※ 考生請注意：本試題 □可 ☑不可 使用計算機

Biomechanics (共50分)

一、單選題(答對一題得 3 分，答錯倒扣 1 分)

1. Two balls have the same size but with different weights. When they are dropped at the same time and from the same height, which one reaches the ground first? Suppose air resistance can be neglected.
(a) the heavier one (b) the lighter one (c) the same

2. Two equally heavy balls have different sizes. When they are dropped at the same time and from the same height, which one reaches the ground first? Air resistance needs to be considered.
(a) the bigger one (b) the smaller one (c) the same

3. A baseball is thrown upward with initial velocity V. When it reaches its maximum height, its velocity is
(a) V/2 (b) V/4 (c) 0

4. Similar to the above question, when the ball reaches its maximum height, its acceleration is
(a) 9.8 m/s^2 upward (b) 9.8 m/s^2 downward (c) 0

5. In vertical jumping, suppose we are interested in the maximum height H reached by the center of mass (COM) after takeoff. Which of the followings is NOT related to H?
(a) body extension after takeoff (b) COM height at takeoff (c) COM velocity at takeoff

6. From question 5 and suppose g is the gravitational acceleration. If the COM height at takeoff is h and COM velocity at takeoff is v, then the maximum height reached by COM after takeoff is
(a) $h + v^2/(2g)$ (b) $h - v^2/(2g)$ (c) $h + v^2/g$

7. In gymnastic vaulting, a gymnast pushes off from the horse (or vaulting table) to enter the post-flight phase. If air resistance is neglected, which of the followings is NOT conserved in this phase?
(a) total linear momentum of the body (b) total angular momentum of the body (c) total kinetic energy of the body

8. A net force of 10 newtons (N) accelerates a shot-put (鉛球) at 5 m/s^2. What net force would be required to accelerate the same object at 1 m/s^2?
(a) 1 N (b) 2 N (c) 3 N

(背面仍有題目,請繼續作答)

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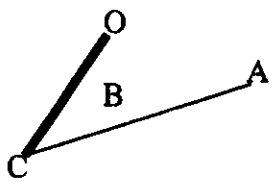
9. A gymnast is performing a pike somersault with the body shape shown below. The head is at point O, the waist is at point C, and the feet are at point A. Point B does not belong to any body segment, and is located between link CO and link CA. Which point best represents the COM position?
(a) A (b) B (c) C



10. In running high jumps, can a jumper clear the height which is even above the maximum height the body COM can achieve?
(a) yes (b) no (c) impossible to know

11. In figure skating, a skater pulls the arms closer to the trunk to increase the spin rate. Which of the following is NOT directly related to this phenomenon?
(a) conservation of angular momentum (b) Newton's third law (c) reducing the moment of inertia about the spin axis

12. Two acrobats A (50 kg) and B (40 kg) are performing together but unfortunately collide with each other in the air. If A moves at 1.5 m/s to the east and B moves at 3 m/s to the west before collision, determine their common velocity immediately after they collide and become coupled together after the collision.
(a) 0.5 m/s to the east (b) 0.5 m/s to the west (c) 0

二、計算題(一題 7 分，答錯不倒扣)

1. A human body is modeled with 3 parts as arms (AR, with mass 5kg), head-trunk (HT, with mass 30kg), and lower body (LB, mass 15kg). From video analysis of a jumping motion the acceleration of each part is known. That is, AR is 0.5 m/s^2, HT is 1 m/s^2, and LB is 2 m/s^2 (all upward).
a) Calculate the ground reaction force (magnitude and direction). 此題 4 分
b) Calculate the force acting between the HT and LB (only magnitude) 此題 3 分

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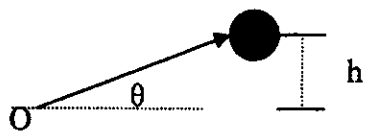
2. A person pushes a shot-put (mass m) with constant force F along the direction shown below. The shot-put starts from rest at the origin O. The release height of the shot-put COM is h. The gravitational acceleration is g.



a) Calculate the velocity magnitude of the shop-put at release. Express your answer in terms of F, m, θ, g, and h. 此題 3 分

b) Suppose the release velocity is v (in the direction of the arrow in the figure), calculate the time when the COM passes through point O. Express your answer in terms of v, θ, g, and h. 此題 4 分

運動生理 (共50分)

1. 試說明運動後氧過耗量（Excess post-exercise oxygen consumption, EPOC）的構成因素有那些？EPOC 和氧債（oxygen debt）有何不同？（10 分）
2. 在非最大運動過程中，運動強度（如：跑步的速度）不變，但為何會有所謂心跳率隨運動時間的增長而慢慢增加的心血管漂移現象（Cardiovascular Drift）？試說明其形成的原因有那些。（10 分）
3. 試簡要說明糖質新生（glyconeogenesis）的過程及其在身體何處進行？新生成之葡萄糖（glucose）之去向（命運）為何？糖質新生在運動過程生所扮演的角色為何？（10 分）
4. 捷恩是一位兩百公尺短跑的選手，在一次的比賽中，他在熱身過程中覺得身體狀況不錯，但因為捷恩求好心切，希望能在這次比賽中創佳績，因此，又在賽前約三十分鐘時，吃了一根巧克力棒，還喝了一瓶高糖飲料，結果，來到比賽時刻，他突然覺得全身無力，裁判槍響後，他起跑的速度遠不如預期，他知道他將輸掉這場比賽，但他不知為何會發生這樣的狀況。試從生理學的角度說明捷恩的賽前準備出了什麼問題？針對此問題，您對捷恩的建議為何？（10 分）
5. 試列舉五種因過度訓練（over training）後所可能表現出來的生理症狀？（10 分）