國立中山大學 109 學年度
碩士暨碩士專班招生考試試題

科目名稱：英文【材光系碩士班甲組、材料前瞻應材碩士班甲組】

－作答注意事項－

考試時間：100 分鐘

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- **答案卷限用藍、黑色筆(含鉛筆)書寫、繪圖或標示，**可攜帶橡皮擦、無色透明無文字墊板、尺規、修正液（帶）、手錶(未附計算器者)。每人每節限使用一份答案卷，不得另攜帶紙張，請衡酌作答。

- 答案卡請以 2B 鉛筆劃記，不可使用修正液（帶）塗改，未使用 2B 鉛筆、劃記太輕或污損致光學閱讀機無法辨識答案者，其後果由考生自行負擔。

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- **試題及答案卷（卡）請務必繳回，未繳回者該科成績以零分計算。**

- **試題採雙面列印，考生應注意試題頁數確實作答。**

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選擇題(兩大題 I 與 II，共 30 題)請於答案卡上作答。

I.　**Multiple Choice Questions (單選題)**
　A.　**Select the preposition that best complete the sentence. (30%, 3 points each)**

1.　We had no computer backup and had to rely on old paper files to _____ the records we lost.
　A.　remedy
　B.　reconstruct
　C.　recondition
　D.　register

2.　The accident happened as a result of years of _____ on the part of the safety.
　A.　indifference
　B.　incuriosity
　C.　consistence
　D.　loneliness

3.　Philosophy differs from science, in that its questions cannot be answered _____, by observation or experiment.
　A.　emotionally
　B.　deliberately
　C.　empirically
　D.　mostly

4.　The chairman proposed that we have someone with _____ and imagination to design a marketing strategy.
　A.　intuition
　B.　enterprise
　C.　conservative
　D.　irritable

5.　Did you find her enthusiasm for the project _____? Almost everyone on the team is now doing their utmost to resolve the difficulty.
　A.　contagious
　B.　operative
　C.　effectual
　D.　infectious

6.　The bank has agreed to _____ the payment on my loan while I am still a student.
　A.　defer
　B.　suspend
　C.　dangle
　D.　sustain

7.　Public _____ of the problem of environment protection will make politicians take it seriously.
　A.　diagnosis
　B.　agitation
　C.　awareness
　D.　proclamation

8.　Recently a large international conference was held with the aim of promoting _____ development in all countries.
　A.　unthinkable
　B.　unpredictable
　C.　retainable
　D.　sustainable

9. Patricia likes doing active things like canoeing, _____ and horse-riding.
   A. wandering
   B. hiking
   C. strolling
   D. roaming

10. The table has a plastic coating that prevents liquid from _____ into the wood beneath.
    A. spilling
    B. scattering
    C. permeating
    D. circulating

B. Choose the option has the closest meaning to the underlined part of the sentence in its context. (30%, 3 points each)

11. A conflict could be approached by bolstering one's position with a system of justification, moral principles, or rules of logic.
    A. combining
    B. criticizing
    C. supporting

12. There was a sudden flash of light, making the driver veer sharply.
    A. change suddenly
    B. adjust slightly
    C. halt completely

13. The farmers were more anxious for rain than the people in the city because they have more at stake.
    A. in vain
    B. in their possession
    C. at risk

14. If social security should be contingent on financial need, there is a danger that such means-testing will later be extended to less affluent people.
    A. relevant to
    B. dependent on
    C. accessible to

15. Reducing unemployment has become an imperative for the new government.
    A. a priority
    B. an undertaking
    C. a promise

16. After several attempts, Thomas embraced an opportunity to further his studies at a national university.
    A. indulged himself in
    B. applied himself to
    C. availed himself of

17. Machine-to-machine exchanges will off-load human brain work the way machines of the industrial Revolution off-loaded muscle work.
    A. reshape
    B. relieve
    C. affect

18. We must get the whole expedition clearly mapped out on paper before we start to order any equipment.
    A. graphed
    B. schemed
    C. reflected

19. The cosmetics advertisement <u>purports</u> to delay the development of wrinkles.
   A. claims
   B. supports
   C. means

20. The economic policies that the government is now pursuing threaten to <u>undermine</u> the health care system, although they claim to maintain it.
   A. weaken
   B. emphasize
   C. strengthen

II. Reading comprehension. (40%, 4 points each)

According to a recent study suggests, the amount of food needed to feed the world's population by the end of the century could increase by almost 80%. Researchers said a trend of increasing Body Mass Index (BMI) is resulting in individuals requiring more calories. The authors warn that failure to meet the need for more calories could lead to greater global inequality.

The study calculated that 60% of the calorie increase would be a result of the growing population in the world. According to the UN World Population Prospects, the global population was estimated to increase from seven billion in 2010 to almost eleven billion in 2100. Yet, more than 18% of the increase in the calories from 2010 levels would come from a **projected** increase in height and weight figures in the global population.

"The increase in the average daily required energy rises by 253 kcal per person between 2010 and 2100 in our estimations, assuming a rising BMI and height," explained Lutz Depenbusch from the World Vegetable Center. "On a global scale, we calculate that the effect of the BMI and height increases in our model would lead to additional calorie requirements that match the combined requirements of India and Nigeria in 2010." In terms of what food would equate to an increase of 253 calories in someone's daily diet, Dr. Depenbusch said an extra two large bananas or a portion of French fries would be on the menu.

Dr. Depenbusch and his colleague, Prof. Stephan Klasen from the University of Gottingen, Germany, said their modeling suggested that sub-Saharan nations would be **extremely** affected by such an increase in future global calorie requirements. In fact, the region has already been witnessing a sharp increase in the need for calories as **it** was undergoing a rate of rapid population growth.

The researchers warned that a failure of the global food policy to accommodate this increase in the demand for more energy could exacerbate food and economic inequality. It is warned that the growing demand for food would lead to an increase in food prices. While rich nations would be able to absorb the increases, poorer nations would struggle and thus lead to more malnutrition.

(Reference: Kinver, M. (2019, December 23). World faces 80% calorie increase by end of century. *BBC News Science & Environment*)

21. The passage primarily discusses:
   A. excess nutrition
   B. food poisoning
   C. malnutrition
   D. food demand

22 Most likely, the word "<u>**it**</u>" in the 4th paragraph refers to the:
   A. Nigeria
   B. India
   C. sub-Saharan nations
   D. Germany

23. Which was claimed in this study to <u>mostly</u> affect the increasing amount of food demand in the near future?
    A. poverty
    B. increase in height figures
    C. increase in weight figures
    D. growing population
24. Where do the authors suggest additional dietary supplements in the article?
    A. Line 10
    B. Line 15
    C. Line 18
    D. Line 22
25. The study mentions all of the following as important in determining the food demand <u>EXCEPT</u> the
    A. increase in food prices
    B. rising BMI value
    C. rapid population growth
    D. average daily required energy per person
26. The word " **projected** " in the second paragraph is closest in meaning to
    A. promised
    B. manipulated
    C. predicted
    D. proposed
27. Which is <u>TRUE</u> concerning the main context?
    A. Poorer nations have a higher potential to conquer the challenge of increasing food demand.
    B. The average daily required energy per person declines from 2010 to 2100.
    C. The global population will exceed eighteen billion in 2100.
    D. An improper food policy could exacerbate food and economic inequality.
28. The word "**extremely**" in the fourth paragraph is closest in meaning to
    A. exceptionally
    B. inferiorly
    C. ordinarily
    D. equally
29. According to the study, what has been done by the researchers for proving the amount of food needed by the end of the century?
    A. market survey
    B. fortune telling
    C. calculation model
    D. live test
30. According to the third paragraph, 253 calories per day may be substituted by
    A. a serving of vegetables
    B. a whole serving of French fries
    C. two large-sized bananas
    D. lack of information

國立中山大學 109 學年度
碩士暨碩士專班招生考試試題

科目名稱：熱力學【材光乙組聯合招生碩士班、材光系碩士班乙組、材料前瞻應材碩士班乙組】

1. According to the following thermodynamic data, calculate the enthalpy (10%), entropy (10%) and Gibbs free energy (10%) of the reaction Pb + 1/2 O$_2$ = PbO at 1000 K.

H$_{PbO (298)}$ = -219,000 J/mole

S$_{Pb (298)}$ = 65 J/K mole

S$_{PbO (298)}$ = 66.3 J/K mole

S$_{O2 (298)}$ = 205 J/K mole

C$_{p, Pb(s)}$ = 23.6 + 9.75*10^{-3}T J/K from 298 K to T$_{m. Pb}$

C$_{p, Pb(l)}$ = 32.4 – 3.1*10^{-3}T J/K from T$_{m.Pb}$ to 1200 K

C$_{p, PbO(s)}$ = 37.9 + 26.8*10^{-3}T J/K from 298 K to T$_{m.PbO}$

C$_{p, O2(g)}$ = 29.96 + 4.18*10^{-3}T – 1.67*10^5 T^{-2} J/K from 298 K to 3000 K

H$_{m,Pb}$ = 4810 J at T$_{m, Pb}$ = 600 K

T$_{m,PbO}$ = 1159 K

2. According to the following figure, (a) describe the meaning of point d and e (10%); (b) write down the triple points of stable and metastable phase equilibria. (10%)
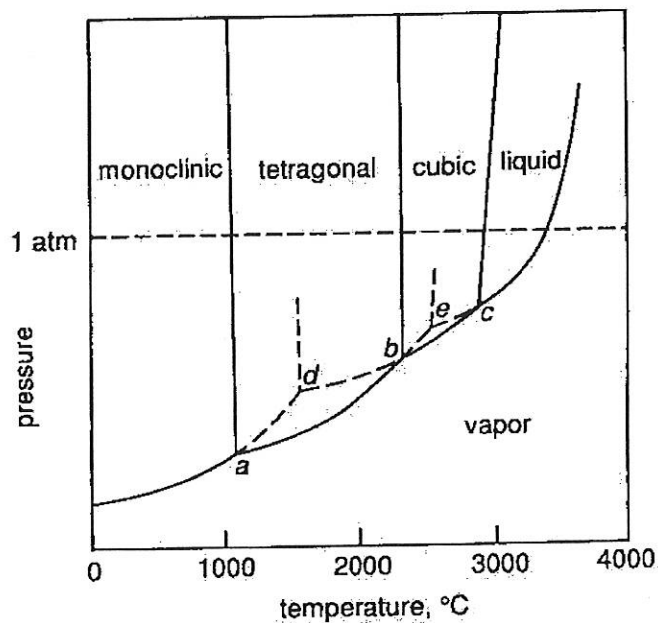

Figure 7.15　A schematic phase diagram for zirconia, ZrO$_2$.

3. One mole of a monatomic ideal gas, in the initial state T = 273 K, P = 1 atm, is subjected to the following three processes, each of which is conducted reversibly:
   a. a doubling of its volume at constant pressure, (10%)
   b. then a doubling of its pressure at constant volume, (10%)
   c. then a return to the initial state along the path P = 6.643 * 10^{-4}V^2 + 0.6667. (10%)

Calculate the heat and work effects which occur during each of the three processes.

4. There are four sets of regular solution parameters as (A) $\Omega_l = 0.0$ kJ, $\Omega_s = 0.0$ kJ; (B) $\Omega_l = 0.0$ kJ, $\Omega_s = 15$ kJ; (C) $\Omega_l = -10$ kJ, $\Omega_s = 0.0$ kJ; (D) $\Omega_l = 10$ kJ, $\Omega_s = 0.0$ kJ，The melting temperatures of A and B are, 800 and 1200 K, respectively, and the molar entropies of melting of both components are 10 J/K. Please mark these parameter sets to match the following four phase diagrams. (20%)
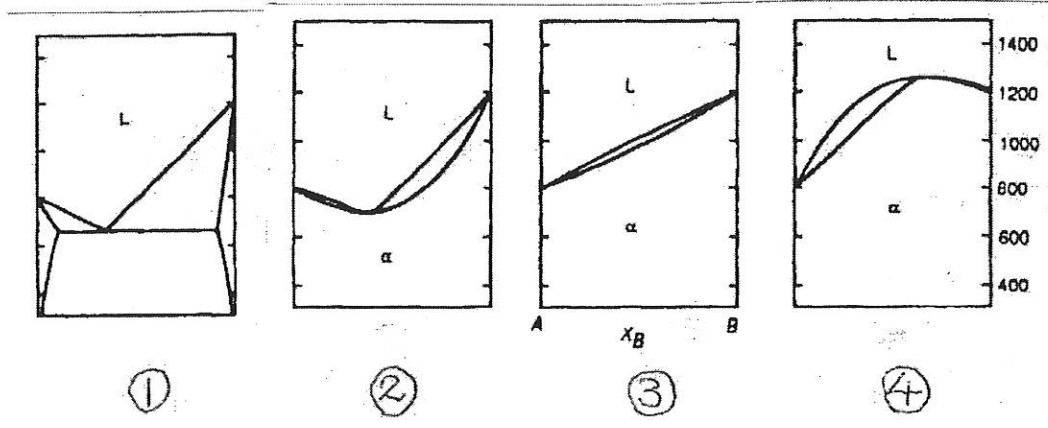
國立中山大學 109 學年度
碩士暨碩士專班招生考試試題

科目名稱：材料科學【材光丙組聯合招生碩士班、材光系碩士班丙組、材料前瞻應材碩士班丙組】

---作答注意事項---

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(1) Compare interstitial diffusion and substitutional diffusion. 　　　　10 points

(2) When people say a crack is (a) stable, or (b) unstable, what does it means?　3 points each,　6 points

(3) Explain the following terms: (a) Fatigue limit, (b) Extrinsic semiconductor, (c) Cup-and-cone fracture surface, (d) Partially stabilized Zirconia, (e) Eutectoid reaction, (f) Hardenability of a steel, and (g) Lever rule. 　　　　　　　　　　　　　　　　5 points each,　　35 points

(4) Discuss the figure shown below. 　　　　　　　　　　　　8 points
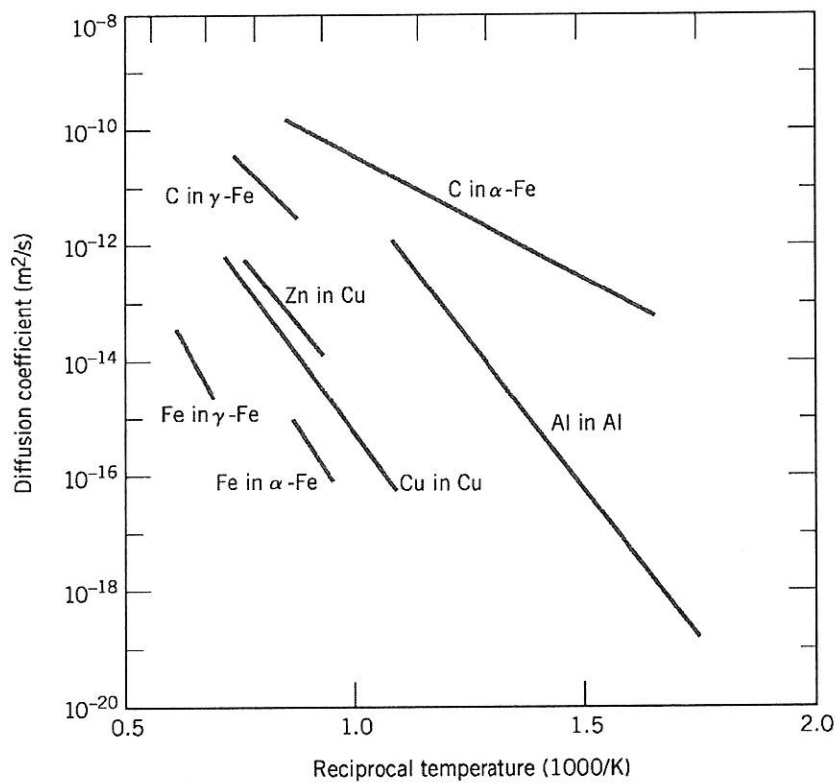
(5) 人造雨的進行一般多用飛機在高空撒播碘化銀，亦可以在地面燃燒碘化銀來造成降雨。請問其所利用的相變化原理為何？ 　　　　　　　　　7 points

(6) Explain what is dielectric constant? 　　　　　　　　　　6 points

(7) Discuss the effect of temperature and stress on creep of metals. 　　　6 points

(8) When you have a pure copper rod, at first the copper rod will be deformed easily by bending. When you try to straighten out the bent rod, you will find that the force required is much more than the force to bend it. Explain this. 　　　　　　　　　　6 points

(9) Work out the common direction between (a) (111) and (001), (b) (231) and (101) in a tetragonal unit cell.　　　　　　　3 points each, 6 points

(10) During dynamic recrystallization, bulge of grain boundaries may occur which cause the generation of new fine grains, as shown in the figure. Grain boundary bulge increases grain boundary surface area, so that increases total grain boundary energy. Since grain boundary bulge increases grain boundary energy, why this process can occur? (Note: dynamic recrystallization is a process of recrystallization which occurs during plastic deformation at an elevated temperature.)　　10 points
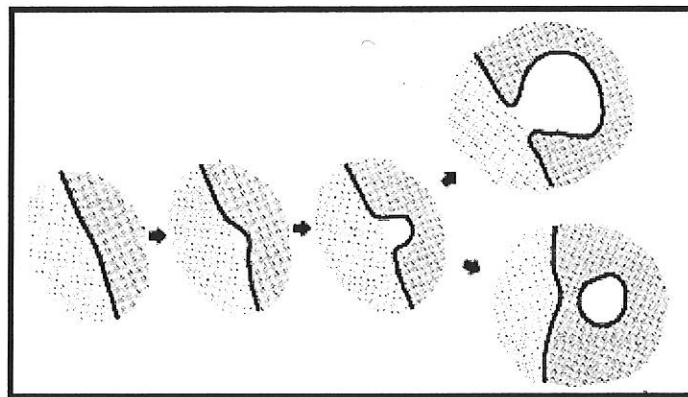
(Figure quoted from: Urai, Janos & Means, W. & Lister, Gordon. (1986). Dynamic recrystallization of minerals)

國立中山大學 109 學年度
碩士暨碩士專班招生考試試題

科目名稱：普通物理【材光丙組聯合招生碩士班、材光系碩士班丙組、材料前瞻應材碩士班丙組】

Problem 1. [10 points] Three masses are placed on the x-axis: 200 g at x = 0, 500 g at x = 30 cm, and, 400 g at x = 70 cm. Find their center of mass.

Problem 2. [10 points] A 1.2 μF capacitor is charged to 3.0 kV. Compute the energy stored in the capacitor.

Problem 3. [5 points] (a) Determine the shortest length of pipe closed at one end that will resonate in air to a sound source of frequency 160 Hz. Take the speed of sound in air to be 340 m/s. [5 points] (b) Repeat for a pipe open at both ends.

Problem 4. [10 points] Positive electric charge Q is distributed uniformly along a line of length 2a lying along the y-axis between y = -a and y = +a (Figure 1). Find the electric potential at a point P on the x-axis at a distance x from the origin.

Figure 1
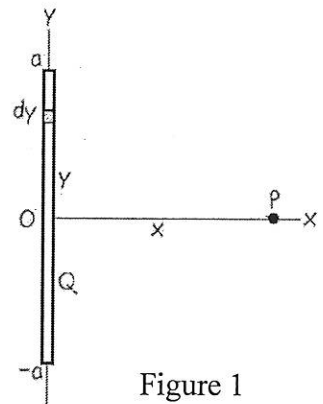
Problem 5. [10 points] A metal rod is 2 m long and 8 mm in diameter. Compute its resistance if the resistivity of the metal is 4×10^{-8} Ω•m.

Problem 6. An electric heater of resistance 8.0 Ω draws 15 A from the service mains. [5 points] (a) At what rate is thermal energy develop, in W? [5 points] (b) What is the cost of operating the heater for a period of 4.0 h at 100 NTD/kW•h?

Problem 7. [10 points] A proton enters a magnetic field of flux density 1.5 Wb/m^2 with a velocity 2.0 $\times 10^7$ m/s at an angle 30^0 with the field. Compute the force on the proton.

Figure 2

Problem 8. [10 points] How much work is required to carry an electron from the positive terminal of a 12-V battery to the negative terminal?

Problem 9. [10 points] In the annular cylindrical space shown in the Figure 2, the magnetic potential is A = -k ln r a_z, where k is a constant. Determine the total magnetic flux in the annular space. (Here, r_1 and r_2 are inner and outer radius, respectively. Ψ_m stands for magnetic flux. L: annular cylinder length. a_z: unit vector in the z direction)

試題請隨卷繳回，請留意背面是否有題

Problem 10. [10 points] As shown in the figure below (Figure 3), a uniform solid sphere rolls on a horizontal surface at 20 *m/s* and then rolls up the incline. If friction losses are negligible, what will be the value of *h* where the ball stops?
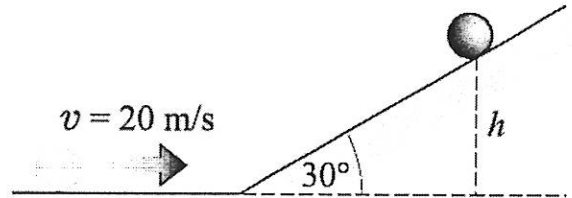
Figure 3

(1) Note that electron charge $q = -1.6 \times 10^{-19}$ C, $g = 9.8$ *m/s²* , NTD: 新台幣

(2) You might need the following integration table.

$$\int \sqrt{a^2 + u^2}\, du = \frac{u}{2}\sqrt{a^2 + u^2} + \frac{a^2}{2}\ln\left(u + \sqrt{a^2 + u^2}\right) + C$$

$$\int u^2 \sqrt{a^2 + u^2}\, du = \frac{u}{8}(a^2 + 2u^2)\sqrt{a^2 + u^2} - \frac{a^4}{8}\ln\left(u + \sqrt{a^2 + u^2}\right) + C$$

$$\int \frac{\sqrt{a^2 + u^2}}{u}\, du = \sqrt{a^2 + u^2} - a\ln\left|\frac{a + \sqrt{a^2 + u^2}}{u}\right| + C$$

$$\int \frac{\sqrt{a^2 + u^2}}{u^2}\, du = -\frac{\sqrt{a^2 + u^2}}{u} + \ln\left(u + \sqrt{a^2 + u^2}\right) + C$$

$$\int \frac{du}{\sqrt{a^2 + u^2}} = \ln\left(u + \sqrt{a^2 + u^2}\right) + C$$

$$\int \frac{u^2\, du}{\sqrt{a^2 + u^2}} = \frac{u}{2}\sqrt{a^2 + u^2} - \frac{a^2}{2}\ln\left(u + \sqrt{a^2 + u^2}\right) + C$$

$$\int \frac{du}{u\sqrt{a^2 + u^2}} = -\frac{1}{a}\ln\left|\frac{\sqrt{a^2 + u^2} + a}{u}\right| + C$$

試題請隨卷繳回，請留意背面是否有題

國立中山大學 109 學年度
碩士暨碩士專班招生考試試題

科目名稱：普通化學【材光系碩士班甲組】

－作答注意事項－

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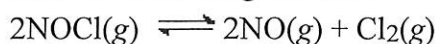- 試題及答案卷（卡）請務必繳回，未繳回者該科成績以零分計算。

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一、單選題（每題 3 分，總計 90 分）

1. Determine the collision frequency for an oxygen molecule ($M = 3.20 \times 10^{-2}$ kg/mol) in a sample of pure oxygen gas at 35°C and 1.7 atm. Assume that the diameter of an O_2 molecule is 300 pm.
   (A) 9×10^9 s^{-1}　　(B) 2×10^9 s^{-1}　　(C) 4×10^9 s^{-1}
   (D) 5×10^9 s^{-1}　　(E) 7×10^9 s^{-1}

2. Consider the following reaction:
   $$2NOCl(g) \rightleftharpoons 2NO(g) + Cl_2(g)$$
   Initially pure NOCl(g) is placed in a vessel at 2.96 atm. At equilibrium, 0.410% of the NOCl has decomposed. Determine the value of K_p.
   (A) 5.00×10^{-5}　　(B) 2.57×10^{-8}　　(C) 6.07×10^{-3}
   (D) 1.03×10^{-7}　　(E) 2.06×10^{-7}

3. How many mmoles of HCl must be added to 155.0 mL of a 0.28 M solution of methylamine (pK_b = 3.36) to give a buffer having a pH of 11.42?
   (A) 19 mmoles　　(B) 0.17 mmoles　　(C) 6.2 mmoles
   (D) 3.7 mmoles　　(E) 0.61 mmoles

4. The value of K_f for the complex ion $Ag(NH_3)_2^+$ is 1.7×10^7. K_{sp} for AgCl is 1.6×10^{-10}. Calculate the molar solubility of AgCl in 1.0 M NH$_3$.
   (A) 1.7×10^{-10}　　(B) 2.9×10^{-3}　　(C) 4.7×10^{-2}
   (D) 1.3×10^{-5}　　(E) 5.2×10^{-2}

5. A 1.00-g sample of the rocket fuel hydrazine, N_2H_4, is burned in a bomb calorimeter containing 1200 g of water. The temperature of the water and the bomb calorimeter rises from 24.62°C to 28.16°C. Assuming the heat capacity of the empty bomb calorimeter is 837 J/°C, calculate the heat of combustion of 1 mol of hydrazine in the bomb calorimeter. (The specific heat capacity of water is 4.184 J/g•°C.)
   (A) –152 kJ　　(B) +47.4 kJ　　(C) +20.7 kJ
   (D) –665 kJ　　(E) –569 kJ

6. Water gas, a commercial fuel, is made by the reaction of hot coke carbon with steam.
   $$C(s) + H_2O(g) \rightarrow CO(g) + H_2(g)$$
   When equilibrium is established at 800°C, the concentrations of CO, H_2, and H_2O are 4.00×10^{-2} mol/L, 4.00×10^{-2} mol/L, and 1.00×10^{-2} mol/L, respectively. Calculate the value of $\Delta G°$ for this reaction at 800°C.
   (A) 16.3 kJ　　(B) 109 kJ　　(C) 193 kJ
   (D) –43.5 kJ　　(E) none of these

7. Calculate the solubility product of silver iodide at 25°C, given the following data:

$$E° \text{ (V)}$$

$AgI(s) + e^- \to Ag(s) + I^-$ -0.15

$I_2(s) + 2e^- \to 2I^-$ $+0.54$

$Ag^+ + e^- \to Ag(s)$ $+0.80$

  (A) 1.9×10^{-4} (B) 8.4×10^{-17} (C) 3.5×10^{-20}

  (D) 2.9×10^{-3} (E) 2.1×10^{-12}

8. Gold is produced electrochemically from an aqueous solution of $Au(CN)_2^-$ containing an excess of CN^-. Gold metal and oxygen gas are produced at the electrodes. How many moles of O_2 will be produced during the production of 1.00 mol of gold?

  (A) 4.00 mol   (B) 3.56 mol   (C) 0.50 mol

  (D) 1.00 mol   (E) 0.25 mol

9. Consider an atom traveling at 1% of the speed of light. The de Broglie wavelength is found to be 3.31×10^{-3} pm. Which element is this?

  (A) P   (B) Ca   (C) He

  (D) F   (E) Be

10. For an electron in a 2.00-nm one-dimensional box, calculate the wavelength of electromagnetic radiation to excite the electron from the ground state to the level with $n = 3$.

  (A) 12,100 nm   (B) 1470 nm   (C) 13,200 nm

  (D) 1650 nm   (E) none of these

11. The first ionization energy of Mg is 735 kJ/mol. Calculate Z_{eff}.

  (A) 2.25   (B) 2.00   (C) 4.00

  (D) 5.04   (E) none of these

12. Which of the following shows these molecules in order from most polar to least polar?

  (A) $CF_2Cl_2 > CF_2H_2 > CCl_2H_2 > CH_4 = CCl_4$

  (B) $CH_4 > CF_2Cl_2 > CF_2H_2 > CCl_4 > CCl_2H_2$

  (C) $CF_2H_2 > CCl_2H_2 > CF_2Cl_2 > CH_4 = CCl_4$

  (D) $CF_2Cl_2 > CF_2H_2 > CCl_4 > CCl_2H_2 > CH_4$

  (E) $CH_4 > CF_2H_2 > CF_2Cl_2 > CCl_4 > CCl_2H_2$

13. Consider the following molecules.

    I.　BF_3　　　II. $CHBr_3$ (C is the central atom.)　　　III. Br_2

    IV. $XeCl_2$　　V. CO　　　　　　　　　　　　　　VI. SF_4

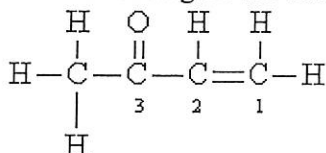Select the molecule(s) that fit the given statement.
These molecules violate the octet rule.

    (A) III, V, VI　　(B) I, II, IV, VI　　　(C) I, IV, VI

    (D) I, II, IV　　(E) I, III, IV, VI

14. Select the correct molecular structure for SF_4.

    (A) pyramidal　　(B) bent　　　　(C) linear

    (D) tetrahedral　　(E) none of these

15. Consider the following Lewis structure. (Lone pairs are not drawn in.)

```
        H   O   H   H
        |   ||  |   |
    H — C — C — C = C — H
        |       3   2   1
        H
```

Which statement about the molecule is *false*?

    (A) Oxygen is sp^3 hybridized.

    (B) This molecule contains 28 valence electrons.

    (C) C-2 is sp^2 hybridized with bond angles of 120.

    (D) There are 10 sigma and 2 pi bonds.

    (E) There are some H–C–H bond angles of about 109° in the molecule.

16. Which statement about the thiocyanate ion, SCN^-, is true?

    (A) Only one correct resonance structure can be drawn.

    (B) Its Lewis structure contains an unpaired electron.

    (C) Its shape is bent like that of H_2O.

    (D) There are more than two σ bonds in the ion.

    (E) none of these

17. Consider the molecular-orbital energy-level diagrams for O_2 and NO. Which of the following is true?

    I.　Both molecules are paramagnetic.

    II.　The bond strength of O_2 is greater than the bond strength of NO.

    III.　NO is an example of a homonuclear diatomic molecule.

    IV.　The ionization energy of NO is smaller than the ionization energy of NO^+.

    (A) I and II only　　(B) I, II, and IV　　(C) I and IV

    (D) II and III　　　(E) I only

18. The following data were collected for the decay of HO_2 radicals.

Time	$[HO_2]$	Time	$[HO_2]$
0 s	1.0×10^{11} mole/cm^3	14 s	1.25×10^{10} mole/cm^3
2 s	5.0×10^{10} mole/cm^3	30 s	6.225×10^{9} mole/cm^3
6 s	2.5×10^{10} mole/cm^3		

Which of the following statements is true?

   (A) The half-life of the reaction is 2 ms.

   (B) A plot of $1/[HO_2]$ versus time gives a straight line.

   (C) The rate of the reaction increases with time.

   (D) The decay of HO_2 occurs by a first-order process.

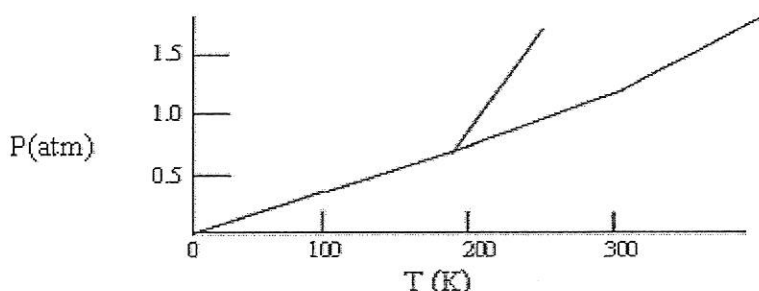   (E) A plot of ln $[HO_2]$ versus time is linear with a slope of $-k$.

19. You are given a small bar of an unknown metal, X. You find the density of the metal to be 10.5 g/cm^3. An X-ray diffraction experiment measures the edge of the unit cell as 409 pm. Assuming that the metal crystallizes in a face-centered cubic lattice, what is X most likely to be?

   (A) Ag   (B) Pt   (C) Rh

   (D) Pb   (E) none of these

20. Alkali halides commonly have either the sodium chloride structure or the cesium chloride structure. The molar mass of CsCl is 2.88 times the molar mass of NaCl, and the edge length of the unit cell for NaCl is 1.37 times the edge length of the CsCl unit cell. Determine the ratio of the density of CsCl to the density of NaCl.

   (A) 0.541   (B) 0.984   (C) 1.85

   (D) 1.02   (E) 2.10

21. Below is a phase diagram for compound X. You wish to purify a sample of X that was collected at $P = 1.0$ atm and $T = 100$ K by subliming it. In order to sublime the sample, you should

   (A) increase T to 300 K, keeping $P = 1.0$ atm.

   (B) abandon the attempt to sublime X.

   (C) lower P to 0.5 atm and then increase T to 200 K.

   (D) increase P to 1.5 atm and then increase T to 300 K.

   (E) increase T to 300 K and then lower P to 0.5 atm.

22. Thyroxine, an important hormone that controls the rate of metabolism in the body, can be isolated from the thyroid gland. If 0.455 g of thyroxine is dissolved in 10.0 g of benzene, the freezing point of the solution is 5.144°C. Pure benzene freezes at 5.444°C and has a value for the molal freezing-point-depression constant of K_f of 5.12°C/m. What is the molar mass of thyroxine?
　　(A) 2330 g/mol　　　(B) 285 g/mol　　　(C) 777 g/mol
　　(D) 3760 g/mol　　　(E) 777,000 g/mol

23. A 5.00-g sample of a compound is dissolved in enough water to form 100.0 mL of solution. This solution has an osmotic pressure of 25 torr at 25°C. If it is assumed that each molecule of the solute dissociates into two particles (in this solvent), what is the molar mass of this solute?
　　(A) 18,600 g/mol　　(B) 37,200 g/mol　　(C) 74,300 g/mol
　　(D) 1560 g/mol　　　(E) none of these

24. Which of the following oxides is amphoteric?
　　(A) BeO　　　　　(B) MgO　　　　　(C) BaO
　　(D) SrO　　　　　(E) CaO

25. Which of the following statements about the complex ion Co(en)$_2$Cl$_2^+$ is true?
(en = ethylenediamine, NH$_2$CH$_2$CH$_2$NH$_2$)
　　(A) The geometric isomers of the complex ion have identical chemical properties.
　　(B) The complex ion exhibits two geometric isomers (*cis* and *trans*) and two optical isomers.
　　(C) Because en is a strong field ligand (large Δ), the complex ion is paramagnetic.
　　(D) The complex ion exhibits *cis* and *trans* geometric isomers, but no optical isomers.
　　(E) The complex ion contains Co(I).

26. Radioactive tracers are useful in studying very low concentrations of chemical species. A chemist has a sample of HgI$_2$ in which part of the iodine is the radioactive nuclide of mass 131, so that the count rate is 5.0×10^{11} counts per minute per mole of I. The solid mercuric iodide is placed in water and allowed to come to equilibrium. Then 100 mL of the solution is withdrawn, and its radioactivity is measured and found to give 22 counts per minute. What is the molar concentration of iodide ion in the solution?
　　(A) 1.1×10^{-11}　　(B) 1.1×10^{-9}　　(C) 1.1×10^{-10}
　　(D) 4.4×10^{-10}　　(E) 4.4×10^{-11}

27. Which of the following statements is/are true of nuclear fission?
1. For the nuclear fission process to be self-sustaining, at least one neutron from each fission event must go on to split another nucleus.
2. If more than one neutron from each nuclear fission event causes another fission event, the process dies out and the reaction is said to be subcritical.
3. A fission bomb operates by suddenly combining two subcritical masses of fissionable material to form a supercritical mass.
　　(A) 1 only　　　　(B) 2 only　　　　(C) 3 only
　　(D) 2 and 3　　　(E) 1 and 3

28. Oxidation of 2-methyl-1-butanol could yield
I.　　2-methyl-1-butanone
II.　　2-methylbutanal
III.　　2-methylbutanoic acid
　　(A) II only　　　　(B) II and III　　　　(C) I and III

　　(D) I only　　　　(E) III only

29. Which of the following statements are true about starch?
I.　　The monomers are fructose and glucose.
II.　　The monomer is glucose.
III.　　It is the main carbohydrate reservoir in plants.
IV.　　It is the main carbohydrate reservoir in animals.
V.　　It is an addition polymer.
VI.　　It is a condensation polymer.
　　(A) II, III, VI　　(B) I, IV, V　　　　(C) I, III, IV, V

　　(D) I, III, V　　　(E) II, IV, VI

30. Which of the following statements is correct?
　　(A) Nucleic acids are made of nucleotides joined together with amide bonds.

　　(B) The primary structure of proteins is determined by 3'–5'.

　　(C) Fats are polymers composed of monomers called monosaccharides.

　　(D) No one has ever made a polymer using amide bonds.

　　(E) None of these statements is correct.

二、非選擇題 (每題 5 分，總計 10 分)
Consider a children's cartoon illustrating a child holding the strings of several helium balloons and being lifted into the sky at a pressure of 1.0 atm and 25°C assuming the air consists of 78% of $N_2(g)$ and 22% of $O_2(g)$.
(a) Estimate the minimum number of 10.-L balloons it would take to lift a 23 kg child. Assume air has an average molar mass of 29 g/mol, and assume the masses of the balloons and strings are negligible. (5 pt)
(b) Explain why the balloons can lift the child. (5 pt)

國立中山大學 109 學年度
碩士暨碩士專班招生考試試題

科目名稱：工程數學【材光乙組聯合招生碩士班、材光系碩士班乙組、材料前瞻應材碩士班乙組】

1. Find the general solution of $y'' + 2y' + 5y = 1.25e^{0.5x} + 40cos4x - 55sin4x$　　(15%)

2. Find the general solution of $y' = \frac{1}{x}y^2 + \frac{1}{x}y - \frac{2}{x}$ and indicate what type of your solution is (implicit or explicit)　　(15%)

3. Find the series solution of $xy'' + y = 0$　　(20%)

4. Solve $y'' + 4y = f(t)$ with $y(0)=y'(0)=0$ by Laplace transform, where $f(t) = 0$ when $t \leq 3$, and $f(t) = t$ when $t \geq 3$　　(15%)

5. Solve the Fourier Transform of $f(x) = \begin{cases} xe^{-x} & , & x > 0 \\ 0 & , & \text{otherwise} \end{cases}$　　(15%)

6. Find $u(x, t)$ of 1-D wave equation, $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$, for the string of length L=1 and c^2=1 when the initial velocity is zero and satisfies $u(0,t)=u(L,t)=0$, $u(x,0)=f(x)$, $u(x,0) = f(x) = k(\pi^2 x - x^3)$ (20%)
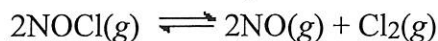
國立中山大學 109 學年度
碩士暨碩士專班招生考試試題

科目名稱：綜合化學【材料前瞻應材碩士班甲組】

一、單選題（每題 3 分，總計 90 分）

1. Determine the collision frequency for an oxygen molecule ($M = 3.20 \times 10^{-2}$ kg/mol) in a sample of pure oxygen gas at 35°C and 1.7 atm. Assume that the diameter of an O_2 molecule is 300 pm.
   (A) 9×10^9 s^{-1}　　(B) 2×10^9 s^{-1}　　(C) 4×10^9 s^{-1}
   (D) 5×10^9 s^{-1}　　(E) 7×10^9 s^{-1}

2. Consider the following reaction:
   $$2NOCl(g) \rightleftharpoons 2NO(g) + Cl_2(g)$$
   Initially pure $NOCl(g)$ is placed in a vessel at 2.96 atm. At equilibrium, 0.410% of the NOCl has decomposed. Determine the value of K_p.
   (A) 5.00×10^{-5}　　(B) 2.57×10^{-8}　　(C) 6.07×10^{-3}
   (D) 1.03×10^{-7}　　(E) 2.06×10^{-7}

3. How many mmoles of HCl must be added to 155.0 mL of a 0.28 M solution of methylamine ($pK_b = 3.36$) to give a buffer having a pH of 11.42?
   (A) 19 mmoles　　(B) 0.17 mmoles　　(C) 6.2 mmoles
   (D) 3.7 mmoles　　(E) 0.61 mmoles

4. The value of K_f for the complex ion $Ag(NH_3)_2^+$ is 1.7×10^7. K_{sp} for AgCl is 1.6×10^{-10}. Calculate the molar solubility of AgCl in 1.0 M NH_3.
   (A) 1.7×10^{-10}　　(B) 2.9×10^{-3}　　(C) 4.7×10^{-2}
   (D) 1.3×10^{-5}　　(E) 5.2×10^{-2}

5. A 1.00-g sample of the rocket fuel hydrazine, N_2H_4, is burned in a bomb calorimeter containing 1200 g of water. The temperature of the water and the bomb calorimeter rises from 24.62°C to 28.16°C. Assuming the heat capacity of the empty bomb calorimeter is 837 J/°C, calculate the heat of combustion of 1 mol of hydrazine in the bomb calorimeter. (The specific heat capacity of water is 4.184 J/g•°C.)
   (A) –152 kJ　　(B) +47.4 kJ　　(C) +20.7 kJ
   (D) –665 kJ　　(E) –569 kJ

6. Water gas, a commercial fuel, is made by the reaction of hot coke carbon with steam.
   $$C(s) + H_2O(g) \rightarrow CO(g) + H_2(g)$$
   When equilibrium is established at 800°C, the concentrations of CO, H_2, and H_2O are 4.00×10^{-2} mol/L, 4.00×10^{-2} mol/L, and 1.00×10^{-2} mol/L, respectively. Calculate the value of $\Delta G°$ for this reaction at 800°C.
   (A) 16.3 kJ　　(B) 109 kJ　　(C) 193 kJ
   (D) –43.5 kJ　　(E) none of these

7. Calculate the solubility product of silver iodide at 25°C, given the following data:

$$E° \text{ (V)}$$

$AgI(s) + e^- \rightarrow Ag(s) + I^-$　　　　　　　-0.15

$I_2(s) + 2e^- \rightarrow 2I^-$　　　　　　　　　　$+0.54$

$Ag^+ + e^- \rightarrow Ag(s)$　　　　　　　　　　$+0.80$

(A) 1.9×10^{-4}　　(B) 8.4×10^{-17}　　(C) 3.5×10^{-20}

(D) 2.9×10^{-3}　　(E) 2.1×10^{-12}

8. Gold is produced electrochemically from an aqueous solution of $Au(CN)_2^-$ containing an excess of CN^-. Gold metal and oxygen gas are produced at the electrodes. How many moles of O_2 will be produced during the production of 1.00 mol of gold?

(A) 4.00 mol　　(B) 3.56 mol　　(C) 0.50 mol

(D) 1.00 mol　　(E) 0.25 mol

9. Consider an atom traveling at 1% of the speed of light. The de Broglie wavelength is found to be 3.31×10^{-3} pm. Which element is this?

(A) P　　　　(B) Ca　　　　(C) He

(D) F　　　　(E) Be

10. For an electron in a 2.00-nm one-dimensional box, calculate the wavelength of electromagnetic radiation to excite the electron from the ground state to the level with $n = 3$.

(A) 12,100 nm　　(B) 1470 nm　　(C) 13,200 nm

(D) 1650 nm　　(E) none of these

11. The first ionization energy of Mg is 735 kJ/mol. Calculate Z_{eff}.

(A) 2.25　　　(B) 2.00　　　(C) 4.00

(D) 5.04　　　(E) none of these

12. Which of the following shows these molecules in order from most polar to least polar?

(A) $CF_2Cl_2 > CF_2H_2 > CCl_2H_2 > CH_4 = CCl_4$

(B) $CH_4 > CF_2Cl_2 > CF_2H_2 > CCl_4 > CCl_2H_2$

(C) $CF_2H_2 > CCl_2H_2 > CF_2Cl_2 > CH_4 = CCl_4$

(D) $CF_2Cl_2 > CF_2H_2 > CCl_4 > CCl_2H_2 > CH_4$

(E) $CH_4 > CF_2H_2 > CF_2Cl_2 > CCl_4 > CCl_2H_2$

13. Consider the following molecules.

    I. BF_3　　　II. $CHBr_3$ (C is the central atom.)　　　III. Br_2

    IV. $XeCl_2$　　V. CO　　　　　　　　　　　　　　　　VI. SF_4

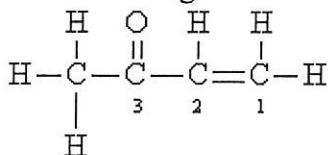Select the molecule(s) that fit the given statement.

These molecules violate the octet rule.

    (A) III, V, VI　　　(B) I, II, IV, VI　　　　(C) I, IV, VI

    (D) I, II, IV　　　(E) I, III, IV, VI

14. Select the correct molecular structure for SF_4.

    (A) pyramidal　　　(B) bent　　　　　(C) linear

    (D) tetrahedral　　　(E) none of these

15. Consider the following Lewis structure. (Lone pairs are not drawn in.)

$$\begin{array}{cccc} & H & O & H & H \\ & | & \| & | & | \\ H- & C- & C- & C= & C-H \\ & | & & & \\ & H & 3 & 2 & 1 \end{array}$$

Which statement about the molecule is *false*?

    (A) Oxygen is sp^3 hybridized.

    (B) This molecule contains 28 valence electrons.

    (C) C-2 is sp^2 hybridized with bond angles of 120.

    (D) There are 10 sigma and 2 pi bonds.

    (E) There are some H–C–H bond angles of about 109° in the molecule.

16. Which statement about the thiocyanate ion, SCN^-, is true?

    (A) Only one correct resonance structure can be drawn.

    (B) Its Lewis structure contains an unpaired electron.

    (C) Its shape is bent like that of H_2O.

    (D) There are more than two σ bonds in the ion.

    (E) none of these

17. Consider the molecular-orbital energy-level diagrams for O_2 and NO. Which of the following is true?

    I.　Both molecules are paramagnetic.

    II.　The bond strength of O_2 is greater than the bond strength of NO.

    III.　NO is an example of a homonuclear diatomic molecule.

    IV.　The ionization energy of NO is smaller than the ionization energy of NO^+.

    (A) I and II only　　　(B) I, II, and IV　　　(C) I and IV

    (D) II and III　　　　(E) I only

18. The following data were collected for the decay of HO_2 radicals.

Time	$[HO_2]$	Time	$[HO_2]$
0 s	1.0×10^{11} mole/cm^3	14 s	1.25×10^{10} mole/cm^3
2 s	5.0×10^{10} mole/cm^3	30 s	6.225×10^9 mole/cm^3
6 s	2.5×10^{10} mole/cm^3		

Which of the following statements is true?

    (A) The half-life of the reaction is 2 ms.

    (B) A plot of $1/[HO_2]$ versus time gives a straight line.

    (C) The rate of the reaction increases with time.

    (D) The decay of HO_2 occurs by a first-order process.

    (E) A plot of $\ln [HO_2]$ versus time is linear with a slope of $-k$.
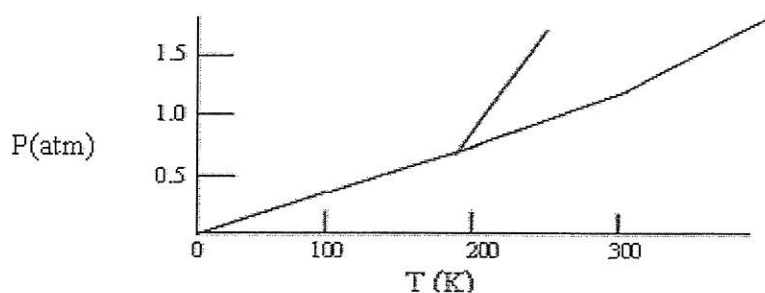
19. You are given a small bar of an unknown metal, X. You find the density of the metal to be 10.5 g/cm^3. An X-ray diffraction experiment measures the edge of the unit cell as 409 pm. Assuming that the metal crystallizes in a face-centered cubic lattice, what is X most likely to be?

    (A) Ag   (B) Pt   (C) Rh

    (D) Pb   (E) none of these

20. Alkali halides commonly have either the sodium chloride structure or the cesium chloride structure. The molar mass of CsCl is 2.88 times the molar mass of NaCl, and the edge length of the unit cell for NaCl is 1.37 times the edge length of the CsCl unit cell. Determine the ratio of the density of CsCl to the density of NaCl.

    (A) 0.541   (B) 0.984   (C) 1.85

    (D) 1.02   (E) 2.10

21. Below is a phase diagram for compound X. You wish to purify a sample of X that was collected at $P = 1.0$ atm and $T = 100$ K by subliming it. In order to sublime the sample, you should

    (A) increase T to 300 K, keeping $P = 1.0$ atm.

    (B) abandon the attempt to sublime X.

    (C) lower P to 0.5 atm and then increase T to 200 K.

    (D) increase P to 1.5 atm and then increase T to 300 K.

    (E) increase T to 300 K and then lower P to 0.5 atm.

22. Thyroxine, an important hormone that controls the rate of metabolism in the body, can be isolated from the thyroid gland. If 0.455 g of thyroxine is dissolved in 10.0 g of benzene, the freezing point of the solution is 5.144°C. Pure benzene freezes at 5.444°C and has a value for the molal freezing-point-depression constant of K_f of 5.12°C/m. What is the molar mass of thyroxine?

   (A) 2330 g/mol　　　(B) 285 g/mol　　　(C) 777 g/mol

   (D) 3760 g/mol　　　(E) 777,000 g/mol

23. A 5.00-g sample of a compound is dissolved in enough water to form 100.0 mL of solution. This solution has an osmotic pressure of 25 torr at 25°C. If it is assumed that each molecule of the solute dissociates into two particles (in this solvent), what is the molar mass of this solute?

   (A) 18,600 g/mol　　(B) 37,200 g/mol　　(C) 74,300 g/mol

   (D) 1560 g/mol　　　(E) none of these

24. Which of the following oxides is amphoteric?

   (A) BeO　　　(B) MgO　　　(C) BaO

   (D) SrO　　　(E) CaO

25. Which of the following statements about the complex ion $Co(en)_2Cl_2^+$ is true?
(en = ethylenediamine, $NH_2CH_2CH_2NH_2$)

   (A) The geometric isomers of the complex ion have identical chemical properties.

   (B) The complex ion exhibits two geometric isomers (*cis* and *trans*) and two optical isomers.

   (C) Because en is a strong field ligand (large Δ), the complex ion is paramagnetic.

   (D) The complex ion exhibits *cis* and *trans* geometric isomers, but no optical isomers.

   (E) The complex ion contains Co(I).

26. Radioactive tracers are useful in studying very low concentrations of chemical species. A chemist has a sample of HgI_2 in which part of the iodine is the radioactive nuclide of mass 131, so that the count rate is 5.0×10^{11} counts per minute per mole of I. The solid mercuric iodide is placed in water and allowed to come to equilibrium. Then 100 mL of the solution is withdrawn, and its radioactivity is measured and found to give 22 counts per minute. What is the molar concentration of iodide ion in the solution?

   (A) 1.1×10^{-11}　　(B) 1.1×10^{-9}　　(C) 1.1×10^{-10}

   (D) 4.4×10^{-10}　　(E) 4.4×10^{-11}

27. Which of the following statements is/are true of nuclear fission?
1. For the nuclear fission process to be self-sustaining, at least one neutron from each fission event must go on to split another nucleus.
2. If more than one neutron from each nuclear fission event causes another fission event, the process dies out and the reaction is said to be subcritical.
3. A fission bomb operates by suddenly combining two subcritical masses of fissionable material to form a supercritical mass.

   (A) 1 only　　　(B) 2 only　　　(C) 3 only

   (D) 2 and 3　　　(E) 1 and 3

試題請隨卷繳回，請留意背面是否有題

28. Oxidation of 2-methyl-1-butanol could yield
I.　2-methyl-1-butanone
II.　2-methylbutanal
III.　2-methylbutanoic acid
　(A) II only　　　　(B) II and III　　　　(C) I and III
　(D) I only　　　　(E) III only

29. Which of the following statements are true about starch?
I.　The monomers are fructose and glucose.
II.　The monomer is glucose.
III.　It is the main carbohydrate reservoir in plants.
IV.　It is the main carbohydrate reservoir in animals.
V.　It is an addition polymer.
VI.　It is a condensation polymer.
　(A) II, III, VI　　　(B) I, IV, V　　　　(C) I, III, IV, V
　(D) I, III, V　　　　(E) II, IV, VI

30. Which of the following statements is correct?
　(A) Nucleic acids are made of nucleotides joined together with amide bonds.
　(B) The primary structure of proteins is determined by 3'–5'.
　(C) Fats are polymers composed of monomers called monosaccharides.
　(D) No one has ever made a polymer using amide bonds.
　(E) None of these statements is correct.

二、非選擇題 (每題 5 分，總計 10 分)
Consider a children's cartoon illustrating a child holding the strings of several helium balloons and being lifted into the sky at a pressure of 1.0 atm and 25°C assuming the air consists of 78% of $N_2(g)$ and 22% of $O_2(g)$.
(a) Estimate the minimum number of 10.-L balloons it would take to lift a 23 kg child. Assume air has an average molar mass of 29 g/mol, and assume the masses of the balloons and strings are negligible. (5 pt)
(b) Explain why the balloons can lift the child. (5 pt)

國立中山大學 109 學年度
碩士暨碩士專班招生考試試題

科目名稱：英文【材光系碩士班甲組、材料前瞻應材碩士班甲組】

―作答注意事項―

考試時間：100 分鐘

- **考試開始鈴響前不得翻閱試題，並不得書寫、劃記、作答。**請先檢查答案卷（卡）之應考證號碼、桌角號碼、應試科目是否正確，如有不同立即請監試人員處理。

- **答案卷限用藍、黑色筆(含鉛筆)書寫、繪圖或標示，**可攜帶橡皮擦、無色透明無文字墊板、尺規、修正液（帶）、手錶(未附計算器者)。每人每節限使用一份答案卷，不得另攜帶紙張，請衡酌作答。

- 答案卡請以 2B 鉛筆劃記，不可使用修正液（帶）塗改，未使用 2B 鉛筆、劃記太輕或污損致光學閱讀機無法辨識答案者，其後果由考生自行負擔。

- 答案卷（卡）應保持清潔完整，不得折疊、破壞或塗改應考證號碼及條碼，亦不得書寫考生姓名、應考證號碼或與答案無關之任何文字或符號。

- 可否使用計算機請依試題資訊內標註為準，如「可以」使用，廠牌、功能不拘，唯不得攜帶具有通訊、記憶或收發等功能或其他有礙試場安寧、考試公平之各類器材、物品（如鬧鈴、行動電話、電子字典等）入場。

- **試題及答案卷（卡）請務必繳回，未繳回者該科成績以零分計算。**

- **試題採雙面列印，考生應注意試題頁數確實作答。**

- **違規者依本校招生考試試場規則及違規處理辦法處理。**

選擇題(兩大題 I 與 II，共 30 題)請於<u>答案卡</u>上作答。

I.　Multiple Choice Questions (單選題)

A.　Select the preposition that best complete the sentence. (30%, 3 points each)

1. We had no computer backup and had to rely on old paper files to _____ the records we lost.
   A. remedy
   B. reconstruct
   C. recondition
   D. register

2. The accident happened as a result of years of _____ on the part of the safety.
   A. indifference
   B. incuriosity
   C. consistence
   D. loneliness

3. Philosophy differs from science, in that its questions cannot be answered _____, by observation or experiment.
   A. emotionally
   B. deliberately
   C. empirically
   D. mostly

4. The chairman proposed that we have someone with _____ and imagination to design a marketing strategy.
   A. intuition
   B. enterprise
   C. conservative
   D. irritable

5. Did you find her enthusiasm for the project _____? Almost everyone on the team is now doing their utmost to resolve the difficulty.
   A. contagious
   B. operative
   C. effectual
   D. infectious

6. The bank has agreed to _____ the payment on my loan while I am still a student.
   A. defer
   B. suspend
   C. dangle
   D. sustain

7. Public _____ of the problem of environment protection will make politicians take it seriously.
   A. diagnosis
   B. agitation
   C. awareness
   D. proclamation

8. Recently a large international conference was held with the aim of promoting _____ development in all countries.
   A. unthinkable
   B. unpredictable
   C. retainable
   D. sustainable

9. Patricia likes doing active things like canoeing, _____ and horse-riding.
   A. wandering
   B. hiking
   C. strolling
   D. roaming

10. The table has a plastic coating that prevents liquid from _____ into the wood beneath.
   A. spilling
   B. scattering
   C. permeating
   D. circulating

B. Choose the option has the closest meaning to the underlined part of the sentence in its context. (30%, 3 points each)

11. A conflict could be approached by <u>bolstering</u> one's position with a system of justification, moral principles, or rules of logic.
   A. combining
   B. criticizing
   C. supporting

12. There was a sudden flash of light, making the driver <u>veer</u> sharply.
   A. change suddenly
   B. adjust slightly
   C. halt completely

13. The farmers were more anxious for rain than the people in the city because they have more <u>at stake</u>.
   A. in vain
   B. in their possession
   C. at risk

14. If social security should be <u>contingent on</u> financial need, there is a danger that such means-testing will later be extended to less affluent people.
   A. relevant to
   B. dependent on
   C. accessible to

15. Reducing unemployment has become <u>an imperative</u> for the new government.
   A. a priority
   B. an undertaking
   C. a promise

16. After several attempts, Thomas <u>embraced</u> an opportunity to further his studies at a national university.
   A. indulged himself in
   B. applied himself to
   C. availed himself of

17. Machine-to-machine exchanges will <u>off-load</u> human brain work the way machines of the industrial Revolution off-loaded muscle work.
   A. reshape
   B. relieve
   C. affect

18. We must get the whole expedition clearly <u>mapped out</u> on paper before we start to order any equipment.
   A. graphed
   B. schemed
   C. reflected

19. The cosmetics advertisement <u>purports</u> to delay the development of wrinkles.
    A.　claims
    B.　supports
    C.　means
20. The economic policies that the government is now pursuing threaten to <u>undermine</u> the health care system, although they claim to maintain it.
    A.　weaken
    B.　emphasize
    C.　strengthen

II.　Reading comprehension. (40%, 4 points each)

According to a recent study suggests, the amount of food needed to feed the world's population by the end of the century could increase by almost 80%. Researchers said a trend of increasing Body Mass Index (BMI) is resulting in individuals requiring more calories. The authors warn that failure to meet the need for more calories could lead to greater global inequality.

The study calculated that 60% of the calorie increase would be a result of the growing population in the world. According to the UN World Population Prospects, the global population was estimated to increase from seven billion in 2010 to almost eleven billion in 2100. Yet, more than 18% of the increase in the calories from 2010 levels would come from a **projected** increase in height and weight figures in the global population.

"The increase in the average daily required energy rises by 253 kcal per person between 2010 and 2100 in our estimations, assuming a rising BMI and height," explained Lutz Depenbusch from the World Vegetable Center. "On a global scale, we calculate that the effect of the BMI and height increases in our model would lead to additional calorie requirements that match the combined requirements of India and Nigeria in 2010." In terms of what food would equate to an increase of 253 calories in someone's daily diet, Dr. Depenbusch said an extra two large bananas or a portion of French fries would be on the menu.

Dr. Depenbusch and his colleague, Prof. Stephan Klasen from the University of Gottingen, Germany, said their modeling suggested that sub-Saharan nations would be **extremely** affected by such an increase in future global calorie requirements. In fact, the region has already been witnessing a sharp increase in the need for calories as **it** was undergoing a rate of rapid population growth.

The researchers warned that a failure of the global food policy to accommodate this increase in the demand for more energy could exacerbate food and economic inequality. It is warned that the growing demand for food would lead to an increase in food prices. While rich nations would be able to absorb the increases, poorer nations would struggle and thus lead to more malnutrition.

(Reference: Kinver, M. (2019, December 23). World faces 80% calorie increase by end of century. *BBC News Science & Environment*)

21. The passage primarily discusses:
    A. excess nutrition
    B. food poisoning
    C. malnutrition
    D. food demand
22 Most likely, the word "**it**" in the 4th paragraph refers to the:
    A. Nigeria
    B. India
    C. sub-Saharan nations
    D. Germany

23. Which was claimed in this study to <u>mostly</u> affect the increasing amount of food demand in the near future?
    A. poverty
    B. increase in height figures
    C. increase in weight figures
    D. growing population

24. Where do the authors suggest additional dietary supplements in the article?
    A. Line 10
    B. Line 15
    C. Line 18
    D. Line 22

25. The study mentions all of the following as important in determining the food demand <u>EXCEPT</u> the
    A. increase in food prices
    B. rising BMI value
    C. rapid population growth
    D. average daily required energy per person

26. The word " **projected** " in the second paragraph is closest in meaning to
    A. promised
    B. manipulated
    C. predicted
    D. proposed

27. Which is <u>TRUE</u> concerning the main context?
    A. Poorer nations have a higher potential to conquer the challenge of increasing food demand.
    B. The average daily required energy per person declines from 2010 to 2100.
    C. The global population will exceed eighteen billion in 2100.
    D. An improper food policy could exacerbate food and economic inequality.

28. The word "**extremely**" in the fourth paragraph is closest in meaning to
    A. exceptionally
    B. inferiorly
    C. ordinarily
    D. equally

29. According to the study, what has been done by the researchers for proving the amount of food needed by the end of the century?
    A. market survey
    B. fortune telling
    C. calculation model
    D. live test

30. According to the third paragraph, 253 calories per day may be substituted by
    A. a serving of vegetables
    B. a whole serving of French fries
    C. two large-sized bananas
    D. lack of information