注意：考試開始鈴響前，不得翻閱試題，並不得書寫、畫記、作答。

國立清華大學 110 學年度碩士班考試入學試題

系所班組別：奈米工程與微系統研究所
　　　　　　甲組(機電組)

科 目 代 碼 ：2102

考 試 科 目 ：科技英文

－作答注意事項－

1. 請核對答案卷（卡）上之准考證號、科目名稱是否正確。

2. 考試開始後，請於作答前先翻閱整份試題，是否有污損或試題印刷不清，得舉手請監試人員處理，但不得要求解釋題意。

3. 考生限在答案卷上標記「┏┛ 由此開始作答」區內作答，且不可書寫姓名、准考證號或與作答無關之其他文字或符號。

4. 答案卷用盡不得要求加頁。

5. 答案卷可用任何書寫工具作答，惟為方便閱卷辨識，請儘量使用藍色或黑色書寫；答案卡限用 2B 鉛筆畫記；如畫記不清（含未依範例畫記）致光學閱讀機無法辨識答案者，其後果一律由考生自行負責。

6. 其他應考規則、違規處理及扣分方式，請自行詳閱准考證明上「國立清華大學試場規則及違規處理辦法」，無法因本試題封面作答注意事項中未列明而稱未知悉。

Time: 10:30~12:10 (100 minutes)

Question I, problem 1-30, 2 points for each question.

Question II, problem 31-35, 2 points for each question.

Question III, Problem 36-45, 3 points for each question.

No points will be deducted for incorrect answers.

Questions I, problem 1-30 (2 points each)

Choose the best answer to replace the section in the question that has an underline.

1. In the past, lions _____ common in many parts of the world.
   (A) were, (B) been, (C) did, (D) do, (E) being

2. I have _____ coins for the last five years.
   (A) collection, (B) been collecting, (C) been collected, (D) collect, (E) collecting

3. The family shared a box of books _____ them
   (A) among, (B) in between, (C) from, (D) of, (E) with

4. A large number of vehicles are now made of plastic _____ of steel.
   (A) part, (B) insist, (C) inspired, (D) inquired, (E) instead

5. Most serious illnesses might be cured if they are _____.
   (A) detect, (B) to detected, (C) detected, (D) being detect, (E) detection

6. _____ use science and math to understand and predict weather and climate.
   (A) Doctors, (B) Lieutenants, (C) Lawyers, (D) Chemists, (E) Meteorologists

7. Microscopes make small things appear larger than they really _____.
   (A) did, (B) does, (C) do, (D) is, (E) are

8. Everybody knows that Henry was given the job on the _____ of his computer skills.
   (A) stream, (B) strength, (C) strange, (D) strait, (E) strike

9. I must do an extra _____ on earthquakes to complete my project.
   (A) reduction, (B) revision, (C) remark, (D) reason, (E) research

10. The manager will certainly _____ your efforts while grading your performance.
    (A) conquer, (B) confer, (C) consist, (D) consider, (E) converse

11. A nice, white cat was _____ for some food to eat.
    (A) searching, (B) serving, (C) search, (D) serve, (E) searched

12. Very few people really _____ the meaning of fine arts to full extent.
    (A) is understood, (B) were understand, (C) are understand, (D) understand, (E) been understood

13. The lieutenant _____ the soldiers to swim across the river in the training.
    (A) compose, (B) comprehend, (C) comprise, (D) commanded, (E) common

14. Every September, apples are _____ from the trees and packed in boxes.
    (A) picking, (B) picked, (C) pick, (D) been pick, (E) part

15. To be appointed, you should have the _____ mentioned in the application form.
    (A) quota, (B) quote, (C) questions, (D) qualifications, (E) quantity

16. They combined these results _____ modeling studies to understand variations in water transport.
    (A) with, (B) together, (C) and, (D) both, (E) within

17. The movement of air into and out of the lungs is carried out by creating a pressure _____ between the lungs and the atmosphere.
    (A) level, (B) amount, (C) gradient, (D) input, (E) quantity

18. A cavity resonator consists of an enclosure in which the dimensions of a hollow space _____ the resonant frequency.
    (A) depends, (B) deteriorates, (C) decreases, (D) detects, (E) determines

19. The working principle of a CMOS (_____ metal oxide semiconductor) image sensor was conceived in the latter half of the 1960s.
    (A) common, (B) complementary, (C) conduct, (D) compressive, (E) computer

20. Magnetic Resonance Imaging (MRI) is a _____ imaging technology that produces three dimensional detailed anatomical images.
    (A) non-disclosure, (B) non-stop, (C) non-invasive, (D) non-volatile, (E) non-default

21. Enzymes provide the necessary impetus for chemical reactions to occur at a rate that can _____ biological life.
    (A) change, (B) decide, (C) actuate, (D) support, (E) calculate

22. Accurately measuring body temperature in horses will _____ the management of horses suffering from or being at risk of developing postrace exertional heat illness.
    (A) image, (B) implicit, (C) implement, (D) imposter, (E) improve

23. Nanoscale-sized particles have emerged as promising tools with broad _____ in drug delivery, diagnostics and several other biological and non-biological areas.
    (A) advances, (B) amount, (C) additive, (D) applications, (E) addition

24. Investigators are still trying to understand what the hackers stole, and active investigations suggest the _____ is more widespread than initially believed.
(A) achievement, (B) attack, (C) break, (D) task, (E) study

25. Heat transfer describes the flow of heat (thermal energy) due to _____ differences and the subsequent temperature distribution and changes.
(A) voltage, (B) current, (C) pressure, (D) force, (E) temperature

26. Machine Design requires the _____ of basic and engineering sciences such as Physics, Mathematics, Engineering Mechanics, Strength of Materials, Theory of Machines, Thermodynamics and Heat Transfer, Vibrations, Fluid Mechanics, Metallurgy, Manufacturing Processes and Engineering Drawing.
(A) catalog, (B) book, (C) knowledge, (D) language, (E) work

27. Even for faculty members who can read subscription-based journals through their institution's libraries, open access could _____ quicker access to articles in journals to which the institution doesn't subscribe.
(A) allow, (B) add, (C) study, (D) evaluate, (E) improve

28. Manufacturing processes in the shoe industry are still _____ to a large extent by human labor, especially in small and medium craft enterprises.
(A) increased, (B) characterized, (C) decreased, (D) driven, (E) enhanced

29. This work describes a solution based on a single LIDAR sensor to maintain a continuous identification of a person _____ time and space.
(A) by, (B) of, (C) in, (D) without, (E) from

30. Future studies to _____ whether the same phenomenon exists in other animal species will be of interest.
(A) consist, (B) forge, (C) secure, (D) examine, (E) encourage

Questions II, problem 31-35 (2 points each)
Try to help complete the Spin Coating Process Description by filling the answers in.

A typical spin process consists __31__ a dispense step in which the resin fluid is deposited onto the substrate surface, a high-speed spin step to thin the fluid, and a drying step to eliminate excess solvents __32__ the resulting film. Two common methods of dispense are Static dispense, and Dynamic dispense.

Static dispense is simply depositing a small puddle of fluid on or near the center of the substrate. This can range from 1 to 10 ml depending on the viscosity of the fluid and the size of the substrate to be coated. Higher viscosity and or larger substrates typically require a larger puddle to ensure full coverage of the substrate during the high-speed spin step. Dynamic dispense is the process of dispensing while the substrate is turning __33__ low speed. A speed of about 500 rpm is commonly used during this step of the process.

This serves to spread the fluid __34__ the substrate and can result in less waste of resin material since it is usually not necessary to deposit as much to wet the entire surface of the substrate. This is a particularly advantageous method when the fluid or substrate itself has poor wetting abilities and can eliminate voids that may otherwise form.

After the dispense step it is common to accelerate to a relatively high speed to thin the fluid to near its final desired thickness. Typical spin speeds for this step range from 1500-6000 rpm, again depending on the properties of the fluid as well as the substrate. This step can take from 10 seconds to several minutes. The combination __35__ spin speed and time selected for this step will generally define the final film thickness.

31.　(A) in, (B) from, (C) at, (D) of, (E) to
32.　(A) in, (B) from, (C) at, (D) of, (E) to
33.　(A) in, (B) from, (C) at, (D) of, (E) to
34.　(A) over, (B) to, (C) at, (D) in, (E) with
35.　(A) in, (B) from, (C) at, (D) of, (E) to

Enhancement of Diversity in Production and Application Utilizing Electrolytically Polymerized Rubber Sensors with MCF: 1st Report on Consummate Fabrication Combining Varied Kinds of Constituents with Porous Permeant Stocking-Like Rubber

Kunio Shimada [1,*], Ryo Ikeda [2], Hiroshige Kikura [2] and Hideharu Takahashi [2]

[1]　Faculty of Symbiotic Systems Sciences, Fukushima University, 1 Kanayagawa, Fukushima 960-1296, Japan
[2]　Institute of Innovative Research, Tokyo Institute of Technology, 2-12-1 Ookayama, Meguro-ku, Tokyo 152-8550, Japan; ikeda.r.ah@m.titech.ac.jp (R.I.); kikura@lane.iir.titech.ac.jp (H.K.); htakahashi@lane.iir.titech.ac.jp (H.T.)
*　Correspondence: shimadakun@sss.fukushima-u.ac.jp; Tel.: +81-24-548-5214
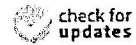
Abstract: To satisfy the requirement of haptic sensibility in rubber such as in the proposed hybrid skin (H-Skin), the authors have demonstrated a new method for solidifying rubber using electrolytic polymerization together with configured magnetic clusters of magnetic compound fluid (MCF) incorporated into the rubber by the application of a magnetic field. However, the rubber and magnetic fluid (MF) involved in the MCF rubber were water-soluble. In addition, the authors have demonstrated the practicability of using electrolytic polymerization with an emulsifier, polyvinyl alcohol (PVA), in which natural rubber (NR) or chloroprene rubber (CR) and silicone rubber (Q) can be mixed as water-soluble and water-insoluble rubbers, respectively. In this study, to enhance production, the feasibility of solidifying rubber by electrolytic polymerization is verified using varied water-insoluble rubber, varied water-insoluble MF, and varied surfactants to aid emulsion polymerization, except in the case of other kinds of rubber and MF which have been demonstrated until recent by the authors. Based on these diverse constituents, the authors propose a consummate fabrication process for multi-layered MCF rubber, which involves porous stocking-like rubber that can be permeated by any liquid. The investigation of this application is presented in the sequential second report.

Keywords: sensor; diene rubber; surfactant; porous; permeation; electrolytic polymerization; magnetic compound fluid (MCF); hybrid skin (H-skin)

Questions III, problem 36-45 (3 points each)

Below is the information from published Journal papers, please try to answer the following questions.

36. What is the purpose for verifying the feasibility of solidifying rubber by electrolytic polymerization?

    (A) reduce cost, (B) enhance production, (C) improve quality, (D) advertisement, (E) management

37. How many keywords are listed in this paper?
    (A) 5, (B) 6, (C) 7, (D) 8, (E) 9

38. According to the above abstract, what will the authors present in the sequential second report?
    (A) commercialization, (B) expense, (C) theory, (D) knowledge, (E) application

39. How many substances involved in the MCF rubber were water-insoluble?
    (A) none, (B) 1, (C) 2, (D) 3, (E) 4

40. How long does it take from the paper submission to publication?
    (A) Approximately four months, (B) roughly one month, (C) about one year (D) one week, (E) two weeks

---

Appendix C

Depending on the type of dopant, MCF rubber obtained by electrolytic polymerization is mainly divided into three types with different electrical properties, as shown in Table A1 [14]. The MCF rubber has induced voltage and electric current. Typically, the value of electric resistance is directly proportional to the induced voltage, such that it rises when induced voltage increases and vice versa. A battery-type MCF rubber is considered as the case of having large induced electric current in a piezo-typed MCF rubber and as a soft polymer battery.

Table A1. Three types of electrolytically polymerized MCF rubber mainly divided by kinds of dopant [14].

MCF Rubber Type	Induced Voltage	Induced Electric Current	Electric Resistance	Dopant
Conductive type	Minimum (1-ordered mV)	Minimum (1-ordered μA)	Minimum (0.1, 1-ordered Ω)	KI, I₂, Tetraethylammonium tetrafluoroborate
Piezo type	Large (10, 100-ordered mV)	Small (10-ordered μA)	Large (kΩ, MΩ)	TiO₂, ZnO, BaTiO, Aluminum nitride, Lead(II) titanium(IV) trioxide, Potassium niobate, Lithium niobate
Battery type	Large (10, 100-ordered mV)	Large (100-ordered μA)	Large (kΩ, MΩ)	KOH, Lithium hydroxide monohydrate, Trilithium Citrate Tetrahydrate

---

41. According to Table A1, which MCF rubber has the smallest electric resistance?
    (A) Battery type, (B) piezo type, (C) conductive type, (D) quantum type, (E) none of above

42. According to Table A1, which MCF rubber has the most diversified dopants?
    (A) Battery type, (B) piezo type, (C) conductive type, (D) quantum type, (E) none

ABSTRACT

A screening method for the highly toxic nerve agent VX is required for forensic and clinical analysis. In this study, a simple colorimetric method using gold nanoparticles (AuNPs) was established as an efficient strategy for VX detection by the naked eye. The AuNPs changed from bright red to deep blue on addition of VX under weakly acidic conditions. In the presence of 2-(diisopropylamino)ethanethiol (DAET), which is a major hydrolysis product of VX, AuNP aggregation was observed. This aggregation occurred under weakly alkaline conditions; therefore, the associated color change occurred at a different pH to that induced by VX addition. The presence of DAET could therefore be identified by a simple pH adjustment. In addition, we developed a hand-powered extraction device for on-site primary screening. The developed method and device were applied for the detection of trace levels of VX and DAET in samples taken from simulated crime scenes.
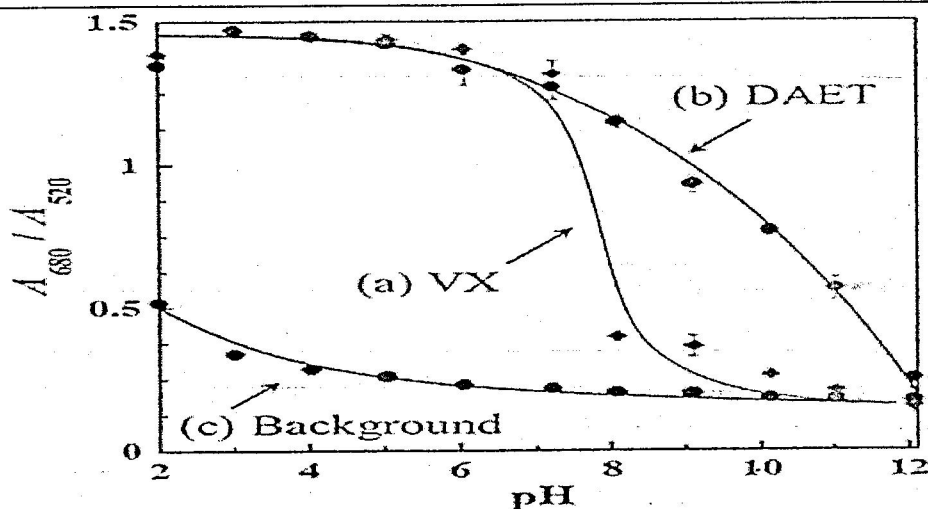
Fig. 6. The effect of pH on the absorbance ratio (A_{680}/A_{520}) in the presence of 1.5 μM (a) VX or (b) DAET. (c) Background absorbance of the AuNPs.

43. Based on Background curve, what is the pH value when (A_{680}/A_{520}) value is 0.5?

    (A) 2, (B) 4, (C) 6, (D) 8, (E) 10

44. If you compare the DAET curve with VX curve, what is the approximate ratio of (A_{680}/A_{520}) when pH values of both curves are 8?

    (A) 2, (B) 3, (C) 4, (D) 5, (E) 6

45. When you compare the VX curve with DAET curve in acid environments, which (A_{680}/A_{520}) is larger?

    (A) VX, (B) DAET, (C) almost the same (D) no information available, (E) Background