centripetal acceleration change?
   (a) 2 (b) 4
   (c) 8 (d) 16

PART B: PROBLEMS (40 MARKS)

Answer the following questions on a separate sheet of paper. You may use the back of this sheet if you wish.

Use g = 9.81 m/s^2[down] where necessary.

1. A cougar is crouched on the branch of a tree that is 3.82 m above the ground. He sees an unsuspecting rabbit on the ground, sitting 4.12 m from the spot directly below the branch on which he is crouched. He jumps horizontally and lands on the rabbit.

{4} (a) How long was the cougar in flight?

{3} (b) What was the initial velocity of the cougar?
{Recall: the cougar jumps horizontally off the branch!}

2. A beam of electrons (mass = 9.11×10^{-31} kg) is caused to move in a circular path of radius 3.00 m at a velocity of 2.00×10^{7} m/s.

{5} (a) Find the (i) centripetal acceleration and (ii) centripetal force acting on one electron.

{1} (b) What type of force supplies the centripetal force?

3. While hiking in the wilderness, you come to the top of a cliff that is 80.0 m high. You throw a stone from the cliff, giving it an initial velocity of 27 m/s at 55° above the horizontal.

{2} (a) What are the horizontal and vertical components of the initial velocity?

{6} (b) How long was the stone in flight?

{3} (c) How far from the base of the cliff does the stone land?

4. A car exiting a freeway enters an icy curve (ie no friction) with a radius of curvature of 175 m is banked at 12°.

{4} (a) Draw a FBD of the situation. Be sure to label your forces appropriately and to include values (if possible).

{5} (b) At what speed (in km/h) must a car travel to ensure that it does not leave the road?

{7} 5. If the coefficient of friction between your running shoes and the gym floor is 0.90, what is the smallest circle (radius) that you could run at 6.2 m/s without slipping? Be sure to include a FBD to help you analyze this problem!