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UNIVERSITY OF BOLTON

SCHOOL OF SPORT & BIOLOGICAL SCIENCES

SPORT AND EXERCISE SCIENCE

SEMESTER ONE EXAMINATIONS 2018/19

INTRODUCTION TO SPORT AND EXERCISE BIOMECHANICS

MODULE NO. SPS4004

Date: Monday 14 January 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 and write it down in the answer book provided.

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.

School of Sport & Biological Sciences
Sport and Exercise Science
Semester One Examinations 2018/2019
Introduction to Sport & Exercise Biomechanics
Module No. SPS4004

1. Which of the following statements best describes postural control in balance.

   a) A summation of static reflexes.
   b) Maintaining neutral spinal alignment.
   c) A complex skill based on the interaction of multiple, dynamic sensorimotor processes.
   d) Not falling over when stood on one leg.

(1 mark)

2. What are the main aims of analysis of human movement through sports biomechanics?

   a) Increasing injury, preventing rehabilitation and reducing performance
   b) Monitoring the motivation of the athlete to perform
   c) Assessing how the body consumes and utilises oxygen
   d) Reducing injury, improving rehabilitation and improving performance

(1 mark)

3. The two main branches of biomechanics are known as:

   a) Velocity: the rate of change of position; Acceleration: the rate of change of velocity.
   b) Kinetics: the study quantities of motion; Kinematics: the study of forces that cause motion
   c) Kinetics: the study forces that cause motion; Kinematics: the study of quantities of motion
   d) Strength: the study of how strong an athlete is; Power: the study of how fast an athlete is

(1 mark)

Please turn the page

4. List **three** ways to improve static or dynamic stability.

(3 marks)

5. General motion in sports biomechanics is defined as:

   a) Motion around an axis of rotation
   b) Motion around an axis of rotation that brings about motion on a linear or curvilinear path
   c) Motion of a body along a linear or curvilinear path
   d) Motion along a linear path

(1 mark)

6. An athletes' weight 851.5N, what is their approximate mass?

(1 mark)

7. Calculate the **Stride Frequency** of a person running at 14 km•h^{-1} with a cadence of 1.85m strides per second?

   a) 2.1 strides/sec
   b) 3.89 m
   c) 2.1 m•s^{-1}
   d) 3.89 m•s^{-1}
   e) 3.89 strides/sec

(1 mark)

Please turn the page

8. What is the average velocity of a weightlifting barbell during a snatch lift, when the barbell covers 2.02 metres in 0.68 seconds?

   a) 2.97 m•s^{-2}

   b) 2.97 m•s^{-1}

   c) 1.37 m•s^{-1}

   d) 1.37 m•s^{-2}

(1 mark)

9. The differences between scalar and vector quantities are best described as:

   a) Scalar quantities have a magnitude, direction and point of application; Vector quantities have a magnitude only
   b) Scalar and Vector quantities both only have a magnitude
   c) Scalar quantities have magnitude only; Vector quantities have a magnitude, direction and point of application
   d) Scalar and Vector quantities both have a magnitude, direction and point of application

(1 mark)

10. A sprinter covers the first 50m of a race with an average acceleration of 3.1 m•s^{-2}, taking them 4.02 seconds. What would be his velocity at this 50m point?

    a) 12.46 m•s^{-1}

    b) 0.77 m•s^{-1}

    c) 16.13 m•s^{-1}

    d) 12.46 m•s^{-2}

(1 mark)

Please turn the page

11. What is **Newton's second law of motion**? Give a brief description and an applied example of when this law is in action in sport.

(5 marks)

12. A gymnast sprints towards a vault, where the time elapsed is 1.7 seconds after the first 15 metres. By the time he reaches the vaulting horse (25 metres from the start position), cumulative time has elapsed to 2.8s. What is the average **acceleration** of the gymnast from the 15 metre mark, to the vaulting horse?

a) $0.25\ m \bullet s^{-1}$

b) $-0.25\ m \bullet s^{-2}$

c) $0.25\ m \bullet s^{-2}$

d) $-0.25\ m \bullet s^{-1}$

(1 mark)

13. What three components of ankle movement are generated in Pronation?

(3 marks)

14. According to **Newton's third law** of motion:

a) For every action by one body on a second there is an equal and opposite reaction by the second body on the first

b) A body will remain in a state of rest or constant motion in a straight line until acted on by an force

c) A force applied to a body causes an acceleration of that body which has a magnitude proportional to the force, and takes place in the direction in which the force acts.

d) 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.

(1 mark)

Please turn the page

15. What is the force required to accelerate a 101 kg rugby player 3.33 $m \bullet s^{-2}$, during a sprint?

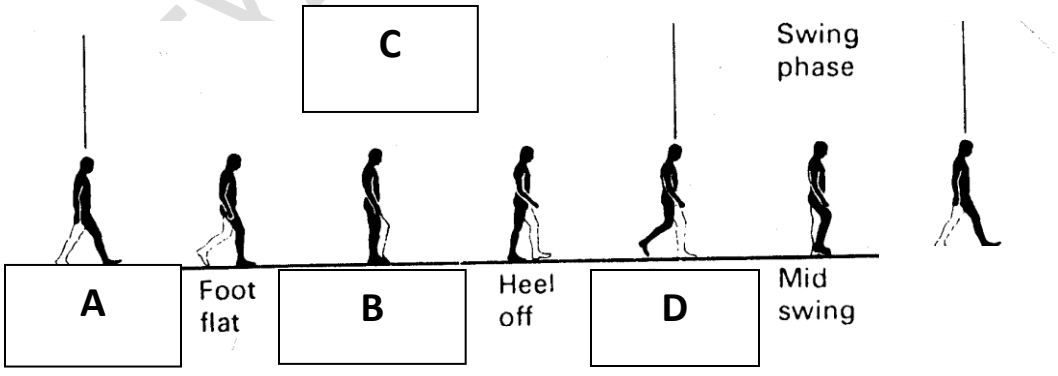
    a) 33.63 N
    b) 3363.33 N
    c) 336.33 N
    d) 3.36 N

(1 mark)

16. Sketch 2 graphs for **time vs. velocity** and **time vs. acceleration** for a 100 m sprint race that one elite level athlete completed in 10 seconds. You should consider the phases of such a race. Include all axis labels and units.

(6 marks)

17. List the missing *phases* and *stages* of the gait cycle from the boxes on the diagram below.



(4 marks)

Please turn the page

18. Outline a procedure for collecting **semi-quantitative** technique data of a Weightlifter. Consider the protocol you would use and the equipment you would require to collect the data and how you may then analyse it.

(10 marks)

19. Which <u>one</u> of the following statements is **true**?

    a) Momentum is a product of force and velocity; Impulse is a product of mass and time
    b) Impulse is a product of force and time; Momentum is a product of mass and velocity
    c) Momentum is a product of force and time; Impulse is a product of mass and velocity
    d) Impulse and Momentum cannot be calculated in kinetics

(1 mark)

20. If a javelin has a velocity of 29.1 $m.s^{-1}$ at the instance of release, and a constant mass of 0.8 kg, what is the momentum of the javelin?

(2 marks)

21. A long jumper (mass = 78.6 kg) has a resultant velocity 12.1 $m.s^{-1}$ immediately prior to landing. What was the average force applied by the long jumper in order to bring their body to rest in 0.43 seconds?

(3 marks)

Please turn the page

22. Sketch a graph to indicate the vertical force vs. time relationship you would expect for a countermovement jump (include axis labels and units)

(3 marks)

23. A basketball shooting guard performs a fade-away jump shot from the 3-point line. He releases the ball with a horizontal velocity of 4.5 $m.s^{-1}$ and a vertical velocity of 7.2 $m.s^{-1}$. Calculate the athlete's resultant release velocity and angle of projection.

(5 marks)

24. A NFL offensive lineman performs a standing vertical jump test during the combine with a vertical velocity of 2.78 $m.s^{-1}$, what was his jump height?

(2 marks)

25. List <u>three</u> important considerations to optimise jumping technique.

(3 marks)

26. Sketch a graph to indicate the vertical force vs. time relationship you would expect for a **'Heel Strike'** runner (include axis labels and units).

(3 marks)

Please turn the page

27. List <u>three</u> ways of improving aerodynamics for a cyclist.

(3 marks)

28. Sketch a graph to highlight the relationship between friction force and applied horizontal force considering static and dynamic friction.

(3 marks)

29. In a lever within the human body that is said to have a **mechanical advantage** which **<u>two</u>** of the following statements are true:

    a) The resistive force moment arm is greater than the muscle force moment arm

    b) The ankle joint in a calf raise exercise is an example of this lever

    c) The muscle force moment arm is greater that the resistive force moment arm

    d) This type of lever does not occur within the human body

    e) The elbow joint in a bicep curl exercise is an example of this lever

(2 marks)

30. The **Front Squat** is a multi-joint exercise (hip, knee and ankle) - which plane of movement would we observe Flexion/Extension at the hip, knee and ankle? What muscle are the prime movers in the ascent or upward phase during flexion and extension at the hip, knee and ankle joints?

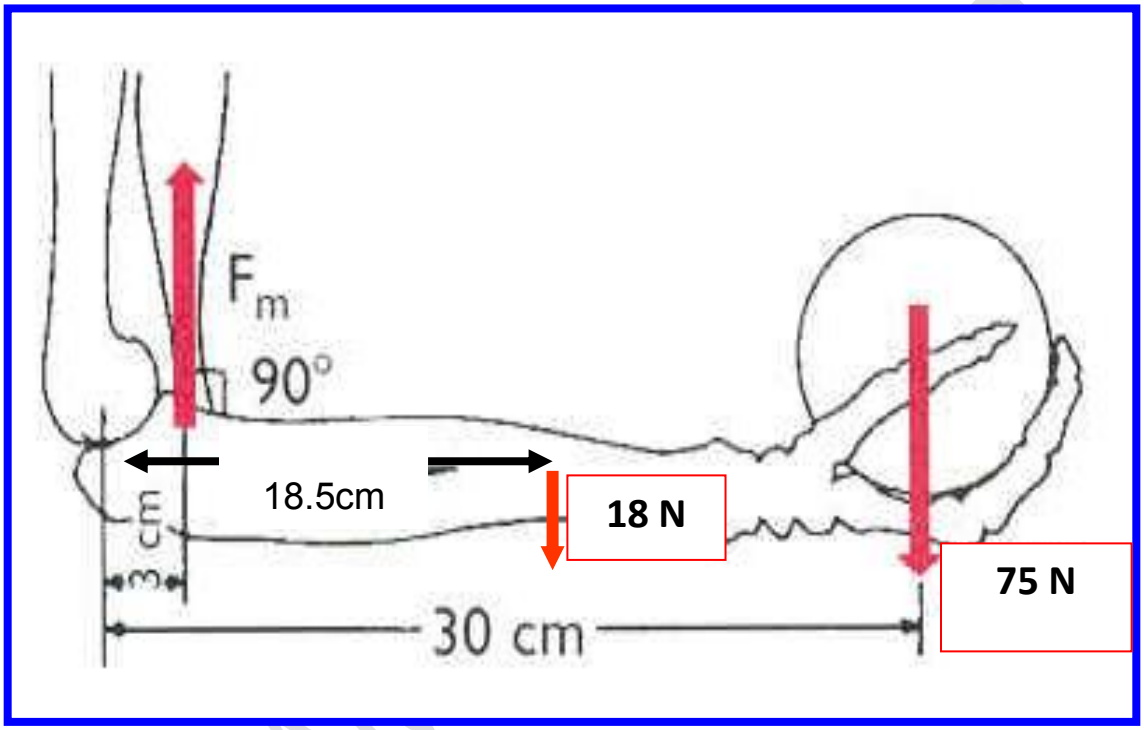
(6 marks)

31. What major muscles are stressed in the **Strict Barbell Overhead Press** exercise? And what type of muscle contraction are these muscles involved in with the descent or **upward phase** of the exercise?

(6 marks)

Please turn the page

32. Calculate the amount of force required in contraction of the Biceps Brachii to maintain a static position/ isometric contraction in the image below. You should consider the resistance from the segments involved, and the external load in your answer.



(5 marks)

33. Outline a procedure for collecting force platform data from an athlete running at 4-5 $m.s^{-1}$. Consider the protocol you would use and the equipment you would require to collect the data.

(10 marks)

END OF QUESTIONS

Formulae
$a^2 + b^2 = c^2$
SOH: Sin = Opposite / Hypotenuse **CAH: Cos = Adjacent / Hypotenuse** **TOA: Tan = Opposite / Hypotenuse**
F= ma
Stride Velocity = Stride Length x Stride Frequency
Velocity= Displacement / Change in time $\mathbf{v = p_2 - p_1 / t_2 - t_1}$
Acceleration = Change in Velocity / Change in time $\mathbf{a = v_2 - v_1 / t_2 - t_1}$
Momentum: **m x v**
Impulse: **F x t**
Impulse-Momentum: $\mathbf{F \times t = (m_2 \times v_2) - (m_1 \times v_1)}$
$v_2^2 = v_1^2 + 2ad$
Torque/Moment: $M = F \bullet x$