ST MARY’S UNIVERSITY

TWICKENHAM, LONDON

BA/BSc Degree Examination students registered for

Level FOUR

Title: Basic Biomechanics

Code: SPS4041

Semester: TWO

Date: May 22nd 2019

Time: 9:30 – 11:00 AM

TIME ALLOWED: ONE HOUR THIRTY MINUTES

Answer ALL questions. Please write your answers in the examination answer book provided.

1. This examination is divided into two sections:

Section A consists of 50 multiple choice questions. You should attempt to answer all questions in section A.

1. Section B consists of 13 short answer and calculation questions. You should attempt to answer all of them. In this section you must show your calculations and units as marks are awarded for this.
2. There are 110 marks available in total. There are 50 marks for section A and 60 marks for section B.
3. You will need a non-programmable calculator.
4. A formula sheet has been provided.

SECTION A

1. A vertical plane through the body dividing it into front and back sections is termed:

a) Sagittal

b) Frontal

c) Longitudinal

d) Vertical

1. How many lumbar vertebrae are there in the human body?

a) 5

b) 8

c) 16

d) 12

1. The two bones of the lower arm are the:

a) Radius and Humerus

b) Humerus and Ulna

c) Ulna and Radius

d) Tibia and Fibula

1. An example of a hinge joint is the:
2. Radio-ulnar joint
3. Shoulder joint
4. Elbow joint
5. Sterno-Clavicular joint
6. The tibia is an example of:

a) A long bone

b) A flat bone

c) An irregular bone

d) A sesamoid bone

1. Which of these is a bi-articular muscle?
2. Teres minor
3. Teres major
4. Biceps Brachii, long head
5. Deltoid
6. Which of the following answers are two of the functions of the skeleton?
7. Protects vital organs, provides shape
8. Cell production, produces force
9. Provides shape, produces hormones
10. Produces force, protects vital organs
11. What is the anatomical name for the knee joint?
12. Talo-Crural
13. Sub-Talar
14. Mid-Tarsal
15. Tibio-Femoral
16. When something is posterior, it is:
    1. Towards the front
    2. Away from the midline
    3. Towards the back
    4. Towards the feet
17. Where would you find the anterior cruciate ligament?

a) Shoulder

b) Hip

c) Ankle

d) Knee

1. Which muscle is involved in shoulder extension?

a) Latissimus dorsi

b) Anterior deltoid

c) Rectus Abdominis

d) Pectoralis major

1. Which of these is a uni-articular muscle?
2. Gracilis
3. Rectus femoris
4. Semimembranosus
5. Pectineus
6. Which of the following bones in the lower limb is mostly involved in weight-bearing during standing?
7. Patella
8. Fibula
9. Calcaneus
10. Coccyx
11. When something is superior, it is:
12. Furthest away from the midline of the body
13. Towards the head
14. Towards the feet
15. Closest to the midline of the body
16. Which of these muscles is not a hip flexor?
17. Semitendinosus
18. Psoas major
19. Iliacus
20. Rectus femoris
21. Which of these muscles laterally flexes the spine?
22. Erector Spinae
23. Trapezius
24. Biceps Brachii
25. Deltiods
26. Which of these muscles is not a hip abductor?
27. Gracilis
28. Tensor Fasciae Latae
29. Gluteus Medius
30. Gluteus Minimus
31. What is the function of a ligament?
    1. To link muscles to bones
    2. To link muscles to muscles
    3. To link bones to bones
    4. All of the above
32. Which muscles flex the shoulder?
33. Bicep brachii, Brachialis, Brachioradialis
34. Pectoralis minor, Biceps brachii, Anterior deltoid
35. Pectoralis minor, Pectoralis major, Biceps brachii, Anterior deltoid
36. Pectoralis major, Biceps brachii, Anterior deltoid
37. Which muscle does not dorsiflex the ankle?
38. Tibialis posterior
39. Tibialis anterior
40. Extensor digitorum longus
41. Extensor hallucis longus
42. Which of these muscles is involved in knee flexion
    1. Rectus femoris
    2. Soleus
    3. Bicep femoris
    4. Vastus medialis
43. How is external rotation defined?
44. A decrease in the angle between 2 articulating bones
45. An increase in the angle between 2 articulating bones
46. Rotating a limb away from the midline of the body
47. Rotating a limb towards the midline of the body
48. An adductor is a skeletal muscle which:
49. Moves a limb away from midline
50. Flexes a muscle
51. Moves a limb towards the midline
52. Moves a limb up
53. Which of these muscles are an antagonistic pair?
54. Pectoralis major and pectoralis minor
55. Semimembranosus and semitendinosus
56. Biceps brachii and brachioradialis
57. Rectus abdominis and erector spinae
58. What is the action of the gluteus maximus?
59. flex and medially rotate the hip
60. flex and laterally rotate the hip
61. extend and medially rotate the hip
62. extend and laterally rotate the hip
63. The patella is an example of:
64. A long bone
65. A sesamoid bone
66. A flat bone
67. An irregular bone
68. The Vertebrae are an example of:
69. A long bone
70. A sesamoid bone
71. A flat bone
72. An irregular bone
73. Where would you find the pubofemoral ligament?
74. Hip
75. Ankle
76. Shoulder
77. Knee
78. What are the names of the three hamstring muscles?
79. Rectus femoris, Semimembranosus, Sartorius
80. Biceps femoris, Sartorius, Semitendinosus
81. Rectus femoris, Semitendinosus, Semimembranosus
82. Biceps femoris, Semitendinosus, Semimembranosus
83. Which muscles are external rotators of the shoulder?

a) Biceps brachii and teres minor

b) Latissimus Dorsi and Pectoralis Major

c) Triceps Brachii and Teres Major

d) Teres minor and Infraspinatus

1. Newton’s third law of linear motion is known as the ‘Law of…
2. Reaction
3. Inertia
4. Acceleration
5. Momentum
6. A positive value of angular displacement is associated with which direction of rotation
   1. Clockwise
   2. Anti-clockwise
   3. Either clockwise or anti-clockwise
   4. None of the above
7. When standing on the ground, body mass is accelerating downwards at:
8. 9.81 m/s2
9. 9.81 m/s
10. 0 m/s2
11. 0 m/s

1. A vector is defined by:
   1. Magnitude only
   2. Magnitude and direction
   3. Direction only
   4. None of the above
2. Which variable is a scalar?
3. Speed
4. Displacement
5. Acceleration
6. None of the above
7. Dina Asher-Smith completed the 200 m sprint in a time of 21.89 s. What was her average speed?
8. 9.14 m/s
9. 0.11 m/s
10. 4378 m/s
11. None of the above
12. Which of the following is a method that can be used to calculate an object’s centre of mass?
13. Force plate method
14. Reaction board method
15. Pythagoras method
16. Trigonometry method
17. How can you reduce torque (moment) to increase stability when standing still?
18. Raise the centre of mass
19. Lower the centre of mass
20. Put arms out to side
21. Put arms across chest
22. Centre of mass of any object is defined as a point:
    1. Around which mass is equally distributed
    2. Through which the line of action of the weight force acts
    3. Through which the force of gravity acts
    4. All of the above
23. What is the unit for momentum?
    1. kg·m/s
    2. N m/s
    3. m/s kg
    4. Nm
24. What is the standard unit for displacement?
25. cm
26. mm
27. m
28. m/s2
29. A cyclist completes 1 lap of a 250m velodrome. Displacement is:
30. 250 m
31. 0 m
32. 1 m
33. None of the above
34. How many degrees (°) are there in three and a half revolutions?
35. 630°
36. 184.45°
37. 1080°
38. 1260°
39. What is the equation to calculate the length of one of the short sides (labelled ‘A’) of a right angle triangle where the other short side is labelled ‘B’ and the longest side labelled ‘C’?
40. A2 = B2 + C2
41. A2 = C2 - B2
42. A2 = B2 - C2
43. A2 = C2 + B2
44. If you have the adjacent and opposite side lengths of a right-angle triangle, which function allows you to calculate the angle?
45. Inverse Sin
46. Sin
47. InverseTan
48. Inverse Cos
49. To convert radians to degrees:
    1. Multiply by π and divide by 180
    2. Multiply by 180 and divide by π
    3. Divide by 360
    4. Multiply by 180
50. Work is equal to:
    1. Force x distance
    2. Momentum x distance
    3. Force x acceleration
    4. Power x distance
51. Converging streamlines around an object represent:
52. Speeding up
53. Slowing down
54. No change in speed
55. Streamlines can't converge
56. By making an object’s shape more streamlined (e.g. changing from a sphere to a tear drop shape) which form of drag is reduced most?

a) Skin drag

b) Water drag

c) Profile drag

d) Curve drag

1. During a sprint start from blocks performance is enhanced by:
2. Greater vertical displacement of the centre of mass
3. Keeping the centre of mass over the base of support
4. Greater posterior displacement of the centre of mass
5. Less vertical displacement of the centre of mass

SECTION B

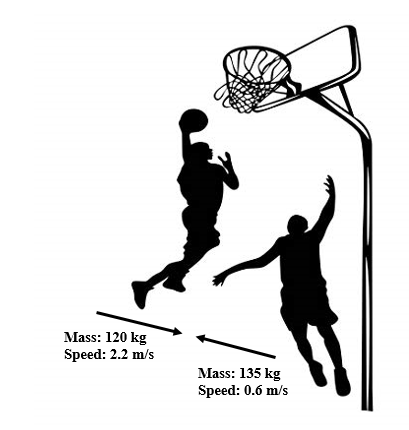
1. A long distance runner completes twelve and a half laps of a 400 m track during a race.
2. What was the athlete’s completed distance? (**2 mark**s)
3. What was the athletes’ completed displacement? (**2 mark**s)
4. A 4 x 100 m relay team completes a race in a total time of 42.57 s. The 100 m split times for each of the four sprinters is in the table below.
5. Calculate the average speed of each sprinter’s split. **(4 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| Split | Time (s) | Distance (m) | Average speed (m/s) |
| 1 | 10.35 | 100 |  |
| 2 | 10.92 | 100 |  |
| 3 | 10.85 | 100 |  |
| 4 | 10.45 | 100 |  |

1. Calculate the average speed of the team over the whole race. **(2 marks)**
2. A rugby player accelerates from 0 m/s to 1.4 m/s over a period of 5.5 s. What is their average acceleration? **(3 marks)**
3. A wheel chair athlete extends their elbow during the downstroke of the push against the wheel from 35° to 100° in 0.18 s.
4. What is their angular velocity during the downstroke? Report your answer in °/s. **(3 marks)**
5. Convert the answer from part a) to rads/s. **(2 marks)**
6. If angular velocity is maintained, how long would it take to fully extend the elbow from 100° to 180° **(4 marks)**
7. State Newton’s first law of motion. **(2 marks)**
8. Name one advantage and one disadvantage of the reaction board method for measuring human body centre of mass. **(2 marks)**
9. Explain two ways a cyclist can reduce drag **(4 marks)**
10. Define centre of mass. **(2 marks**)
11. What force must be applied to a 70kg object to accelerate it by 0.8 m/s2?

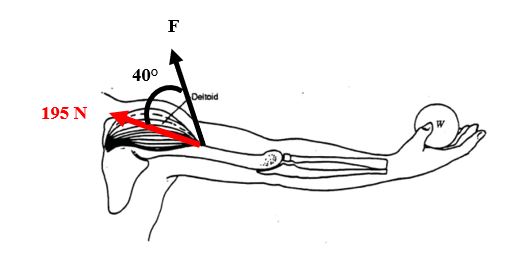
**(3 marks)**

1. A power forward with a mass of 120 kg travels in a straight line at a speed of 2.2 m/s towards a shooting guard with a mass of 135 kg. The shooting guard is travelling towards the power forward in the same line but at -0.6 m/s. They collide and move off with a constant velocity (v) in the same direction:



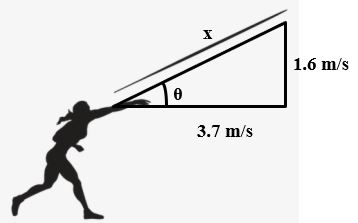
* 1. Calculate the final velocity (v) of the players after the collision.

**(5 marks)**

1. The deltoid muscle is pulling with a resultant force of 195 N at an angle of 40°:
   * 1. What is the magnitude of the vertical force vector (F)? Use trigonometry. **(5 marks)**
2. A gymnast performs a backward one and a half somersault, in an anti-clockwise direction (as shown in the figure below). Please use the appropriate sign in your answer



1. Calculate their angular **distance** in revolutions. **(2 marks)**
2. Calculate their angular **displacement** in revolutions. **(3 marks)**
3. A javelin thrower releases the javelin with a horizontal velocity of 3.7 m/s and a vertical velocity of 1.6 m/s:



1. Calculate the resultant velocity (x) of the javelin at release using Pythagoras’ theorem. **(5 marks)**
2. Calculate the angle (θ) using Trigonometry. **(5 marks)**

END OF EXAMINATION