UNIVERSITY OF BOLTON

SCHOOL OF SPORT AND BIOLOGICAL SCIENCES

SPORT AND EXERCISE SCIENCE PATHWAY

SEMESTER TWO EXAMINATION 2018/2019

SPORT AND EXERCISE BIOMECHANICS

MODULE NO: SPS5005

Date: Tuesday 21 May 2019 **Time: 2.00 pm – 4.00 pm**

INSTRUCTIONS TO CANDIDATES:

There are 6 questions on this paper, 2 questions in section A and 4 questions in section B.

Answer ONE question from Section A and TWO questions from Section B.

Write your answers in the answer book provided NOT on the question paper. You must clearly label each answer with the corresponding section letter, question number and part letter.

Electronic calculators may be used provided that data and programme storage memory is cleared prior to the examination.

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Module No. SPS5005

Section A: Experimental

Answer ONE question from this section.

1.

a) What is a piezoelectric force platform and how is it typically used in sport and exercise biomechanics?

(10 marks)

b) A Strength and Conditioning Coach requires information on single-leg countermovement jump symmetry (dominant versus non-doiminant limb) on a squad of soccer players. How can the measure of Ground Reaction Force (GRF) using force platforms assist in scientific support in the above scenario?

Outline an assessment session designed for this group of athletes. In your design, consider protocol and data analysis, including familiarisation, normalisation, and notes on the interpretation of the potential results.

(30 marks)

c) What would the inclusion of 2D or 3D kinematic data from video add to the assessment outlined above? Consider the additional biomechanical data that would be available, and practical application to this sporting scenario.

(10 Marks)

2.

a) **Outline** an experiment to assess quadriceps strength in knee extension for a team of soccer players using the Isokinetic Dynamometer. **Provide details** of experimental design including familiarisation and speed selection.

(30 Marks)

b) With reference to literature, **discuss** the reliability and validity of isokinetic strength assessment using an isokinetic dynamometer in the context soccer kicking.

(20 Marks)

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Section B: Theoretical

Answer TWO questions from this section.

3.

a) Calculate the **linear tangential velocity** of a *Driver* golf club head, just before impact, which has an angular velocity of 28.5 rad • s^{-1} and a radius of rotation of 2.09 m.

(3 marks)

b) The same golfer swings a *9–iron* with the same angular velocity stated above, but the radius of rotation is now 1.96 m.

i) Calculate the **linear tangential velocity** of the 9-iron club head, just before impact.

ii) What is the **change** in club head speed from the *9–iron* to the *Driver* swings?

iii) **Explain** briefly the benefit of this result to the golfer.

(7 marks)

c) Calculate the **linear tangential velocity**, **tangential acceleration** & **radial acceleration** relating to a soccer players leg in a penalty kick, at the instant before contact. The angular velocity at that instant was 19.5 rad • s^{-1} and the swing time of that phase of the kick was 0.08 s. The length of the extended leg in that phase of the kick was 0.92 m.

(15 Marks)

Formulae:	$V_t = r\,\omega$
	$a_t = r\,\alpha$
	$a_r = V_t^{\,2} / r$

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4.

a) Using the Parallel Axis Theorem calculate the instantaneous **moment of inertia** of the left leg about the hip axis of a sprinter's leg below (see figure 1).
(13 Marks)

Formula: $I = I_{CG} + mk^2$

Sprinter's mass = 96.2 kg

Segmental mass ratios:

Thigh = 0.103 (10.3%)
Shank/Calf = 0.043 (4.3%)
Foot = 0.015 (1.5%)

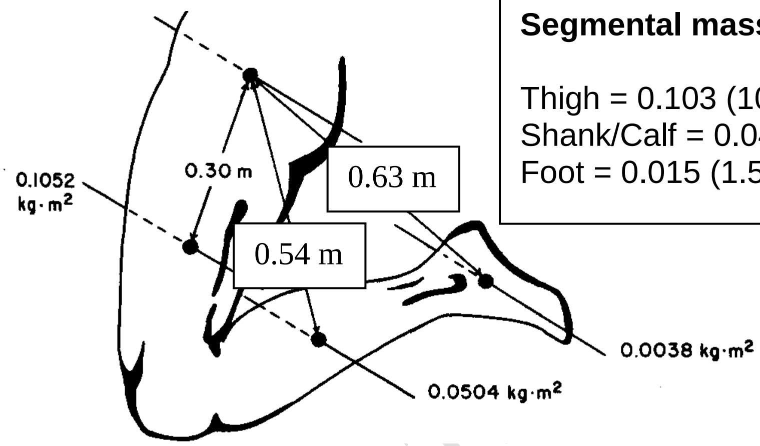


Figure 1. Sprinter's leg in recovery swing phase, position 1.

b) Calculate the instantaneous **moment of inertia** for the same sprinter at this position, a little further on in the rotation of the swinging leg (see figure 2).
(12 Marks)

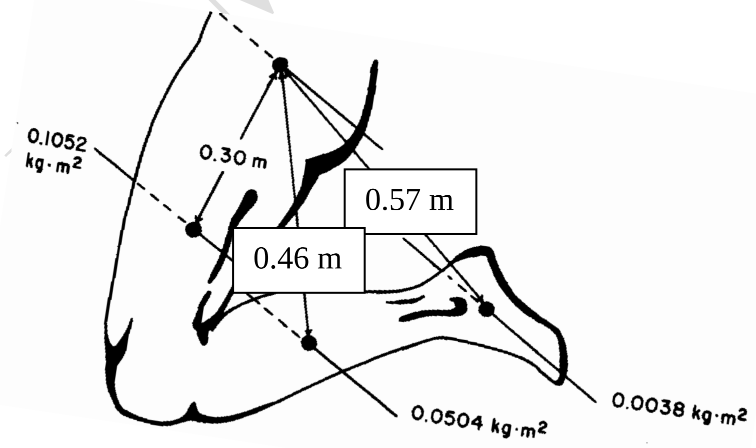
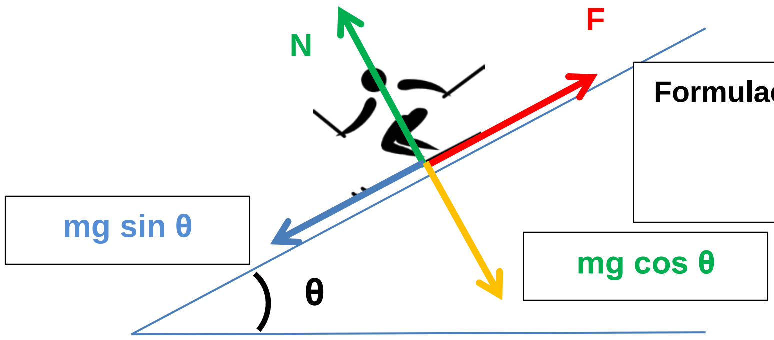


Figure 2. Sprinter's leg in recovery swing phase, position 2.

5.



Formulae: $R_p = mg \bullet \sin\theta - Fr$
$Fr = \mu \bullet N$
$N = mg \bullet \cos\theta$
$F = m \bullet a$

Figure 3. Skier in decent on a slope.

a) Calculate the acceleration of a skier (mass = 72.8 kg) down a slope of (θ) 53°, if the coefficient of friction (μ) is 0.058.

(13 Marks)

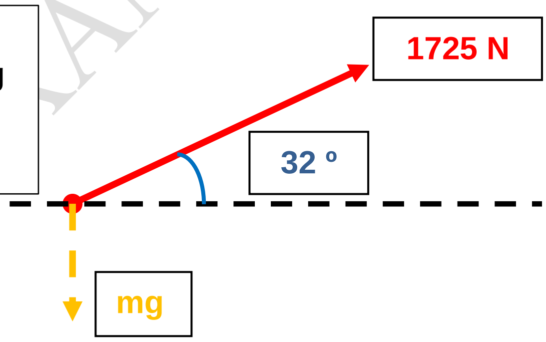
b) Calculate the acceleration of the same skier on a steeper part of the same run, where the slope is (θ) 58°. The coefficient of friction (μ) is still 0.058.

(12 Marks)

6.

a) Calculate the resultant acceleration of a sprinter (mass = 78.7 kg) in a sprint start, applying an instantaneous thrust of 1725 N at 32 º to the horizontal.

Formulae:
$FV = F \bullet \sin\theta - mg$
$FH = F \bullet \cos\theta$
$F = m \bullet a$



(13 Marks)

b) If the sprinter applies 1898 N, at 39° to the horizontal, on the next step, what is the resultant acceleration at that instant? Which step, a) or b), provides the greatest instantaneous acceleration?

(12 marks)

END OF QUESTIONS