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 108 學年度碩士班考試入學試題

系所班組別：**動力機械工程學系 己組**

考試科目(代碼)：**科技英文(1602)**

—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. 作答中如有發現試題印刷不清，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。

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　　*請在【答案卷、卡】作答

(1) **40** questions in total　(2) **2.5** points for each question

(3) **1** point will be deducted for each incorrect answer　(4) Choose **the best** answer for each question.

Part 1. Grammar

1. It is crucial to understand how one form of energy can _____ into another.

(A) convert

(B) converts

(C) be converted

(D) converting

(E) be converting

2. Curiosity keeps _____ us down new paths.

(A) to lead　(B) lead

(C) for leading　(D) leading

(E) led

3. Technology is advancing at a rapid speed and engineers need _____ to compete and advance.

(A) to do the same

(B) doing the same

(C) the same

(D) same

(E) to do same

4. Before _____ to the graduate school, I had to go through an examination.

(A) to admit

(B) being admitted

(C) having been admitted

(D) admitting

(E) admit

5. I could have done my homework better, if I _____ to school yesterday.

(A) came

(B) have come

(C) come

(D) have came

(E) had come

6. We believe this malfunction _____ due to poor mechanical design.

(A) are　(B) is

(C) to be　(D) be

(E) was

7. Hsinchu Science Park _____ an important center for technology development in Taiwan since 1980s.

(A) was

(B) has been

(C) is

(D) had been

(E) had

8. An engineer must _____ domain knowledge to be successful.

(A) have

(B) has

(C) to have

(D) having

(E) do have

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9. Graphene is one of the earth's strongest _____ ever measured.

(A) material

(B) materials

(C) that

(D) Materials

(E) which was

10. The experiment will be finished in _____ five weeks.

(A) more

(B) the other

(C) other

(D) less

(E) another

11. The subject _____ I am most interested is Mechanical Engineering.

(A) in which

(B) in that

(C) in what

(D) in where

(E) whichever

12. I want to become _____ of National Tsing Hua University.

(A) student

(B) the student

(C) a student

(D) students

(E) new student

13. The weight of our microrobot is _____ a kilogram.

(A) smaller

(B) less

(C) lower than

(D) less than

(E) more little than

14. Industry 4.0 impacts how engineers design products for _____ manufacturing facilities.

(A) increasing smartly

(B) increasing smart

(C) increasingly and smartly

(D) increasingly and smart

(E) increasingly smart

15. The Porche 959 was _____ street car in the world when introduced in 1987.

(A) a fastest

(B) the most fast

(C) the maximum fast

(D) most fast

(E) the fastest

16. Physics _____ a very important subject for engineering students.

(A) are

(B) is

(C) was

(D) were

(E) must be

17. This machine used centrifugal force to separate particles _____ air.

(A) from

(B) out of

(C) away

(D) to

(E) versus

18. Carbon dioxide sorbents absorb _____ when cool and release it when heated.

(A) gas

(B) gases

(C) the gas

(D) them

(E) that

Part 2. Reading Comprehension

Article I (Crawford, M., ASME.org, Jan. 2018)

The following technologies are typically considered key components of Industry 4.0:

Internet of Things (IoT) - uses sensor technology to connect the entire manufacturing ecosystem with real-time communication and data from interconnected machines and devices, tracking operational performance

Big data and analytics - utilizes the Internet of Things to capture, analyze, and store data on every stage of production, from design through production

Engineering simulation - relies on virtual reality and augmented reality to create realistic, perfectly scaled, three-dimensional images that speed up product design, reduce iterations, and shorten time to market

Additive manufacturing, including 3D and 4D printing - these rapidly-advancing technologies allow engineers to design and manufacture complex products that often cannot be made using traditional manufacturing methods.

Each of these Industry 4.0 components has big impacts on engineering design. For example, with the Internet of Things, data can be used to optimize manufacturing processes, often through engineering adjustments. Robotics and automation, also key Industry 4.0 technologies, need to be integrated into manufacturing equipment, often in the form of added material-handling features. Data-collection features such as RFID can also be designed into parts and products.

Quick, production-ready prototypes are essential for efficient manufacturing and speed to market. Modeling/simulation scenarios early in the design process help determine the best possible design for prototyping. Virtual reality and augmented reality programs are rapidly becoming potent visualization and design tools, especially in medical R&D.

When companies embrace Industry 4.0, they must also embrace big data and analytics. This sometimes requires hiring their own data-management scientists. Big data is essential for optimizing performance at every stage of development, from design through production. Performance data from the end-use environment can also lead to engineering design changes for future versions. Big data is also needed to identify and analyze consumer trends, which can directly impact what engineers make, and how they make them.

19. In this article, which of the following was NOT considered as key technology of Industry 4.0?

(A) Modeling　　(B) Augmented reality

(C) 3D printing　　(D) Iterations

(E) Automation

20. Which of the following best describes the "Big data" for Industry 4.0?

(A) RFID data

(B) Data from big companies

(C) A lot of data

(D) Simulation data

(E) Data collected from IoT

21. Which of the following is NOT a comment made by the author?

(A) Additive manufacturing can be used to make complex products.

(B) Companies embracing Industry 4.0 must hire data-management scientists.

(C) Modeling/simulation can accelerate product design.

(D) Big data can be useful in marketing

(E) Virtual reality is an important tool in designing medical devices.

22. Which of the following is irrelevant to Industry 4.0?

(A) Data optimization　(B) Data storage

(C) Data acquisition　(D) Data analysis

(E) None of the above

Article II (Abrams, M., ASME.org, Aug. 2016)

The autonomous car is easy. Yes, compared to the doltish vehicles of decades past, completely dependent, as they were, for all navigation on the people at their wheels - be they drunk, sober, passive, aggressive, reckless, erratic, law-fearing, or plain bonkers - the self-driving auto is a marvel to behold. But, to get a human-free car to safely guide itself through the streets and highways of our land, there's already a baseline to go by: the rules of the road. And our computational wonderthings are very good at following rules.

But there's another arena of transportation that's more lawless. Or, at least, the rules are unspoken, the sidewalk. Navigating the strips on concrete that line our streets is a much more subtle affair, dependent on body language, unconscious conventions, and social and cultural norms.

Now a team of researchers led by Professor S. Salvarese has taken up the challenge of creating a self-navigating machine, Jackrabbot, for the sidewalk. The goal is to have a robot that moves like a pedestrian. To do so it has to understand a lot more than human to human interactions. The sidewalk, after all, hosts skateboarders, bicyclists, hoverboarders, wheelchairs, dog walkers, and squirrels. "You can see that the complexity of interaction is much richer than that between humans," says Salvarese.

To understand this complexity, and get it into the Jackrabbot, the team collected a massive data set of interactions on collegiate walkways. "What we did is fly a drone over the campus," says Savarese, "and we recorded hours and hours of footage of all possible actors that populate the campus: pedestrians, bikes, skateboards, strollers. All these agents and trajectories are for learning inter-class relationships." The data also includes non-agents such as sidewalk, grass, trees, fountains, and staircases.

A side effect of the project is that, in learning how to best inform Jackrabbot on how to navigate among humans, they've learned a lot about how humans navigate among humans. Their data could be used by civil engineers and sociologists hoping to better understand the flow of humanity. And their technique needn't be limited to understanding human interactions. In fact, one colleague at the school has put the team and their practices to use in an attempt to track the relationships of hens in large colonies. And, of course, those autonomous cars could make use of the approach. There's more to the rules of the road than the rules, after all. At urban intersections with stop signs, self-driving cars will have to understand when walker hesitation is just a safety check, and when it's a sign that the right of way had been surrendered.

More immediate applications for the Jackrabbot could include assisting shoppers, patrolling the campus as a mobile information booth, and solving the "last mile problem" (that is, unloading deliveries of cargo delivered by self-driving truck).

23. Jackrabbot is designed to be a

(A) Autonomous drone　(B) Electric car

(C) Pedestrian-like robot

(D) Campus navigator

(E) Highway autonomous car

24. Which of the following was NOT likely included in the data collected by the research team?

(A) Skateboarders　(B) Shoppers

(C) Dog walkers　(D) Buildings

(E) Sidewalk

25. Which of the following is the most important component to this research project?

(A) Machine learning

(B) Campus patrolling

(C) Flow of humanity

(D) Human body language

(E) Solving the "last mile problem"

26. Which subject was NOT mentioned at all by the author in this article?

(A) Automatic control　(B) Computer science

(C) Zoology　(D) Aerodynamics

(E) None of the above

Paragraphs

27. The windmill is a national symbol of the Netherlands, which has for centuries harnessed the fresh breezes coming off the North Sea to pump water and power small industries. It's fitting, then, that a Dutchman was tasked by GE Renewable Energy to manage the design and fabrication of the world's largest wind turbine. (Winters, J. and Saunders, Z., *Mechanical Engineering* 140 (12), 31, Dec 01, 2018)

(A) The windmill pumps water from the North Sea by GE.

(B) A Dutchman was tasked by GE to make fittings for the world's largest wind turbine.

(C) Wind power from the North Sea has been used for centuries.

(D) Small industries in Netherlands provide power to GE Renewable Energy.

(E) The world's largest windmill is the national symbol of Netherland.

28. Engineers typically build a fuel bed of shredded wood on the floor of the tunnel to replicate sloped terrain. Roof fans pull outside air through heating and cooling coils to adjust its temperature. A large fan blows the conditioned air into an 80-foot-tall burn chamber, where is mixed with the air in the room and is drawn into the wind tunnel at up to 8 miles per hour. (Fellet M., *Mechanical Engineering*, ASME, Nov. 2018)

(A) Large roof fans pull the air to outside.

(B) An 80-foot-tall chamber is air-conditioned.

(C) Heating and cooling coils are mixed by air flows at 8 miles per hour.

(D) The wind tunnel is 80-foot-tall.

(E) The fan is used to cool the wind tunnel.

29. The microrobot weighs 1.2 g, and the researchers achieved a speed of 2.2 cm per second, with peak velocity across water reaching 8 cm per second. That is much slower than its ground speed of 40 cm per second. (Shah, A., *Mechanical Engineering*, ASME, Nov. 2018)

(A) The microrobot moves slower than the ground.

(B) The microrobot was moved by the researcher slowly.

(C) In the test, water flows at a peak velocity of 8 cm per second.

(D) The microrobot could move across a 10 cm water trench within 2 seconds.

(E) It takes 40 seconds for the microrobot to move one cm on the ground.

30. The eyes of mantis shrimp detect ______ types of polarization: horizontal, vertical, and two types each of diagonal and spiral. They have 16 color receptors stacked atop on another. Shorter wavelength receptors go on top and sensors for longer wavelengths, which penetrate tissue ______, on the bottom. (Brown, A. S., *Mechanical Engineering*, ASME, Dec. 2018)

(A) four / more

(B) four / better

(C) six / deep

(D) six / better

(E) six / faster

Part 3. Cloze

Corrugated cardboard is a staple in the packaging industry. It (31) the standard sandwich structure: two solid sandwich panels separated by a layer of lightweight webbing or lattice. This design provides the (32) combination of low weight and high stiffness. Sandwich-structure composite materials are common across a variety of industries, especially for applications that require those characteristics. But, of course, industry is always looking for (33), stronger materials. A team of engineers from the University of Pennsylvania has created a new material called nanocardboard that is the ultrathin (34) of corrugated paper cardboard. Not only is it extremely light weight - one square centimeter weighs less than a thousandth of a gram - it is an excellent thermal insulator and springs back to its (35) shape after being bent in half. (Crawford, M., ASME.org, Dec. 2016)

31. (A) utilizes (B) utilizations (C) utilized

(D) is used (E) has used

32. (A) ideal (B) good (C) highest (D) excellent

(E) optimum

33. (A) cheaper (B) lighter (C) better

(D) more useful (E) the best

34. (A) sample (B) example (C) equivalent

(D) alternative (E) replacement

35. (A) early (B) best (C) old (D) original

(E) own

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A control system consists of subsystems and processes (or plants) assembled for the purpose of obtaining a desired output with desired performance, given a specified input. Figure 1.1 shows a control system in its simplest form. For example, consider an elevator. When the fourth-floor button is pressed on the first floor, the elevator rises to the fourth floor with a speed and floor-leveling accuracy designed for passenger comport. The push of the fourth-floor button is an (36) that represents our desired (37), shown as a step function in Figure 1.2. The performance of elevator can be seen from the elevator response curve in the figure. Two major measured of performance are apparent: the transient response and the steady-state error. In our example, passenger comfort and passenger patience are dependent upon the (38). If this response is too fast, passenger comfort is sacrificed; if too slow, passenger patience is sacrificed. The (39) is another important performance specification since passenger safety and convenience would be sacrificed if the elevator did not (40) properly. (Nise, N. S., *Control System Engineering*, 7th ed., John Wiley & Sons, 2015)

36. (A) accuracy (B) output (C) assembly (D) input (E) error
37. (A) accuracy (B) output (C) assembly (D) input (E) error
38. (A) measurement (B) steady-state response (C) transient response (D) input (E) steady-state error
39. (A) measurement (B) steady-state response (C) transient response (D) input (E) steady-state error
40. (A) level (B) control (C) measure (D) push (E) step

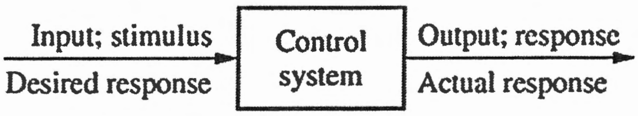

FIGURE 1.1 Simplified description of a control system

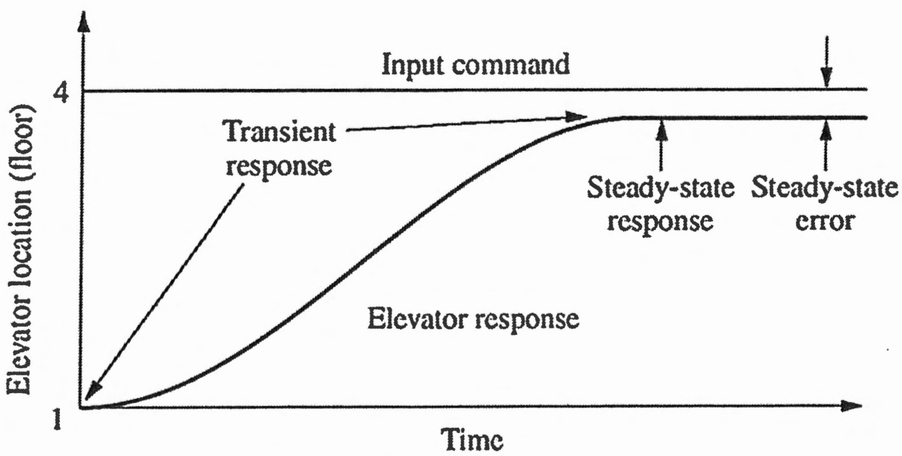

FIGURE 1.2 Elevator response