

Assignment #1 HK 376 – Biomechanics

September 10th, 2018

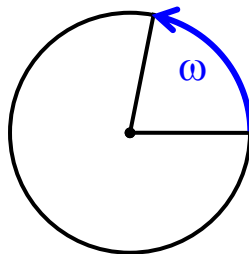
- 1) Convert 360° degrees into radians. (1)

- 2) A golf club head is travelling at -2.62 radians/s, convert into degrees/s? (1)

- 3) Which of the following is true of acceleration? (1)
 - a. It is always a scalar quantity.
 - b. The direction of the motion dictates the direction of acceleration.
 - c. An object can be accelerating even if the speed is constant.
 - d. It is the rate of motion of an object
 - e. Both c and b

- 4) Is it possible for a rotating object to have a positive instantaneous tangential velocity and a negative instantaneous tangential acceleration? Why or why not? Please explain and provide an example. (1)

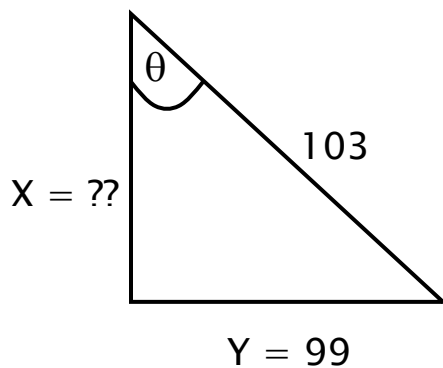
- 5) Clearly describe the direction that the angular velocity vector associated with the diagram below would point? (1)



6) On the advice of a rookie lab instructor, Hank Aaron has decided to come out of retirement in order to regain his homerun title from Barry Bonds. A new rule in baseball permits players over the age of 60 to use longer bats that have the same mass as those used by younger players. Why would Aaron choose to use a longer bat for hitting homeruns? What is an associated kinematic equation that supports your answer. (1)

7) Describe how displacement, velocity and acceleration are related mathematically? I.e., describe all possible ways one variable can be determined from another. (2)

8) What is the angle θ and length of X for the triangle below? (1)



- 9) A firefighter climbs a ladder that has a vertical distance between each step of 25 cm. The following table provides the time taken to climb each step.

Step	1	2	3	4	5
Time	1.4 sec	1.7 sec	2.0 sec	2.2 sec	1.2 sec

- a. Determine the greatest climbing velocity and at which step this occurred. (1)
 - b. Determine the average climbing velocity for the firefighter to climb entire ladder. (1)
- 10) A point on the end of a baseball bat has an angular velocity of 4834 degrees/sec and makes contact with a ball with a tangential velocity of 122 m/sec. If the bat is experiencing pure rotational movement, then how far away is the point on the end of the bat to the point of rotation? (1)
- 11) Daniel decides to go for a run. He leaves his house and jogs 4800 m North, then stops and turns around. He continues to jog for 4700 m to the South.
- a. What is his displacement? (1)
 - b. What is his average speed if it took him 45 minutes? (1)
- 12) If a rock tied on the end of a string has a radius of 2.6m and has an angular displacement of 145 degrees, what is the arc length traced out by the rock? (1)

- 13) Determine the average velocity of an Olympic 4x400m sprint team that runs in the inside line of a 400 m track and finishes in a time of 2 minutes and 57 seconds. (1)
- 14) Determine the average acceleration of a 200 m Olympic sprinter if he starts from rest and finishes the race at a velocity of 16 m/s. Assume constant acceleration throughout the entire 200 m. (1)
- 15) During a hockey game against the dominate X-Men hockey team, a Dalhousie defenseman picks the puck up at the intersection of the icing line and the west side of the boards. In an attempt to relieve the pressure he dumps the puck 110 feet up the ice before it is intercepted by an X-Men forward at the opposing blue line in the St.F.X. end. If the puck was intercepted 25 feet from the west side boards, what was the displacement of the puck at the point of interception? (1)
- 16) Later, during the same hockey game a St.F.X. forward standing in front of the Dalhousie goal tender receives a perfect pass from a streaking St.F.X. right winger. The puck (mass = 170 grams) was traveling with a velocity of 18 m/s in the west direction when it touches the St.F.X.'s forwards stick. As he cushions the puck to slow it down, the puck undergoes an acceleration of -23 m/s^2 . How long will it take for the puck to come to a complete stop on the forward's stick? (1)

17) GOAL! After receiving the beautiful set-up from the right winger, the St.F.X forward pots the winning goal. He then proceeds to re-enact the Sidney Crosby 2010 overtime gold winning goal celebration; this has upset the Dalhousie tough guy, who is looking for some retribution. In an attempt to escape, the forward skates 145 meters West and 20 meters South in 3 minutes with the tough guy on his back, what was their average velocity? (1)

18) At the end of a routine on the uneven parallel bars a gymnast performs a forward somersault before landing safely on the ground. If the gymnast had an average angular velocity of 26 rad/s and she was in the air for 0.98 seconds, how many rotations are completed before she lands? (1)

19) In Antigonish's Highland games, there is an event which involves throwing a heavy implement called the Scottish hammer. This event consists of a 10 kg weight attached at the end of a 1.22 m shaft. An athlete is spinning about an axis that runs vertically straight through the centre of his body. The distance (radius) from his spin axis to his outstretched hands that are gripping the start of the hammer cable is 0.42 m. The hammer is being whirled around with an instantaneous angular acceleration of 45 rad/s/s about his spin axis.

- What is the component of linear acceleration acting perpendicular to the radius in m/s/s? (1)
- The moment the athlete releases the hammer he has an angular velocity of 80 rad/s, if it takes him 1.3 seconds to stop spinning, what is his angular acceleration? (1)

20) If you were cycling around a perfectly circular velodrome with a constant speed of 6 m/s, what types of acceleration are you undergoing? Explain? (1)

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This assignment is due at the beginning of class on Monday, September 17th. Please show all your work.

Late assignments will result in a 25% per day deduction in the assignment mark.