

令和8年度（令和8年4月入学）
京都工芸繊維大学大学院 工芸科学研究科 博士後期課程

物質・材料化学専攻

一般入試（第Ⅱ期）

外国語

A

1. 問題冊子は、表紙を含めて4枚である。試験開始後に確認すること。
2. 解答用紙は、表紙を含めて4枚、下書き用紙1枚が配られているか、確認すること。
3. 配布された解答用紙の表紙に受験番号を記入すること。
4. 解答は、必ず解答用紙の指定された場所(問題番号と一致した場所)に記入すること。
5. 試験終了後には、解答用紙、問題冊子、下書き用紙の全てを回収する。

問 1. Read the text that provides a detailed explanation of cyber-physical systems (CPS) and answer questions (1) to (2) below.

A Cyber-Physical System (CPS) is a system in which information processing in the cyber domain and processes in the physical world are tightly coupled and operate in real time through continuous bidirectional interaction. Sensors play a fundamental role as the entry point to this system, measuring physical quantities such as temperature, pressure, position, and chemical concentration, and converting them into digital data. This enables CPS to quantitatively perceive the physical environment and provides the basis for analysis, prediction, and decision-making. The continuous data supplied by sensors serves not only for monitoring but also as essential input for control and optimization.

The collected data is transmitted to the cyber space via wired networks such as Ethernet or Fieldbus, or wireless technologies such as Wi-Fi and LTE/5G. Emerging technologies—including 5G and future 6G for ultra-low latency, Time-Sensitive Networking (TSN) for deterministic real-time communication, and edge computing for distributed processing—significantly enhance the scalability and reliability of CPS, especially in mission-critical infrastructures where delays cannot be tolerated.

In the cyber domain, advanced optimization methods are applied. Examples include Model Predictive Control (MPC), digital twins that simulate physical systems, AI and machine learning for anomaly detection and forecasting, and reinforcement learning or mathematical optimization for autonomous control. These approaches shift CPS from reactive control to predictive and proactive operation, improving safety, efficiency, and reliability.

The control decisions derived in the cyber space are fed back to the physical world through wired control networks, dedicated wireless links, or edge-mediated control buses, leading actuators to adjust real-world processes. Maintaining this fast and reliable loop allows CPS to sustain real-time coupling and continuous optimal operation.

Beyond being a technological system, CPS is positioned as a foundational pillar of next-generation social infrastructure. In domains such as energy, water, transportation, manufacturing, and healthcare, CPS enables autonomous and resilient operation, enhances disaster response, reduces energy consumption, addresses labor shortages, and fosters new value creation. In essence, CPS is a transformative infrastructure technology that integrates the physical and digital worlds, guiding society toward a data-driven, autonomous, and optimized future.

(1) Cyber-Physical System (CPS)技術が、なぜ次世代社会に必要とされているか、以下のキーワードのなかで3つの観点から英文で説明せよ。(～500 words)

キーワード: 社会インフラの複雑化(Complexity of social infrastructure)、事故・災害リスク(risk of accidents and disasters)、労働力不足・熟練技術者減少(labor shortages and a decline in skilled engineers)、省エネルギー・脱炭素(energy conservation and decarbonization)、経済価値と新産業創出(economic value and the creation of new industries)、データ駆動型社会への移行(transition to a data-driven society)

(2) (1)で選択した3つの観点について、それぞれ Cyber-Physical System (CPS)における現在の技術課題を述べ、その解決方法のアイデアを英語で簡潔に述べよ。(100~300 words)

問 2. 次の英語をよみ、(1)、(2)を回答せよ。

※著作権の関係で掲載しておりません

引用 : George M. Whitesides, "Whitesides' Group: Writing a Paper", *Advanced Materials*, 16, 15, Special Issue: Soft Lithography, 1375-1377, 2004.

- (1) 上記の文章は、Whitesides 氏著 "Whitesides' Group: Writing a Paper"の一節である。和文要約せよ。(500字程度以内)
- (2) この一節を読み、論文を執筆するために、普段から研究に取り組む姿勢や、その考え方(マインド)を考察し、英語でまとめて説明せよ。(about 1000 words)

問3. 次の(1)、(2)英文に従って日本語で回答せよ。

(1) Write an itemized program algorithm that calculates “n!” factorial (KAIJO in Japanese) using the “FOR” statement. And then, write the program example in C language or Python language?

(2) Probabilistic simulations can be used to numerically approximate the value of π “Pi”. For example, one may define a square region and a geometrically related circular region, then place random points within the square to estimate an area ratio connected to π .

- Define a square region and a circular region that is inscribed in, circumscribed by related to the square (it can be seen in Fig. 1), and design a method to estimate π using randomly generated points.
- Clearly specify the probabilistic model required for the method, including the procedure for generating points, the definition of the regions, and the formula used to estimate the area ratio.
- Derive the mathematical relationship that connects this ratio to π .
- Implement the proposed method in a programming language in C language or Python language, and investigate how the estimation accuracy changes as the number of simulation trials N varies.
- State the general “Japanese name” of this class of numerical methods that use random sampling for estimation.

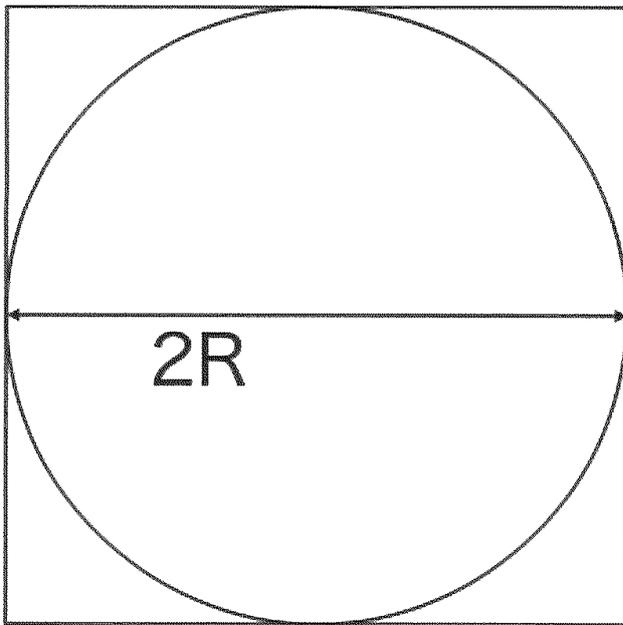


Fig. 1. The square with a diameter of $2R$ and the circle with a radius of R .

出題意図

— 問題 A —

受験者が本学博士後期課程で研究する専門分野の技術や、研究論文の意義などを述べた英文の一部を日本語、またその研究背景に内在する研究課題を英文で要約して説明させ、専門分野における語学力と課題解決能力を確認した。また、今後の研究テーマに必要な予備知識を英文で問い、考察・解説させた。