**ST MARY’S UNIVERSITY**

**TWICKENHAM, LONDON**

BA/BA(ITT)/BSc Degree Examination students registered for

Level **FIVE**

Title**: Sports Biomechanics**

Code: **SPS5041**

Semester: **Resit**

Date: **03 July 2019**

Time: **13:30-15:00pm**

TIME ALLOWED: **ONE HOUR** AND **THIRTY** MINUTES

A formula sheet has been provided to help you answer the questions.

You are permitted to use calculators for this exam.

Answer **ALL** questions in the answer book provided.

There are a total of 75 marks available. Some of these marks are available for correct units and correct number of decimal places.

##### **Formula Sheet**

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| **Linear Motion** | **Angular Motion** |
| v = d ÷ t | ω = θ ÷ t |
| a = Δv ÷ t | α = Δω ÷ t |
|  |  |
| F = m × a | T = I x α |
| I = F × Δt | M = F × d |
| F × Δt = m × vf – m × vi | H = I × ω |
| F = μ × R |  |
| W = F × d |  |
| W = ∆KE + ∆PE |  |
| KE = ½ x m × v2 |  |
| PE = m × g × h |  |
| SE = ½ x k × x2 |  |
| P = W ÷ t |  |
| P = F × v |  |
|  |  |
| Cr = (Vb minus Va) divided by (Ua minus Ub) |  |
|  |  |
| v = u + a × t |  |
| s = u × t + ½ × a × t2 |  |
| v2 = u2 + 2 × a × s |  |

1. When conducting a biomechanical analysis using a video camera, there are several important camera settings that we must select. Identify two of these settings and explain why they are important to consider when conducting a biomechanical analysis. (4 marks)
2. Sometimes we use markers when doing a video analysis. List two advantages and two disadvantages of using markers to identify anatomical landmarks. (4 marks)
3. When throwing a cricket ball, Joe Root’s elbow extends from 35° to 170° in 0.25 seconds. Calculate the average angular velocity of the elbow extension. (3 marks)
4. During a 100 m sprint, Christian Coleman increases his horizontal centre of mass velocity from 9.6 m/s to 11.3 m/s. If it takes him 1.1 s to do this;
5. Calculate the average horizontal acceleration of his centre of mass over this time period. (3 marks)
6. Given that Christian Coleman’s mass was 72 kg during this race, calculate the average horizontal force that he required to achieve this acceleration. (3 marks)
7. A boxer throws a punch connecting with the opponents shoulder with a force of 1000 N. If the punch is in contact with the shoulder for 0.3 s, calculate the impulse imparted. (3 marks)
8. If a surface-ball combination has a coefficient of restitution close to 0, what does this mean in terms of the kinetic energy lost during a collision? (1 mark)
9. A pole vaulter uses a pole with a stiffness constant of 1250 N/m. Calculate how much strain potential energy is stored in the pole when it deforms by 1.3 m. (3 marks)
10. Name the five attributes of normal healthy gait according to Gage (1991). (5 marks)

a) A gymnast leaves the floor with an angular momentum of 20 kg·m2/s. When fully extended he has a moment of inertia of 9 kg·m2 – calculate his angular velocity. (3 marks)

b) The gymnast then tucks in and reduces his moment of inertia to 5 kg·m2. Work out what his angular velocity has changed to. (2 marks)

1. A long jumper takes off from the floor with a velocity of 9.0 m/s. If the long jumper’s mass was 74 kg, calculate their:
   1. Kinetic energy at take-off (2 marks)
   2. Gravitational potential energy at the top of their jump (2 marks)
   3. Kinetic energy at the top of the their jump (1 mark)
2. A weightlifter lifts a 65 kg weighted barbell to a height of 2.1 m.

|  |
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| image showing a weightlifter lifter a 65kg barbell to a height of 2.1m |

1. Calculate the weight of the barbell (2 marks)
2. Calculate the work done to lift the weighted barbell to this height (3 marks)
3. Identify whether this is positive or negative work and explain your answer (2 marks)
4. If the weight was lifted in 1.3 s, how much power did the weightlifter produce? (3 marks)
5. What is a Magnus force? (2 marks)
6. Calculate the coefficient of restitution when a tennis player hits a volley. The ball is travelling into the racket at 6.5 m/s and the racket is stationary before the ball hits it. Immediately after the ball is hit, the ball has a velocity of 5 m/s and the racket is moving in the opposite direction at 0.5 m/s. (5 marks)
7. In the correct order, list the four typical steps involved in a qualitative biomechanical analysis of a sporting skill (as used in the four-task model proposed by Knudson and Morrison, 2002). (4 marks)
8. Define friction and state the equation we use to calculate it. (2 marks)

**Use the equations of constant acceleration to help you answer question 16.**

***Please show all of your working clearly as you may be awarded some marks even if you do not get to the correct final answer*:**

* 1. A diver drops from the 7.5 m platform with an initial vertical velocity of 0.0 m/s. What was the vertical velocity of the diver immediately before he enters the water? (5 marks)
  2. How long did it take the diver to reach the water? (4 marks)
  3. If the diver needed to clear the edge of the pool by 1.5 m, what was the horizontal velocity of the diver at the instant of take-off? (4 marks)

**END OF EXAMINATION**