

2022 IUT 3rd Admission Test(SBL)
Math Examination(TYPE A)

< Multiple choice Types > There is only one correct answer for each question. Mark your choice on the OMR answer sheet.

- The points for each question are listed next to the question number.
- You can use the right side of each page for your memo.

1. [4 points]

Compute $\sqrt{6 - \sqrt{35}} + \sqrt{6 + \sqrt{35}}$.

- ① $\sqrt{2}$ ② $\sqrt{6}$ ③ $\sqrt{10}$ ④ $\sqrt{14}$ ⑤ $\sqrt{18}$

2. [4 points]

Compute

$\log_2 \frac{2}{5} + \log_2 \frac{5}{16} + \log_2 5 \times \log_7 8 \times \log_5 49$.

- ① 1 ② 3 ③ 5 ④ 7 ⑤ 9

3. [4 points]

If a polynomial $P(x)$ is divided by $x - 2$, the remainder is 5. If $P(x)$ is divided by $x + 2$, the remainder is 0. If $P(x)$ is divided by $x^2 - 4$, the remainder is $ax + b$. Find $a^2 + b^2$.

- ① $\frac{105}{16}$ ② $\frac{125}{16}$ ③ $\frac{145}{16}$ ④ $\frac{165}{16}$ ⑤ $\frac{185}{16}$

4. [4 points]

When $x + x^{-1} = 4$ and $x > 1$, find $\frac{x^3 + x^{-3} - 4}{x^2 - x^{-2}}$.

- ① $\sqrt{2}$ ② $\sqrt{3}$ ③ $\sqrt{6}$ ④ $2\sqrt{2}$ ⑤ $2\sqrt{3}$

5. [4 points]

When $x^2 - x + 1 = 0$, find $10x^{30} + x^{24} - x^{23} + x^{17}$.

- ① 9 ② 10 ③ 11 ④ 12 ⑤ 13

6. [5 points]

When $60^x = 8$, $3^y = 4$, and $5^z = 2$, find

$\frac{3}{x} - \frac{2}{y} - \frac{1}{z}$.

- ① 0 ② 2 ③ 4 ④ 6 ⑤ 8

7. [5 points]

When $A = \begin{pmatrix} 1 & 3 \\ 0 & -1 \end{pmatrix}$, $B = \begin{pmatrix} -2 & 2 \\ 1 & 1 \end{pmatrix}$ and

$A^{-1}B - BA^{-1} = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$, find $a+b+c+d$.

- ① 11 ② 13 ③ 15 ④ 17 ⑤ 19

8. [5 points]

Find $\sum_{n=1}^{10} \frac{2}{n^2 + 4n + 3}$.

- ① $\frac{15}{52}$ ② $\frac{20}{52}$ ③ $\frac{25}{52}$ ④ $\frac{30}{52}$ ⑤ $\frac{35}{52}$

9. [5 points]

When α and β are the solutions of $x^2 - 17x + 4 = 0$ with $0 < \alpha < \beta$, find

$$\frac{1}{\sqrt{\alpha}} - \frac{1}{\sqrt{\beta}}.$$

- ① $\frac{\sqrt{11}}{2}$ ② $\frac{\sqrt{13}}{2}$ ③ $\frac{\sqrt{15}}{2}$
④ $\frac{\sqrt{17}}{2}$ ⑤ $\frac{\sqrt{19}}{2}$

10. [5 points]

Simplify $(\sqrt{2+\sqrt{2}} + i\sqrt{2-\sqrt{2}})^{20}$.

- ① -2^{20} ② 2^{20} ③ $-2^{20}i$ ④ $2^{20}i$ ⑤ $2^{20}\left(\frac{1+i}{\sqrt{2}}\right)$

11. [5 points]

Compute $\operatorname{tg}\left(\frac{\pi}{12}\right)$, where $\operatorname{tg} \theta = \frac{\sin \theta}{\cos \theta}$.

- ① $4 - \sqrt{3}$ ② $2 - \sqrt{3}$ ③ $\sqrt{3}$
④ $2 + \sqrt{3}$ ⑤ $4 + \sqrt{3}$

12. [5 points]

Find the sum of all solutions of

$$2^x - 1 = \frac{2^x - 22}{2^x - 10}.$$

- ① 1 ② 3 ③ 5 ④ 7 ⑤ 9

13. [5 points]

When $\sin \theta - \cos \theta = \frac{1}{\sqrt{2}}$, find

$$\frac{(\sin^2 \theta - \cos^2 \theta)^2}{\sin^3 \theta - \cos^3 \theta}.$$

- ① $\frac{\sqrt{2}}{5}$ ② $\frac{2\sqrt{2}}{5}$ ③ $\frac{3\sqrt{2}}{5}$
④ $\frac{4\sqrt{2}}{5}$ ⑤ $\sqrt{2}$

14. [5 points]

Find the sum of all solutions of

$$6 \sin^2 x - 3 = 3 \cos 2x \text{ for } 0 \leq x \leq 2\pi.$$

- ① π ② 2π ③ 3π ④ 4π ⑤ 5π

15. [5 points]

$$\text{Find } \lim_{x \rightarrow 0} \frac{x \cos 2x + 2 \sin 3x}{\sin 2x - 3x \cos x}.$$

- ① -1 ② -3 ③ -5 ④ -7 ⑤ -9

16. [6 points]

$$\text{When } f(x) = \frac{12}{\sqrt[3]{x+1}}, \text{ find } f'(8).$$

- ① $-\frac{1}{9}$ ② $-\frac{2}{9}$ ③ $-\frac{5}{9}$ ④ $-\frac{7}{9}$ ⑤ $-\frac{8}{9}$

17. [6 points]

Find the minimum value of

$$f(x) = x^4 - 2x^3 + 4x^2 - 12x + 11.$$

- ① $\frac{1}{16}$ ② $\frac{3}{16}$ ③ $\frac{5}{16}$ ④ $\frac{7}{16}$ ⑤ $\frac{9}{16}$

18. [6 points]

When $y = ax + b$ is the tangent line to

$$y = x^4 - x^3 - 2x^2 + 5x + 1 \text{ at } (1, 4), \text{ find } a + b.$$

- ① -4 ② -2 ③ 0 ④ 2 ⑤ 4

19. [6 points]

$$\text{Compute } \int_0^{\frac{\pi}{2}} \cos x (1 + \sin x)^4 dx.$$

- ① $\frac{31}{5}$ ② $\frac{33}{5}$ ③ $\frac{36}{5}$ ④ $\frac{37}{5}$ ⑤ $\frac{39}{5}$

20. [6 points]

Find the area of the region enclosed by two

$$\text{curves } y = x^3 + 2x^2 - x + 5 \text{ and}$$

$$y = x^3 + x^2 - 3x + 8.$$

- ① $\frac{32}{3}$ ② $\frac{34}{3}$ ③ $\frac{35}{3}$ ④ $\frac{37}{3}$ ⑤ $\frac{38}{3}$

2022 IUT 3rd SBL Answer Sheets

Type A

1	2	3	4	5	6	7	8	9	10
④	②	②	⑤	③	②	①	⑤	②	④
11	12	13	14	15	16	17	18	19	20
②	③	③	④	④	①	③	⑤	①	①

2022 IUT 3rd Admission Test(SOCIE)
Math Examination(TYPE A)

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1. [4 points]

Simplify $\sqrt[3]{\sqrt{8} \times \frac{\sqrt[4]{2}}{\sqrt[3]{4}}}$.

- ① $2^{\frac{13}{36}}$ ② $2^{\frac{17}{36}}$ ③ $2^{\frac{19}{36}}$
④ $2^{\frac{23}{36}}$ ⑤ $2^{\frac{25}{36}}$

2. [4 points]

Simplify $\left(\frac{\sqrt{3}+i}{1+i}\right)^{30}$.

- ① 2^{15} ② -2^{15} ③ $-2^{15}i$
④ $2^{15}\left(\frac{1+i}{\sqrt{2}}\right)$ ⑤ $2^{15}\left(\frac{1-i}{\sqrt{2}}\right)$

3. [4 points]

When $2^a = 3^b = 5^c > 1$, find $\frac{c}{a} + \frac{2c}{b}$.

- ① $\log_5 4$ ② $\log_5 6$ ③ $\log_5 9$
④ $\log_5 12$ ⑤ $\log_5 18$

4. [4 points]

Simplify $\operatorname{tg} \frac{3\pi}{10} \times \operatorname{tg} \frac{4\pi}{5}$, where $\operatorname{tg} \theta = \frac{\sin \theta}{\cos \theta}$.

- ① -1 ② $-\frac{\sqrt{3}}{3}$ ③ $\frac{\sqrt{3}}{3}$ ④ 1 ⑤ $\sqrt{3}$

5. [5 points]

When $A = \begin{pmatrix} 2 & -1 \\ 1 & 1 \end{pmatrix}$ and $A^2 + 3A^{-1} = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$, find $a+b+c+d$.

- ① 5 ② 6 ③ 7 ④ 8 ⑤ 9

6. [5 points]

Find the sum of all solutions of

$$2\sin^2 x + 3\cos x = 0, \quad 0 \leq x < 2\pi.$$

- ① π ② $\frac{4\pi}{3}$ ③ $\frac{5\pi}{3}$
④ 2π ⑤ $\frac{7\pi}{3}$

7. [5 points]

Compute $\lim_{n \rightarrow \infty} \frac{1}{n^5} \sum_{k=n+1}^{2n} k^4$

- ① $\frac{23}{5}$ ② 5 ③ $\frac{27}{5}$ ④ $\frac{29}{5}$ ⑤ $\frac{31}{5}$

8. [5 points]

When $\lim_{x \rightarrow 0} \frac{\sin(2x)}{e^x + a} = b$ for some constants a and b , find $a + b$.

- ① 1 ② 2 ③ 3 ④ 4 ⑤ 5

9. [5 points]

Find the maximum value of

$$f(x) = \frac{x}{x^2 + x + 1}.$$

- ① 1 ② $\frac{1}{2}$ ③ $\frac{1}{3}$ ④ $\frac{1}{4}$ ⑤ $\frac{1}{5}$

10. [5 points]

When $f(x) = 2^{\sin x}$, find $f'(\pi)$.

- ① $-e \ln 2$ ② $-\ln 2$ ③ 0 ④ $\ln 2$ ⑤ $e \ln 2$

11. [6 points]

When the equation $e^x = kx$ has only one solution, find the positive constant k .

- ① e^{-2} ② e^{-1} ③ 1 ④ e ⑤ e^2

12. [6 points]

Compute $\int_0^\pi \sin^2 x \cos^2 x \, dx$.

- ① $\frac{\pi}{2}$ ② $\frac{\pi}{4}$ ③ $\frac{\pi}{8}$
④ $\frac{\pi}{16}$ ⑤ $\frac{\pi}{32}$

13. [6 points]

Find the area of the region enclosed by two curves $y = x^3 + 2x^2 + x - 5$ and $y = x^3 + x^2 - 3$.

- ① $\frac{1}{2}$ ② $\frac{3}{2}$ ③ $\frac{5}{2}$ ④ $\frac{7}{2}$ ⑤ $\frac{9}{2}$

14. [6 points]

Let A be the region enclosed by $y = x^2 + 1$ and $y = x + 3$. Find the volume of the solid obtained by rotating the region A about the x -axis.

- ① $\frac{111\pi}{5}$ ② $\frac{113\pi}{5}$ ③ 23π
④ $\frac{117\pi}{5}$ ⑤ $\frac{119\pi}{5}$

2022 IUT 3rd SOCIE Answer Sheets

Type A

1	2	3	4	5	6	7
①	③	⑤	①	②	④	⑤
8	9	10	11	12	13	14
①	③	②	④	③	⑤	④

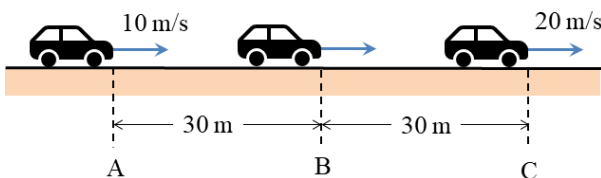
2022 IUT Admission Test(SOCIE)
Physics Examination(A TYPE)

<Multiple choice Types> There is only one correct answer per each question. Mark your answer choice on the OMR answer sheet.

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- No penalty point is applied to an incorrect answer.

1. [6 points]

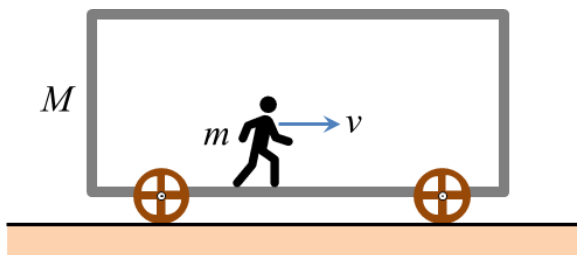
The speed of a car moving in a straight line with constant acceleration is changed from 10 m/s at point A to 20 m/s at point C as shown in the figure. What is the speed of the car at point B?



- ① $5\sqrt{5}$ m/s ② $10\sqrt{2}$ m/s ③ $5\sqrt{10}$ m/s
- ④ 15 m/s ⑤ 16 m/s

2. [5 points]

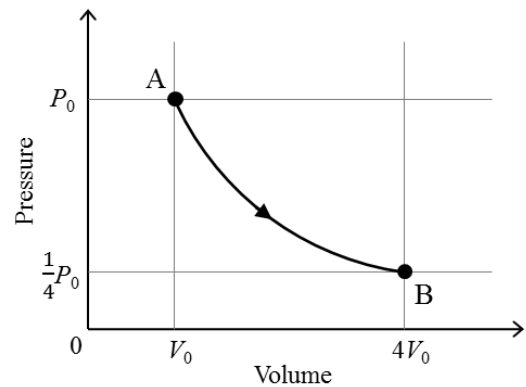
As shown in the figure below, a person of mass $m = 60$ kg is initially at rest in a stationary train of mass $M = 1000$ kg. If this person suddenly moves to the front of the train at speed $v = 5$ m/s, what will be the speed of the train? (Here, the speed v of the person is the speed measured by a stationary observer outside the train and it is assumed that there is no friction in the train wheels.)



- ① 0.2 m/s ② 0.3 m/s ③ 0.4 m/s
- ④ 0.5 m/s ⑤ 0.6 m/s

3. [4 points]

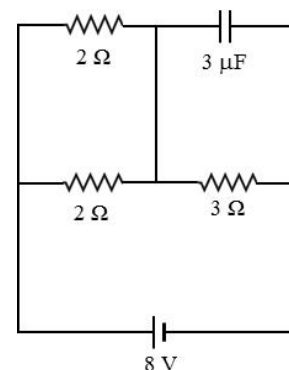
As shown in the graph below, the state of a certain amount of ideal gas changes from state A to state B. If the temperature of the gas in state A is 320 K, what is the temperature of the gas in state B?



- ① 40 K ② 80 K ③ 160 K
- ④ 320 K ⑤ 640 K

4. [6 points]

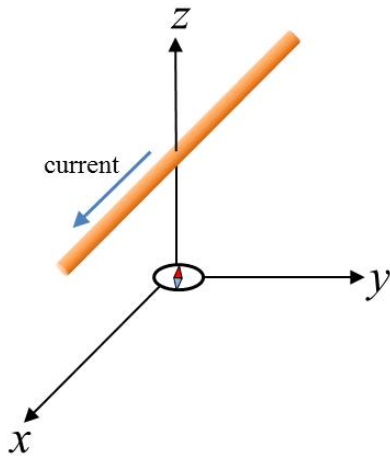
In the circuit where the resistors and a capacitor are connected as shown in the figure, what is the amount of charge charged in the capacitor of $3 \mu\text{F}$?



- ① $2 \mu\text{C}$ ② $3 \mu\text{C}$ ③ $6 \mu\text{C}$
- ④ $9 \mu\text{C}$ ⑤ $18 \mu\text{C}$

5. [4 points]

As shown in the figure, there is a long conducting rod placed parallel to the x -axis direction above the xy plane, and current flows in the $+x$ -axis direction in the rod. When a compass is placed at the origin, in which direction does the N pole of the compass point?



- ① $+x$ ② $-x$ ③ $+y$ ④ $-y$ ⑤ $+z$

6. [5 points]

If a concave lens with a focal length of 10 cm produces an image of which the size is $\frac{1}{3}$ of that of the object, what is the distance from the lens to the object?

- ① 20 cm ② 25 cm ③ 30 cm
④ 40 cm ⑤ 60 cm

Physics Examination(A TYPE) Answers

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Answers:

1. ③
2. ②
3. ④
4. ⑤
5. ③
6. ①