

國 立 清 華 大 學 命 題 紙

98 學年度 奈米工程與微系統研究所碩士班入學考試

科目 英文 科目代碼 1802 共 10 頁第 1 頁 *請在【答案卷卡】內作答

INEMS English Examination for Entrance of 2009

(85 problems in this exam with 100 points in total)

Part I. There are 70 problems in this part. You have to choose the best answer, marked A, B, C, or D, to each question and mark your answer in the associated card. You will have 1 point for each correct answer and there is no penalty with wrong answers.

1. [] Learning a language other ----- introduces students to other languages as means of accessing other peoples, ideas and ways of thinking. (A) English (B) being English (C) than English (D) than English is
2. [] For any wafer bonding technologies to make a really strong bond, ----- to be bonded must be absolutely clean and free from moisture or particles. (A) and surfaces of wafers (B) when surfaces of wafers (C) surfaces of wafers that (D) the surfaces of wafers
3. [] Although still underneath, this metallic needle, an inspection tip, ----- close to the surface of the sample to be observed. (A) is being brought (B) to be brought (C) being brought (D) brought
4. [] ----- unstable and explodes as a supernova is not known. (A) For a star to become (B) A star becomes (C) How a star becomes (D) That a star is becoming
5. [] Not until Japan attacked Pearl Harbor and the U.S. Congress declared war against Japan ----- allies. (A) the U.S. and China did become (B) did the U.S. and China become (C) the U.S. and China become (D) the U.S. and China become did
6. [] The motion of comb-drive actuators can be observed under the microscope by ----- the proof mass or fingers of the actuator structures. (A) watch (B) watched (C) watching (D) to watch
7. [] Barack Omaba, the first African American President of the United States, served as senate from Illinois, an office ----- he was elected in 2005. (A) which (B) being which (C) and which (D) to which
8. [] A car must be strong enough to support its own weight ----- the weight of the driver and passengers who use it. (A) as well (B) so well (C) as well as (D) so well as
9. [] Charlie Parker, -----, was one of the great blues players. (A) a great jazz improviser who (B) to improvise great jazz (C) a great jazz improviser (D) improvised great jazz
10. [] Because China clay deforms in firing at a different rate than ordinary clay, ----- when creating crockery using both types of clay. (A) the required special handling (B) special handling required (C) a requirement of special handling (D) special handling is required
11. [] Many people ----- stay at home than go out for a walk in the rain. (A) even rather (B) better (C) like (D) would rather

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科目 英文 科目代碼 1802 共 10 頁第 2 頁 *請在【答案卷卡】內作答

12. [] Most of the people in the 1980's retired ----- they were unable to make the transition from agriculture world to industrial business. (A) because (B) in spite of (C) nevertheless (D) and for
13. [] Thomas Edison's first patented invention was a device ----- in Congress. (A) votes counted for (B) for counting votes (C) had been counting votes (D) be a counted vote
14. [] Jupiter, the fifth planet from the Sun and the largest planet within the Solar System, has ----- solid surface and is primarily composed of hydrogen with a small proportion of helium. (A) not (B) nor (C) no (D) neither
15. [] The black-billed cuckoo has been known to eat eggs ----- to other birds. (A) belong (B) that belong (C) which they belong (D) which belonging
16. [] The purpose of this course is ----- an introductory and basic understanding of Micro-Electro-Mechanical Systems and related technologies. (A) to provide (B) provided (C) which provided (D) providing that
17. [] Earthquakes can damage a bridge ----- violently, and it can take several months for the bridge to be rebuilt. (A) when shaking it causes (B) to cause shaking (C) to cause to shake it (D) by causing it to shake
18. [] Built in 1882, the Kinzua Viaduct in McKean County is open only to those visitors ----- are able to walk its 2,058-foot length. (A) who (B) to whom (C) which they (D) that which
19. [] The colors and patterns of moths and butterflies help ----- the organism against the attacks from predators. (A) protect (B) protection of (C) protecting (D) being protected
20. [] Near the South Pole -----, the coldest and most desolate continent on Earth. (A) Antarctica lies and (B) lies Antarctica (C) Antarctica lies where (D) where Antarctica lies
21. [] ----- created traditionally has been a subject of debate among scholars. (A) How poems were (B) Poems were how (C) How poems that were (D) Were poems how
22. [] Tornado, a violent, rotating column of air, occurs most often in the spring when hot winds ----- over flat land encounter heavy, cold air. (A) are rising (B) that rising (C) which to rise (D) rising
23. [] ----- a necessary dimension for measuring the distance between celestial bodies and the Earth. (A) It is time (B) The time (C) Time is (D) Once in time
24. [] Silicon nitride etching follows the same sequence of operations ----- etching. (A) that silicon dioxide (B) where silicon dioxide (C) silicon dioxide (D) as silicon dioxide
25. [] ----- to study this element because only a few atoms of this substrate can be isolated at one time. (A) Even though difficult (B) Why it is difficult (C) It is difficult (D) The difficulty

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科目 英文 科目代碼 ⁰⁸⁰² 1802 共 10 頁第 3 頁 *請在【答案卷卡】內作答

26. [] Fingerprints, an impression of the friction ridges of all part of the finger, form an unchangeable signature, and ----- for identification, despite changes in the individual's age or appearance. (A) with the use of fingerprint records (B) fingerprint records can be used (C) when fingerprint records are used (D) the use of fingerprint records
27. [] The migrant birds in South Taiwan are famous ----- to the same places in Kenting National Park each spring. (A) to return (B) who returned (C) they returned (D) for returning
28. [] The art of landscape architecture is almost as old ----- of architecture itself. (A) as that (B) than (C) than that (D) as
29. [] Human beings obtain their energy from ----- . (A) their food to eat (B) eat their food (C) the food they eat (D) they eat the food
30. [] Thomas Paine, -----, greatly influenced his contemporaries and, especially, the American revolutionaries. (A) whose eloquent writing (B) writer of eloquent (C) an eloquent writer (D) writing eloquent
31. [] Liquid water has fewer hydrogen bonds than ice, so more molecules can occupy the same space, making liquid water ----- than ice. (A) more dense (B) as more dense (C) more than dense (D) is more dense
32. [] Carl Luis, ----- the world record in the 100m sprint in the 1984 Olympics, also won the long jump in that year. (A) who set (B) which she set (C) whoever set (D) whose setting
33. [] The 100,000-year-old fossilized remains of a previously unknown giant camel species ----- a dog have been found in Syria. (A) no more large (B) no larger than (C) not larger (D) which no larger
34. [] Gorillas, the largest of the living primates, are often quiet ----- they are capable of making more than 20 different sounds. (A) which (B) whether (C) even though (D) as well as
35. [] Although the chemical composition of the Earth had been researched for many years, only toward the end of the nineteenth century ----- as a discipline in its own right. (A) then recognized as geochemistry (B) as geochemistry was recognized (C) when geochemistry was recognized (D) was geochemistry recognized
36. [] By the time Christopher Columbus reached the New World in 1492, corn was the ----- in the Americas. (A) most grown widely plant (B) most widely grown plant (C) widely most grown plant (D) plant widely grown most
37. [] The lower ----- in a room, the more slowly and difficultly our eyes can focus. (A) the level of lighting (B) lighting is level (C) leveling of light (D) light level

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38. [] I have ----- help him since I came here last week. (A) been able to (B) be able to (C) able to (D) able to be
39. [] Manufacturing is Taiwan's most important economic activity, ----- most of the workforce. (A) that it engages (B) engages (C) and to engage (D) engaging
40. [] Natural selection is defined as the process ----- the course of evolution by preserving those traits best adapted for an organism's survival. (A) directs it (B) of which directs it (C) to which directs (D) that directs
41. [] ----- was founded in experiments of iron and steel conducted in the nineteenth century. (A) Both twentieth-century architecture and its history (B) The history of twentieth-century architecture (C) That the history of twentieth-century architecture (D) While the history of twentieth-century architecture
42. [] ----- 363 miles between the Hudson River and Lake Erie in New York State, the Erie Canal helped connect the Great Lakes with the Atlantic Ocean. (A) Extends (B) The extension (C) Extending (D) The extension of
43. [] The primary source of energy for tropical hurricanes is the potential heat released when ----- . (A) water vapor condenses (B) the condensation of water vapor (C) does water vapor condense (D) condensed water vapor
44. [] Not until 1864 ----- the thirty-sixth state of the United States. (A) Nevada became (B) did Nevada become (C) Nevada did become (D) became Nevada
45. [] The wind-rippled sand at Michigan's Sleeping Bear Dunes resembles ----- . (A) to be an ocean floor (B) being an ocean floor (C) an ocean floor (D) as an ocean floor
46. [] Fossils, the preserved remains or traces of animals, plants, and other organisms from the remote past, indicate ----- existing in the past have become extinct. (A) many species of organisms are (B) there are many organisms (C) that many species of organisms (D) many species of organisms that
47. [] Experiments related to the sense of force and displacement are more easily ----- than those related to measurement of stress and strain. (A) sets up those (B) set up (C) to set up (D) setting them up
48. [] The Nobel Prize has been ----- in Physics, Chemistry, Physiology or Medicine, Literature, and Peace worldwide for more than hundred years. (A) the most prestigious award (B) the award most prestigious that (C) most prestigious award (D) a prestigious award that most
49. [] Not only ----- all the positive charge of an atom, but it is also the site of the weight of every atom. (A) holds the nucleus (B) the nucleus does hold (C) the nucleus holding (D) does the nucleus hold

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科目 英文 科目代碼 1802 共 10 頁第 5 頁 *請在【答案卷卡】內作答

50. [] In 1912 Alaska, the largest state of the United States of America by area, entered the United States as ----- forty-ninth state. (A) the (B) was the (C) to be the (D) in the
51. [] Bob Stephenson, a biologist in Alaska who studies the Canadian lynx, a type of wildcat, has learned ----- from studying their tracks in the snow. (A) how hunt lynx (B) lynx how hunt (C) how lynx hunt (D) lynx hunt how
52. [] ----- lay eggs, but some give birth to live young. (A) Although most sharks (B) Most sharks (C) Despite most sharks (D) Most sharks that
53. [] By means of various types of sensors, ----- simulate most of the environmental variations to which a micro system is subjected. (A) the ability of MEMS engineers to (B) MEMS engineers, being able to (C) which MEMS engineers can (D) MEMS engineers can
54. [] -----, Sarah Orne Jewett, an American novelist and short story writer, read widely in her family's extensive library. (A) The little formal education that she received (B) That she received little education formally (C) Although she received little formal education (D) Little formal education that was received by
55. [] ----- planes in flight between airports, air traffic control systems rely heavily on radar. (A) Of tracking (B) Track of (C) To Track (D) Tracked
56. [] The operating principles of the telecommunication are ----- they were in the nineteenth century. (A) the same today (B) the same as today (C) the same today as (D) today what the same
57. [] Everyone of us ----- for home at this time tomorrow. (A) left (B) to be leaving (C) have left (D) will be leaving
58. [] The term belles-lettres is used to denote literary forms that contain -----, such as drama, poetry, essays, and novels. (A) artistic, creative writing (B) them is artistic, creative writing (C) artistic, creative, and writing (D) writing that artistic, creative
59. [] There are two machines in the corner; one is an automatic coin changer and ----- a vending machine. (A) one (B) other (C) the other (D) another
60. [] Let her ----- her own way. (A) had (B) have (C) has (D) has had
61. [] ----- in cases where special oxidants are used, fires are the result of a fuel rapidly combining with the oxygen in the air. (A) Even though (B) There are (C) Except (D) How
62. [] The daytime ----- bright because the Earth's atmosphere scatters sunlight. (A) has a sky (B) while sky (C) for the sky (D) sky is
63. [] Although the Nobel Prize is difficult to win, there are still ----- scholars who are awarded the Prize every year. (A) few (B) many (C) a lot (D) a few

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科目 英文 科目代碼 1802 共 10 頁第 6 頁 *請在【答案卷卡】內作答

64. [] The development of synthetic fibers led to the production of new types of fabrics ----- more durable and easier to care for. (A) that were (B) that they were (C) and were (D) were
65. [] Pure iron cannot be hardened by temperature treatment, as -----, because iron lacks the necessary carbon. (A) so can steel (B) with steel can (C) can steel (D) steel it can
66. [] Airsickness is produced by a disturbance of the inner ear, ----- psychogenic factors, such as fear, also play a part. (A) nor (B) neither (C) in spite of (D) although
67. [] The world's deepest cave is almost three times as deep ----- . (A) as the Empire State Building is high (B) is higher than the Empire State Building (C) that the Empire State Building is higher (D) and the Empire State Building's height
68. [] In 1880, ----- that the piezoelectric effect occurs when the charge balance within the crystal lattice of a material is disturbed. (A) the discovery (B) it was discovered (C) with the discovery (D) if it was discovered
69. [] Hillary Clinton's career as United States Senator from New York ----- in 2001 and that election marked the first time an American First Lady had run for public office. (A) begin (B) began (C) to have begun (D) have begun
70. [] Although beavers, known for building dams, rarely remain submerged for more than two minutes, they can stay underwater ----- fifteen minutes before having to surface for air. (A) as long as (B) as long (C) so long that (D) so long

Part II. Answer problems 71-85 based on the following excerpts of conference papers. You will have 2 points for each in problems 71-85. There is no minus point for problems in this part so try your best to have the correct answers.

Single-cell analysis has generated a wealth of information in cell population studies [1]. Using single-cell analysis, the characteristics of cells in a heterogeneous population can be analyzed without the loss of information that results from averaging the population as a whole. Until now, most single-cell analysis, such as flowcytometry and automated microscopy, has been focused on cell surface properties due to the lack of proper cytosolic analysis tools. Studies that report on single-cell analysis of cytosolic components can be categorized by the access methods to cytosolic components: biochemical [2] or physical [3,4]. In the biochemical access methods (Figure 1a), fluorescence markers penetrate through the plasma membrane into the cytosol or are expressed in the cytosol. Subsequently, using continuous fluidics, the automated microscope or flowcytometer successively measures the fluorescent light from individual cells as a measure of the target cytosolic component. However, only limited markers, such as fluorescent probes for calcium, can penetrate the membrane and report on the cytosol. For other components, the cell membrane needs to be made permeable in order to give access to compounds such as antibodies, while maintaining the cytosolic component to be measured inside the cell. In other approaches, the cell membranes are pierced (Figure 1b) or removed to release cytosol (Figure 1c) using MEMS devices that can manipulate single cells individually. In these methods, however, the cells are maintained in a stationary or quasi-stationary liquid to prevent diffusion of the cytosolic component. This in turn does not allow fast successive measurements of a significant number of cells, important to analyze cell populations. Thus, Many important cytosolic components are difficult to measure in single cells in a heterogeneous population. While these cellular compounds can be sensitively measured in a (lysed) cell population as a whole, the measurement of individual cells in a heterogeneous population is difficult.

The proposed flow-lysometer technique (Figure 1d) achieves high-throughput measurements using the continuous flow microchannel, while maintaining the target flexibility of the physical access methods. We propose to successively lyse single cells one by one, and sense the released cytosolic component in a continuous flow channel. Since the cell lysis in continuous flow causes unstable measurements, we also add a synchronizing cell detector. The cell-detector enables the synchronization of the cytosolic sensing signals with detected cell positions. Thus, the proposed flow-lysometry technique can analyze cytosolic components in single cells from heterogeneous cell populations.

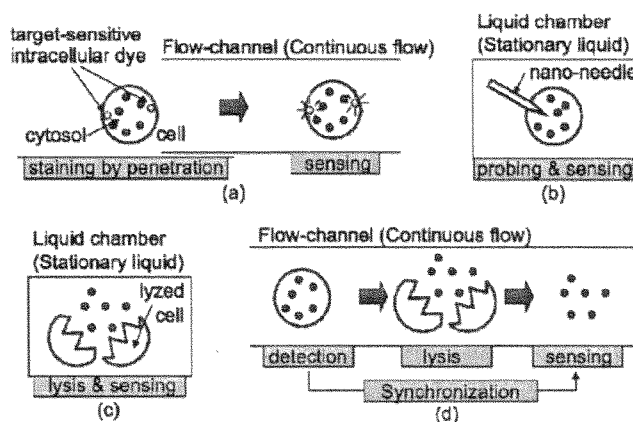


Figure 1: Single-cell cytosol analyzers: (a) the conventional method based on intracellular staining [2]; (b) the conventional method based on single-cell probing [3]; (c) the conventional method based on single-cell lysis [4]; (d) the proposed flow-lysometry.

71. [] What is the major problem for analyzing cells in a heterogeneous population? (A) difficult to distinguish cells (B) varieties of cell species (C) loss of information (D) equipment limitation

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72. [] What is the reason causing the loss of information in the analysis of cells in a heterogeneous? (A) cell mixing in the population (B) cell averaging of the population (C) cell contamination within the population (D) the size of the population is too small
73. [] Why do the most single-cell analyses focus on cell surface properties only? (A) Due to the mixed cell populations (B) Due to the high-throughput measurements (C) Due to the wide target components (D) Due to the lack of analysis tools
74. [] People often use ----- to categorize the studies on single-cell analysis into biochemical and physical aspects. (A) Radiation methods (B) Heating methods (C) Lightening methods (D) Access methods
75. [] What is the major disadvantage of the approach in Fig. 1(a). (A) Limited markers (B) Low speed of analysis (C) Require continuous fluidics (D) Need fluorescence markers
76. [] What kind of substances CANNOT penetrate the membrane of the cell in the approach of Fig. 1(a)? (A) Antibodies (B) Water (C) Oxygen (D) Calcium
77. [] What is the definition of “lysis” in cell analysis? (A) Piercing the cell membrane (B) Detecting the cell membrane (C) Constructing the cell membrane (D) Removing the cell membrane
78. [] What is the main shortcoming of the approaches of Fig. 1(b) and (c) for analyzing cell populations? (A) Difficult to prevent diffusion of the cytosolic components (B) Require stationary liquids (C) Slow measurement of large numbers of cells (D) Cannot penetrate the cell membrane
79. [] What is the purpose of synchronization of the cytosolic sensing signals with detected cell positions in Fig. 1(d)? (A) Count the number of cells passing through the channel (B) Avoid unstable measurements (C) Calculate the speed of the continuous flow (D) Achieve high-through measurements
80. [] What is NOT one of the advantages of proposed flow-lysometer technique in Fig. 1(d)? (A) High-throughput measurements (B) Wide target components (C) Can verify population analysis of single cells in mixed cell populations (D) Fastest successive measurements in biochemical approaches

Capacitive sensing is commonly used for humidity sensing due to the high dielectric constant of water. Large capacitance changes have been demonstrated using vertical parallel plate sensors consisting of a polyimide film sandwiched between two metal electrodes (Figure 1a). Sensitivities reported are approximately 0.2% change in capacitance for every 1% change in relative humidity [1]. This structure is difficult to integrate with CMOS circuitry, so past integrated capacitive sensors have consisted of interdigitated electrodes coated with adsorbent material (Figure 1b). Since the electrodes sit on the substrate, a parallel capacitance through the substrate exists that can be as large as or larger than through the adsorbent material, resulting in significantly lower sensitivity. CMOS chips also contain a layer of oxide between the metal electrodes, decreasing the sensitivity even further. In [2], the second layer of metal in CMOS is used to force more electric field lines to pass through the sensitive polymer to improve the sensitivity of the interdigitated electrode approach (Figure 1c). Despite this technique, a large parallel capacitance remains. In [2], the sensing capacitance is 1.4 pF in parallel with a substrate capacitance of 6.4 pF. Since 18% of the total capacitance is affected by analyte, the sensitivity is at most 18% of that of the parallel plate sensor, or about 0.04% change in capacitance per percent relative humidity.

This paper demonstrates a technique to eliminate the parallel substrate capacitance by removing the underlying substrate and releasing the structure (Figure 1d). By using the metal layers available in CMOS to create a horizontal parallel plate capacitor, a comparable sensitivity to the vertical parallel plate can be integrated with CMOS.

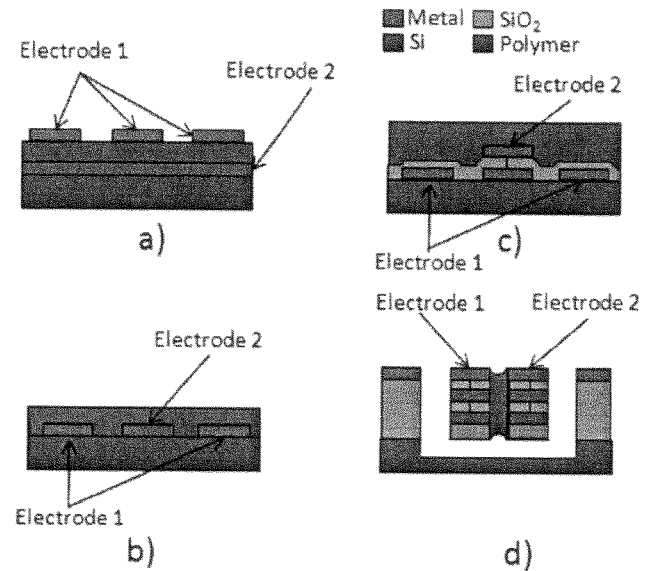


Figure 1: Designs of capacitive humidity sensors

81. [] What is the principle of humidity sensor to make capacitance change? (A) The gap between electrodes of the capacitor changes because of containing water (B) The overlap area between electrodes of the capacitor changes because of containing water (C) The dielectric constant change because of containing water (D) Water introduces stress in the sensing capacitor
82. [] Why are the interdigitated electrodes adopted for humidity sensing? (A) Integration with CMOS circuits (B) Larger transduction areas of humidity sensors (C) Higher sensitivity than parallel-plate capacitors (D) Wider measured range of humidity sensing
83. [] What degrades the sensitivity of the integrated humidity sensors of Fig. 1(b)? (A) Smaller capacitance due to interdigitated electrodes (B) Lower dielectric constant of adsorbent material (C) A layer of oxide between electrodes (D) Parallel capacitance through the substrate

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科目 英文 科目代碼 1802 共 10 頁第 10 頁 *請在【答案卷卡】內作答

84. [] How dose the capacitive sensor of Fig. 1(c) improve the sensitivity of the integrated sensor of Fig. 1(b) by using the second layer of metal in CMOS? (A) Generate large substrate parallel capacitance (B) Force the electric field lines to pass through the polymer (C) Reduce the capacitance from the layer of oxide (D) Generate large vertical parallel capacitance
85. [] What is NOT the key factor for the proposed approach to increase the sensitivity by using a horizontal parallel plate capacitor? (A) Removing the substrate (B) Releasing the sensor structure (C) Eliminating the substrate capacitance (D) Using the high-k dielectric material between the electrodes