***Year 11 ATAR  
Physical Education Studies***

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***Task 2***

***Biomechanics Lab & Investigation Book***

***Weighting: 7.5%***

***STUDENT NAME: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_***

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| --- | --- | --- |
|  | **Possible Marks** | **Allocated Marks** |
| **Lab 1** | **20 Marks** |  |
| **Lab 2** | **16 Marks** |  |
| **Lab 3** | **15 Marks** |  |
| **Lab 4** | **11 Marks** |  |
| **Lab 5** | **11 Marks** |  |
| **Lab 6** | **27 Marks** |  |
| **TOTAL MARKS** | **100 Marks** |  |

###### LABORATORY REPORT 1: VELOCITY & ACCELERATION

**Aim**

* To measure students’ velocity and acceleration in the 50m sprint
* To compare the difference between velocity and acceleration

**Equipment**

12 cones

6 stopwatches

Tape measure (50m)

**Method**

* Accurately measure a 50-metre distance. Place markers at the start and at 10-metre intervals up to 50 metres.
* A student with a stopwatch stands at each marker and records the time of a sprinter as they pass the marker.
* Another student/whistle signals the start of the sprint and the students with stopwatches need to commence timing.

**Results**

1. Record the time, velocity and acceleration for each distance, using the following formulas:

velocity = displacement / time taken

acceleration = (final velocity – initial velocity) / interval time taken

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Position | Time (s) | Interval time (s) | velocity (m/s) | Acceleration (m/s2) |
| 0m |  |  |  |  |
| 10m |  | 10m t - 0m t | 10m/t | 10m v – 0m v / it |
| 20m |  | 20m t -10m t | 20m/t | 20m v – 10m v / it |
| 30m |  | 30m t - 20m t | 30m/t | 30m v – 20m v / it |
| 40m |  | 40m t -30m t | 40m/t | 40m v – 30m v / it |
| 50m |  | 50m t -40m t | 50m/t | 50m v – 40m v / it |

(6 Marks)

1. Draw a graph of the final results, showing the velocity and acceleration over the 50 metres

Velocity of Acceleration of Running 50m

Time (sec)

|  |  |  |  |  |  |  |  |  |  |
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Distance (m)

(2 Marks)

Discussion Questions

1. At which point was the velocity the lowest? Why? (2 Marks)
2. Where did the sprinter reach maximum velocity? Can you explain why it may have occurred at this distance?   
    (2 Marks)
3. Where did the sprinter reach maximum acceleration? Can you explain why it may have occurred at this distance?

(2 Marks)

1. Define Zero Acceleration – what does it mean? Did the sprinter experience zero acceleration at any stage? Explain.

(2 Marks)

1. Define Negative Acceleration – what does this mean? Did the sprinter experience negative acceleration at any stage? Explain.

(2 Marks)

6. Notice that elite male sprinters have a very large mass. How would they manage to achieve faster velocities at each interval in comparison to an individual with a smaller inertia, or someone who has less resistance to overcome?  
 (2 Marks)

###### LABORATORY REPORT 2: THE PRINCIPLE OF OPTIMAL PROJECTION

**Lab 2 - Part 1**

**Equipment**

* Garden Hose
* Brick wall to run the water stream against and measure
* Tape Measure
* Large Maths Protractor

**Procedure**

*Condition A – Angle of Release*

Using a hose, direct a stream of water from ground level to cover the greatest distance possible. Record the distance and the angle of the nozzle.

*Condition B – Height of Release*

Repeat A, but hold the nozzle of the hose at hip height. Record the distance and the angle of the nozzle.

*Condition C – Velocity of Release*

Repeat B, keeping the angle of the projection the same and increase the velocity of the stream of water (Turn the tap on as fast as possible). Record the distance.

**Results**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Distance(m)** | | |
| **Angle** | Condition A | Condition B | Condition C |
| 10° |  |  |  |
| 20° |  |  |  |
| 30° |  |  |  |
| 40° |  |  |  |
| 50° |  |  |  |
| 60° |  |  |  |
| 70° |  |  |  |

(1.5 Marks)

Discussion Questions

1. Use the below area to draw the OPTIMAL trajectory/water pathway of each Condition, ensuring you clearly label each (A, B & C).   
(i.e.- only plot the path of the furthest result for each condition)

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(1.5 Marks)

2a. Identify what would be the optimal angle of release for Condition A? Why?

(1 Mark)

2b. Describe the shape of this trajectory/water pathway (why is it this shape)?

(1 Mark)

3. Identify what the optimal angle of release is for Condition B?

(1 Mark)

4. Compare the angle of release in Condition A to Condition B

(1 Mark)

5. What factors influence the angle of release in Condition B?

(1 Mark)

6. What observations can be made relating to the difference in pathways in Condition B & C? You may wish to support your response with a diagram.

(2 Marks)

7. Of the factors that determine the distance a projectile travels, which is the most important in achieving the greatest distance? Explain.

(2 Marks)

**Lab 2 - Part 2**

Study a video of a long jumper and answer the following questions.  
<https://www.youtube.com/watch?v=fXIbLmlUdOQ> (watch from 1min – 1.45min)

1. Describe the pathway of the long-jumper

(1 Marks)

1. What is the angle of take-off?

(1 Marks)

1. What factors investigated in task one would cause a reduction in take-off angle from 45-degrees?

(1 Mark)

1. What aspect of a long-jumper’s technique would account for the angle of take-off?

(1 Mark)

###### LABORATORY REPORT 3: NEWTON’S LAWS OF MOTION

**Lab 3 - Task 1**

###### Aim By completing this experiment outlined below you will observe and evaluate the role of the key movement principles in velocity development of the tennis serve.

**Equipment**

* Four tennis racquets
* One child’s racquet
* One weighted racquet
* Bucket tennis balls

**Procedure**

* In groups of four you will be required to examine the effects of the following activities
* Complete the table

|  |  |  |
| --- | --- | --- |
| **Activity** | **What movement principle(s) was (were) affected?** | **How?** |
| 1. Tennis serve with no knee flexion or extension |  |  |
| 2. Tennis serve with no follow-through |  |  |
| 3.  a) Tennis serve front on  b) Tennis serve with a variety of ball toss locations |  |  |
| 4.  a) Tennis serve with racquets of different length  b) Tennis serve with racquets with varying weights attached (or of different mass) |  |  |

(8 Marks)

**Lab 3 - Task 2**

**Procedure**

* Study the following video of a volleyball player performing a spike and answer the following questions concerning the actions observed
* https://www.youtube.com/watch?v=FMtUqoxfR50

**Discussions Questions**

During the flight stage of a volleyball spike, the player’s body hyperextends and then flexes at the hip.

1. State and define which of Newton’s Laws of Motion best describes the body’s action represented in this flight stage of the spike

(3 Marks)

1. Using one of Newton’s Laws of Motion to assist, explain how the player can attain greater acceleration of the ball.

(3 Marks)

1. Which of Newton’s Laws of Motion best describes the change of direction of the ball after impact? Explain

(1 Mark)

###### LABORATORY REPORT 4: SEQUENTIAL MOVEMENTS OF BODY PARTS

**Equipment**

* One softball and pair of catching gloves per student pair

**Procedure**

In pairs, sit opposite each other at a safe distance apart and throw the softball from the following positions, make a note of how far you are able to throw:

1. Sitting with legs crossed, using only your wrist to throw
2. Sitting with legs crossed, using wrist and elbow to throw
3. Kneeling, using shoulder, elbow and wrist to throw
4. Standing with feet together, using trunk, shoulder, elbow and wrist to throw
5. Standing, then stepping forward with one leg and using trunk, shoulder, elbow and wrist to throw

**Results**

|  |  |
| --- | --- |
|  | **Distance of Throw (m)** |
| **1** |  |
| **2** |  |
| **3** |  |
| **4** |  |
| **5** |  |

(3 Marks)

**Discussion Questions**

1. Which technique produced the best results for you and your partner? Why?

(1 Mark)

1. How can you explain these results in terms of force production and summation of momentum?

(4 Marks)

1. Describe another three skills where the correct sequencing of body parts helps to maximise technique.

(3 Marks)

###### LABORATORY REPORT 5: FLATTENING THE ARC VERSUS ACCURACY

**Equipment**

* Hockey stick
* Tennis Ball
* Target (or chalk on wall of CASS 1m x 1m)
* Markers or set of goals

**Procedure**

Make five attempts at hitting the target by doing a:

* Hockey drive – into a 1m target (2 markers)
* Underhand softball pitch – into a 1m x 1m wall square/round target

**Trial 1:** Do not step forward, transfer your weight forward or follow through

**Trial 2:** Step forward or transfer your weight forward and follow through

**Trial 3:** Step forward or transfer your weight forward, but do not follow through

**Results**

Use the following table to represent your results: (give 1-point for hitting the target)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Hockey Drive** | Attempt 1 | Attempt 2 | Attempt 3 | Attempt 4 | Attempt 5 | Overall Score |
| Trial 1 |  |  |  |  |  | / 5 |
| Trial 2 |  |  |  |  |  | / 5 |
| Trial 3 |  |  |  |  |  | / 5 |

(2 Marks)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Softball Pitch** | Attempt 1 | Attempt 2 | Attempt 3 | Attempt 4 | Attempt 5 | Overall Score |
| Trial 1 |  |  |  |  |  | / 5 |
| Trial 2 |  |  |  |  |  | / 5 |
| Trial 3 |  |  |  |  |  | / 5 |

(2 Marks)

**Discussion Questions**

1. How does stepping forward increase the accuracy of performance?

(2 Marks)

1. How does the follow-through improve accuracy?

(2 Marks)

1. How accurate was your performance of each of the tasks? Did your results differ between the three trials? Why?

(3 Marks)

###### LABORATORY REPORT 6: BALANCE & STABILITY

The control that an athlete has over his or her balance and stability is vital in maximising performance. In some sports the emphasis is placed on increasing stability (eg. wrestling) whilst in others the athlete wishes to decrease stability to enhance performance (eg. sprint start).

**Equipment**

* Stop watches
* Tape measures

**Procedure**

**Task 1**

Have your partner try to push you off balance when you are in the following positions and rank them from most stable (1) to least stable (3). *Ensure that your feet are always in the same position.*

|  |  |
| --- | --- |
| **POSITION** | **RANK** |
| 1. Standing with your arms straight above your head. |  |
| 1. Standing with your arms at your sides. |  |
| 1. Standing in a crouched position (knees bent). |  |

(1 Mark)

**Task 2**

Have your partner push from the side to try and make you off balance when you are in the following positions and rank them from most stable (1) to least stable (3).

|  |  |
| --- | --- |
| **POSITION** | **RANK** |
| 1. Standing on tiptoes, with your feet as close together as possible. |  |
| 1. Standing with feet wide apart and flat footed. |  |
| 1. On all fours. |  |

(1 Mark)

**Task 3**

Have your partner push from the side to try make you off balance when you are in the following positions and rank them from most stable (1) to least stable (3).

|  |  |
| --- | --- |
| **POSITION** | **RANK** |
| 1. Standing with feet spread wide to the front/back. |  |
| 1. Standing with feet spread wide to the side. |  |
| 1. Standing with your feet together. |  |

(1 Mark)

**Task 4**

Have your partner time you for a 10m sprint from the following starting positions:

|  |  |
| --- | --- |
| **Starting Position** | **Time** |
| 1. Standing straight with arms by your side. |  |
| 1. Feet apart with a slight lean forward and arms in the ready position. |  |
| 1. Crouch start. |  |

(1 Mark)

**Discussion Questions**

1. What was the effect of the height of the centre of gravity on balance and stability? Why?

(2 Marks)

2. What was the effect of the area of the base of support on balance and stability? Why?

(2 Marks)

3. What was the effect on the alignment of the base of support on balance and stability? Why?

(2 Marks)

4. In terms of balance and stability, which starting position was the fastest? Why?

(2 Marks)

1. Stand with your back and heels touching a wall. Slowly attempt to bend down and touch your toes, keeping your legs straight. Can you do it? Why or why not?

(2 Marks)

1. Repeat the activity, this time standing away from the wall. Explain the differences you experience.

(2 Marks)

1. Now stand with your side against a wall and lift your outside foot to the side. What happens? How can you explain this?

(2 Marks)

1. Stand facing a partner no more than 1 metre away. Place your palms together and move your feet into various positions to experiment with the base of support. Try applying gradual force from different directions. What determines maximum stability when trying to push each other off balance? Explain the differences noted.

(3 Marks)

1. Perform a regular push-up. Why is it easier to perform a push-up by using your knees as a point of support than using your toes as a point of support? What changes in positioning are necessary if you take one hand away and try to do a single-arm push-up? Explain any differences?

(3 Marks)

1. Think of three sporting situations where it is advantageous to move the line of gravity close to or beyond the edge of the base of support.

(3 Marks)