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.

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1. [4 points]

Compute $\sqrt{8+2\sqrt{15}} - \sqrt{8-2\sqrt{15}}$.

① $\sqrt{3}$ 　　② $2\sqrt{3}$ 　　③ $3\sqrt{3}$

④ $4\sqrt{3}$ 　　⑤ $5\sqrt{3}$

2. [4 points]

When $\sqrt{a} - \dfrac{1}{\sqrt{a}} = 2$, find $a^2 + \dfrac{1}{a^2}$.

① 30 　　② 32 　　③ 34

④ 36 　　⑤ 38

3. [4 points]

For $A = \begin{pmatrix} 1 & 2 \\ 2 & 3 \end{pmatrix}$ and $B = \begin{pmatrix} -2 & 3 \\ 5 & 1 \end{pmatrix}$, let

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

① 11 　　② 13 　　③ 15

④ 17 　　⑤ 19

4. [4 points]

When α, β, γ are the solutions of

$3x^3 + 2x^2 - 4x + 1 = 0$, find $\dfrac{1}{\alpha} + \dfrac{1}{\beta} + \dfrac{1}{\gamma}$.

① -4 　　② -2 　　③ 0

④ 2 　　⑤ 4

5. [4 points]

Compute $\sin\dfrac{11\pi}{12}$.

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

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

6. [5 points]

When $2^x = \sqrt{3}$, $9^y = 5$ and $25^z = 8$, find xyz .

① $\dfrac{1}{8}$ 　　② $\dfrac{3}{8}$ 　　③ $\dfrac{5}{8}$

④ $\dfrac{7}{8}$ 　　⑤ $\dfrac{9}{8}$

7. [5 points]
   Find the sum of all solutions of
   $\cos 2x - 4\cos x - 2\sin^2 x = 0$ for $0 < x < 2\pi$.

   ① $\dfrac{\pi}{2}$　　　② π　　　③ $\dfrac{5\pi}{4}$

   ④ $\dfrac{3\pi}{2}$　　　⑤ 2π

8. [5 points]
   When $\omega = \dfrac{-1+\sqrt{3}\,i}{2}$, find $\displaystyle\sum_{k=1}^{100} \omega^k$.

   ① 0　　　　② 1　　　　③ i

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

9. [5 points]
   When $tg\,\theta = 2$ for $0 < \theta < \dfrac{\pi}{2}$, find

   $\sin 2\theta + \cos 2\theta$, where $tg\,\theta = \dfrac{\sin\theta}{\cos\theta}$.

   ① 0　　　　② $\dfrac{1}{5}$　　　　③ $\dfrac{3}{5}$

   ④ 1　　　　⑤ $\dfrac{7}{5}$

10. [5 points]
    Find the sum of all integer solutions of
    $x^2 - 2x + 8 < 7x - 4$.

    ① 15　　　② 18　　　③ 21
    ④ 24　　　⑤ 27

11. [5 points]
    Find the minimum value of the function
    $f(x) = |x + 3| + |2x - 1|$.

    ① $\dfrac{1}{2}$　　　② $\dfrac{3}{2}$　　　③ $\dfrac{5}{2}$

    ④ $\dfrac{7}{2}$　　　⑤ $\dfrac{9}{2}$

12. [5 points]
    Find $\displaystyle\lim_{x\to\infty} x\left(\sqrt{x^2+2} - \sqrt{x^2-2}\right)$.

    ① 1　　　　② 2　　　　③ 4

    ④ $\dfrac{1}{2}$　　　⑤ $\dfrac{1}{4}$

13. [5 points]
    Find the sum of all solutions of
    $3^{2x} - 3^{x+1} + 3^{-x+4} = 27$.

    ① $\dfrac{1}{2}$　　　② $\dfrac{3}{2}$　　　③ $\dfrac{5}{2}$

    ④ $\dfrac{7}{2}$　　　⑤ $\dfrac{9}{2}$

14. [5 points]
    Find the sum of all solutions of

    $\sin x - \cos x = \dfrac{\sqrt{6}}{2}$ for $0 < x < 2\pi$.

    ① π　　　② $\dfrac{5\pi}{4}$　　　③ $\dfrac{3\pi}{2}$

    ④ $\dfrac{7\pi}{4}$　　　⑤ 2π

15. [5 points]

Let M and m be the maximum and minimum values of $f(x) = \dfrac{1}{3}x^3 + \dfrac{1}{2}x^2 - 2x + 2$ ($0 \le x \le 2$). Find $M + m$.

① $\dfrac{1}{2}$ ② $\dfrac{3}{2}$ ③ $\dfrac{5}{2}$

④ $\dfrac{7}{2}$ ⑤ $\dfrac{9}{2}$

16. [6 points]

Find $\displaystyle\lim_{x\to 0}\dfrac{\sin^3 2x}{x^2\, tg\, x}$, where $tg\, x = \dfrac{\sin x}{\cos x}$.

① 2 ② 4 ③ 8

④ 12 ⑤ 16

17. [6 points]

When $f(x) = \dfrac{\sqrt[4]{7x+2}}{\sqrt{x+2}}$, find $f'(2)$.

① $-\dfrac{1}{64}$ ② $-\dfrac{1}{56}$ ③ $-\dfrac{1}{48}$

④ $-\dfrac{1}{40}$ ⑤ $-\dfrac{1}{32}$

18. [6 points]

Let $y = ax + b$ be the tangent line to $y = \dfrac{3x^2+2}{2x-1}$ at $x = 1$. Find $a^2 + b^2$.

① 85 ② 88 ③ 91

④ 94 ⑤ 97

19. [6 points]

Find $\displaystyle\int_0^2 9x^2\sqrt{2x^3+1}\ dx$.

① $17\sqrt{17}-1$ ② $17\sqrt{17}-3$ ③ $17\sqrt{17}-5$

④ $17\sqrt{17}-7$ ⑤ $17\sqrt{17}-9$

20. [6 points]

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

① $\dfrac{23}{3}$ ② $\dfrac{26}{3}$ ③ $\dfrac{29}{3}$

④ $\dfrac{32}{3}$ ⑤ $\dfrac{35}{3}$

2022 IUT 2nd Admission Test(SBL Pre-University) Answer Sheet

Type A

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

Math Examination (A TYPE)

<Multiple choice Types> There is only one correct answer per each question. Mark your answer choice on the OMR answer sheet.
○ For each correct answer, you will get the points indicated next to each question number.
○ No penalty point is applied to an incorrect answer.

1. [8 points]
Simplify $\left(\dfrac{1-i}{1+i}\right)^{30}$.

① -1　　② $-i$　　③ $1+i$
④ 1　　⑤ i

2. [8 points]
When α, β, γ are solutions of
$x^3 - 4x^2 - x + 3 = 0$, find $\dfrac{\alpha}{\beta\gamma} + \dfrac{\beta}{\alpha\gamma} + \dfrac{\gamma}{\alpha\beta}$.

① -2　② -4　③ -6　④ -8　⑤ -10

3. [8 points]
Simplify $(\log_4 9 + \log_8 3) \times \log_9 16$.

① $\dfrac{2}{3}$　② $\dfrac{4}{3}$　③ 2　④ $\dfrac{8}{3}$　⑤ $\dfrac{10}{3}$

4. [10 points]
Find the sum of all integer solutions of
$$\frac{(x^2-9)(x-5)(x-7)}{x^2-1} < 0.$$

① 0　　② 2　　③ 4　　④ 6　　⑤ 8

5. [10 points]
When $\sin A = \dfrac{\sqrt{5}}{5}$ and $\sin B = \dfrac{\sqrt{10}}{10}$ for $0 < A < \pi/2$, $0 < B < \pi/2$, find $A+B$.

① $\dfrac{\pi}{2}$　② $\dfrac{\pi}{3}$　③ $\dfrac{\pi}{4}$　④ $\dfrac{\pi}{5}$　⑤ $\dfrac{\pi}{6}$

6. [10 points]
Evaluate $\displaystyle\int_0^1 \frac{x}{\sqrt{x+1}}dx$.

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

7. [10 points]
When $\displaystyle\lim_{x\to 1}\frac{x^{10}+ax+b}{x^2-1}=2$
for real numbers a, b, find $a-b$.

① -3　　② -5　　③ -7
④ -9　　⑤ -11

8. [12 points]

When a continuous function $f(x)$ satisfies

$$\int_0^x (x-t)f(t)dt = e^{2x} + ax + b$$

for real numbers a, b, find $f(0)+a+b$.

① 0   ② 1   ③ 2   ④ 3   ⑤ 4

9. [12 points]

When a tangent line to the graph of
$y = xe^x$ passes through $(-4, 0)$ and $(0, k)$,
find k.

① $-e^{-1}$ ② $-2e^{-1}$ ③ $-2e^{-2}$

④ $-4e^{-2}$ ⑤ $-8e^{-2}$

10. [12 points]

Find the volume of the solid obtained by revolving the region bounded by the curves $y = x^2$, $y = \sqrt{x}$ about x-axis.

① $\dfrac{\pi}{10}$ ② $\dfrac{3\pi}{10}$ ③ $\dfrac{\pi}{2}$

④ $\dfrac{7\pi}{10}$ ⑤ $\dfrac{9\pi}{10}$

Answers (SOCIE, Pre-University)

Type A

1	2	3	4	5	6	7	8	9	10
①	③	④	④	③	⑤	⑤	②	④	②

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.
○ For each correct answer, you will get the points indicated next to each question number.
○ No penalty point is applied to an incorrect answer.

1. [10 point]
Two trains initially at rest leave the station at the same time. Train A is running in straight line with an acceleration of $a_A = 2 \text{ m/s}^2$ and train B in the opposite direction to A with an acceleration of $a_B = 1 \text{ m/s}^2$. What is the relative speed of train B with respect to train A, 10 seconds after departure?

① 10 m/s   ② 20 m/s   ③ 30 m/s
④ 40 m/s   ⑤ 50 m/s

2. [12 point]
As shown in the figure below, a spring with a spring constant $k = 40 \text{ N/m}$ fixed to the wall is compressed by 0.1 m by object A with a mass $m = 0.1 \text{ kg}$ on a horizontal frictionless plane. When the spring is released, object A is pushed out and collides with stationary object B with the same mass m, and then goes up the slope together as one body. What is the maximum height to which objects A and B can rise? (Assume that the magnitude of gravitational acceleration is 10 m/s²)
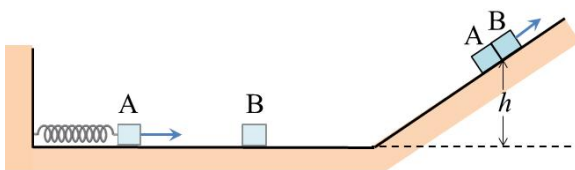
① 1 cm   ② 2 cm   ③ 2.5 cm
④ 4 cm   ⑤ 5 cm

3. [8 point]
When a certain amount of the ideal gas was slowly heated, the pressure and volume changed as shown in the graph below. If the temperature of the gas in state A is 100 K, what is the temperature of the gas in state B?
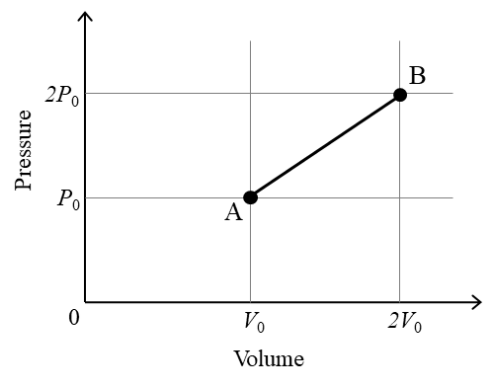

① 200 K   ② 300 K   ③ 400 K
④ 600 K   ⑤ 800 K

4. [8 points]
What is the final velocity of a charged particle of mass m and charge q initially at rest when it is accelerated by a potential difference of V?

① $\sqrt{\dfrac{2qV}{m}}$ ② $\sqrt{\dfrac{qV}{2m}}$ ③ $\sqrt{2mqV}$

④ $\sqrt{\dfrac{mV}{2q}}$ ⑤ $\sqrt{\dfrac{2mV}{q}}$

5. [12 points]

As shown in the figure, capacitors of $1\,\mu\mathrm{F}$, $2\,\mu\mathrm{F}$, and $3\,\mu\mathrm{F}$ are connected to a power source with a voltage of $6\,\mathrm{V}$. How much electric energy is stored in the capacitor of $3\,\mu\mathrm{F}$?
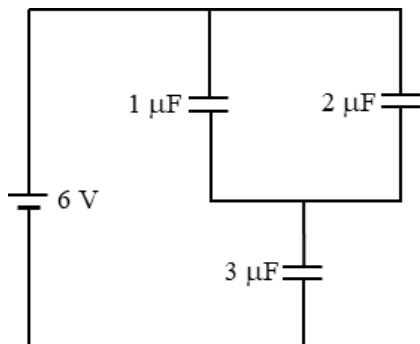
① $12.0\,\mu\mathrm{J}$　② $12.5\,\mu\mathrm{J}$　③ $13.0\,\mu\mathrm{J}$
④ $13.5\,\mu\mathrm{J}$　⑤ $14.0\,\mu\mathrm{J}$

6. [12 point]

Following figure shows a rod of length L that is forced to move at a constant speed v along horizontal rails. The rod and rails form a conducting loop. Assume that the rod has resistance R; the rest of the loop has no resistance. Between the rails, there is a uniform magnetic field of magnitude B. What is the magnitude of force required to pull the rod at a constant speed v?
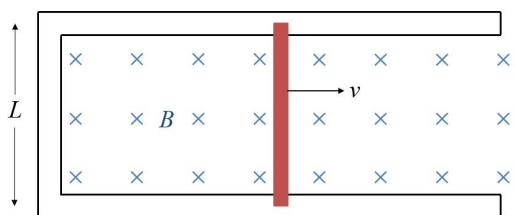
① $\dfrac{B^2 Lv}{R}$　　② $\dfrac{B^2 L^2 v}{R}$　　③ $\dfrac{BLv^2}{R}$

④ $\dfrac{BL^2 v^2}{R}$　　⑤ $\dfrac{BLv^2}{R^2}$

7. [10 points]

The wave function of a transverse wave traveling along a string is as follows.
$y(x,t) = (0.5\,\mathrm{m})\sin[(6.0\,\mathrm{rad/m})\,x - (3.0\,\mathrm{rad/s})\,t]$
What is the speed of this wave?

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

8. [10 point]

A person is standing on a straight line perpendicular to the flat mirror. What is the speed of the person's image when the person and the mirror are approaching each other with speed of v and u, respectively?
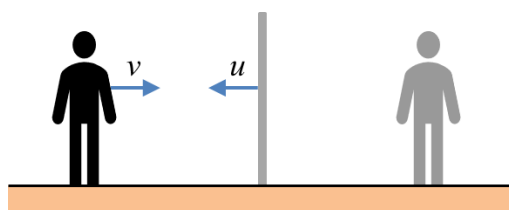
① $v + 2u$　　② $v + u$　　③ $2v + u$
④ $2v + 2u$　　⑤ $2v - u$

9. [8 points]

What is the momentum of a photon of frequency f? (Here, Planck constant is h, and the speed of light in vacuum is c)

① hf　② fc　③ hfc　④ $\dfrac{fc}{h}$　⑤ $\dfrac{hf}{c}$

10. [10 points]

As shown in the figure, the magnetic field B is in the y-axis direction and the electric field E is in the $-z$-axis direction. An electron with an electric charge e is moving in a straight line along the x-axis. What is the speed of this electron?
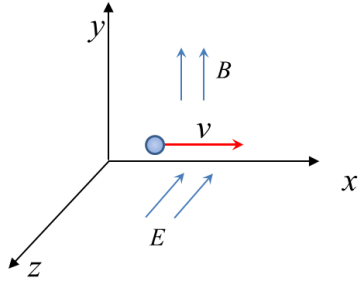
① $\dfrac{eB}{E}$ ② $\dfrac{E}{B}$ ③ EB

④ $\dfrac{B}{E}$ ⑤ $\dfrac{eE}{B}$

Physics Examination(A TYPE)

Answers

1. ③
2. ⑤
3. ③
4. ①
5. ④
6. ②
7. ⑤
8. ①
9. ⑤
10. ②