國立中山大學101學年度轉學生招生考試試題

科目：微積分【海工系學士班二年級】

題號：7038

共十題, 每題10分. 答題時, 請寫下題號與詳細計算步驟.

1. Given that $x^2+xy-y^3=1$ is a smooth curve near $(-1,0)$, find $y''(-1)$.

2. Find the point on the curve $y=x^2+1$ that is closest to the point $(3,1)$.

3. Find the area of the region bounded by $y=x+1$ and $y=x^2-1$.

4. Evaluate $\int_{1/2}^{1} x\sin^{-1}x\,dx$.

5. Find the Maclaurin series of $f(x)=xe^x$.

6. Find the interval of convergence of $\sum_{n=1}^{\infty}2^{-n}(x+1)^n$.

7. Find all the first and the second partial derivatives of $f(x,y)=e^{x/y}$.

8. Evaluate $\int_0^{\infty}\int_0^{y}e^{-x^2-y^2}\,dy\,dx$.

9. Evaluate

$$\int_0^2\int_0^{\sqrt{4-x^2}}\int_{\sqrt{1-x^2-y^2}}^{\sqrt{4-x^2-y^2}} xz\,dz\,dy\,dx.$$

10. Evaluate the line integral

$$\int_C y\,dx+x^2\,dy,$$

where C is the arc of the parabola $x=4-2y^2$ from $(-4,2)$ to $(2,1)$.

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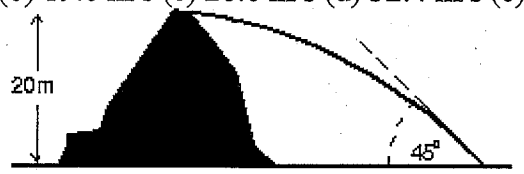
國立中山大學 101 學年度轉學生招生考試試題

科目：普通物理【海工系學士班二年級】

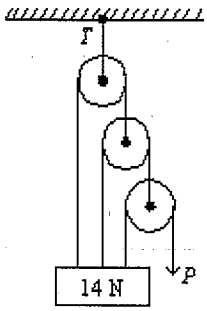
題號：7039

選擇題 60%（單選，每題5分，答錯不倒扣）

1. A car travels 40 kilometers at an average speed of 80 km/h and then travels 40 kilometers at an average speed of 40 km/h. The average speed of the car for this 80 km trip is: (a) 40 km/h (b) 45 km/h (c) 48 km/h (d) 53 km/h (e) 80 km/h.
2. A racing car traveling with constant acceleration increases its speed from 10 m/s to 30 m/s over a distance of 80 m. How long does this take? (a) 2.0 s (b) 4.0 s (c) 5.0 s (d) 8.0 s (e) The time cannot be calculated since the speed is not constant.
3. A ball is thrown horizontally from the top of a 20-m high hill. It strikes the ground at an angle of 45°. With what speed was it thrown? (The gravitational acceleration constant g=9.8 m/s^2) (a) 14.2 m/s (b) 19.8 m/s (c) 28.6 m/s (d) 32.4 m/s (e) 40 m/s.



4. A 90-kg man stands in an elevator that has a downward acceleration of 1.4 m/s^2. The force exerted by him on the floor is about: (The gravitational acceleration constant g=9.8 m/s^2) (a) zero (b) 90 N (c) 756 N (d) 882 N (e) 1008 N.
5. A 12-kg crate rests on a horizontal surface and a boy pulls on it with a force that is 30° below the horizontal. If the coefficient of static friction is 0.40, the minimum magnitude force he needs to start the crate moving is: (a) 44 N (b) 47 N (c) 54 N (d) 56 N (e) 71 N.
6. A 0.50-kg block attached to an ideal spring with a spring constant of 80 N/m oscillates on a horizontal frictionless surface. The total mechanical energy is 0.12 J. The greatest extension of the spring from its equilibrium length is: (a) 1.5×10^{-3} m (b) 3.0×10^{-3} m (c) 0.039 m (d) 0.054 m (e) 18 m.
7. A 0.20-kg particle moves along the x axis under the influence of a stationary object. The potential energy is given by $U(x) = (8.0\text{J/m}^2)x^2 + (2.0\text{J/m}^4)x^4$, where x is in coordinate of the particle. If the particle has a speed of 5.0 m/s when it is at $x = 1.0$ m, its speed when it is at the origin is: (a) 0 (b) 2.5 m/s (c) 5.7 m/s (d) 7.9 m/s (e) 11 m/s.
8. The pull P is just sufficient to keep the 14-N block and the weightless pulleys in equilibrium as shown. The tension T in the upper cable is: (a) 14 N (b) 28 N (c) 16 N (d) 9.33 N (e) 18.7 N.



9. A Carnot engine operates between 200°C and 20°C. Its maximum possible efficiency is: (a) 90% (b) 100% (c) 38% (d) 72% (e) 24%.
10. A plane parallel plate capacitor has plates of 10 cm^2 area that are 1.0 mm apart. At an instant when charge is being accumulated on the plates at a rate of 12 nC/s, the displacement current between the plates is (a) 1.06×10^{-16} A (b)1.2×10^{-8} A (c)8.85×10^{-9} A

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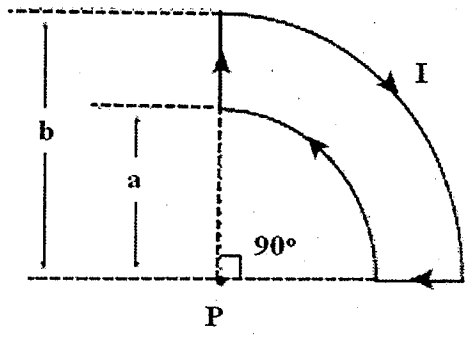
(d)1.00 A (e)1.36 A.

11. If a = 1.0 cm, b = 3.0 cm, and I = 30 A, what is the magnitude of the magnetic field at point P? (Permeability of free space $\mu_0=4\pi\times10^{-7}$ T·m/A) (a) 0.62 mT (b)0.59 mT (c)0.35 mT (d)0.31 mT (e)0.10 mT.



12. The phase difference between the two waves which give rise to a dark spot in a Young's double-slit experiment is (where m = integer): (a) zero (b) $2\pi m + \pi/8$ (c) $2\pi m + \pi/4$ (d) $2\pi m + \pi/2$ (e) $2\pi m + \pi$.

非選擇題（40%）

1. A solid cube of wood of side 2a and mass M is resting on a horizontal surface. The cube is constrained to rotate about a fixed axis AB (Fig. P1). A bullet of mass m and speed v is shot at the face opposite ABCD at a height of 4a/3. The bullet becomes embedded in the cube. (a) Please show that the rotational momentum inertia of cube along one of its edge is $8Ma^2/3$. (10 分) (b) Find the minimum value of v required to tip the cube so that it falls on face ABCD. (10 分) Assume m<< M.

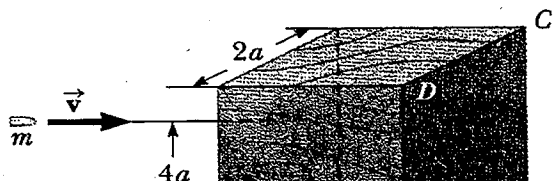


Figure P1

2. A conducting bar of length ℓ moves to the right on two frictionless rails as shown in Fig. P2. A uniform magnetic field directed into the page has a magnitude of 0.3 T. Assume R=9.00Ω and ℓ = 0.35m (a) At what constant speed should the bar move to produce an 8.50 mA current in the resistor? (7 分) (b) What is the direction of the induced current? (6 分) (c) At what rate is energy delivered to the resistor? (7 分)

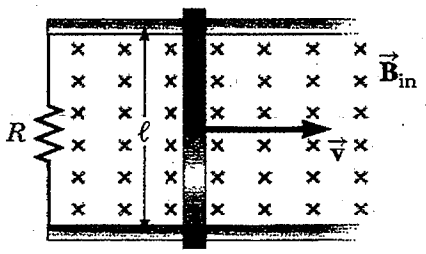


Figure P2

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國立中山大學101學年度轉學生招生考試試題

科目：普通化學【海工系學士班二年級】

題號：7040

選擇題(均為單選，每題4分，答錯到扣1分，未作答則不計分亦不倒扣。)

1. 1 μg (microgram) is
   (A) 10 g (B) 10^{-1} g (C) 10^{-3} g (D) 10^{-6} g (E) 10^{-9} g

2. What is the most likely electron configuration for a sodium ion in its ground state?
   (A) $1s^2 2s^2 2p^5$ (B) $1s^2 2s^2 2p^6$ (C) $1s^2 2s^2 2p^6 3s^1$
   (D) $1s^2 2s^2 2p^5 3s^2$ (E) $1s^2 2s^2 2p^6 3s^2$

3. Which of the following elements and ions is paramagnetic?
   (A) H (B) He (C)Be (D) O^{2-} (E) F^-

4. In which of the following species does the central atom NOT form sp^2 hybrid orbitals?
   (A) SO_2 (B)BF_3 (C)NO_3^- (D)SO_3 (E)PCl_3

5. The temperature of a sample of an ideal gas confined in 2.0 L container was raised from 27 ℃ to 77 ℃. If the initial pressure of the gas was 1200 mm Hg, what was the final pressure of the gas?
   (A) 300 mm Hg (B) 600 mm Hg (C) 1400 mm Hg
   (D) 2400 mm Hg (E) 3600mm Hg

6. A sealed container contains 0.20 moles of oxygen gas and 0.10 moles of hydrogen gas. If the temperature is 25 ℃ throughout the container, which of the following is true?
   (A) The partial pressures of the two gases are the same.
   (B) The average kinetic energy of the two gases are the same.
   (C) The molecular masses of the two gases are the same.
   (D) The total masses of the two gases are the same.
   (E) The average molecular speeds of the two gases are the same.

7. Which of the following will be true when a pure substance in liquid phase freezes spontaneously?
   (A) △G, △H and △S are all positive.
   (B) △G, △H and △S are all negative.
   (C) △G and △H are negative, but △S is positive.
   (D) △G and △S are negative, but △H is positive.
   (E) △S and △H are negative, but △G is positive.

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8. If an endothermic reaction is spontaneous at 298 K, which of the following must be true for the reaction?
   Ⅰ. △G is greater than zero.
   Ⅱ. △H is greater than zero.
   Ⅲ. △S is greater than zero.
   (A) I only (B) II only (C) I and II only
   (D) II and III only (E) I, II and III

9. The addition of a catalyst will have which of the following effects on a chemical reaction?
   Ⅰ. The enthalpy change will decrease.
   Ⅱ. The entropy change will decrease.
   Ⅲ. The activation energy will decrease.
   (A) I only (B) II only (C) III only
   (D) I and II only (E) II and III only

10. $H_{2(g)}+F_{2(g)}\rightarrow 2HF_{(g)}$
    Gaseous hydrogen and fluorine combine in the reaction above to form hydrogen fluoride with an enthalpy change of -540 kJ. What is the value of the heat of formation of $HF_{(g)}$?
    (A) -1080 kJ/mol (B) -540 kJ/mol (C) -270 kJ/mol
    (D) 270 kJ/mol (E) 540 kJ/mol

11. $2S_{(s)}+3O_{2(g)} \rightarrow 2SO_{3(g)}$ △H= +800 kJ/mol
    $2SO_{3(g)} \rightarrow 2SO_{2(g)} + O_{2(g)}$ △H= -200 kJ/mol
    Based on the information given above, what is △H for the follwing reaction?
    $S_{(s)}+O_{2(g)} \rightarrow SO_{2(g)}$
    (A) 300 kJ/mol (B) 500 kJ/mol (C) 600 kJ/mol
    (D) 1000 kJ/mol (E) 1200 kJ/mol

12. A 0.5 molar solution of which of the following salts will have the lowest pH?
    (A) KCl (B) CH_3COONa (C) NaI (D) KNO_3 (E) NH_4Cl

13. Which of the following salts will produce a solution with a pH of greater than 7 when placed in distilled water?
    (A) NaCN (B) KCl (C) $NaNO_3$ (D) NH_4NO_3 (E) KI

14. Oxygen takes the oxidation state -1 in hydrogen peroxide, H_2O_2. The equation for the decomposition of H_2O_2 is shown below.

$$2\ H_2O_2 \rightarrow 2H_2O + O_2$$

Which of the following statements about the reaction above is true?

(A) Oxygen is reduced and hydrogen is oxidized.
(B) Oxygen is oxidized and hydrogen is reduced.
(C) Oxygen is both oxidized and reduced.
(D) Hydrogen is both oxidized and reduced.
(E) Neither oxygen nor hydrogen changes oxidation state.

15. Which of the following statements is true regarding the mass and magnitude of charge of alpha particles and beta particles ?

(A) Alpha particles are more highly charged and have greater mass than beta particles.
(B) Beta particles are more highly charged and have greater mass than alpha particles.
(C) Alpha particles are more highly charged than beta particles, but beta particles have greater mass.
(D) Beta particles are more highly charged than alpha particles, but alpha particles have greater mass.
(E) Alpha particles are more highly charged than beta particles, but the masses of the two types of particles are the same.

16. Strontium-90 decays through the emission of beta particles. It has a half-life of 29 years. How long does it take for 80% of a sample of strontium-90 to decay?

(A) 9.3 years (B) 21 years (C) 38 years (D) 67 years (E) 96 years

17. Which of the following experimental procedures is used to separate two substances by taking advantage of their differing boiling points?

(A) Titration (B) Distillation (C) Filtration
(D) Decantation (E) Hydration

18. Which of the following substances experiences the strongest attractive intermolecular forces?

(A) H_2 (B) N_2 (C) CO_2 (D) NH_3 (E) CH_4

19. Which of the following sets of gases would be most difficult to separate if the method of gaseous effusion is used?

(A) O_2 and CO_2 (B) N_2 and C_2H_4 (C) H_2 and CH_4
(D) He and Ne (E) O_2 and He

20. Which of the following pairs of compounds are isomers?
(A) HCOOH and CH_3COOH
(B) CH_3CH_2CHO and C_3H_7OH
(C) C_2H_5OH and CH_3OCH_3
(D) C_2H_4 and C_2H_6
(E) C_3H_8 and C_4H_{10}

21. $2NO_{(g)}+2H_{2(g)} \rightarrow N_{2(g)}+2H_2O_{(g)}$
Which of the following is true regarding the relative molar rates of disappearance of the reactants and appearance of the products?
Ⅰ. N_2 appears at the same rate that H_2 disappears.
Ⅱ. H_2O appears at the same rate that NO disappears.
Ⅲ. NO disappears at the same rate that H_2 disappears.
(A) I only (B) I and II only (C) I and III only
(D) II and III only (E) I, II and III

22. Which of the following salts will produce a colorless solution when added to water?
(A) $Cu(NO_3)_2$ (B) $NiCl_2$ (C) $KMnO_4$ (D) $ZnSO_4$ (E) $FeCl_3$

23. Which of the following procedures will produce a buffered solution?
Ⅰ. Equal volumes of 1 M NH_3 and 1 M NH_4Cl solutions are mixed.
Ⅱ. Equal volumes of 1 M H_2CO_3 and 1 M $NaHCO_3$ solutions are mixed.
Ⅲ. Equal volumes of 1 M NH_3 and 1 M H_2CO_3 solutions are mixed.
(A) I only (B) III only (C) I and II only
(D) II and III only (E) I, II and III

24. Which of the following species is amphoteric?
(A) H_2SO_4 (B) H_3PO_4 (C) SO_4^{2-} (D) HPO_4^{2-} (E) PO_4^{3-}

25. Which of the following is a possible set of quantum numbers for an electron?
(A) $1,1,0,\frac{1}{2}$ (B) $1,0,1,\frac{1}{2}$ (C) 1,1,1,0 (D) $1,0,0,\frac{1}{2}$ (E) 1,0,0,0

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