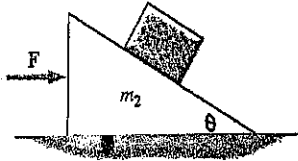


國立中山大學九十一學年度轉學生招生考試試題

科目：普通物理【海工系二年級】

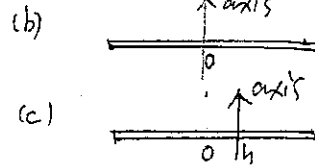
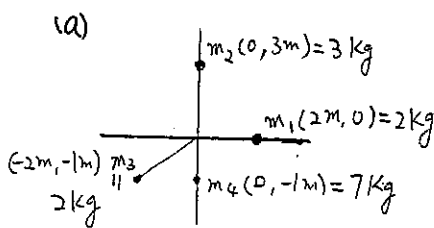
共 3 頁 第 1 頁

(10%) 1. A rectangular block of mass m_1 rests on a wedge-shaped block of m_2 , as shown in the following figure. All contact surfaces are frictionless. Find an expression for the magnitude of the horizontal force F that must be applied to the wedge in order that the rectangular block not slide along the wedge.

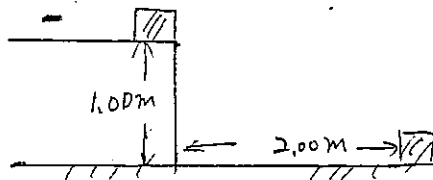


(15%) 2. What are the moment of inertia I of the following configurations.

- (a) several masses rotate around the z-axis.
- (b) a uniform long rod, length L , mass m , rotation axis perpendicular to the rod through center.
- (c) the above rod, but the rotation axis moves h away from center.
- (d) a combination structure, the center part is a uniform disk, mass is M , radius is R , rotation axis is perpendicular to the disk at the center.



(10%) 3. An 8.00-g bullet is fired into a 2.50-kg block that is initially at rest at the edge of a frictionless table of height 1.00 m (Fig.). The bullet remains in the block, and after impact the block lands 2.00 m from the bottom of the table. Determine the initial speed of the bullet.



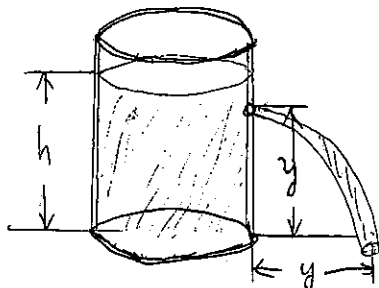
國立中山大學九十一學年度轉學生招生考試試題

科目：普通物理【海工系二年級】

共 3 頁 第 2 頁

(10%) 4. (a). Write down and explain the continuity equation and Bernoulli's equation, which can explain many fluid phenomena.

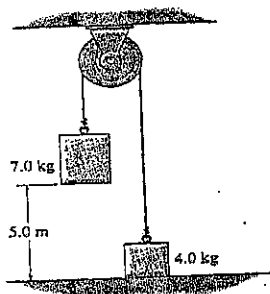
(b). A tank of height H is full of water. At what height y should a small hole be cut so the water initially goes as far horizontally as it does vertically, as shown in the following figure?



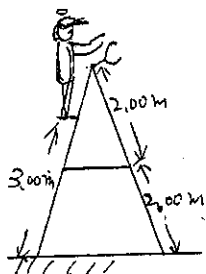
(10%) 5. (a). Explain the Carnot engine which is an ideal engine cycle including four reversible processes.

(b). A Carnot engine extracts 240J of heat from a high-temperature reservoir during each cycle. It rejects 100J of heat to a reservoir at 15°C. How much work does the engine do in one cycle? What is its efficiency? What is the temperature of the hot reservoir?

(15%) 6. The masses shown in the figure are connected by a massless string over a frictionless pulley and are released from rest. Use energy conservation to find (a) the velocity of the 7.0-kg mass just before it hits the floor, (b) the maximum height reached by the 4.0-kg mass, and (c) the fraction of the system's initial mechanical energy lost when the 7.0-kg mass comes to rest on the floor.



(10%) 7. A stepladder of negligible weight is constructed as shown in the figure. A painter with a mass of 70.0 kg stands on the ladder 3.00 m from the bottom. Assuming that the floor is frictionless, find (a) the tension in the horizontal bar connecting the two halves of the ladder, (b) the normal forces at the single hinge C that the left half of the ladder exerts on the right half.



國立中山大學九十一學年度轉學生招生考試試題

科目：普通物理【海工系二年級】

共 3 頁 第 3 頁

(10%) 8. The motion of a particle is described by

$$x = (45 \text{ cm})[\sin(\pi t + \pi/6)],$$

with x in cm and t in seconds. At what time is the potential energy twice the kinetic energy? What is the position of the particle at this time?

(10%) 9. A 1.2-kg block rests on a frictionless surface and is attached to a horizontal spring of constant $k = 23 \text{ N/m}$. The block is oscillating with amplitude 10 cm and with phase constant $\Phi = -\pi/2$. A block of mass 0.80 kg is moving from the right at 1.7 m/s. It strikes the first block when the latter is at the rightmost point in its oscillation. The collision is completely inelastic, and the two blocks stick together. Determine the frequency, amplitude, and phase constant (relative to the original $t=0$) of the resulting motion.

國立中山大學九十一學年度轉學生招生考試試題

科目：微積分【物理系二年級、電機系二年級、資工系二年級、海工系二年級】

共 / 頁 第 / 頁

共七題，滿分100分。答題時，每題都必須寫下題號與步驟。

1. Let $a_i > 0$ for $i = 1, 2, \dots, n$. Find

(a) $\lim_{p \rightarrow 0} (a_1^p + a_2^p + \dots + a_n^p)^{1/p}$. (5分)

(b) $\lim_{p \rightarrow -\infty} (a_1^p + a_2^p + \dots + a_n^p)^{1/p}$. (5分)

(c) $\lim_{p \rightarrow \infty} (a_1^p + a_2^p + \dots + a_n^p)^{1/p}$. (5分)

2. Let $\alpha = \sqrt{2} + \sqrt{3}$.

(a) Find a polynomial $p(x)$ with integer coefficients such that $p(\alpha) = 0$. (5分)

(b) Use one iterate of Newton method with initial value 3 to approximate α . (10分)

3. Calculate $\int \frac{1+x^3+x^4+x^5}{1+x^2+x^4+x^6} dx$. (10分)

4. Let $L = \{(r, \theta) \mid r = 1 + \sin \theta, \theta \in \mathbb{R}\}$.

(a) Sketch the curve L . (5分)

(b) Calculate the area of the region enclosed by L . (10分)

5. Let $p(x) = x^{100} + 1$ and $g(x) = (x-1)^2$. Find the remainder of $p(x)/g(x)$. (10分)

6. Find the radius of convergence and interval of convergence of the power series

$$\sum_{k=0}^{\infty} 2^k (x-4)^k / \ln(k+2).$$

(15分)

7. Let $S = \{(x, y, z) \mid 0 \leq \sqrt{x^2 + y^2} \leq 4 - z, 0 \leq z \leq 2\}$.

(a) Sketch the graph of S . (5分)

(b) Find the volume of S . (10分)

(c) Find the tangent plane to S at $(3, 0, 1)$. (5分)

國立中山大學九十一學年度轉學生招生考試試題

科目：普通化學【海資系二年級、生科系二年級、海工系二年級】 共 3 頁 第 1 頁

請注意：所有選擇題均為單選題，每題 4 分。答錯不計分，並倒扣 1 分；不作答則不計分亦不倒扣。

$$(\log 2 = 0.3010 \quad \log 3 = 0.4771)$$

- Which of the following processes is endothermic?
(a) freezing water (b) boiling water (c) combustion
(d) condensing steam (e) none of above
- Which of the following molecules doesn't have a dipole moment?
(a) H₂O (b) PF₃ (c) BF₃ (d) SO₂ (e) HCl
- Assuming that all volumes are additive, how much water should be added to 25.00 mL of 6.00 F HNO₃ to prepare 0.500 F HNO₃?
(a) 350mL (b) 325mL (c) 300mL (d) 275mL (e) 250mL
- In which of the following liquids would you expect the solubility of NaCl to be the smallest?
(a) HF (b) CH₃OH (c) CH₃COCH₃ (acetone) (d) H₂O (e) CCl₄
- Which of the following ions has the largest radius?
(a) Be²⁺ (b) Li⁺ (c) N³⁻ (d) O²⁻ (e) F⁻
- Which of the following has the smallest mass?
(a) a hydrogen nucleus (b) an alpha particle (c) a neutron
(d) a helium nucleus (e) a beta particle
- At a given temperature the equilibrium constant for the reaction
$$\text{PCl}_{5(g)} \rightleftharpoons \text{PCl}_{3(g)} + \text{Cl}_{2(g)}$$
is 2.4×10^{-3} . What is the equilibrium constant for the reaction
$$\text{PCl}_{3(g)} + \text{Cl}_{2(g)} \rightleftharpoons \text{PCl}_{5(g)}$$
at the same temperature?
(a) 2.4×10^{-3} (b) -2.4×10^{-3} (c) 4.2×10^{-2} (d) 4.2×10^2 (e) 2.4×10^5
- For the system $\text{NH}_4\text{Cl}_{(s)} \rightleftharpoons \text{NH}_3(g) + \text{HCl}(g)$, if the concentration of NH₃ is doubled, the equilibrium constant will
(a) double (b) increase, but by less than a factor of 2 (c) be halved
(d) remain the same (e) decrease, but by less than a factor of 2.
- The pH of 0.050 F HA solution is 5.35. What is K_a for HA?
(a) 2.0×10^{-11} (b) 4.0×10^{-10} (c) 4.5×10^{-6} (d) 8.9×10^{-5} (e) 5.0×10^{-2}

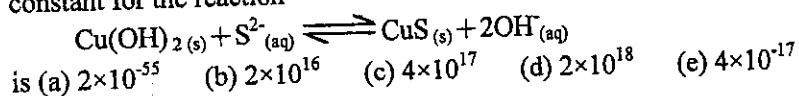
國立中山大學九十一學年度轉學生招生考試試題

科目：普通化學【海資系二年級、生科系二年級、海工系二年級】 共 3 頁 第 2 頁

10. A buffer that is a mixture of acetic acid and potassium acetate has a $\text{pH} = 5.24$. The K_a of acetic acid is 4.75. The $[\text{acetate}] / [\text{acetic acid}]$ ratio in this buffer is
 (a) 1 : 1 (b) 3 : 1 (c) 5 : 1 (d) 1 : 3 (e) 1 : 5

11. At the temperature at which the molar solubility of PbBr_2 in water is $2.3 \times 10^{-2} \text{ M}$, what is the K_{sp} of PbBr_2 ?
 (a) 5.3×10^{-4} (b) 1.2×10^{-5} (c) 2.4×10^{-5} (d) 2.3×10^{-2} (e) 4.9×10^{-5}

12. If the K_{sp} of $\text{Cu}(\text{OH})_2$ is 2×10^{-19} and the K_{sp} of CuS is 8.7×10^{-36} , the equilibrium constant for the reaction



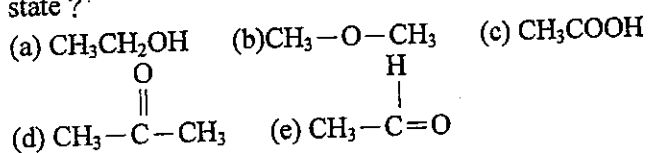
13. Which of the following has the highest percentage of ionic character in its bonding?
 (a) LiI (b) MgCl_2 (c) CsF (d) CsI (e) AlCl_3

14. Which of the following sets of the four quantum numbers n , ℓ , m_ℓ , and m_s describes one of the outermost electrons in a ground state strontium atom?
 (a) 5, 1, 1, 1/2 (b) 5, 0, 0, -1/2 (c) 5, 0, 1, 1/2 (d) 5, 1, 0, 1/2 (e) 5, 2, 1, -1/2

15. Which of the following diatomic species do you expect to have the longest bond length?
 (a) NO^+ (b) O^{2-} (c) CO (d) O^{2+} (e) N^{2+}

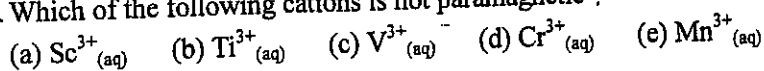
16. A sulfur-containing species that cannot be a reducing agent is
 (a) SO_2 (b) SO_3^{2-} (c) SO_4^{2-} (d) S^{2-} (e) $\text{S}_2\text{O}_3^{2-}$

17. In which of the following compounds is there a carbon atom in the +3 oxidation state?



18. Aluminum-25 decays by emitting a positron. The species immediately produced has
 (a) 12p, 13n, 13e⁻ (b) 13p, 12n, 13e⁻ (c) 12p, 13n, 12e⁻
 (d) 14p, 11n, 14e⁻ (e) 13p, 13n, 13e⁻

19. Which of the following cations is not paramagnetic?



國立中山大學九十一學年度轉學生招生考試試題

科目：普通化學【海資系二年級、生科系二年級、海工系二年級】 共 3 頁 第 3 頁

20. If concentrations are measured in moles per liter and time in minutes, the units for the rate of a third-order reaction are

- (a) min^{-1} (b) $\text{L}\cdot\text{mole}^{-1}\text{min}^{-1}$ (c) $\text{L}^2\text{mole}^{-2}\text{min}^{-1}$
(d) $\text{mole}\cdot\text{L}^{-1}\text{min}^{-1}$ (e) $\text{mole}^2\text{L}^{-2}\text{min}^{-1}$

21. For a hypothetical reaction $A + 2B \rightarrow 3C + D$, $d[C]/dt$ is equal to

- (a) $-d[A]/dt$ (b) $-d[B]/dt$ (c) $+3d[A]/dt$ (d) $(-3/2)d[B]/dt$ (e) $+d[A]/dt$

22. For the reaction $A + 2B \rightarrow 2C$, the rate law for formation of C is

- (a) $\text{rate} = k[A][B]^2$ (b) $\text{rate} = k[A][B]$ (c) $\text{rate} = k[C]^2 / [A][B]^2$
(d) $\text{rate} = k[A]^2[B]$ (e) impossible to state from the data given.

23. Consider the cell $\text{Cd}_{(s)}|\text{Cd}^{2+}(1.0\text{M})||\text{Cu}^{2+}(1.0\text{M})|\text{Cu}_{(s)}$. If we wanted to make a cell with a more positive voltage using the same substances, we should

- (a) Increase both the $[\text{Cd}^{2+}]$ and $[\text{Cu}^{2+}]$ to 2.00M.
(b) Increase only the $[\text{Cd}^{2+}]$ to 2.00M.
(c) Decrease both the $[\text{Cd}^{2+}]$ and $[\text{Cu}^{2+}]$ to 0.100M.
(d) Decrease only the $[\text{Cd}^{2+}]$ to 0.100M.
(e) Decrease only the $[\text{Cu}^{2+}]$ to 0.100M.

24. An adiabatic process is one in which there is no transfer of heat across the boundary between system and surroundings. For such a process

- (a) $P_{\text{ext}}\Delta V = 0$ (b) $q = w$ (c) $\Delta E = w$ (d) $\Delta H = 0$ (e) $\Delta E = q$

25. If a process is both endothermic and spontaneous then

- (a) $\Delta S > 0$ (b) $\Delta S < 0$ (c) $\Delta H < 0$ (d) $\Delta G > 0$ (e) $\Delta E = 0$