

國立中山大學九十三年度轉學生招生考試試題

科目：微積分【機電系二年級】

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1. 求下列極限 (40%)

(a) $\lim_{x \rightarrow \infty} \left[\sin\left(x + \frac{1}{x}\right) - \sin x \right]$

(b) $\lim_{x \rightarrow \infty} x^4 \left(\cos \frac{1}{x} - 1 + \frac{1}{2x^2} \right)$

(c) $\lim_{x \rightarrow 2^+} \frac{[x^2] - 4}{x - 2}$

(d) $\lim_{x \rightarrow \infty} \frac{x - [x]}{3x + 2}$

其中 $[a]$ 表示大於 a 之最大整數。

2. 求下列積分 (40%)

(a) $\int \frac{x^4 + 3x^2 + x - 2}{x^3 - 1} dx$

(b) $\int \frac{\sqrt{x^2 - 1}}{x} dx$

3. 由點 $(2, \frac{1}{2})$ 至拋物線 $y = x^2$ 之何點有最短距離? (10%)4. 設 $f(x) = \tan^{-1} x$, 若 $\lim_{h \rightarrow 0} \frac{f(a+4h) - f(a-3h)}{h} = 1$,求常數 a 之值 (10%)

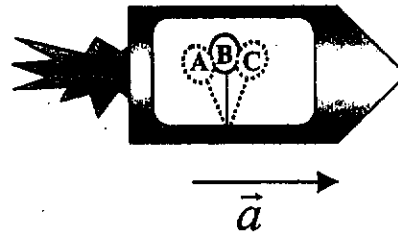
國立中山大學九十三年度轉學生招生考試試題

科目：普通物理【機電系二年級、海工系二年級】

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Selections (5% for each question, total 30%)

1. A tank is filled up with pure water and is carried by a rocket acceleration horizontally to the right as shown in the figure 1. A balloon is fixed by a wire attached to the bottom of the water tank, where will the balloon stabilize at (1) A, (2) B, (3) C and (4) the bottom of the tank.



2. An ambulance running with a velocity of \vec{v}_0 away from an observer who stands still on the ground. If the emergency alarm is of frequency f , what frequency (f') should the observer hear? (a) $f' = f\left(1 - \frac{v_0}{v}\right)$, (b) $f' = f\left(1 + \frac{v_0}{v}\right)$, (c)

$$f' = f\left(\frac{1}{1 - \frac{v_0}{v}}\right), \text{ (d) } f' = f\left(\frac{1}{1 + \frac{v_0}{v}}\right).$$

3. What will happen when a balloon filled with He gas is warmed up? (a) He atoms moves slower, (b) He atoms moves faster, (c) He atoms moves toward the same direction, (d) the speed of He atoms does not change.
4. A conductor is charged with Q . What is the electric field (E) and the electric potential (V) inside the conductor? (a) $E = \text{constant}$, $V = \text{constant}$; (b) $E = \text{constant}$, $V = 0$; (c) $E = 0$, $V = 0$; (d) $E = 0$, $V = \text{constant}$.
5. Two parallel wires carry the same current that flow in the same direction, the two wires will (a) remain still; (b) reject each other; (c) attract with each other; (d) become twisted.
6. Total reflection will occur at an interface when light is traveling from (a) the medium with small n to the medium with large n , (b) the medium with large n to the medium with small n , (c) mediums with the same refractive index, (d) the air into water. (n is the refractive index)

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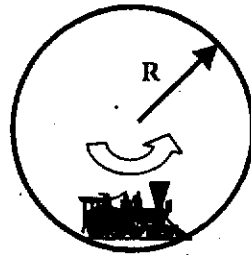
科目：普通物理【機電系二年級、海工系二年級】

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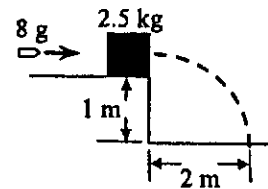
Calculations (total 70%)

1. (15%) A train of mass m is running on a vertical circle rail with radius of R as shown in the right figure.

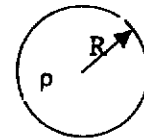
- (a) In order to run through the top of the rail without falling down, what does the minimum speed the train need?
- (b) What is the normal force at the bottom of the rail need to support the train?



2. (10%) An 8-g bullet is fired into a 2.5-kg block initially at rest at the edge of a frictionless table of height 1 m. The bullet remains in the block, and after impact the block lands 2 m from the bottom of the table. Determine the initial speed of the bullet.



3. (25%) A sphere with a radius R contains charges distributed as $\rho = br$ where ρ and r are the charge density and the distance to the center of the sphere. Please calculate the electric field (\vec{E}) and the electric potential (V) at $r < R$, $r = R$ and $r > R$.



4. (20%) Two parallel conduction wires carry the same current I in opposite directions and separate each other with a distance H . Please determine the magnetic force on each other?

