編號： 291

國立成功大學 105 學年度碩士班招生考試試題

系　　所：體育健康與休閒研究所

考試科目：運動生物力學

考試日期：0228，節次：3

※ 考生請注意：本試題不可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

單選題 40%，每題 4 分 (Please choose one answer from the provided options)

1. 葉問出拳平均速率為每秒 20 公尺（20 m/s）。若攻擊前方對手時，出拳方向為斜向上（與水平面夾 45 度角），則要打到站在前方 50 公分的巨人，約需多少時間？A) 0.01 秒，B) 0.02 秒，C) 0.025 秒，D) 0.035 秒。
2. 承上題，若一開始從靜止狀態出拳，則其瞬間最大拳速與應 A) 大於， B) 小於， C) 等於， D) 以上都可能 出拳平均速率？
3. 若葉問朝正前方出拳，在距離目標 0.3 公尺時拳速正好為 20m/s。此時忽然發現目標並非壞人，而想剛好在即將接觸目標時將拳速降為 0。假設此時（離目標 0.3 公尺）開始拳頭之加速度為定值（應為負值），則從此時到拳頭停在目標前經過多久時間？A) 0.01 秒，B) 0.02 秒，C) 0.03 秒，D) 0.015 秒。
4. 葉問受暗算，從屋頂掉落。此時他身上剛好背著重物。如果要減小他本身落地的速度量值，則應該把重物 A) 向上拋， B) 向下拋， C) 向左拋， D) 不要拋。
5. 不考慮空氣阻力時，以初速+v 將球往上拋（以向上為正），則球受重力落回原處時速度為 A) -v， B) -2v， C) +v， D) 0.
6. 承上題，若重力加速度為 g，當球飛到最高點時球所受的加速度為 A) 0， B) g， C) 2g， D) 0.5g
7. 從已知的（例如攝影機記錄的）動作推算物體或人體所受的力與力矩稱為 A) 正向動力學， B) 逆向動力學，C) 方向動力學， D) 影像動力學.
8. The center of mass (COM) position of a human body　A) is at a fixed positon， B) is always located inside the trunk， C) depends on the current posture， D) none of the above.
9. In elastic and inelastic collisions, A) only the total momentum is conserved in both cases， B) only the total energy is conserved in both cases， C) both the total momentum and energy are conserved in both cases， D) none of the above.
10. A man (mass = M) starts from a static squat positon and jumps up with upward takeoff velocity V m/s. It takes him T seconds to complete the movement (from the initial static posture to takeoff). Suppose his upward acceleration is a constant and gravitational acceleration is g, what is the ground reaction force during ground contact? A) Mg, B) MV，C) Mg+ MV/T， D) Mg- MV/T.

簡答與計算題(60%)，每題 10 分

1. 請簡述何謂線動量，角動量（以質點為例），與牛頓三大運動定律。

2. (a)將 f(x)對 x 微分，即 df(x)/dx，其定義如下：

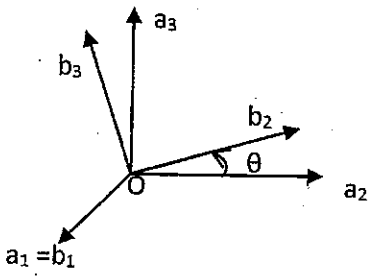
$$\lim_{\Delta x \to 0} \frac{f(x+\Delta x)-f(x)}{\Delta x}$$

根據這個定義，請計算 f(x)=x 及 f(x)=x^2 時，對 x 微分的結果分別為何？

(b)What is the "chain rule" in differentiation? Please also provide an example for applying the chain rule.

3. Define the center of pressure (COP) and center of mass (COM). What is the relation between COM ground projection and COP? Use the example of human standing to illustrate the ideas.

4. As is shown in the figure below, reference frame B (with mutually perpendicular unit vectors $\hat{b}_1$, $\hat{b}_2$, $\hat{b}_3$) initially coincides with frame A (with mutually perpendicular unit vectors $\hat{a}_1$, $\hat{a}_2$, $\hat{a}_3$). Then frame B rotates about the axis $\hat{b}_1 = \hat{a}_1$ with the rotation angle θ. (Note: A unit vector has length = 1.)



Please express $\hat{b}_2$ and $\hat{b}_3$ in terms of $\hat{a}_2$ and $\hat{a}_3$.

5. The result of vector differentiation depends on the reference frame from which you perform the differentiation (but scalar differentiation is the same in any reference frame). For example, suppose vector $\vec{v} = t^2 \hat{a}_1$. Then time derivative of $\vec{v}$ taken in frame A, denoted as ${}^A(d\vec{v}/dt)$, is equal to $(d(t^2)/dt)\hat{a}_1 + {}^A(d\hat{a}_1/dt)\,t^2$. Because $\hat{a}_1$ is fixed in reference frame A, the term ${}^A(d\hat{a}_1/dt)=0$. Thus ${}^A(d\vec{v}/dt) = (d(t^2)/dt)\hat{a}_1 = 2t\hat{a}_1$. Similarly, ${}^B(d\vec{v}/dt) = (d(t^2)/dt)\hat{a}_1 + {}^B(d\hat{a}_1/dt)\,t^2$. From this description and suppose $\vec{w} = t^2\hat{b}_2$, please perform the calculation ${}^A(d\vec{w}/dt)$. (Note: If you do not know how to write $\hat{b}_2$ correctly, you can assume $\hat{b}_2 = f(\theta)\hat{a}_2 + g(\theta)\hat{a}_3$)

6. Use the same figure shown above. Suppose unit vectors $\hat{a}_1$, $\hat{a}_2$, $\hat{a}_3$ are fixed to the trunk (which is fixed to the earth) and unit vectors $\hat{b}_1$, $\hat{b}_2$, $\hat{b}_3$ are fixed to the upper arm. Point O is the center of shoulder joint. First and second time derivatives of θ, that is, dθ/dt and d(dθ/dt)/dt, are denoted as $\dot{\theta}$ and $\ddot{\theta}$, respectively. Assume the vector from O to elbow joint center is $L\hat{b}_2$ (and L is a constant scalar). Calculate the velocity vector and acceleration vector of the elbow joint in frame A. (Hint: Perform the differentiation in reference frame A.)