平成２９年度　入学者選抜学力試験（前期）

数　　学

注 意 事 項

1. 試験開始の合図があるまで，この問題冊子と解答冊子を開かないでください．
2. 問題は必須問題と選択問題に分かれています．
3. 必須問題は3問あり，それらは1ページから2ページにあります．選択問題は問題範囲ごとにそれぞれ2問ずつあります．数学I・数学II・数学A・数学Bの問題は3ページから4ページに，数学IIIの問題は5ページにあります．
4. 解答冊子は，必須問題用と選択問題用の2冊に分かれています．それぞれの解答冊子の表紙の所定欄に氏名と受験番号をはっきりと記入してください．
5. 選択問題は解答する問題範囲を選び，選択問題用解答冊子の表紙の解答問題欄の選択欄に○印を記入してください．○印を記入していない場合，または複数の選択欄に○印を記入した場合は，0点となります．
6. 計算用紙は，解答冊子の中に綴じてあります．
7. 試験中に問題冊子の印刷不明瞭，ページの落丁・乱丁および解答用紙の汚れ等に気づいた場合は，静かに手を挙げて監督員に知らせてください．
8. 試験終了後，問題冊子は持ち帰ってください．
9. 解答時間は120分です．
10. 問題ごとに配点が記されています．

必須問題

I 正の実数 x に関する 2 つの条件

$p : 2\log_{\frac{1}{2}}(x+3) > \log_{\frac{1}{2}}(5x+3) - 1$

$q : x^2 = 9 - |9 - x^2|$

について，以下の問いに答えよ．（配点 60 点）

問 1　条件 p, q をみたす x の範囲をそれぞれ求めよ．

問 2　命題 $p \Rightarrow q$ の真偽を調べよ．

問 3　命題 $\bar{p} \Rightarrow \bar{q}$ の真偽を調べよ．

II 座標平面上の三角形 OAB を考える．$\overrightarrow{\mathrm{OA}} = \vec{a}$, $\overrightarrow{\mathrm{OB}} = \vec{b}$ とし，$\angle \mathrm{AOB} = \dfrac{\pi}{3}$, $\dfrac{\mathrm{OB}}{\mathrm{OA}} = \dfrac{3}{4}$ とする．点 B から辺 OA に垂線を下ろしてその交点を C とし，点 A から辺 OB に垂線を下ろしてその交点を D とする．以下の問いに答えよ．（配点 60 点）

問 1　$\overrightarrow{\mathrm{OC}}$ を $\vec{a}$ を用いて表せ．

問 2　$\overrightarrow{\mathrm{OD}}$ を $\vec{b}$ を用いて表せ．

問 3　AD と BC の交点を点 P とするとき，$\overrightarrow{\mathrm{OP}}$ を $\vec{a}$, $\vec{b}$ を用いて表せ．

III 関数 $f(x)$ を

$$f(x) = \int_{|x|}^{1-|x-1|} (|t| - 1)dt$$

とするとき，以下の問いに答えよ．（配点 60 点）

問 1 $y = 1 - |x - 1|$ のグラフを描け．

問 2 $f(-2)$ および $f(2)$ の値をそれぞれ求めよ．

問 3 $f(x)$ の最大値を求めよ．

必須問題は，このページで終りである．

選択問題 (数学 I・数学 II・数学 A・数学 B)

I m を正の整数とする．2 つの整数 a, b について，a を m で割った余りと b を m で割った余りが等しいとき，a と b は m を法として合同であるといい $a \equiv b \pmod{m}$ と表す．p を素数，n を正の整数として，以下の問いに答えよ．（配点 60 点）

問 1　k は p より小さな正の整数とする．${}_p\mathrm{C}_k\, k!$ を p で割った余りを求めよ．また，${}_p\mathrm{C}_k$ を p で割った余りを求めよ．

問 2　$(n+1)^p \equiv n^p + 1 \pmod{p}$ であることを示せ．ここで，二項定理

$$(a+b)^k = \sum_{l=0}^{k} {}_k\mathrm{C}_l a^l b^{k-l}$$

を証明なしに用いてよい．ただし，a, b は実数である．

問 3　$n^p \equiv n \pmod{p}$ を数学的帰納法により証明せよ．

問 4　2020^{2017} を 2017 で割った余りを求めよ．ただし，2017 は素数である．

II $\theta = \dfrac{\pi}{5}$ とするとき，座標平面上の点 $P_n(x_n, y_n)$ $(n = 0, 1, 2, \cdots, 10)$ を次の式で与える．

$$\begin{cases} x_n = \left(1 + \dfrac{1}{5}(-1)^n\right)\cos n\theta \\ y_n = \left(1 + \dfrac{1}{5}(-1)^n\right)\sin n\theta \end{cases}$$

以下の問いに答えよ．（配点 60 点）

問 1　点 P_0, P_1,$\cdots$, P_{10} の順序で各点を線分で結んで描かれる図形の概形を，解答用紙に与えた座標平面上に描け．ただし，各点の座標は記入しなくてよい．また，座標平面上に点線で描かれた図形は，単位円に内接する正 10 角形であり，その頂点の 1 つの座標は $(1, 0)$ である．

問 2　$5\theta = \pi$ を用いて，$\sin 3\theta = \sin 2\theta$ が成り立つことを示せ．

問 3　問 2 で示した等式を用いて，$\cos\theta$ の値を求めよ．

問 4　線分 P_0P_1, 線分 P_1P_2, $\cdots$, 線分 P_9P_{10} の長さの総和を $4\sqrt{a + b\sqrt{c}}$ と表すとき，整数 a, b, c の値を求めよ．

数学 I・数学 II・数学 A・数学 B の問題は，
このページで終りである．

選択問題 (数学 III)

I 座標平面上で，$0 \leqq x \leqq \dfrac{\pi}{2}$ において定義された 2 つの曲線 $y = \cos x$, $y = \sin \dfrac{x}{2}$ と x 軸で囲まれた図形を D とする．以下の問いに答えよ．（配点 60 点）

問 1　図形 D を座標平面上に図示せよ．

問 2　図形 D の面積 S を求めよ．

問 3　図形 D を x 軸のまわりに 1 回転させてできる立体の体積 V を求めよ．

II 以下の問いに答えよ．（配点 60 点）

問 1　$x \geqq 1$ のとき，$\log x \leqq 2\sqrt{x}$ を示せ．

問 2　$\displaystyle\lim_{x \to \infty} \frac{\log x}{x} = 0$ を示せ．

問 3　$y = \dfrac{\log x}{x}$ のグラフを描け．

問 4　e^{π} と π^{e} はどちらが大きいか，理由と共に答えよ．

数学 III の問題は，このページで終りである．

平成29年度　入学者選抜学力試験（前期）

外国語（英語）

注 意 事 項

1. 試験開始の合図があるまで，この問題冊子と解答冊子を開かないでください．
2. 問題は1ページから11ページにあります．
3. 解答冊子の表紙の所定欄に氏名と受験番号をはっきりと記入してください．
4. 下書き用紙は，解答冊子の中に綴じてあります．
5. 辞書を使用することができます．
6. 試験中に問題冊子の印刷不明瞭，ページの落丁・乱丁および解答用紙の汚れ等に気づいた場合は，静かに手を挙げて監督員に知らせてください．
7. 試験終了後，問題冊子は持ち帰ってください．
8. 解答時間は90分です．
9. Part ごとに配点が記されています．

Part 1 Reading Comprehension （配点 80 点）

Read the following article and answer questions (1) – (10).

Bitcoins & Blockchains

Bitcoin is a form of digital money that was introduced in 2008 by an unknown programmer with the pseudonym Satoshi Nakamoto. A bitcoin is not a solid piece of metal, but is like a file which is saved on a computer or smartphone. You can buy bitcoins online with traditional money like yen and dollars. Before doing this, you need to download a personal bitcoin wallet which you save on your computer or smartphone. This wallet stores all the bitcoins you own.

Bitcoin is recognized as a valid currency (The Economist, 2015), so you can use bitcoins to buy products and services in some online stores and even a few traditional shops. Like national currencies such as the yen, Bitcoin has its own currency code, BTC, and it is exchangeable with other currencies. At the time of writing, the exchange rate is 61,573 yen for one bitcoin. At this rate, a bowl of ramen would cost about 0.01137 bitcoins.

One of the requirements for bitcoins to become widely used as a currency is that people need to trust that the Bitcoin system cannot be defrauded. This trust is created and maintained by 'blockchain' technology. The blockchain is a public database of all bitcoin transactions in the world. It is saved on many computers at the same time and is constantly updated as people buy and sell things with bitcoins. This technology prevents someone trying to spend the same bitcoin twice. In other words, the blockchain technology makes it possible to transfer bitcoins between computers, but prevents the copying of bitcoins from one computer to another. The blockchain is therefore a technical way of maintaining trust in Bitcoin between buyers and sellers. "Simply put, it is a machine for creating trust" (The Economist, 2015).

As a result of its ability to create trust between people who would normally have no reason to trust each other, blockchain technology is attracting more attention than the digital money it supports. The International Monetary Fund (IMF) has recognised that this 'distributed ledger technology' offers benefits that exceed the possible usefulness of Bitcoin (International Monetary Fund, 2016). Banks and governments are interested in the technology. Bank Santander believes the technology could save banks up to $20 billion a year by 2022 (Wild, Arnold & Stafford, 2015). The People's Bank of China has shown an interest in blockchain technology and the Philippines is trying to use blockchain technology to issue its own digital currency (Chen & Lee, 2016).

There are also possible uses of blockchain technology that do not involve money. For example, Greece and Honduras have shown an interest in blockchains as a way of maintaining a secure public record of land ownership (The Economist, 2015). Another use of this technology is to record information about important legal documents into a blockchain. Thirdly, it will help

people control their online identities by letting them decide who can access their personal information (Shin, 2016).

In conclusion, bitcoins may disappear because there are still not many shops that accept them as payment (Hill, 2013). However, because of its ability to create trust, blockchain technology is likely to play an important role in how transactions are performed and how records are kept.

Glossary

International Monetary Fund (IMF): 国際通貨基金

References

Chen, L. W., & Lee, J. (2016, January 21). China Mulls Answer to Bitcoin with Digital Currency Study. *Bloomberg*. Retrieved from http://www.bloomberg.com/news/articles/2016-01-21/chinese-central-bank-studies-prospect-of-own-digital-currency. [Accessed: July 4, 2016].

Hill, K. (2013, May 9). 21 Things I Learned about Bitcoin from Living on it for a Week. *Forbes*. Retrieved from http://www.forbes.com/sites/kashmirhill/2013/05/09/25-things-i-learned-about-bitcoin-from-living-on-it-for-a-week. [Accessed: July 4, 2016].

International Monetary Fund. (2016, January). Virtual Currencies and Beyond: Initial Considerations. *IMF*. Retrieved from https://www.imf.org/external/pubs/ft/sdn/2016/sdn1603.pdf. [Accessed: July 4, 2016].

Shin, L. (2016, May 26). How The Blockchain will Transform Everything from Banking to Government to our Identities. *Forbes*. Retrieved from http://www.forbes.com/sites/laurashin/2016/05/26/how-the-blockchain-will-transform-everything-from-banking-to-government-to-our-identities/. [Accessed: July 4, 2016].

The Economist. (2015, October 31). The Trust Machine. *The Economist*. Retrieved from http://www.economist.com/news/leaders/21677198-technology-behind-bitcoin-could-transform-how-economy-works-trust-machine. [Accessed: July 4, 2016].

Wild, J., Arnold, M., & Stafford, P. (2015, November 1). Technology: Banks Seek the Key to Blockchain. Retrieved from http://www.ft.com/cms/s/2/eb1f8256-7b4b-11e5-a1fe-567b37f80b64.html. [Accessed: July 4, 2016].

(1) According to the article, what is Bitcoin?

（ア）a technical way of maintaining trust
（イ）a computer program
（ウ）a metal coin
（エ）a type of money

(2) According to the article, where is Satoshi Nakamoto from?

（ア）Japan
（イ）Honduras
（ウ）The IMF
（エ）The article does not say.

(3) According to the article, where are bitcoins stored?

（ア）They are stored in a leather purse.
（イ）They are stored on a computer or smartphone.
（ウ）They are physically stored in a bank.
（エ）They are stored in a bank account.

(4) According to the article, which of the following statements about bitcoins is true?

（ア）They are made of metal.
（イ）They are accepted at many shops.
（ウ）They can be used to buy things.
（エ）They cannot be exchanged.

(5) Based on the information in the article, about how many bitcoins do you need to buy a 150-yen bottle of water?

（ア）9,235,950
（イ）0.00244
（ウ）410
（エ）150

(6) Based on the article, what is the future of bitcoins?

（ア）They might not survive.
（イ）They will play an important role in people's lives.
（ウ）They will replace national currencies by 2022.
（エ）All institutions will recognize their importance.

(7) Based on the article, which of the following statements about blockchain technology is true?

（ア）It has no future.
（イ）It prevents fraud.
（ウ）There is no interest in the technology.
（エ）It makes it possible for people to easily copy computer files.

(8) According to the article, why are Greece and Honduras interested in blockchain technology?

（ア）They are looking for a way of maintaining trust in their currency.
（イ）They need to reduce the costs of their financial transactions.
（ウ）They are interested in creating their own digital currencies.
（エ）They want to develop a trustworthy database of land ownership.

(9) In the article, what is the ‘distributed ledger technology’ mentioned by the IMF?

（ア）blockchain technology
（イ）digital currencies
（ウ）databases
（エ）bitcoin wallets

(10) According to the article, why will blockchain technology play an important role in the future?

（ア）It prevents people from controlling their online identities.
（イ）It will always be needed to buy and sell things.
（ウ）It is able to create trust between people.
（エ）It will allow people to freely access information about others.

（このページは白紙である）

Part 2　Reading Comprehension （配点 40 点）

次の文章を読んで後の問い(1)-(3)に答えよ．　*のついた語句は，注を参照すること．

著作権保護のため問題文は省略してあります

Akiyama, Sanae. wired.co.jp,「勤勉さとオープンマインドは，知性に勝る：研究結果」(wired news, 2015.01.27), http://wired.jp/2015/01/27/learning-and-individual-differences *(アクセス: 2016年6月10日)* より一部を抜粋. ただし，一カ所脱字を修正した.

(注)

*Learning and Individual Differences - 「学びと個人差」というテーマに関する論文を掲載する学術雑誌

*因子 - 研究で測定するテストなどに影響を与える要因

*サンプル数 - 研究におけるサンプルとは，調査対象となる集団全体から抽出したデータをさす. 標本ともいう.

*メタ分析: 過去に行われた複数の研究データをまとめ，統計的に分析・解析する方法
→本文にある「より多くのサンプル数としてメタ分析を行った」は，「より多くの研究データに対してメタ分析を行った」という意味

(1) According to the article on pages 7 and 8, which of the following is a correct description of the research conducted by Poropat?

（ア）The result showed that students' test scores were better when their teachers praised their effort than when teachers praised their smartness.
（イ）The research showed for the first time that personality characteristics are strongly connected to academic performance.
（ウ）The research aimed to find an algorithm that learners use to transform their learning to knowledge.
（エ）The result found why personality traits rated by students themselves reflect their study performance better than personality traits rated by other people.
（オ）none of the above

(2) In what order does the article describe the following information (A) to (E)? Choose the correct answer from (ア) to (オ).

(A) describing what Poropat did in the current study
(B) introducing Poropat and the key finding of his study
(C) describing what Poropat found in his current study and how it differed from previous studies
(D) describing what Poropat infers from the result of his current study
(E) introducing what previous research showed and what Poropat said about it

（ア） (E) → (A) → (C) → (D) → (B)
（イ） (D) → (B) → (E) → (C) → (A)
（ウ） (B) → (A) → (D) → (E) → (C)
（エ） (B) → (E) → (A) → (C) → (D)
（オ） (E) → (B) → (A) → (C) → (D)

(3) The following is a short summary of the article. From the list below the summary, choose the words that best fit into the blanks, and write their corresponding katakana characters (ア) to (サ) in the answer sheet.

Poropat examined the relationship between students' academic success and their personality traits. Among the five personality traits examined, (a)_____ and (b)_____ were found to contribute to academic performance. The importance of the former trait has been suggested by other studies in the past. According to Poropat, these two personality traits are (c)_____ than (d)_____ because they influence how much (e)_____ students can make and where they choose to use the effort.

（ア） cooperativeness
（イ） diligence
（ウ） effort
（エ） emotional stability
（オ） extraversion
（カ） intelligence
（キ）less important
（ク）more important
（ケ）mistakes
（コ）open-mindedness
（サ）personality

Part 3　Writing （配点 50 点）

Write one paragraph (about 100 words) in English explaining some of the disadvantages and advantages of traditional money (metal coins and paper notes).

Part 4　Writing　（配点 30 点）

Write one paragraph (about 60 words) in English explaining what motivates you to learn about new things.