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 115 學年度碩士班考試入學試題

系所班組別：太空工程研究所

科目代碼：2302

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. 提早交卷者不可攜出試題，請將試題連同答案卷(卡)交予監考人員，攜出將以違規論處。當節考試結束後試題將置於講台，可自行取回，本試場不負保管責任。
7. 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。

國立清華大學115學年度碩士班考試入學試題

系所班組別：太空工程研究所

考試科目（代碼）：科技英文(2302)

Section I (2.5 points for each question)

Choose the best answer to replace the underlined part of the sentence.

1. Photonic quantum systems provide ___ paths for all of the essential areas of modern quantum technology.
   (A) educational (B) symbolic (C) recreational (D) auxiliary (E) practical
2. ___ are used in experiments to ensure that the observed effects are due to the variables being tested.
   (A) Controls (B) Outcomes (C) Predictions (D) Assumptions (E) Hypotheses
3. The measurement results were highly ___, indicating good repeatability of the experiment.
   (A) variable (B) consistent (C) same (D) arbitrary (E) approximate
4. A sensor converts physical quantities into signals that can be ___ and analyzed.
   (A) interpreted (B) enforced (C) eliminated (D) interrupted (E) distorted
5. Structural health monitoring and damage ___ are essential for ensuring the safety and performance of engineering systems.
   (A) identification (B) communication (C) motion (D) protocol (E) record
6. The concept of entropy was first introduced ___ the field of thermodynamics.
   (A) to (B) in (C) on (D) at (E) with
7. A material that deforms permanently after stress removal is described as ___.
   (A) elastic (B) brittle (C) plastic (D) rigid (E) resilient
8. The project leader is ___ coordinating the experimental procedures and assigning tasks to team members.
   (A) on demand (B) beyond the scope of (C) in charge of (D) ahead of (E) in accordance with
9. Noise in a signal can significantly reduce the ___ of the transmitted information.
   (A) attitude (B) quantity (C) acceptability (D) fraction (E) clarity
10. The accuracy of the instrument must be ___ regularly to ensure reliable measurements.
    (A) calibrated (B) simulated (C) assembled (D) accelerated (E) multiplexed
11. In research papers, figures are used to ___ trends and key results.
    (A) obscure (B) demonstrate (C) complicate (D) smear (E) observe

12. A diode allows electric current to flow primarily in ___ direction.
    (A) either (B) neither (C) multiple (D) one (E) opposite
13. A composite material is formed by combining two or more materials ___ distinct properties.
    (A) retaining (B) retained (C) retains (D) to retain (E) retain
14. ___ is a branch of physics that deals with the study of mechanical waves in gases, liquids, and solids.
    (A) Optics (B) Thermodynamics (C) Electromagnetism (D) Acoustics (E) Mechanics
15. A robot can be guided by an external control device, or the control may be embedded ___.
    (A) at (B) in (C) of (D) with (E) within
16. Silicon ___ is a hard chemical compound containing silicon and carbon.
    (A) carbide (B) carbon (C) carton (D) carpet (E) cargo
17. Scientific models are simplified representations designed to ___ complex physical phenomena.
    (A) correspond (B) complicate (C) represent (D) exaggerate (E) control
18. One tenth of one giga-ohm is equal to ___ kilo-ohms.
    (A) 10^4 (B) 10^5 (C) 10^6 (D) 10^7 (E) 10^8
19. A hypothesis must be ___ so that it can be evaluated experimentally.
    (A) flexible (B) testable (C) general (D) subjective (E) speculative
20. A satellite is an object, typically a spacecraft, placed into ___ around a celestial body.
    (A) channel (B) string (C) field (D) ring (E) orbit
21. The relative isotopic mass of carbon is 12 ___.
    (A) g (B) g/mL (C) u (D) u/s (E) u/mL
22. Grinding is a ___ of cutting, as grinding is a true metal-cutting process.
    (A) hierarchy (B) style (C) change (D) subset (E) base
23. The experimental setup was relatively simple; ___, it produced highly reliable results.
    (A) otherwise (B) nevertheless (C) at the same time (D) moreover (E) therefore

24. A method is a ___ procedure for bringing about a certain goal, like acquiring knowledge or verifying knowledge claims.
(A) completed (B) developed (C) patterned (D) determined (E) structured
25. The first and second boxes contain 3 and 7 bolts, ___, on the table.
(A) respectively (B) correspondingly (C) alternately (D) consequently (E) lately
26. The use of lidar can detect the movement and behavior of ___ flying insects, with identification down to sex and species.
(A) family (B) single (C) more (D) group (E) individual
27. ___ an estimated 43,000 species of bacteria have been named, most of them have never been studied.
(A) After (B) Although (C) Because (D) Roughly (E) In total
28. In the field of optics, transparency is the physical property of ___ light ___ pass through the material
(A) preventing…from (B) preventing…to (C) allowing…to (D) allowing…for (E) none of the above
29. Vibe coding is an artificial intelligence-___ software development technique.
(A) entailed (B) entailing (C) entail (D) assisted (E) assistant
30. The minimum voltage that must be applied for the light bulb to turn on is called the ___ voltage.
(A) peak (B) range (C) nominal (D) input (E) threshold

Section II (2.5 points for each question)

Choose the best answer to replace the underlined parts in the following paragraph as the abstract of a perspective on silicon photonics. (Source: Shekhar, Sudip, et al. "Roadmapping the next generation of silicon photonics." *Nature Communications* 15.1 (2024): 751.)

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Silicon photonics has developed into a mainstream technology driven by advances in optical communications. The current generation has led to a __31__ of integrated photonic devices from thousands to millions-mainly in the form of communication transceivers for data centers. Products in many exciting applications, such as sensing and computing, are __32__. What will it take to increase the __31__ of silicon photonics from millions to billions of units shipped? What will the next generation of silicon photonics look like? What are the common threads in the integration and fabrication bottlenecks that silicon photonic applications face, and which emerging technologies can solve them? This perspective article is an __33__ to answer such questions. We chart the generational trends in silicon photonics technology, drawing parallels from the generational definitions of CMOS technology. We identify the crucial challenges that must be solved to make giant strides in CMOS-foundry-compatible devices, circuits, integration, and packaging. We identify challenges critical to the next generation of systems and applications—in communication, signal processing, and sensing. By identifying and summarizing such challenges and opportunities, we aim to stimulate further research __34__ devices, circuits, and systems for the silicon photonics ecosystem.

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31. (A) proliferation (B) materialization (C) population (D) correlation (E) portion
32. (A) at once (B) on hold (C) around the corner (D) on paper (E) in view
33. (A) attempt (B) aspiration (C) illustration (D) effort (E) escort
34. (A) to (B) as (C) of (D) with (E) on

Section III (3 points for each question)

Answer the following questions based on the figures and the captions.

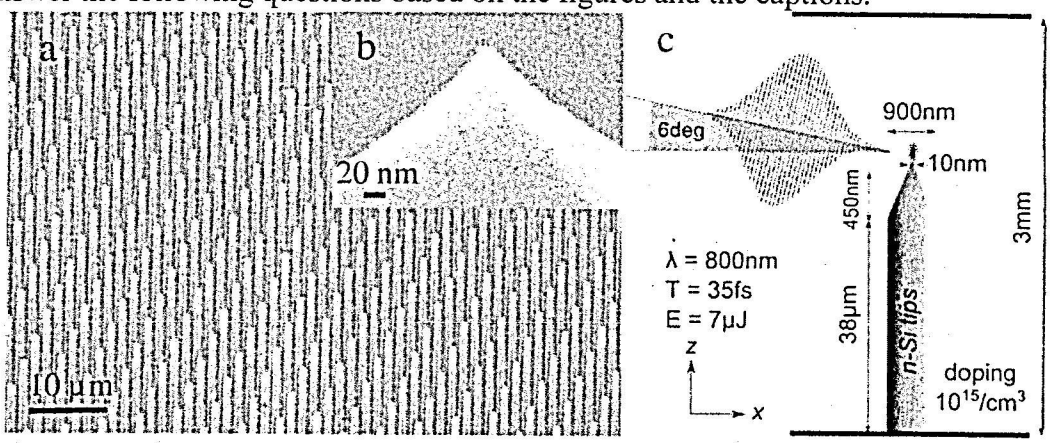

Figure 1. Images and schematic of emitter structure: (a) Scanning electron microscope (SEM) image of uniform array of high-aspect-ratio Si columns with 5 μm pitch. (b) SEM close-up of a single tip. (c) Schematic of a single 800 nm pulse interacting with a single silicon tip. λ is the laser wavelength, T is the pulse duration, and E is laser energy. (Swanwick, Michael E., et al. "Nanostructured ultrafast silicon-tip optical field-emitter arrays." *Nano letters* 14.9 (2014): 5035-5043.)

35. What type of energy source was used to interact with the emitter tip?
    (A) Pulsed electron beam with 900 nm beam diameter
    (B) Pulsed laser beam with 900 nm beam diameter
    (C) Pulsed electron beam with 35 fs pulse duration
    (D) Pulsed laser beam with 800 nm wavelength
    (E) Scanning electron beam with 35 fs pulse duration

36. Choose the **correct** description of Figure 1.
    (A) The length of the straight part of a single silicon tip was 3 mm.
    (B) The ratio between the length of the straight part and that of the tapered part of a single silicon tip was larger than 100.
    (C) The total number of silicon tips that the authors have ever fabricated might be less than 100.
    (D) Michael E. Swanwick is the only author of the publication.
    (E) The ratio of the magnification of Figure 1(b) and that of Figure 1(a) was larger than 50.

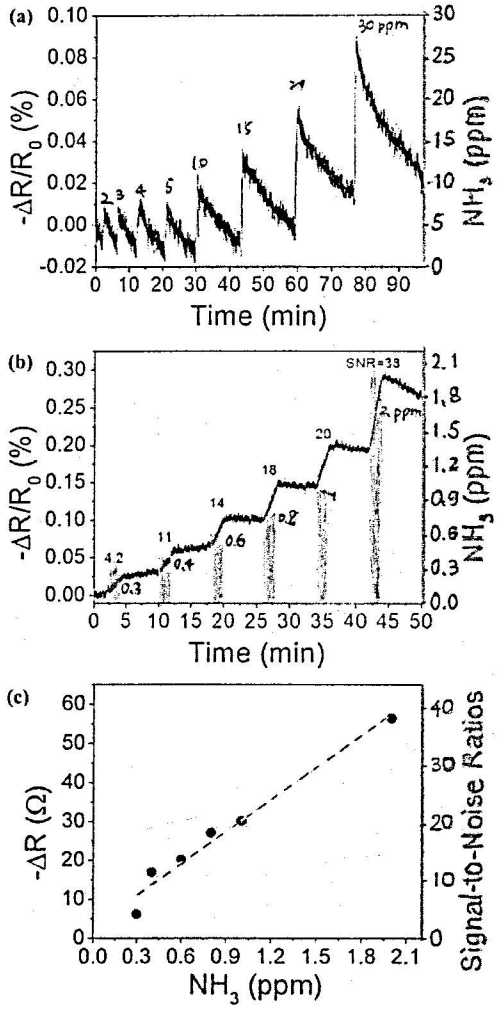

Figure 2. Sensor response plots show percentile resistance change versus time of the MoS_2 film with a bias voltage of 0.5 V, upon consequent NH_3 exposures at various concentrations: a) from 2 ppm to 30 ppm and b) 300 ppb to 2 ppm. The gray vertical bars indicate NH_3 gas injections for: a) 15 s and b) 2 min, respectively. The signal-to-noise ratio (SNR) of each folding curve is shown to verify a sensible signal. c) Plots of resistance change (black solid circles) and signal-to-noise ratios (gray open boxes) as a function of NH_3 concentration. The linear dashed line indicates the fitted line. (Source: Lee, Kangho, et al. "High-performance sensors based on molybdenum disulfide thin films." *Advanced materials (Deerfield Beach, Fla.)* 25.46 (2013): 6699-6702.)

37. How many different NH_3 exposure concentrations were used in total in Figure 2?
(A) 10 (B) 11 (C) 12 (D) 13 (E) 14

38. Choose the **incorrect** description of Figure 2.
(A) More concentration steps were tested in the 15-s NH_3 exposure series than in the 2-min NH_3 exposure series.
(B) The percentile resistance change caused by NH_3 exposure increased with the NH_3 concentration in the 15-s NH_3 exposure series.
(C) The highest used NH_3 concentration was 300 ppb.
(D) The SNR value of the test using 5 ppm NH_3 was not reported.
(E) The percentile resistance change caused by 15 ppm NH_3 exposure was larger than 0.02%.

39. Choose the **correct** description of Figure 2.

(A) The SNR value of the test using 0.8 ppm NH_3 was higher than double the SNR value of the test using 0.4 ppm NH_3.

(B) The SNR value of the test using 1 ppm NH_3 was higher than double the SNR value of the test using 0.4 ppm NH_3.

(C) The absolute resistance change caused by 0.3 ppm NH_3 exposure was larger than 10 ohms.

(D) The absolute resistance change caused by 1 ppm NH_3 exposure was larger than 40 ohms.

(E) The absolute resistance change caused by 2 ppm NH_3 exposure was larger than 50 ohms.