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UNIVERSITY OF BOLTON

SCHOOL OF SPORT & BIOLOGICAL SCIENCES

BSc (HONS) SPORT REHABILITATION

SEMESTER TWO EXAMINATIONS 2018/2019

CLINICAL BIOMECHANICS

MODULE NO. SRB4010

Date: Monday 20 May 2019 **Time: 2.00 pm – 4.00 pm**

INSTRUCTIONS TO CANDIDATES:

Answer ALL questions on this paper.

This Paper contains both multiple choice and short-answer questions:

For multiple choice questions, select one answer per question unless otherwise directed.

For the short-answer questions write down your answer using concise scientific language and diagrams where applicable. Use the marks offered for each question as a guide for time allocation to complete your answers. Write all equations and numeracy on the question paper.

There are 100 Marks available on this paper.

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1. Which of the following is NOT an anatomical plane of motion?

   a. Transverse
   b. Posterior
   c. Sagittal
   d. Coronal

1 mark

2. What two components define a vector quantity? Give a kinematic example of a vector quantity.

2 marks

3. The two main branches of biomechanics are best described as:

   a. Kinetics: the study forces that cause motion; Kinematics: the study of quantities of motion

   b. Kinetics: the study quantities of motion; Kinematics: the study of forces that cause motion

   c. Displacement: the change in position of a body; Velocity: the change in acceleration of a body

   d. Strength: the study of how strong an athlete is; Power: the study of how fast an athlete is

1 mark

4. Which statement is true?

   a. Movements occurring in the Sagittal plane include: Adduction, Spinal Lateral Flexion & Abduction.

   b. Movements occurring in the Transverse plane; Adduction, Spinal Lateral Flexion & Abduction.

   c. Movements occurring in the Frontal plane; Adduction, Spinal Lateral Flexion & Abduction.

1 mark

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5. If the Weight of an athlete is 1010N, what is their Mass?

1 mark

6. Which of the following is NOT a *kinematic* characteristic?

   a. Angular Velocity
   b. Displacement
   c. Torque
   d. Radial Acceleration

1 mark

7. Which of the following is NOT a spatial gait characteristic?

   a. Step length
   b. Step Frequency
   c. Foot angle
   d. Base width

1 mark

8. A gymnast covers 15m in 3.2 seconds during their run up, what was their average velocity?

   a. 4.69 $m \bullet s^{-2}$
   b. 46.9 $m \bullet s^{-1}$
   c. 4.69 $m \bullet s^{-1}$
   d. 4.35 $m \bullet s^{-1}$

1 mark

9. Which of the following is a typical gait adaptation brought about by Excessive Anteversion?

   a. Toe-out Gait
   b. Toe-in Gait
   c. Overstriding
   d. Slap Gait

1 mark

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10. The velocity of a sprinter at the 50m mark of a 100m sprint race was 11.33 $m \cdot s^{-1}$. At the 80m mark, the sprinters velocity was 8.5 $m \cdot s^{-1}$. Calculate the average acceleration of the Sprinter between 50m & 80m, if the time taken to cover this distance was 2.66 seconds?

    a. -0.94 $m \bullet s^{-2}$
    b. -1.06 $m \bullet s^{-2}$
    c. 1.06 $m \bullet s^{-2}$
    d. 7.46 $m \bullet s^{-2}$
    e. -7.46 $m \bullet s^{-2}$

1 mark

11. What is the velocity of a runner, with a stride length of 4.55 m and a stride frequency of 3.6 strides per second?

    a. 16.38 $m \bullet s^{-1}$
    b. 1.26 $m \bullet s^{-1}$
    c. 1.26 $m \bullet s^{-2}$
    d. 16.38 $m \bullet s^{-2}$

1 mark

12. What typical movement pattern can be observed during a squatting motion in individuals with limited Ankle Dorsi-flexion and poor gluteus medius muscle fibre recruitment?

    a. Excessive Ankle Pronation
    b. Correct Hip, Knee & Ankle Alignment
    c. Posterior Pelvic Tilt
    d. Knee Varus

1 mark

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13. A person walks West for 11.79 km, then South for 5.5 km.

    a. What is the DISTANCE covered?

    b. What is the DISPLACEMENT of the person?

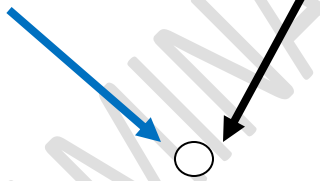
3 marks

14. A rugby player takes a conversion kick, where the ball has an instantaneous velocity of 65 $m \bullet s^{-1}$ and travels at 49 degrees to the horizontal. Resolve this vector to calculate the vertical velocity and horizontal velocity of this kick.

3 marks

15. Two footballers simultaneously run towards a stationary ball with the following velocities:

Player **A** runs with a velocity of 8.44 $m.s^{-1}$ at an angle of 40° to the vertical.



Player B runs with a velocity of 7.2 $m.s^{-1}$ at an angle of 22.5° to the vertical.

Calculate the resultant velocity **and** angle of the ball if they both contact the ball at the same instance.

6 marks

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16. According to Newton's **Third (3rd)** law:

a. A body will remain in a state of rest or constant motion in a straight line until acted on by an force
b. For every action by one body on a second there is an equal and opposite reaction by the second body on the first
c. All bodies are attracted to one another with a force which is proportional to the product of their masses, and inversely proportional to the square of the distance between them.
d. The acceleration of an object is directly proportional to the net force acting on it and inversely proportional to the mass of the object.

1 mark

17. Explain Newton's **second** law, using a practical example:

3 marks

18. A person performing a deadlift generates a vertical force of 2995 N on the barbell, what is the barbells instantaneous vertical acceleration, if the total mass lifted is 220 kg?

a. 12.15 $m \cdot s^{-2}$
b. 76,2704.64 $m \cdot s^{-2}$
c. 76,2704.64 $m \cdot s^{-1}$
d. 12.15 $m \cdot s^{-1}$

1 mark

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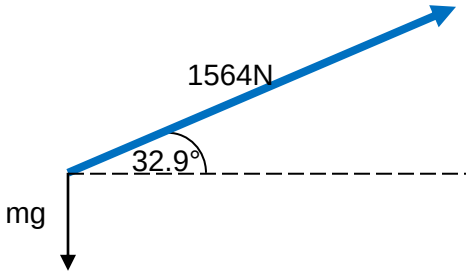
19. Based on the diagram below, calculate the resultant acceleration at take-off, for an athlete with a mass of 65kg.



6 marks

20. Describe, in detail the characteristics and stages of the gait cycle. Also state the functions of these stages of the gait cycle.

9 marks

21. Describe the **motion of the ankle joint** in the sagittal plane during the stages of the gait cycle.

6 marks

22. Measuring the magnitude of ground impact during running can be achieved using:
    a. Accelerometers
    b. Digital Cameras
    c. Timing gate sensors
    d. Force platforms

1 mark

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23. Describe a **MOTION ANALYSIS** procedure for collecting biomechanical data for a counter movement jump for an athlete. Consider the protocol you would use and the equipment (and settings) you would require, to collect the data, and how you may then analyse it.

6 marks

24. Sketch a typical vertical ground reaction force (GRF) graph for a **counter-movement jump**. Ensure you include axis labels and units.

3 marks

25. A Ground Reaction force is made up of :
    a. 4 orthogonal forces
    b. 1 orthogonal force
    c. 3 orthogonal forces
    d. 7 orthogonal forces

1 mark

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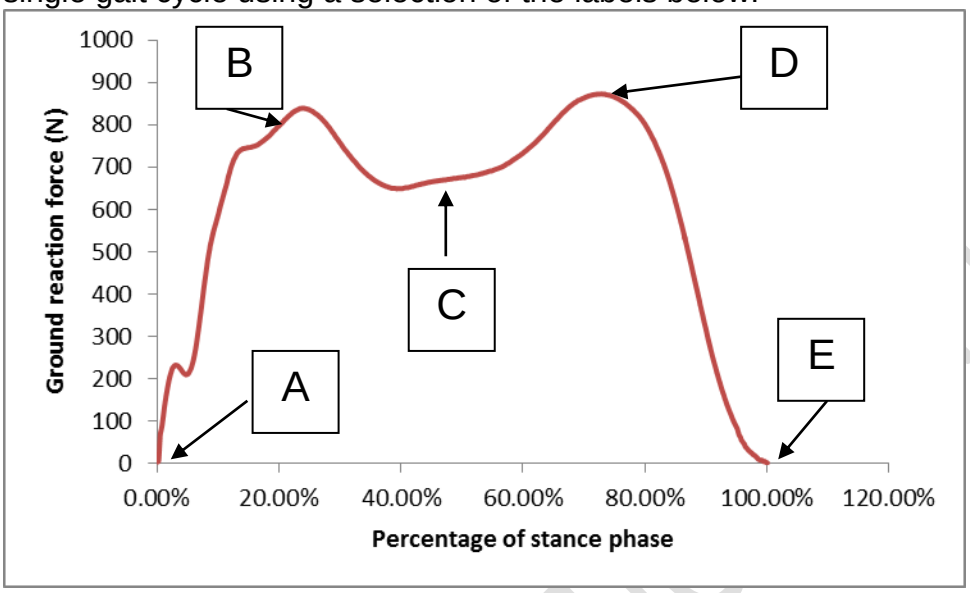
26. Label the following Vertical Ground Reaction Force **graph points A-E** during a single gait cycle using a selection of the labels below:



5 marks

Possible labels:

Heel Strike	Shock absorption		Heel lift
Mid stance	Vertical	Toe off	Anterior-posterior

27. What are the differences between ‘open-chain’ and ‘closed- chain’ movements?

3 marks

28. A force acting 0.36m from a joint centre, has a magnitude of 278N. Calculate the turning moment created by the force.

2 marks

29. What is the effect of changing a lever arm **length** upon the turning moment it produces?

1 mark

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30. According to the Functional Movement Screen (FMS) scoring system (1, 2 or 3), score the following observed movements A, B & C, and give a reason for the score you have attributed.

A

Trunk Stability Push-up

Deep Squat

B

In-line Lunge

C

3 Marks

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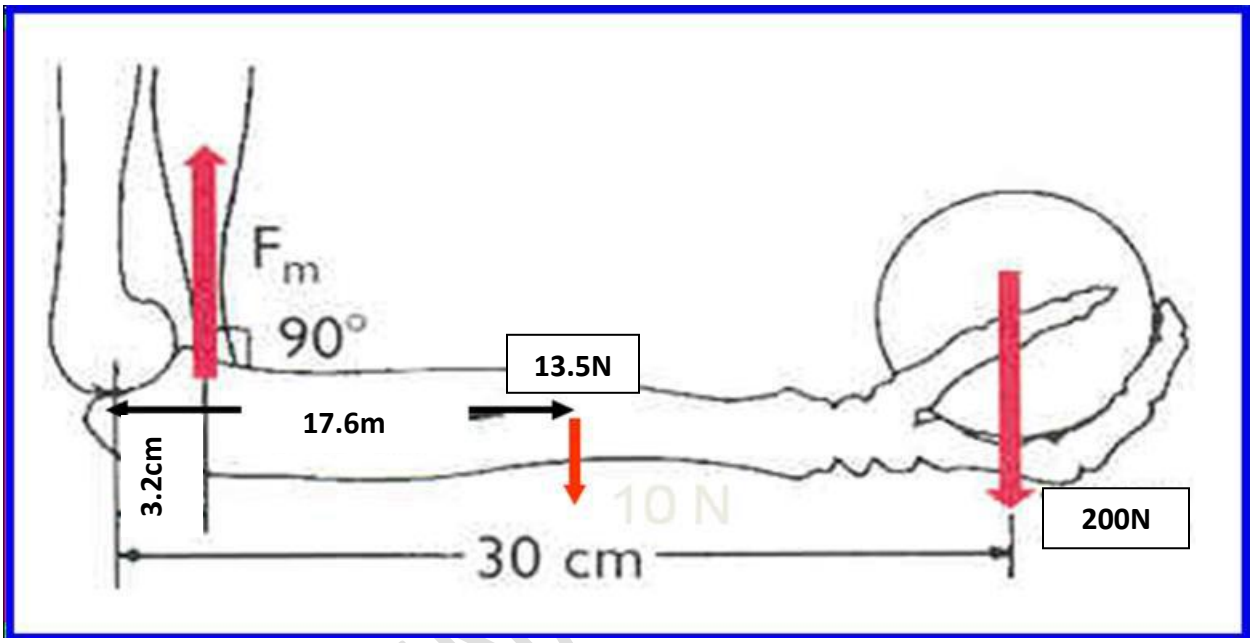
31. Calculate the amount of muscle force required to maintain an isometric contraction/static position in the image below.



5 Marks

32. What major muscles are stressed during a Chin-up exercise? And what type of contraction is used in the lowering phase of the exercise?

4 Marks

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33. Describe the *Muscle and Joint* actions during the jumping exercise using the guidelines below for the **hip, knee and ankle**.

a. In the **downward** phase:

state the movement type for each joint

state the Agonist muscle groups involved for each joint action

state the type of contraction for each muscle group provided

b. In the **upward** phase:

state the movement type for each joint

state the Agonist muscle groups involved for each joint action

state the type of contraction for each muscle group provided

15 marks

END OF QUESTIONS

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PAST EXAMINATION PAPER

SRB4010 Formula Sheet

Force = Mass x Acceleration	$F = m \times a$
Velocity = Δ Displacement / ΔTime	$v = p_2 - p_1 / t_2 - t_1$
Acceleration = Δ Velocity / ΔTime	$a = v_2 - v_1 / t_2 - t_1$
Velocity = Stride Frequency x Stride Length	$v = SF \times SL$
Pythagoras' Theorem	$a^2 + b^2 = c^2$
Trigonometry	$\sin \theta$ = Opposite / Hypontenuse $\cos \theta$ = Adjacent / Hypontenuse $\tan \theta$ = Opposite / Adjacent
Moment/Torque = Force x Perpendicular Distance from axis of rotation	$M = F \bullet x$