HPER P391 Biomechanics **Spring, 2004**

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TEST #3

Equations:

$$S = S_0 + v \cdot t$$

$$S = S_0 + v_0 \cdot t - 1/2 \cdot 9.81 \cdot t^2$$

$$v = v_0 - 9.81 \cdot t$$

Remember: * **Pick the BEST answer to each question.**

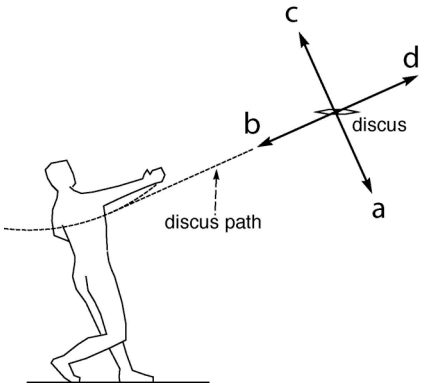
* **Some questions may give you more information than what you need to solve them.**

1. The support phase of a running step has to be executed in such a way that the c.m. will reach at least a certain moderate height in the non-support phase that follows. The main **purpose** (goal) of this is to:

   (a) give the recovery leg enough time during the non-support phase to move forward and then to move actively backward relative to the body before the start of the next support phase.
   (b) give the runner a larger downward vertical velocity just before starting the next support phase.
   (c) increase the horizontal propulsive force in the second half of the support phase.
   (d) give the runner a smaller downward vertical velocity just before starting the next support phase.

2. The sketch below shows the path followed by a discus after release. Look **carefully** at the direction of motion and the angle of the discus, and state if there is:

   (a) a lift force exerted on the discus, marked by vector "a".
   (b) a lift force exerted on the discus, marked by vector "b".
   (c) a lift force exerted on the discus, marked by vector "c".
   (d) a lift force exerted on the discus, marked by vector "d".
   (e) no lift force exerted on the discus.



3. Which of the following statements is FALSE? In sprinting, it is good to:

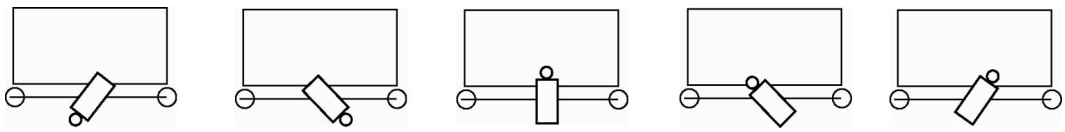
   (a) fully extend the knee of the support leg at the end of the support phase.
   (b) bring the swinging leg actively downward and backward immediately before it makes contact with the ground.
   (c) lift the knee of the swinging leg.
   (d) reach forward with the foot of the swinging leg, to make it land as far as possible ahead of the body.

4. What is the main advantage that tall high jumpers have over short high jumpers?

   (a) The centers of mass of tall high jumpers start their parabolas at a greater height.
   (b) A tall high jumper should generally be expected to achieve a larger vertical velocity.
   (c) Gravity pulls down on the tall high jumpers with a smaller force.
   (d) The tall high jumpers can stay in the air for a longer time.

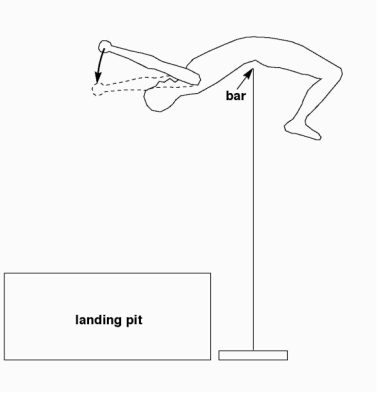
5. Consider a high jumper that takes off from the left leg (like almost all the examples given in class). If this high jumper, instead of the normal somersaulting angular momentum that high jumpers get, obtained only **lateral** somersaulting angular momentum (and zero forward somersaulting angular momentum), in which of the positions shown below would the trunk be at the peak of the jump? (The drawings show views seen from overhead, and the small circle represents the athlete's head.)

(a) (b) (c) (d) (e)



6. A high jumper was trying to clear the bar. In the view seen in the figure below, the jumper was rotating counterclockwise. The jumper then moved the arms in the form shown in the drawing. This action of the arms:

(a) increased the overall speed of rotation of the whole body.
(b) made the legs move up faster.
(c) made the legs slow down their counterclockwise rotation.
(d) did not affect the motions of the legs.



7. Which of the following factors can't contribute to produce a bad bar clearance in high jumping? If all of them can contribute to produce a bad bar clearance, answer "e".

(a) poor timing of the arching/un-arching
(b) large moment of inertia about the transverse axis
(c) a small amount of angular momentum
(d) weak arching over the bar

8. The forces exerted by the water on the hands of a swimmer who uses the **front crawl** technique are:

(a) propulsive and drag.
(b) resistive and lift.
(c) resistive and drag.
(d) propulsive, lift and drag.
(e) propulsive and lift.

9. The main objective of a sprinter during the ground support phase is:

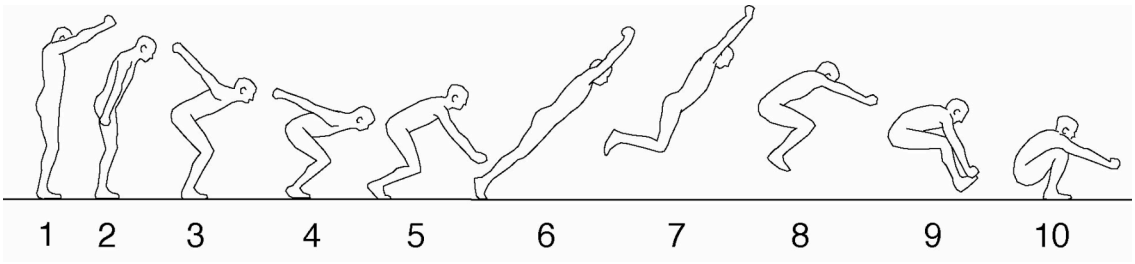
(a) to increase the stride length.
(b) to minimize the air resistance force.
(c) to increase the stride frequency.
(d) to minimize ground braking forces and maximize ground propulsive forces.

10. In **long** jumping, the main reason why it is important to have a fast approach run is that:

(a) it will allow you to have more leftover horizontal velocity by the time you leave the ground.
(b) it will decrease the braking of horizontal velocity that occurs during the takeoff phase.
(c) it will increase the height that your c.m. parabola will reach after you leave the ground.
(d) it will stimulate the muscles of your takeoff leg.

11. In the sequence shown below, if the arms of the jumper were to swing violently clockwise from the position that they have in image 7, to a position behind the body, the feet of the jumper would land:

(a) at the same distance from the point of takeoff as in the original jump.
(b) nearer to the point of takeoff than in the original jump.
(c) farther from the point of takeoff than in the original jump.



12. Which of the following statements is **FALSE**? If all of them are true, answer "e".

The lateral lean that a high jumper has at the end of the run-up:

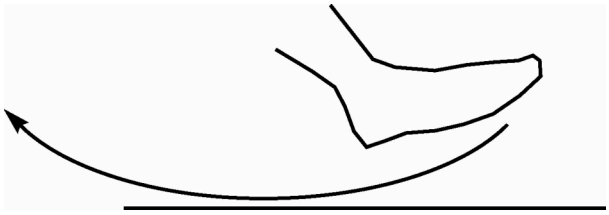
(a) contributes to make the c.m. of the jumper be lower at the start of the takeoff phase.
(b) helps to increase the vertical range of motion available to the c.m. during the takeoff phase.
(c) indirectly helps the athlete to be vertical at the end of the takeoff phase.
(d) is affected both by the curvature of the run-up and by the speed of the run-up.

13. In the front crawl swimming technique, the trunk should be kept aligned with the direction of the race, in order to:

(a) minimize the resistive forces exerted on the trunk.
(b) maximize the propulsive forces exerted on the arms.
(c) minimize the resistive forces exerted on the head during breathing.
(d) maximize the propulsive forces exerted on the legs.

14. Long jumpers should be recommended to try to "paw" backward on the ground as they plant the takeoff foot.

(a) TRUE
(b) FALSE



15. The height reached by a high jumper is determined mainly by:

(a) the vertical velocity of the high jumper at takeoff.
(b) the size of the resultant velocity of the high jumper at takeoff.
(c) the mass of the high jumper.
(d) the horizontal displacement of the high jumper while the body is in the air.
(e) the horizontal velocity of the high jumper at takeoff.

16. During a normal long jump takeoff phase, the athlete will try to:

(a) gain as much vertical velocity as possible.
(b) gain as much vertical velocity as possible, while losing as little horizontal velocity as possible.
(c) gain as much horizontal velocity as possible, while losing as little vertical velocity as possible.
(d) gain as much horizontal velocity as possible.

17. Which of the following statements is FALSE? If you think that they are all true, answer "e".

(a) At the end of the run-up a high jumper should be running rather fast.
(b) In the first half of the takeoff phase of a high jump, the athlete should make a large effort trying to resist against the flexing of the takeoff leg.
(c) During the takeoff phase, a high jumper should swing the arms very hard.
(d) At the end of the run-up the hips of a high jumper should be rather low.

18. In a view from the right side of a long jumper, the angular momentum of the athlete will usually be _____ during the airborne phase.

(a) counterclockwise
(b) zero
(c) clockwise

19. During the second half of the takeoff phase of a high jump, the quadriceps muscles of the takeoff leg are mostly in:

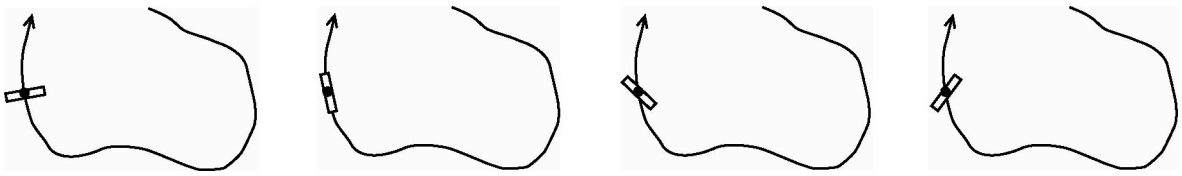
(a) eccentric conditions.
(b) isometric conditions.
(c) concentric conditions.

20. On a ball that has topspin, the Magnus effect will:

(a) tend to make it come down to the ground later than if it had had no spin.
(b) tend to make it come down to the ground earlier than if it had had no spin.
(c) have no effect on the time that the ball will be in the air.

21. The four drawings below show a side view of the underwater pattern of motion of a butterfly-style swimmer's hand relative to the water. The subject is swimming from left to right. Each drawing shows a different orientation of the hand at a single point of its path. Indicate which hand orientation would be most advantageous for the swimmer. (HINT: Draw the lift and drag forces for each drawing, and then see which of the hand orientations provides a resultant force that is most closely aligned with the direction of the race.)

(a) (b) (c) (d)



22. During the first half of the takeoff phase of a high jump, the quadriceps muscles of the takeoff leg are mostly in:

(a) eccentric conditions.
(b) isometric conditions.
(c) concentric conditions.

23. A high jumper should plant the takeoff foot:

(a) aligned with the final direction of the run-up.
(b) "toeing in" (i.e., "pigeon toed") relative to the final direction of the run-up.
(c) "toeing out" relative to the final direction of the run-up.

24. In the breaststroke swimming technique, the hands move:

(a) outward, backward and inward relative to the body, and also relative to the water.
(b) outward and inward relative to the body, and also relative to the water.
(c) outward, backward and inward relative to the body, but outward and inward relative to the water.
(d) outward and inward relative to the body, but outward, backward and inward relative to the water.

25. A sprinter covered the final 20 meters of a 100 meter race in 2.3 seconds. The wind was blowing in the same direction as the race was run, at a speed of 3.9 m/s. The force exerted by the air on the runner:

(a) pointed in the direction of the race.
(b) pointed against the direction of the race.
(c) was zero.