2025 IUT Admission Test(SBL, Contract)

Math Examination(TYPE A)

< Multiple choice Types > <u>There is only one correct answer for each question.</u> 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. [3 points]

Compute $\sqrt{6+2\sqrt{5}}-\sqrt{6-2\sqrt{5}}$.

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

2. [3 points]

Simplify $\dfrac{\sqrt[3]{6}\times\sqrt[3]{9}}{\sqrt[9]{8}}$.

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

3. [3 points]

Find a positive real number a satisfying

$a^2-\dfrac{1}{a^2}=4$.

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

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

4. [3 points]

When α and β are the solutions of $x^2+2x+3=0$, find $\alpha^4\beta+\alpha\beta^4$.

① 24 ② 27 ③ 30 ④ 33 ⑤ 36

5. [3 points]

When $x=\sqrt{\sqrt{2}+\sqrt{3}}$ is a solution of $x^8+ax^4+1=0$, find a.

① -2 ② -4 ③ -6 ④ -8 ⑤ -10

6. [3 points]

When (x_1, y_1) and (x_2, y_2) are solutions of

$$\begin{cases} x+y^2=4 \\ 2x+3y=3 \end{cases},$$

find $x_1+x_2+y_1+y_2$.

① $\frac{8}{3}$ ② $\frac{9}{4}$ ③ 2 ④ $\frac{11}{6}$ ⑤ $\frac{12}{7}$

7. [3 points]

Find $\displaystyle\sum_{n=1}^{10}\frac{1}{n(n+1)}$.

① $\frac{9}{10}$ ② $\frac{10}{11}$ ③ $\frac{11}{12}$ ④ $\frac{12}{13}$ ⑤ $\frac{13}{14}$

8. [3 points]

When α, β are two solutions of $x+\dfrac{1}{x^2}=2$ with $\alpha\neq 1\neq\beta$ and $\alpha>0$, find $\alpha-\beta$.

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

9. [3 points]

Find $\log_2(7+\sqrt{17})+\log_2(7-\sqrt{17})$.

① 3 ② 5 ③ 7 ④ 9 ⑤ 11

10. [3 points]

When $20^x=8$ and $2^y=5$, find $\dfrac{1}{x}-\dfrac{y}{3}$.

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

11. [3 points]
Find the sum of all solutions of $2 \cdot 3^x + 6 \cdot 3^{-x} = 7$.

① 0 ② 1 ③ $\frac{1}{2}$ ④ $\frac{1}{3}$ ⑤ $\frac{1}{6}$

12. [3 points]
When $a > 1$, $b > 1$ and $\log_{\sqrt{2}} a = \log_4 (ab)$, find $\log_a b$.

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

13. [3 points]
When g is the inverse function of $f(x) = \log_3(x-1)+2$, find $g(4)$.

① 10 ② 12 ③ 14 ④ 16 ⑤ 18

14. [3 points]
When $\frac{\sqrt{2}+\sqrt{3}\,i}{1-\sqrt{3}\,i} = a+bi$ for real numbers a and b, find a^2+b^2.

① $\frac{3}{2}$ ② $\frac{4}{3}$ ③ $\frac{5}{4}$ ④ $\frac{6}{5}$ ⑤ $\frac{7}{6}$

15. [3 points]
When $a = 2+\sqrt{3}\,i$ and $b = -2+\sqrt{3}\,i$, find $a^3 - b^3$.

① -20 ② -22 ③ -24 ④ -26 ⑤ -28

16. [3 points]
When $tg\,\alpha = \frac{1}{2}$ $(0 \le \alpha < \frac{\pi}{2})$, find $\sin^2 \frac{\alpha}{2}$, where $tg\,\theta = \frac{\sin\theta}{\cos\theta}$.

① $\frac{1}{10}$ ② $\frac{3+2\sqrt{5}}{10}$ ③ $\frac{3-2\sqrt{5}}{10}$ ④ $\frac{5+2\sqrt{5}}{10}$ ⑤ $\frac{5-2\sqrt{5}}{10}$

17. [3 points]
When $3\cos\left(\theta+\frac{\pi}{2}\right) = \cos\theta$ for $\frac{\pi}{2} \le \theta \le \pi$, find $\sin\theta$.

① $\frac{\sqrt{2}}{10}$ ② $\frac{1}{5}$ ③ $\frac{\sqrt{6}}{10}$ ④ $\frac{\sqrt{2}}{5}$ ⑤ $\frac{\sqrt{10}}{10}$

18. [3 points]
When $A = \begin{pmatrix} 1 & 3 \\ 2 & 4 \end{pmatrix}$, $B = \begin{pmatrix} -1 & 2 \\ 1 & -2 \end{pmatrix}$, and $A^{-1}B = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$, find $a+b+c+d$.

① 0 ② -1 ③ -2 ④ -3 ⑤ -4

19. [3 points]
When $A = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$, $B = \begin{pmatrix} 1 & -1 \\ -5 & -7 \end{pmatrix}$ and $A(A^{-1}+2B^{-1})B = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$, find $a+b+c+d$.

① 8 ② 9 ③ 10 ④ 11 ⑤ 12

20. [3 points]
Find $\lim_{x\to\infty}\left(\sqrt{x^2+2} - \sqrt{x^2+3x+1}\right)$.

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

21. [4 points]
Find the maximum value of
$f(x) = \sin^2\left(x+\frac{\pi}{8}\right) + \sin\left(x-\frac{3\pi}{8}\right)+1$.

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

22. [4 points]
Find $\lim_{x\to 0}\frac{3x\sin x}{1-\cos 2x}$.

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

23. [4 points]
When $y=ax+b$ is the tangent line to $y = \sqrt{x^3+1}$ at $x=2$, find $a+b$.

① 1 ② 3 ③ 5 ④ 7 ⑤ 9

24. [4 points]
When M and m are the maximum and minimum values of $f(x) = 2x^3-9x^2+16$, $(0 \le x \le 4)$, find $M+m$.

① 1 ② 3 ③ 5 ④ 7 ⑤ 9

25. [4 points]
When $f(x) = \frac{\sqrt{2x+2}}{x^2-x+3}$, find $f'(1)$.

① $-\frac{1}{10}$ ② $-\frac{1}{12}$ ③ $-\frac{1}{14}$
④ $-\frac{1}{16}$ ⑤ $-\frac{1}{18}$

26. [4 points]
Compute $\int_0^1 (2x^2+1)^2\,dx$.

① $\frac{41}{15}$ ② $\frac{43}{15}$ ③ 3 ④ $\frac{47}{15}$ ⑤ $\frac{49}{15}$

27. [4 points]
Compute $\int_0^1 (2x^2-x+2)^3(8x-2)dx$.

① $\frac{61}{2}$ ② $\frac{63}{2}$ ③ $\frac{65}{2}$ ④ $\frac{67}{2}$ ⑤ $\frac{69}{2}$

28. [4 points]
Find $\lim_{n\to\infty}\sum_{k=1}^{n}\frac{\sqrt{3k^4+(nk)^2}}{n^3}$.

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

29. [4 points]
When $\int_0^x tf(t)\,dt = 2x^4-3x^3+ax^2$ and $f(0)=2$ for a differentiable function $f(x)$, find a .
① 1 ② 3 ③ 5 ④ 7 ⑤ 9

30. [4 points]
Find the area of the region enclosed by $y = x^3-3x^2-5x+1$ and $y = x^3-4x^2-x-2$.

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

2025 IUT 2nd Admission Test(SBL Non-scholarship)

Math Examination(TYPE B)

< **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. [3 points]

When $x = \sqrt{\sqrt{2}+\sqrt{3}}$ is a solution of $x^8 + ax^4 + 1 = 0$, find a.

① -2 ② -4 ③ -6 ④ -8 ⑤ -10

2. [3 points]

Compute $\sqrt{6+2\sqrt{5}} - \sqrt{6-2\sqrt{5}}$.

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

3. [3 points]

Simplify $\dfrac{\sqrt[3]{6}\times\sqrt[3]{9}}{\sqrt[9]{8}}$.

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

4. [3 points]

Find a positive real number a satisfying

$a^2 - \frac{1}{a^2} = 4$.

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

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

5. [3 points]

When α and β are the solutions of $x^2+2x+3=0$, find $\alpha^4\beta+\alpha\beta^4$.

① 24 ② 27 ③ 30 ④ 33 ⑤ 36

6. [3 points]

When $20^x = 8$ and $2^y = 5$, find $\frac{1}{x} - \frac{y}{3}$.

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

7. [3 points]

When (x_1, y_1) and (x_2, y_2) are solutions of

$$\begin{cases} x + y^2 = 4 \\ 2x + 3y = 3 \end{cases},$$

find $x_1 + x_2 + y_1 + y_2$.

① $\frac{8}{3}$ ② $\frac{9}{4}$ ③ 2 ④ $\frac{11}{6}$ ⑤ $\frac{12}{7}$

8. [3 points]

Find $\sum_{n=1}^{10} \frac{1}{n(n+1)}$.

① $\frac{9}{10}$ ② $\frac{10}{11}$ ③ $\frac{11}{12}$ ④ $\frac{12}{13}$ ⑤ $\frac{13}{14}$

9. [3 points]

When α, β are two solutions of $x + \frac{1}{x^2} = 2$ with $\alpha \neq 1 \neq \beta$ and $\alpha > 0$, find $\alpha - \beta$.

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

10. [3 points]

Find $\log_2(7+\sqrt{17}) + \log_2(7-\sqrt{17})$.

① 3 ② 5 ③ 7 ④ 9 ⑤ 11

11. [3 points]
When $a=2+\sqrt{3}\,i$ and $b=-2+\sqrt{3}\,i$, find a^3-b^3.

① -20 ② -22 ③ -24 ④ -26 ⑤ -28

12. [3 points]
Find the sum of all solutions of $2\cdot 3^x+6\cdot 3^{-x}=7$.

① 0 ② 1 ③ $\frac{1}{2}$ ④ $\frac{1}{3}$ ⑤ $\frac{1}{6}$

13. [3 points]
When $a>1$, $b>1$ and $\log_{\sqrt{2}}a=\log_4(ab)$, find $\log_a b$.

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

14. [3 points]
When g is the inverse function of $f(x)=\log_3(x-1)+2$, find $g(4)$.

① 10 ② 12 ③ 14 ④ 16 ⑤ 18

15. [3 points]
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① $\frac{3}{2}$ ② $\frac{4}{3}$ ③ $\frac{5}{4}$ ④ $\frac{6}{5}$ ⑤ $\frac{7}{6}$

16. [3 points]
Find $\lim_{x\to\infty}\left(\sqrt{x^2+2}-\sqrt{x^2+3x+1}\right)$.

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

17. [3 points]
When $tg\,\alpha=\frac{1}{2}$ $(0\le\alpha<\frac{\pi}{2})$, find $\sin^2\frac{\alpha}{2}$, where $tg\,\theta=\frac{\sin\theta}{\cos\theta}$.

① $\frac{1}{10}$ ② $\frac{3+2\sqrt{5}}{10}$ ③ $\frac{3-2\sqrt{5}}{10}$
④ $\frac{5+2\sqrt{5}}{10}$ ⑤ $\frac{5-2\sqrt{5}}{10}$

18. [3 points]
When $3\cos\left(\theta+\frac{\pi}{2}\right)=\cos\theta$ for $\frac{\pi}{2}\le\theta\le\pi$, find $\sin\theta$.

① $\frac{\sqrt{2}}{10}$ ② $\frac{1}{5}$ ③ $\frac{\sqrt{6}}{10}$ ④ $\frac{\sqrt{2}}{5}$ ⑤ $\frac{\sqrt{10}}{10}$

19. [3 points]
When $A=\begin{pmatrix}1&3\\2&4\end{pmatrix}$, $B=\begin{pmatrix}-1&2\\1&-2\end{pmatrix}$, and $A^{-1}B=\begin{pmatrix}a&b\\c&d\end{pmatrix}$, find $a+b+c+d$.

① 0 ② -1 ③ -2 ④ -3 ⑤ -4

20. [3 points]
When $A=\begin{pmatrix}1&2\\3&4\end{pmatrix}$, $B=\begin{pmatrix}1&-1\\-5&-7\end{pmatrix}$ and $A(A^{-1}+2B^{-1})B=\begin{pmatrix}a&b\\c&d\end{pmatrix}$, find $a+b+c+d$.

① 8 ② 9 ③ 10 ④ 11 ⑤ 12

21. [4 points]
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① $-\frac{1}{10}$ ② $-\frac{1}{12}$ ③ $-\frac{1}{14}$
④ $-\frac{1}{16}$ ⑤ $-\frac{1}{18}$

22. [4 points]
Find the maximum value of
$f(x) = \sin^2\left(x+\frac{\pi}{8}\right) + \sin\left(x-\frac{3\pi}{8}\right) + 1$.

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

23. [4 points]
Find $\lim_{x\to 0}\frac{3x\sin x}{1-\cos 2x}$.

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

24. [4 points]
When $y = ax+b$ is the tangent line to $y = \sqrt{x^3+1}$ at $x=2$, find $a+b$.

① 1 ② 3 ③ 5 ④ 7 ⑤ 9

25. [4 points]
When M and m are the maximum and minimum values of $f(x) = 2x^3-9x^2+16$, ($0 \le x \le 4$), find $M+m$.

① 1 ② 3 ③ 5 ④ 7 ⑤ 9

26. [4 points]
Find the area of the region enclosed by $y = x^3-3x^2-5x+1$ and $y = x^3-4x^2-x-2$.

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

27. [4 points]
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① $\frac{41}{15}$ ② $\frac{43}{15}$ ③ 3 ④ $\frac{47}{15}$ ⑤ $\frac{49}{15}$

28. [4 points]
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① $\frac{61}{2}$ ② $\frac{63}{2}$ ③ $\frac{65}{2}$ ④ $\frac{67}{2}$ ⑤ $\frac{69}{2}$

29. [4 points]
Find $\lim_{n\to\infty}\sum_{k=1}^{n}\frac{\sqrt{3k^4+(nk)^2}}{n^3}$.

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

30. [4 points]
When $\int_0^x tf(t)\,dt = 2x^4-3x^3+ax^2$ and $f(0)=2$ for a differentiable function $f(x)$, find a .
① 1 ② 3 ③ 5 ④ 7 ⑤ 9

2025 IUT 2nd Admission Test(SBL Non-scholarship)

Math Examination(TYPE C)

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

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1. [3 points]
When α and β are the solutions of $x^2+2x+3=0$, find $\alpha^4\beta+\alpha\beta^4$.
① 24 ② 27 ③ 30 ④ 33 ⑤ 36

2. [3 points]
When $x=\sqrt{\sqrt{2}+\sqrt{3}}$ is a solution of $x^8+ax^4+1=0$, find a.
① -2 ② -4 ③ -6 ④ -8 ⑤ -10

3. [3 points]
Compute $\sqrt{6+2\sqrt{5}}-\sqrt{6-2\sqrt{5}}$.
① 2 ② $2\sqrt{2}$ ③ $2\sqrt{3}$ ④ 4 ⑤ $2\sqrt{5}$

4. [3 points]
Simplify $\dfrac{\sqrt[3]{6}\times\sqrt[3]{9}}{\sqrt[9]{8}}$.
① $\frac{1}{2}$ ② $\frac{1}{\sqrt{3}}$ ③ $\frac{1}{\sqrt{2}}$ ④ 2 ⑤ 3

5. [3 points]
Find a positive real number a satisfying $a^2-\dfrac{1}{a^2}=4$.
① $\sqrt{1+\sqrt{2}}$ ② $\sqrt{1+\sqrt{5}}$ ③ $\sqrt{2+\sqrt{2}}$
④ $\sqrt{2+\sqrt{5}}$ ⑤ $\sqrt{3+\sqrt{5}}$

6. [3 points]
Find $\log_2(7+\sqrt{17})+\log_2(7-\sqrt{17})$.
① 3 ② 5 ③ 7 ④ 9 ⑤ 11

7. [3 points]
When $20^x=8$ and $2^y=5$, find $\dfrac{1}{x}-\dfrac{y}{3}$.
① $\frac{1}{3}$ ② $\frac{2}{5}$ ③ $\frac{1}{2}$ ④ $\frac{2}{3}$ ⑤ 1

8. [3 points]
When (x_1, y_1) and (x_2, y_2) are solutions of
$$\begin{cases} x+y^2=4 \\ 2x+3y=3, \end{cases}$$
find $x_1+x_2+y_1+y_2$.
① $\frac{8}{3}$ ② $\frac{9}{4}$ ③ 2 ④ $\frac{11}{6}$ ⑤ $\frac{12}{7}$

9. [3 points]
Find $\sum_{n=1}^{10}\dfrac{1}{n(n+1)}$.
① $\frac{9}{10}$ ② $\frac{10}{11}$ ③ $\frac{11}{12}$ ④ $\frac{12}{13}$ ⑤ $\frac{13}{14}$

10. [3 points]
When α, β are two solutions of $x+\dfrac{1}{x^2}=2$ with $\alpha\neq 1\neq\beta$ and $\alpha>0$, find $\alpha-\beta$.
① $\sqrt{2}$ ② $\sqrt{3}$ ③ 2 ④ $\sqrt{5}$ ⑤ $\sqrt{6}$

11. [3 points]
When $\dfrac{\sqrt{2}+\sqrt{3}\,i}{1-\sqrt{3}\,i} = a+bi$ for real numbers a and b, find a^2+b^2.

① $\dfrac{3}{2}$ ② $\dfrac{4}{3}$ ③ $\dfrac{5}{4}$ ④ $\dfrac{6}{5}$ ⑤ $\dfrac{7}{6}$

12. [3 points]
When $a = 2+\sqrt{3}\,i$ and $b = -2+\sqrt{3}\,i$, find a^3-b^3.

① -20 ② -22 ③ -24 ④ -26 ⑤ -28

13. [3 points]
Find the sum of all solutions of $2\cdot 3^x + 6\cdot 3^{-x} = 7$.

① 0 ② 1 ③ $\dfrac{1}{2}$ ④ $\dfrac{1}{3}$ ⑤ $\dfrac{1}{6}$

14. [3 points]
When $a>1$, $b>1$ and $\log_{\sqrt{2}} a = \log_4 (ab)$, find $\log_a b$.

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

15. [3 points]
When g is the inverse function of $f(x) = \log_3(x-1)+2$, find $g(4)$.

① 10 ② 12 ③ 14 ④ 16 ⑤ 18

16. [3 points]
When $A = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$, $B = \begin{pmatrix} 1 & -1 \\ -5 & -7 \end{pmatrix}$ and $A(A^{-1}+2B^{-1})B = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$, find $a+b+c+d$.

① 8 ② 9 ③ 10 ④ 11 ⑤ 12

17. [3 points]
Find $\lim_{x\to\infty}\left(\sqrt{x^2+2} - \sqrt{x^2+3x+1}\right)$.

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

18. [3 points]
When $tg\,\alpha = \dfrac{1}{2}$ $\left(0 \le \alpha < \dfrac{\pi}{2}\right)$, find $\sin^2\dfrac{\alpha}{2}$, where $tg\,\theta = \dfrac{\sin\theta}{\cos\theta}$.

① $\dfrac{1}{10}$ ② $\dfrac{3+2\sqrt{5}}{10}$ ③ $\dfrac{3-2\sqrt{5}}{10}$
④ $\dfrac{5+2\sqrt{5}}{10}$ ⑤ $\dfrac{5-2\sqrt{5}}{10}$

19. [3 points]
When $3\cos\left(\theta+\dfrac{\pi}{2}\right) = \cos\theta$ for $\dfrac{\pi}{2} \le \theta \le \pi$, find $\sin\theta$.

① $\dfrac{\sqrt{2}}{10}$ ② $\dfrac{1}{5}$ ③ $\dfrac{\sqrt{6}}{10}$ ④ $\dfrac{\sqrt{2}}{5}$ ⑤ $\dfrac{\sqrt{10}}{10}$

20. [3 points]
When $A = \begin{pmatrix} 1 & 3 \\ 2 & 4 \end{pmatrix}$, $B = \begin{pmatrix} -1 & 2 \\ 1 & -2 \end{pmatrix}$, and $A^{-1}B = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$, find $a+b+c+d$.

① 0 ② -1 ③ -2 ④ -3 ⑤ -4

21. [4 points]
When M and m are the maximum and minimum values of $f(x) = 2x^3-9x^2+16$, $(0 \le x \le 4)$, find $M+m$.

① 1 ② 3 ③ 5 ④ 7 ⑤ 9

22. [4 points]

When $f(x) = \dfrac{\sqrt{2x+2}}{x^2 - x + 3}$, find $f'(1)$.

① $-\dfrac{1}{10}$ ② $-\dfrac{1}{12}$ ③ $-\dfrac{1}{14}$

④ $-\dfrac{1}{16}$ ⑤ $-\dfrac{1}{18}$

23. [4 points]

Find the maximum value of

$f(x) = \sin^2\left(x + \dfrac{\pi}{8}\right) + \sin\left(x - \dfrac{3\pi}{8}\right) + 1$.

① 2 ② $\dfrac{3}{2}$ ③ $\dfrac{5}{2}$ ④ $\dfrac{7}{4}$ ⑤ $\dfrac{9}{4}$

24. [4 points]

Find $\lim\limits_{x \to 0} \dfrac{3x \sin x}{1 - \cos 2x}$.

① $\dfrac{1}{2}$ ② $\dfrac{3}{2}$ ③ $\dfrac{5}{2}$ ④ $\dfrac{7}{2}$ ⑤ $\dfrac{9}{2}$

25. [4 points]

When $y = ax + b$ is the tangent line to $y = \sqrt{x^3 + 1}$ at $x = 2$, find $a + b$.

① 1 ② 3 ③ 5 ④ 7 ⑤ 9

26. [4 points]

When $\int_0^x t f(t)\,dt = 2x^4 - 3x^3 + ax^2$ and $f(0) = 2$ for a differentiable function $f(x)$, find a .

① 1 ② 3 ③ 5 ④ 7 ⑤ 9

27. [4 points]

Find the area of the region enclosed by $y = x^3 - 3x^2 - 5x + 1$ and $y = x^3 - 4x^2 - x - 2$.

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

28. [4 points]

Compute $\int_0^1 (2x^2 + 1)^2\,dx$.

① $\dfrac{41}{15}$ ② $\dfrac{43}{15}$ ③ 3 ④ $\dfrac{47}{15}$ ⑤ $\dfrac{49}{15}$

29. [4 points]

Compute $\int_0^1 (2x^2 - x + 2)^3 (8x - 2)\,dx$.

① $\dfrac{61}{2}$ ② $\dfrac{63}{2}$ ③ $\dfrac{65}{2}$ ④ $\dfrac{67}{2}$ ⑤ $\dfrac{69}{2}$

30. [4 points]

Find $\lim\limits_{n \to \infty} \sum_{k=1}^{n} \dfrac{\sqrt{3k^4 + (nk)^2}}{n^3}$.

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

2025 IUT 2nd Admission Test(SBL Non-scholarship)

Math Examination(TYPE D)

< 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. [3 points]
Find a positive real number a satisfying
$a^2 - \frac{1}{a^2} = 4$.
① $\sqrt{1+\sqrt{2}}$ ② $\sqrt{1+\sqrt{5}}$ ③ $\sqrt{2+\sqrt{2}}$
④ $\sqrt{2+\sqrt{5}}$ ⑤ $\sqrt{3+\sqrt{5}}$

2. [3 points]
When α and β are the solutions of $x^2+2x+3=0$, find $\alpha^4\beta+\alpha\beta^4$.
① 24 ② 27 ③ 30 ④ 33 ⑤ 36

3. [3 points]
When $x = \sqrt{\sqrt{2}+\sqrt{3}}$ is a solution of $x^8+ax^4+1=0$, find a.
① -2 ② -4 ③ -6 ④ -8 ⑤ -10

4. [3 points]
Compute $\sqrt{6+2\sqrt{5}} - \sqrt{6-2\sqrt{5}}$.
① 2 ② $2\sqrt{2}$ ③ $2\sqrt{3}$ ④ 4 ⑤ $2\sqrt{5}$

5. [3 points]
Simplify $\frac{\sqrt[3]{6}\times\sqrt[3]{9}}{\sqrt[9]{8}}$.
① $\frac{1}{2}$ ② $\frac{1}{\sqrt{3}}$ ③ $\frac{1}{\sqrt{2}}$ ④ 2 ⑤ 3

6. [3 points]
When α, β are two solutions of $x+\frac{1}{x^2}=2$ with $\alpha \neq 1 \neq \beta$ and $\alpha > 0$, find $\alpha-\beta$.
① $\sqrt{2}$ ② $\sqrt{3}$ ③ 2 ④ $\sqrt{5}$ ⑤ $\sqrt{6}$

7. [3 points]
Find $\log_2(7+\sqrt{17})+\log_2(7-\sqrt{17})$.
① 3 ② 5 ③ 7 ④ 9 ⑤ 11

8. [3 points]
When $20^x=8$ and $2^y=5$, find $\frac{1}{x}-\frac{y}{3}$.
① $\frac{1}{3}$ ② $\frac{2}{5}$ ③ $\frac{1}{2}$ ④ $\frac{2}{3}$ ⑤ 1

9. [3 points]
When (x_1, y_1) and (x_2, y_2) are solutions of
$$\begin{cases} x+y^2=4 \\ 2x+3y=3 \end{cases},$$
find $x_1+x_2+y_1+y_2$.
① $\frac{8}{3}$ ② $\frac{9}{4}$ ③ 2 ④ $\frac{11}{6}$ ⑤ $\frac{12}{7}$

10. [3 points]
Find $\sum_{n=1}^{10}\frac{1}{n(n+1)}$.
① $\frac{9}{10}$ ② $\frac{10}{11}$ ③ $\frac{11}{12}$ ④ $\frac{12}{13}$ ⑤ $\frac{13}{14}$

11. [3 points]
When g is the inverse function of $f(x) = \log_3(x-1)+2$, find $g(4)$.

① 10 ② 12 ③ 14 ④ 16 ⑤ 18

12. [3 points]
When $\dfrac{\sqrt{2}+\sqrt{3}\,i}{1-\sqrt{3}\,i} = a+bi$ for real numbers a and b, find a^2+b^2.

① $\frac{3}{2}$ ② $\frac{4}{3}$ ③ $\frac{5}{4}$ ④ $\frac{6}{5}$ ⑤ $\frac{7}{6}$

13. [3 points]
When $a = 2+\sqrt{3}\,i$ and $b = -2+\sqrt{3}\,i$, find a^3-b^3.

① -20 ② -22 ③ -24 ④ -26 ⑤ -28

14. [3 points]
Find the sum of all solutions of $2 \cdot 3^x + 6 \cdot 3^{-x} = 7$.

① 0 ② 1 ③ $\frac{1}{2}$ ④ $\frac{1}{3}$ ⑤ $\frac{1}{6}$

15. [3 points]
When $a > 1$, $b > 1$ and $\log_{\sqrt{2}} a = \log_4(ab)$, find $\log_a b$.

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

16. [3 points]
When $A = \begin{pmatrix} 1 & 3 \\ 2 & 4 \end{pmatrix}$, $B = \begin{pmatrix} -1 & 2 \\ 1 & -2 \end{pmatrix}$, and $A^{-1}B = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$, find $a+b+c+d$.

① 0 ② -1 ③ -2 ④ -3 ⑤ -4

17. [3 points]
When $A = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$, $B = \begin{pmatrix} 1 & -1 \\ -5 & -7 \end{pmatrix}$ and $A(A^{-1}+2B^{-1})B = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$, find $a+b+c+d$.

① 8 ② 9 ③ 10 ④ 11 ⑤ 12

18. [3 points]
Find $\lim_{x \to \infty}\left(\sqrt{x^2+2} - \sqrt{x^2+3x+1}\right)$.

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

19. [3 points]
When $tg\,\alpha = \frac{1}{2}$ $(0 \le \alpha < \frac{\pi}{2})$, find $\sin^2\frac{\alpha}{2}$, where $tg\,\theta = \dfrac{\sin\theta}{\cos\theta}$.

① $\frac{1}{10}$ ② $\frac{3+2\sqrt{5}}{10}$ ③ $\frac{3-2\sqrt{5}}{10}$
④ $\frac{5+2\sqrt{5}}{10}$ ⑤ $\frac{5-2\sqrt{5}}{10}$

20. [3 points]
When $3\cos\left(\theta+\frac{\pi}{2}\right) = \cos\theta$ for $\frac{\pi}{2} \le \theta \le \pi$, find $\sin\theta$.

① $\frac{\sqrt{2}}{10}$ ② $\frac{1}{5}$ ③ $\frac{\sqrt{6}}{10}$ ④ $\frac{\sqrt{2}}{5}$ ⑤ $\frac{\sqrt{10}}{10}$

21. [4 points]
When $y = ax+b$ is the tangent line to $y = \sqrt{x^3+1}$ at $x=2$, find $a+b$.

① 1 ② 3 ③ 5 ④ 7 ⑤ 9

22. [4 points]
When M and m are the maximum and minimum values of $f(x) = 2x^3 - 9x^2 + 16$, $(0 \le x \le 4)$, find $M + m$.

① 1 ② 3 ③ 5 ④ 7 ⑤ 9

23. [4 points]
When $f(x) = \dfrac{\sqrt{2x+2}}{x^2 - x + 3}$, find $f'(1)$.

① $-\dfrac{1}{10}$ ② $-\dfrac{1}{12}$ ③ $-\dfrac{1}{14}$
④ $-\dfrac{1}{16}$ ⑤ $-\dfrac{1}{18}$

24. [4 points]
Find the maximum value of
$f(x) = \sin^2\left(x + \dfrac{\pi}{8}\right) + \sin\left(x - \dfrac{3\pi}{8}\right) + 1$.

① 2 ② $\dfrac{3}{2}$ ③ $\dfrac{5}{2}$ ④ $\dfrac{7}{4}$ ⑤ $\dfrac{9}{4}$

25. [4 points]
Find $\displaystyle\lim_{x \to 0} \frac{3x \sin x}{1 - \cos 2x}$.

① $\dfrac{1}{2}$ ② $\dfrac{3}{2}$ ③ $\dfrac{5}{2}$ ④ $\dfrac{7}{2}$ ⑤ $\dfrac{9}{2}$

26. [4 points]
Find $\displaystyle\lim_{n \to \infty} \sum_{k=1}^{n} \frac{\sqrt{3k^4 + (nk)^2}}{n^3}$.

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

27. [4 points]
When $\displaystyle\int_0^x tf(t)\,dt = 2x^4 - 3x^3 + ax^2$ and $f(0) = 2$ for a differentiable function $f(x)$, find a.
① 1 ② 3 ③ 5 ④ 7 ⑤ 9

28. [4 points]
Find the area of the region enclosed by $y = x^3 - 3x^2 - 5x + 1$ and $y = x^3 - 4x^2 - x - 2$.

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

29. [4 points]
Compute $\displaystyle\int_0^1 (2x^2 + 1)^2\,dx$.

① $\dfrac{41}{15}$ ② $\dfrac{43}{15}$ ③ 3 ④ $\dfrac{47}{15}$ ⑤ $\dfrac{49}{15}$

30. [4 points]
Compute $\displaystyle\int_0^1 (2x^2 - x + 2)^3 (8x - 2)\,dx$.

① $\dfrac{61}{2}$ ② $\dfrac{63}{2}$ ③ $\dfrac{65}{2}$ ④ $\dfrac{67}{2}$ ⑤ $\dfrac{69}{2}$

2025 IUT 2nd SBL Non-Scholarship Answer Sheets

[TypeA]

No.	1	2	3	4	5	6	7	8	9	10
Ans.	①	⑤	④	③	⑤	②	②	④	②	④
No.	11	12	13	14	15	16	17	18	19	20
Ans.	②	③	①	③	①	⑤	⑤	③	①	④
No.	21	22	23	24	25	26	27	28	29	30
Ans.	⑤	②	①	③	⑤	④	③	④	①	②

[TypeB]

No.	1	2	3	4	5	6	7	8	9	10
Ans.	⑤	①	⑤	④	③	④	②	②	④	②
No.	11	12	13	14	15	16	17	18	19	20
Ans.	①	②	③	①	③	④	⑤	⑤	③	①
No.	21	22	23	24	25	26	27	28	29	30
Ans.	⑤	⑤	②	①	③	②	④	③	④	①

[TypeC]

No.	1	2	3	4	5	6	7	8	9	10
Ans.	③	⑤	①	⑤	④	②	④	②	②	④
No.	11	12	13	14	15	16	17	18	19	20
Ans.	③	①	②	③	①	①	④	⑤	⑤	③
No.	21	22	23	24	25	26	27	28	29	30
Ans.	③	⑤	⑤	②	①	①	②	④	③	④

[TypeD]

No.	1	2	3	4	5	6	7	8	9	10
Ans.	④	③	⑤	①	⑤	④	②	④	②	②
No.	11	12	13	14	15	16	17	18	19	20
Ans.	①	③	①	②	③	③	①	④	⑤	⑤
No.	21	22	23	24	25	26	27	28	29	30
Ans.	①	③	⑤	⑤	②	④	①	②	④	③

2025 IUT 2nd Admission Test(SBL Non-scholarship) Solution

(1) Compute $\sqrt{6+2\sqrt{5}}-\sqrt{6-2\sqrt{5}}$.

(SOL) $\sqrt{6+2\sqrt{5}}-\sqrt{6-2\sqrt{5}} = (\sqrt{5}+1)-(\sqrt{5}-1) = 2.$

(2) Simplify $\dfrac{\sqrt[3]{6}\times\sqrt[3]{9}}{\sqrt[9]{8}}$.

(SOL) $\dfrac{\sqrt[3]{6}\times\sqrt[3]{9}}{\sqrt[9]{8}} = 2^{\frac{1}{3}}\times 3^{\frac{1}{3}}\times 3^{\frac{2}{3}}\times 2^{-\frac{1}{3}} = 3.$

(3) Find the positive real number a satisfying $a^2-\dfrac{1}{a^2}=4.$

(SOL) Multiplying by a^2, we get $a^4-4a^2-1=0$. It follows that $a^2=2+\sqrt{5}$ and hence, $a=\sqrt{2+\sqrt{5}}$.

(4) When α and β are the solutions of $x^2+2x+3=0$, find $\alpha^4\beta+\alpha\beta^4$.

(SOL) Since $\alpha+\beta=-2$ and $\alpha\beta=3$, it follows that

$\alpha^3+\beta^3=(\alpha+\beta)^3-3\alpha\beta(\alpha+\beta)=-8-9\cdot(-2)=10.$

Hence, $\alpha^4\beta+\alpha\beta^4=\alpha\beta(\alpha^3+\beta^3)=30.$

(5) When $x=\sqrt{\sqrt{2}+\sqrt{3}}$ is a solution of $x^8+ax^4+1=0$, find a.

(SOL) Putting $x=\sqrt{\sqrt{2}+\sqrt{3}}$, we get $x^4=(\sqrt{2}+\sqrt{3})^2=5+2\sqrt{6}$.

So, $(x^4-5)^2=24$ which yields $x^8-10x^4+1=0$. Hence, $a=-10$.

(6) When (x_1, y_1) and (x_2, y_2) are solutions of

$$\begin{cases} x+y^2=4 \\ 2x+3y=3 \end{cases},$$

find $x_1+x_2+y_1+y_2$.

(SOL) Note that $\begin{cases} x+y^2=4 \\ 2x+3y=3 \end{cases} \Rightarrow \begin{cases} x+y^2=4 \\ 2y^2-3y-5=0 \end{cases}$. It follows that

$2y^2-3y-5=(2y-5)(y+1)=0$. Hence, the solutions are $(3,-1)$ and $\left(-\dfrac{9}{4},\dfrac{5}{2}\right)$ and $x_1+x_2+y_1+y_2=\dfrac{9}{4}$.

(7) Find $\displaystyle\sum_{n=1}^{10}\frac{1}{n(n+1)}$.

(SOL) $\displaystyle\sum_{n=1}^{10}\frac{1}{n(n+1)}=\sum_{n=1}^{10}\left(\frac{1}{n}-\frac{1}{n+1}\right)=1-\frac{1}{11}=\frac{10}{11}.$

(8) When α, β are two solutions of $x + \frac{1}{x^2} = 2$ with $\alpha \neq 1 \neq \beta$ and $\alpha > 0$, find $\alpha - \beta$.

(SOL) Multiplying by x^2, we get $x^3 - 2x^2 + 1 = (x-1)(x^2 - x - 1) = 0$. Hence, $\alpha = \frac{1+\sqrt{5}}{2}$, $\beta = \frac{1-\sqrt{5}}{2}$, and $\alpha - \beta = \sqrt{5}$.

(9) Find $\log_2(7+\sqrt{17}) + \log_2(7-\sqrt{17})$.

(SOL) $\log_2(7+\sqrt{17}) + \log_2(7-\sqrt{17}) = \log_2(49-17) = \log_2 32 = 5$.

(10) When $20^x = 8$ and $2^y = 5$, find $\frac{1}{x} - \frac{y}{3}$.

(SOL) Since $x = \log_{20} 8$ and $y = \log_2 5$, it follows that

$\frac{1}{x} - \frac{y}{3} = \log_8 20 - \frac{1}{3}\log_2 5 = \frac{1}{3}\log_2 20 - \frac{1}{3}\log_2 5 = \frac{\log_2 4}{3} = \frac{2}{3}$.

(11) Find the sum of all solutions of $2 \cdot 3^x + 6 \cdot 3^{-x} = 7$.

(SOL) Multiplying by 3^x, we get $2(3^x)^2 - 7(3^x) + 6 = (2 \cdot 3^x - 3)(3^x - 2) = 0$, it follows that $3^x = 2, \frac{3}{2}$. Hence, the sum of solutions is $\log_3 2 + \log_3 \frac{3}{2} = \log_3 3 = 1$.

(12) When $a > 1$, $b > 1$ and $\log_{\sqrt{2}} a = \log_4(ab)$, find $\log_a b$.

(SOL) Since $\log_{\sqrt{2}} a = 2\log_2 a$ and $\log_4(ab) = \frac{1}{2}\log_2(ab)$, it follows $\log_2(a^4) = \log_2(ab)$. Hence, $a^4 = ab$ which yields $a^3 = b$. Therefore, $\log_a b = 3$.

(13) When g is the inverse function of $f(x) = \log_3(x-1) + 2$, find $g(4)$.

(SOL) Letting $g(4) = x$, we get $\log_3(x-1) + 2 = 4$, which yields $\log_3(x-1) = 2$. It follows that $x - 1 = 9$. Hence, $x = 10$.

(14) When $\frac{\sqrt{2}+\sqrt{3}\,i}{1-\sqrt{3}\,i} = a + bi$ for real numbers a and b, find $a^2 + b^2$.

(SOL) Since $\frac{\sqrt{2}+\sqrt{3}\,i}{1-\sqrt{3}\,i} = \frac{1}{4}\{(\sqrt{2}+\sqrt{3}\,i)(1-\sqrt{3}\,i)\} = \frac{1}{4}\{(\sqrt{2}-3) + (\sqrt{6}+\sqrt{3})i\}$, it follows that $a^2 + b^2 = \frac{1}{16}\{(11 - 6\sqrt{2}) + (9 + 6\sqrt{2})\} = \frac{20}{16} = \frac{5}{4}$.

(15) When $a = 2 + \sqrt{3}\,i$ and $b = -2 + \sqrt{3}\,i$, find $a^3 - b^3$.

(SOL) $a^3 - b^3 = (a-b)^3 + 3ab(a-b) = 4^3 + 3 \cdot (-7) \cdot 4 = -20.$

(16) When $tg\,\alpha = \frac{1}{2}$ $(0 \le \alpha < \frac{\pi}{2})$, find $\sin^2\frac{\alpha}{2}$, where $tg\,\theta = \frac{\sin\theta}{\cos\theta}$.

(SOL) Since $\sec^2\alpha = 1 + \frac{1}{4} = \frac{5}{4}$. it follows that $\cos\alpha = \frac{2}{\sqrt{5}}$.

Hence, $\sin^2\frac{\alpha}{2} = \frac{1-\cos\alpha}{2} = \frac{1-\frac{2}{\sqrt{5}}}{2} = \frac{5-2\sqrt{5}}{10}$.

(17) When $3\cos\left(\theta + \frac{\pi}{2}\right) = \cos\theta$ for $\frac{\pi}{2} \le \theta \le \pi$, find $\sin\theta$.

(SOL) Note that $3\cos\left(\theta + \frac{\pi}{2}\right) = \cos\theta \Rightarrow -3\sin\theta = \cos\theta \Rightarrow tg\theta = -\frac{1}{3}$. It follows that $\cos^2\theta = \frac{9}{10}$ and $\cos\theta = -\frac{3}{\sqrt{10}}$. Hence, $\sin\theta = \frac{1}{\sqrt{10}} = \frac{\sqrt{10}}{10}$.

(18) When $A = \begin{pmatrix} 1 & 3 \\ 2 & 4 \end{pmatrix}$, $B = \begin{pmatrix} -1 & 2 \\ 1 & -2 \end{pmatrix}$, and $A^{-1}B = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$, find $a+b+c+d$.

(SOL) Since $A^{-1}B = -\frac{1}{2}\begin{pmatrix} 4 & -3 \\ -2 & 1 \end{pmatrix}\begin{pmatrix} -1 & 2 \\ 1 & -2 \end{pmatrix} = -\frac{1}{2}\begin{pmatrix} -7 & 14 \\ 3 & -6 \end{pmatrix}$, it follows that $a+b+c+d = -2$.

(19) When $A = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$, $B = \begin{pmatrix} 1 & -1 \\ -5 & -7 \end{pmatrix}$ and $A(A^{-1} + 2B^{-1})B = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$, find $a+b+c+d$.

(SOL) $A(A^{-1} + 2B^{-1})B = B + 2A = \begin{pmatrix} 1 & -1 \\ -5 & -7 \end{pmatrix} + 2\begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix} = \begin{pmatrix} 3 & 3 \\ 1 & 1 \end{pmatrix}$, Hence, $a+b+c+d = 8$.

(20) Find $\lim_{x\to\infty}\left(\sqrt{x^2+2} - \sqrt{x^2+3x+1}\right)$.

(SOL) $\lim_{x\to\infty}\left(\sqrt{x^2+2} - \sqrt{x^2+3x+1}\right) = \lim_{x\to\infty}\frac{2-(3x+1)}{\sqrt{x^2+2}+\sqrt{x^2+3x+1}} = -\frac{3}{2}$.

(21) Find the maximum value of $f(x) = \sin^2\left(x + \frac{\pi}{8}\right) + \sin\left(x - \frac{3\pi}{8}\right) + 1$.

(SOL) Note that $\sin\left(x - \frac{3\pi}{8}\right) = \sin\left(x + \frac{\pi}{8} - \frac{\pi}{2}\right) = -\cos\left(x + \frac{\pi}{8}\right)$.

Putting $A = \cos\left(x + \frac{\pi}{8}\right)$, it follows that $|A| \le 1$ and

$\sin^2\left(x + \frac{\pi}{8}\right) + \sin\left(x - \frac{3\pi}{8}\right) + 1 = -A^2 - A + 2 = -\left(A + \frac{1}{2}\right)^2 + \frac{9}{4}$.

Hence, the maximum value is $\frac{9}{4}$.

(22) Find $\lim_{x\to 0}\frac{3x\sin x}{1-\cos 2x}$.

(SOL) $\lim_{x\to 0}\frac{3x\sin x}{1-\cos 2x} = \lim_{x\to 0}\frac{3x\sin x}{2\sin^2 x} = \lim_{x\to 0}\frac{3x}{2\sin x} = \frac{3}{2}$.

(23) When $y=ax+b$ is the tangent line to $y=\sqrt{x^3+1}$ at $x=2$, find $a+b$.

(SOL) Let $f(x)=\sqrt{x^3+1}$. Since $f(2)=3$ and $f'(2)=\left.\frac{3x^2}{2\sqrt{x^3+1}}\right|_{x=2}=\frac{12}{6}=2$, the tangent line is $y=2(x-2)+3=2x-1$. Hence, $a+b=2-1=1$.

(24) When M and m are the maximum and minimum values of $f(x)=2x^3-9x^2+16$, $(0\le x\le 4)$, find $M+m$.

(SOL) Note that $f'(x)=6x^2-18x=6x(x-3)$. Since $f(0)=16$, $f(3)=-11$ and $f(4)=0$, it follows that $M=16$ and $m=-11$. Hence, $M+m=5$.

(25) When $f(x)=\frac{\sqrt{2x+2}}{x^2-x+3}$, find $f'(1)$.

(SOL) $f'(1)=\left.\frac{\frac{1}{\sqrt{2x+2}}(x^2-x+3)-\sqrt{2x+2}\,(2x-1)}{(x^2-x+3)^2}\right|_{x=1}=\frac{\frac{1}{2}\cdot 3-2\cdot 1}{9}=-\frac{1}{18}$.

(26) Compute $\int_0^1 (2x^2+1)^2\,dx$.

(SOL) $\int_0^1 (2x^2+1)^2\,dx=\int_0^1 (4x^4+4x^2+1)\,dx=\left[\frac{4}{5}x^5+\frac{4}{3}x^3+x\right]_0^1=\frac{4}{5}+\frac{4}{3}+1=\frac{47}{15}$.

(27) Compute $\int_0^1 (2x^2-x+2)^3(8x-2)dx$.

(SOL) $$\int_0^1 (2x^2-x+2)^3(8x-2)dx = 2\int_0^1 (2x^2-x+2)^3(4x-1)\,dx$$
$$= 2\left[\frac{1}{4}(2x^2-x+2)^4\right]_0^1=\frac{1}{2}(81-16)=\frac{65}{2}.$$

(28) Find $\lim_{n\to\infty}\sum_{k=1}^{n}\frac{\sqrt{3k^4+(nk)^2}}{n^3}$.

(SOL) $\lim_{n\to\infty}\sum_{k=1}^{n}\frac{\sqrt{3k^4+(nk)^2}}{n^3} = \lim_{n\to\infty}\sum_{k=1}^{n}\frac{k}{n}\sqrt{3\left(\frac{k}{n}\right)^2+1}\ \frac{1}{n} = \int_0^1 x\sqrt{3x^2+1}\ dx$

$$= \left[\frac{1}{9}\left(3x^2+1\right)^{\frac{3}{2}}\right]_0^1 = \frac{1}{9}(8-1) = \frac{7}{9}.$$

(29) When $\int_0^x tf(t)\,dt = 2x^4-3x^3+ax^2$ and $f(0)=2$ for a differentiable function $f(x)$, find a.

(SOL) Differentiating both sides, it follows that $xf(x)=8x^3-9x^2+2ax$, which yields $f(x)=8x^2-9x+2a$. Hence, $a=\frac{f(0)}{2}=1$.

(30) Find the area of the region enclosed by $y = x^3-3x^2-5x+1$ and $y = x^3-4x^2-x-2$.

(SOL) Setting $f(x) = x^3-3x^2-5x+1$ and $g(x) = x^3-4x^2-x-2$, we get $g(x)-f(x) = -x^2+4x-3 = -(x-1)(x-3)$. It follows that the curves meet at $x=1,3$ and the area is $\int_1^3(g(x)-f(x))\,dx = \int_1^3\left(-x^2+4x-3\right)dx = \left[-\frac{1}{3}x^3+2x^2-3x\right]_1^3$

$$= (-9+18-9)-\left(-\frac{1}{3}+2-2\right) = \frac{4}{3}.$$

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.

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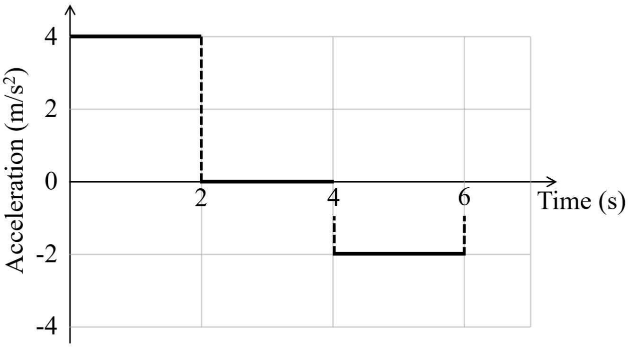
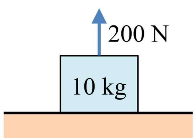
1. [5 points]
The graph below shows the acceleration over time of an object that was initially at rest and moves in a straight line. What is the total distance the object moves between 0 and 6 seconds?



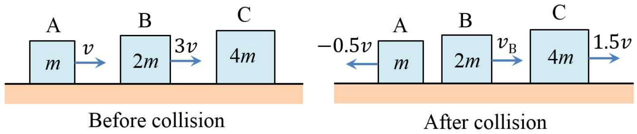
① 32 m ② 36 m ③ 42 m
④ 50 m ⑤ 72 m

2. [3 points]
As shown in the figure, an object with a mass of 10 kg on the ground is pulled vertically upward with a force of 200 N. What is the magnitude of the object's acceleration? (Assume that the magnitude of the gravitational acceleration is 10 $\mathrm{m/s^2}$.)



① 10 $\mathrm{m/s^2}$ ② 15 $\mathrm{m/s^2}$ ③ 20 $\mathrm{m/s^2}$
④ 25 $\mathrm{m/s^2}$ ⑤ 30 $\mathrm{m/s^2}$

3. [4 points]
As shown in the figure below, objects A, B, and C with masses m, $2m$, and $4m$ are placed on a frictionless horizontal surface. Before collision, A is moving with a velocity of v, B with a velocity of $3v$, and C is at rest. After collision, if A moves with a velocity of $-0.5v$ and C with a velocity of $1.5v$, what will be the velocity v_B of object B?



① $0.25v$ ② $0.5v$ ③ $0.75v$
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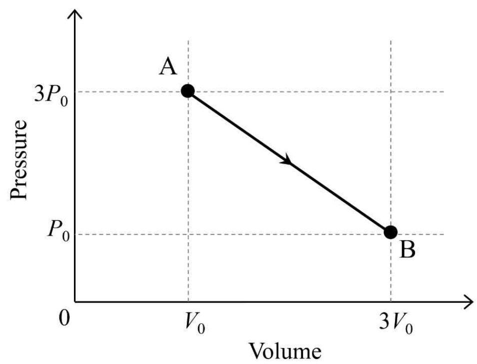

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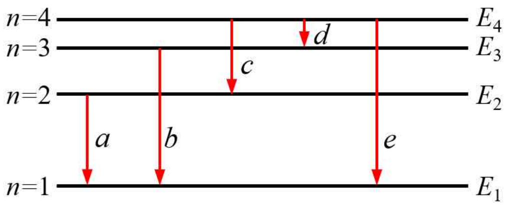
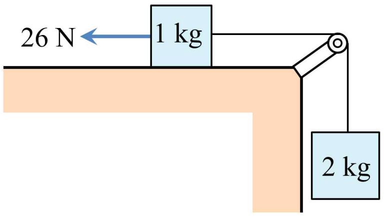
5. [3 points]
The two hypotheses of Einstein's special theory of relativity are as follows. Hypothesis 1: The (Ⓐ) is/are the same in all inertial frames of reference. Hypothesis 2: The (Ⓑ) in a vacuum is/are always constant, regardless of the motion of the light source or the observer. What are the correct words to fill in the parentheses Ⓐ and Ⓑ above?
① laws of physics, energy of light
② mass of objects, speed of light
③ charge of objects, energy of light
④ laws of physics, speed of light
⑤ mass of objects, frequency of light

6. [3 points]
The figure below shows the energy levels of the hydrogen atom according to quantum numbers and the electronic transition processes a, b, c, d, and e. Which transition process has the shortest wavelength of light emitted during the transition process?



① a ② b ③ c
④ d ⑤ e

7. [3 points]
As shown in the figure, objects with masses of 1 kg and 2 kg are connected by a string and are initially at rest. When a constant force of 26 N is applied to the object with mass 1 kg and moves it 1 m, what will be the speed of the two objects? (Assume that the magnitude of the gravitational acceleration is $10\ \mathrm{m/s^2}$, and ignore the mass of the string and all frictional forces.)



① 1 m/s ② 2 m/s ③ 2.5 m/s
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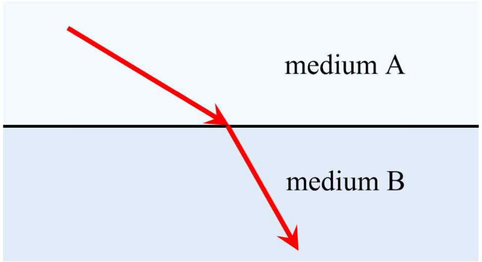
8. [3 points]
The figure below shows how light refracts at the boundary when it passes from medium A to medium B. If the refractive indices in medium A and medium B are n_A and n_B, the speeds of light are v_A and v_B, the wavelengths of light are λ_A and λ_B, and the frequencies of light are f_A and f_B, respectively, which of the following is correct?



① $n_A < n_B$, $v_A < v_B$, $\lambda_A > \lambda_B$, $f_A > f_B$
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9. [3 points]
Let the masses of two particles A and B be m_{A} and m_{B}, respectively. If the kinetic energy E_{B} of particle B is three times the kinetic energy E_{A} of particle A, and the de Broglie wavelength λ_{B} of particle B is half the de Broglie wavelength λ_{A} of particle A, that is, $E_{\mathrm{B}} = 3E_{\mathrm{A}}$, $\lambda_{\mathrm{B}} = \frac{\lambda_{\mathrm{A}}}{2}$, what is the mass ratio $m_{\mathrm{A}} : m_{\mathrm{B}}$ of the two particles?

① 3 : 4 ② 4 : 3 ③ 3 : 2
④ 2 : 3 ⑤ 4 : 9

2025 IUT Admission Test(SOCIE)

Physics Examination(A TYPE) Answers

<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.

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Answers:

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

2025 IUT Admission Test(SOCIE)

Physics Examination(A TYPE) Solutions

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1. [5 points]

For 0 to 2 seconds, the object moves with constant acceleration, so the distance traveled is $s_1 = \frac{1}{2}at^2 = \frac{1}{2}(4\ \mathrm{m/s^2})(2\ \mathrm{s})^2 = 8\ \mathrm{m}$. And the velocity at 2 seconds is

$v(2\,\mathrm{s}) = at = (4\ \mathrm{m/s^2})(2\ \mathrm{s}) = 8\ \mathrm{m/s}$.

For 2 to 4 seconds, the object moves with constant velocity, so $s_2 = v(2\ \mathrm{s})t = (8\,\mathrm{m/s})(2\ \mathrm{s}) = 16\ \mathrm{m}$.

For 4 to 6 seconds, the object moves with constant acceleration at $a = -2\ \mathrm{m/s^2}$, so

$s_3 = v(4\,\mathrm{s})t + \frac{1}{2}at^2$

$= (8\ \mathrm{m/s})(2\ \mathrm{s}) + \frac{1}{2}(-2\ \mathrm{m/s^2})(2\ \mathrm{s})^2 = 12\mathrm{m}$.

Therefore, the total distance traveled is

$s = s_1 + s_2 + s_3 = 36\ \mathrm{m}$.

Answer) ② 36 m

2. [3 points]

The force of $200\ \mathrm{N}$ acts vertically upward on the object, and a gravity of $mg = (10\ \mathrm{kg})(10\ \mathrm{m/s^2}) = 100\ \mathrm{N}$ acts vertically downward, so the net force acting on the object is $F = 200\ \mathrm{N} - 100\ \mathrm{N} = 100\ \mathrm{N}$. The acceleration a is obtained using the equation of motion $F = ma$,

$a = \frac{F}{m} = \frac{100\ \mathrm{N}}{10\ \mathrm{kg}} = 10\ \mathrm{m/s^2}$.

Answer) ① $10\ \mathrm{m/s^2}$

3. [4 points]

When objects collide, the momentum before and after the collision is conserved, so applying the law of conservation of momentum, we get:

$mv + 2m(3v) + 0 = m(-0.5v) + 2mv_{\mathrm{B}} + 4m(1.5v)$.

Therefore, $v_{\mathrm{B}} = 0.75v$

Answer) ③ $0.75v$

4. [3 points]

Since the area under the pressure-volume graph is the work done by the gas, the work done by the gas on the outside is $W = \frac{1}{2}(3P_0 + P_0)(2V_0) = 4P_0V_0$.

Answer) ⑤ $4P_0V_0$

5. [3points]

The two hypotheses of Einstein's special theory of relativity are as follows. Hypothesis 1: The (laws of physics) are the same in all inertial frames of reference. Hypothesis 2: The (speed of light) in a vacuum is always constant, regardless of the motion of the light source or the observer.

Answer) ④ laws of physics, speed of light

6. [3 points]

The energy of the photon emitted when an electron transitions is equal to the difference between the two energy levels. Since the energy of the photon is $E = h\nu = \frac{hc}{\lambda}$ (Here, h is Planck's constant, ν is frequency, c is the speed of light, and λ is wavelength.), the transition process with the shortest wavelength is the transition process e, which is the transition process with the largest difference between the two energy levels.

Answer) ⑤ e

7. [3 points]

According to the law of conservation of energy, the work done by the force is equal to the increase in the kinetic energy and potential energy of the two objects. Therefore,

$$(26\,\mathrm{N})(1\,\mathrm{m}) = \frac{1}{2}(1\,\mathrm{kg})v^2 + \frac{1}{2}(2\,\mathrm{kg})v^2 + (2\,\mathrm{kg})(10\,\mathrm{m/s^2})(1\,\mathrm{m}).$$

That is, $\frac{3}{2}v^2 = 6$, $\therefore v = 2\,\mathrm{m/s}$.

Answer) ② $2\,\mathrm{m/s}$

8. [3 points]

From Snell's law $n_{\mathrm{A}}\, sin\theta_{\mathrm{A}} = n_{\mathrm{B}}\sin\theta_{\mathrm{B}}$, since the angle of incidence θ_{A} is greater than the angle of refraction θ_{B}, $n_{\mathrm{A}} < n_{\mathrm{B}}$. The speed of light in a medium $v\frac{c}{n}$ (where c is the speed of light in a vacuum), so $v_{\mathrm{A}} > v_{\mathrm{B}}$. The wavelength of light in a medium $\lambda = \frac{\lambda_0}{n}$ (where λ_0 is the wavelength of light in a vacuum), so $\lambda_{\mathrm{A}} > \lambda_{\mathrm{B}}$. The frequency of light does not change depending on the medium.

Answer) ③ $n_{\mathrm{A}} < n_{\mathrm{B}}$, $v_{\mathrm{A}} > v_{\mathrm{B}}$, $\lambda_{\mathrm{A}} > \lambda_{\mathrm{B}}$, $f_{\mathrm{A}} = f_{\mathrm{B}}$

9. [3 points]

The de Broglie wavelength is $\lambda = \frac{h}{p}$ (where h s Planck's constant and p is momentum). The kinetic energy $E = \frac{1}{2}mv^2 = \frac{(mv)^2}{2m} = \frac{p^2}{2m} = \frac{1}{2m}\left(\frac{h}{\lambda}\right)^2$, so $m = \frac{1}{2E}\left(\frac{h}{\lambda}\right)^2$. Therefore

$$m_{\mathrm{A}} : m_{\mathrm{B}} = \frac{1}{E_{\mathrm{A}}\lambda_{\mathrm{A}}^2} : \frac{1}{E_{\mathrm{B}}\lambda_{\mathrm{B}}^2} = 1 : \frac{1}{3\times(1/2)^2} = 3:4.$$

Answer) ① $3:4$

2025 IUT Admission Test(SOCIE)

Physics Examination(B TYPE)

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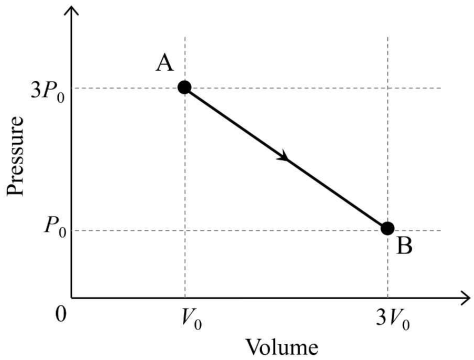
---

1. [3 points]

The figure below shows the relationship between pressure and volume when a certain amount of ideal gas changes state from A to B. How much work does the gas do on the outside while the state changes from A to B?



① $P_0 V_0$ ② $2P_0 V_0$ ③ $2.5P_0 V_0$
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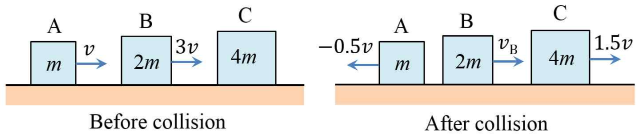

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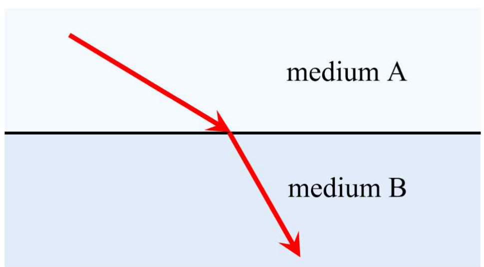
The figure below shows how light refracts at the boundary when it passes from medium A to medium B. If the refractive indices in medium A and medium B are n_A and n_B, the speeds of light are v_A and v_B, the wavelengths of light are λ_A and λ_B, and the frequencies of light are f_A and f_B, respectively, which of the following is correct?



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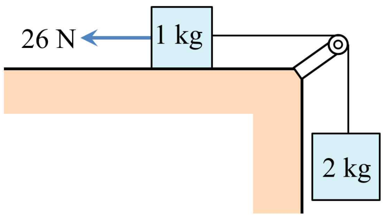
4. [3 points]
As shown in the figure, objects with masses of 1 kg and 2 kg are connected by a string and are initially at rest. When a constant force of 26 N is applied to the object with mass 1 kg and moves it 1 m, what will be the speed of the two objects? (Assume that the magnitude of the gravitational acceleration is $10\ m/s^2$, and ignore the mass of the string and all frictional forces.)



① 1 m/s ② 2 m/s ③ 2.5 m/s
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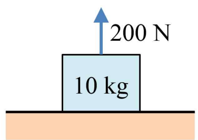
5. [3 points]
As shown in the figure, an object with a mass of 10 kg on the ground is pulled vertically upward with a force of 200 N. What is the magnitude of the object's acceleration? (Assume that the magnitude of the gravitational acceleration is $10\ m/s^2$.)



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6. [3 points]
Let the masses of two particles A and B be m_A and m_B, respectively. If the kinetic energy E_B of particle B is three times the kinetic energy E_A of particle A, and the de Broglie wavelength λ_B of particle B is half the de Broglie wavelength λ_A of particle A, that is, $E_B = 3E_A$, $\lambda_B = \frac{\lambda_A}{2}$, what is the mass ratio $m_A : m_B$ of the two particles?

① 3 : 4 ② 4 : 3 ③ 3 : 2
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7. [3 points]
The two hypotheses of Einstein's special theory of relativity are as follows. Hypothesis 1: The (Ⓐ) is/are the same in all inertial frames of reference. Hypothesis 2: The (Ⓑ) in a vacuum is/are always constant, regardless of the motion of the light source or the observer. What are the correct words to fill in the parentheses Ⓐ and Ⓑ above?

① laws of physics, energy of light
② mass of objects, speed of light
③ charge of objects, energy of light
④ laws of physics, speed of light
⑤ mass of objects, frequency of light

8. [5 points]
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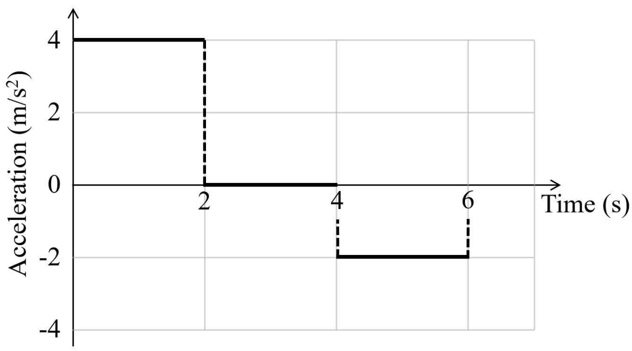

① 32 m ② 36 m ③ 42 m
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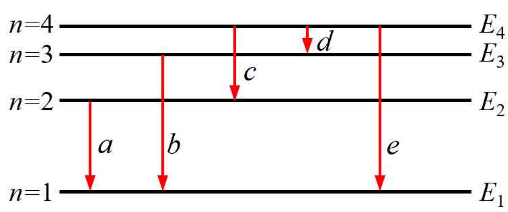
9. [3 points]
The figure below shows the energy levels of the hydrogen atom according to quantum numbers and the electronic transition processes a, b, c, d, and e. Which transition process has the shortest wavelength of light emitted during the transition process?



① a ② b ③ c
④ d ⑤ e

2025 IUT Admission Test(SOCIE)

Physics Examination(B TYPE) Answers

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Answers:

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

2025 IUT Admission Test(SOCIE)

Physics Examination(C TYPE)

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1. [3 points]

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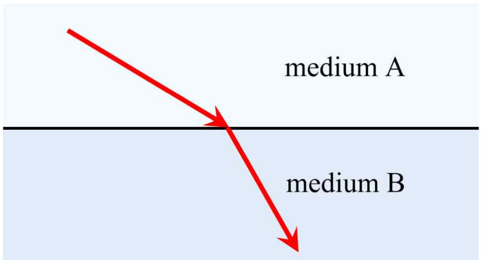

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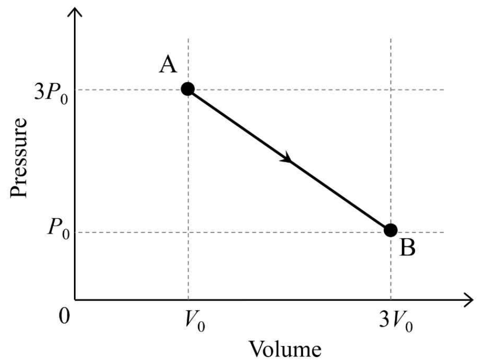

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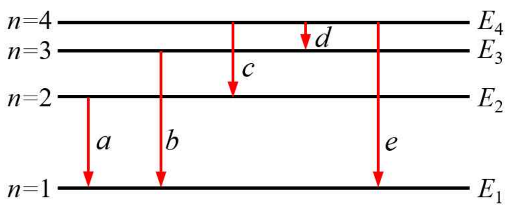

① a ② b ③ c

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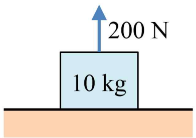
4. [3 points]

As shown in the figure, an object with a mass of $10\,\mathrm{kg}$ on the ground is pulled vertically upward with a force of $200\,\mathrm{N}$. What is the magnitude of the object's acceleration? (Assume that the magnitude of the gravitational acceleration is $10\ \mathrm{m/s^2}$.)



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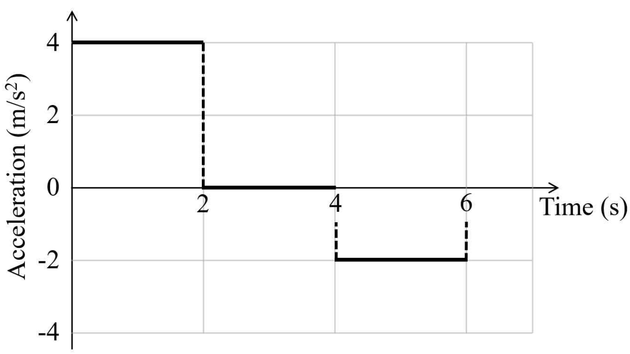

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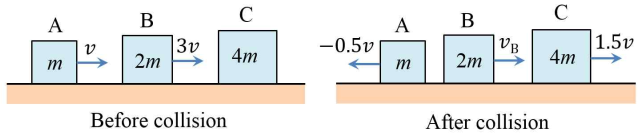

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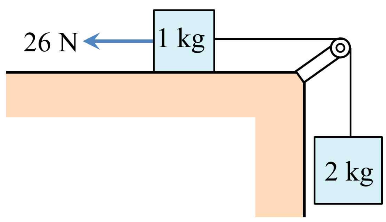
8. [3 points]

As shown in the figure, objects with masses of 1 kg and 2 kg are connected by a string and are initially at rest. When a constant force of 26 N is applied to the object with mass 1 kg and moves it 1 m, what will be the speed of the two objects? (Assume that the magnitude of the gravitational acceleration is $10\ \mathrm{m/s^2}$, and ignore the mass of the string and all frictional forces.)



① 1 m/s ② 2 m/s ③ 2.5 m/s
④ 3 m/s ⑤ 4 m/s

9. [3 points]

The two hypotheses of Einstein's special theory of relativity are as follows. Hypothesis 1: The (Ⓐ) is/are the same in all inertial frames of reference. Hypothesis 2: The (Ⓑ) in a vacuum is/are always constant, regardless of the motion of the light source or the observer. What are the correct words to fill in the parentheses Ⓐ and Ⓑ above?

① laws of physics, energy of light
② mass of objects, speed of light
③ charge of objects, energy of light
④ laws of physics, speed of light
⑤ mass of objects, frequency of light

2025 IUT Admission Test(SOCIE)

Physics Examination(C TYPE) Answers

<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.

Answers:

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

2025 IUT Admission Test(SOCIE)

Physics Examination(D 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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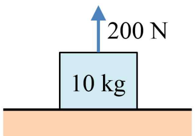
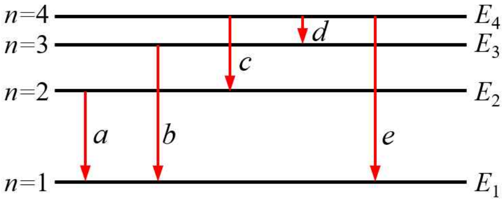
○ No penalty point is applied to an incorrect answer.

1. [3 points]
As shown in the figure, an object with a mass of $10\ \mathrm{kg}$ on the ground is pulled vertically upward with a force of $200\ \mathrm{N}$. What is the magnitude of the object's acceleration? (Assume that the magnitude of the gravitational acceleration is $10\ \mathrm{m/s^2}$.)



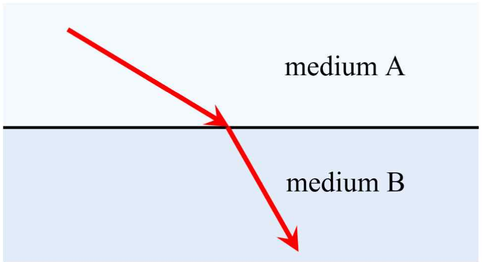
① $10\ \mathrm{m/s^2}$ ② $15\ \mathrm{m/s^2}$ ③ $20\ \mathrm{m/s^2}$
④ $25\ \mathrm{m/s^2}$ ⑤ $30\ \mathrm{m/s^2}$

2. [3 points]
The figure below shows the energy levels of the hydrogen atom according to quantum numbers and the electronic transition processes a, b, c, d, and e. Which transition process has the shortest wavelength of light emitted during the transition process?



① a ② b ③ c
④ d ⑤ e

3. [3 points]
The figure below shows how light refracts at the boundary when it passes from medium A to medium B. If the refractive indices in medium A and medium B are n_A and n_B, the speeds of light are v_A and v_B, the wavelengths of light are λ_A and λ_B, and the frequencies of light are f_A and f_B, respectively, which of the following is correct?

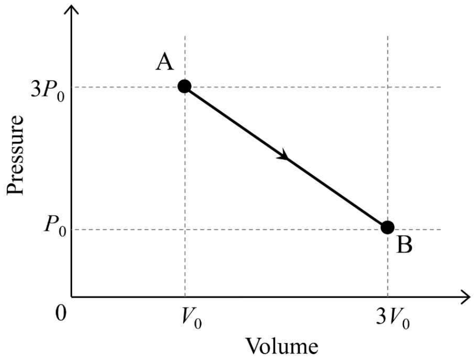


① $n_A < n_B$, $v_A < v_B$, $\lambda_A > \lambda_B$, $f_A > f_B$
② $n_A > n_B$, $v_A > v_B$, $\lambda_A < \lambda_B$, $f_A < f_B$
③ $n_A < n_B$, $v_A > v_B$, $\lambda_A > \lambda_B$, $f_A = f_B$
④ $n_A > n_B$, $v_A < v_B$, $\lambda_A > \lambda_B$, $f_A = f_B$
⑤ $n_A > n_B$, $v_A > v_B$, $\lambda_A < \lambda_B$, $f_A > f_B$

4. [3 points]
The two hypotheses of Einstein's special theory of relativity are as follows. Hypothesis 1: The (Ⓐ) is/are the same in all inertial frames of reference. Hypothesis 2: The (Ⓑ) in a vacuum is/are always constant, regardless of the motion of the light source or the observer. What are the correct words to fill in the parentheses Ⓐ and Ⓑ above?

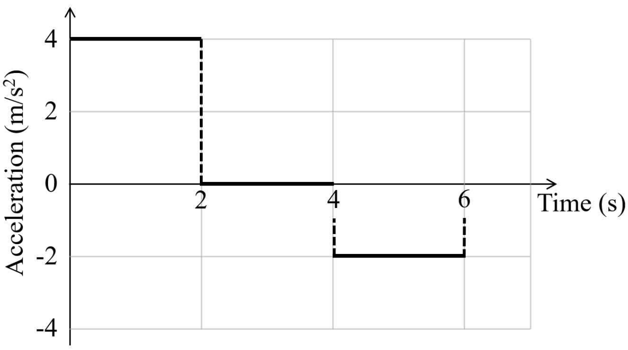
① laws of physics, energy of light
② mass of objects, speed of light
③ charge of objects, energy of light
④ laws of physics, speed of light
⑤ mass of objects, frequency of light

5. [3 points]
The figure below shows the relationship between pressure and volume when a certain amount of ideal gas changes state from A to B. How much work does the gas do on the outside while the state changes from A to B?



① P_0V_0 ② $2P_0V_0$ ③ $2.5P_0V_0$
④ $3P_0V_0$ ⑤ $4P_0V_0$

6. [5 points]
The graph below shows the acceleration over time of an object that was initially at rest and moves in a straight line. What is the total distance the object moves between 0 and 6 seconds?

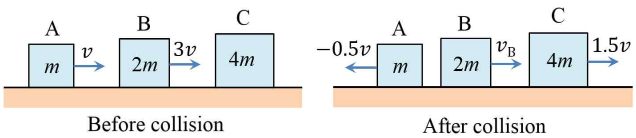


① 32 m ② 36 m ③ 42 m
④ 50 m ⑤ 72 m

7. [3 points]
Let the masses of two particles A and B be m_A and m_B, respectively. If the kinetic energy E_B of particle B is three times the kinetic energy E_A of particle A, and the de Broglie wavelength λ_B of particle B is half the de Broglie wavelength λ_A of particle A, that is, $E_B = 3E_A$, $\lambda_B = \frac{\lambda_A}{2}$, what is the mass ratio $m_A : m_B$ of the two particles?

① 3 : 4 ② 4 : 3 ③ 3 : 2
④ 2 : 3 ⑤ 4 : 9

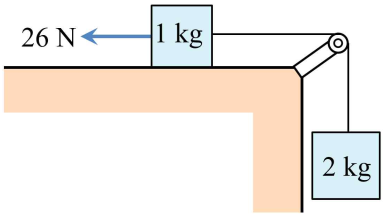
8. [4 points]
As shown in the figure below, objects A, B, and C with masses m, $2m$, and $4m$ are placed on a frictionless horizontal surface. Before collision, A is moving with a velocity of v, B with a velocity of $3v$, and C is at rest. After collision, if A moves with a velocity of $-0.5v$ and C with a velocity of $1.5v$, what will be the velocity v_B of object B?



① $0.25v$ ② $0.5v$ ③ $0.75v$
④ v ⑤ $1.25v$

9. [3 points]

As shown in the figure, objects with masses of 1 kg and 2 kg are connected by a string and are initially at rest. When a constant force of 26 N is applied to the object with mass 1 kg and moves it 1 m, what will be the speed of the two objects? (Assume that the magnitude of the gravitational acceleration is $10\ m/s^2$, and ignore the mass of the string and all frictional forces.)



① 1 m/s ② 2 m/s ③ 2.5 m/s

④ 3 m/s ⑤ 4 m/s

2025 IUT Admission Test(SOCIE)

Physics Examination(D TYPE) Answers

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○ No penalty point is applied to an incorrect answer.

Answers:

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