

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.

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1. [8 points]

When $a = \frac{\sqrt{5} + \sqrt{3}}{\sqrt{5} - \sqrt{3}}$, find $a^2 + \frac{1}{a^2}$.

- ① 60 ② 62 ③ 64 ④ 66 ⑤ 68

2. [8 points]

When α, β, γ are solutions of

$x^3 - 5x^2 + 4x + 3 = 0$, find $\frac{\alpha^2 + \beta^2 + \gamma^2}{\alpha\beta\gamma}$.

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

3. [8 points]

When $\sin 2\theta = \frac{3}{4}$ for $0 \leq \theta \leq \frac{\pi}{2}$.

find $\sin \theta + \cos \theta$.

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

4. [10 points]

Find the sum of all real solutions of

$$9^x - 3^{x+1} + \frac{12}{3^x} = 4.$$

- ① $\log_3 2$ ② $\log_3 4$ ③ $\log_3 6$
 ④ $\log_3 8$ ⑤ $\log_3 10$

5. [10 points]

When $39^x = 81$ and $13^y = \frac{1}{9}$, find $\frac{2}{x} + \frac{1}{y}$.

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

6. [10 points]

Find the sum of all solutions of

$$\cos 2x + 5 \sin^2 x = 8 \cos x + 1, \quad 0 \leq \theta \leq 2\pi.$$

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

7. [10 points]

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

- ① $\frac{11}{50}$ ② $\frac{11}{52}$ ③ $\frac{11}{54}$
 ④ $\frac{11}{56}$ ⑤ $\frac{11}{58}$

8. [12 points]

When M and m are the maximum and minimum values of $f(x) = x^3 - 6x^2 - 15x + 12$, ($-2 \leq x \leq 2$), find $M + m$.

- ① -12 ② -14 ③ -16 ④ -18 ⑤ -20

9. [12 points]

Find $\int_1^e x \ln x \, dx$.

- ① $\frac{e^2}{4}$ ② $\frac{e^2 - 2}{4}$ ③ $\frac{e^2 - 1}{4}$
④ $\frac{e^2 + 1}{4}$ ⑤ $\frac{e^2 + 2}{4}$

10. [12 points]

Find the volume of the solid obtained by rotating the region enclosed by $y = x$ and $y = \sqrt{2x^2 - 5x + 6}$ about the x -axis.

- ① $\frac{\pi}{2}$ ② $\frac{\pi}{3}$ ③ $\frac{\pi}{4}$ ④ $\frac{\pi}{5}$ ⑤ $\frac{\pi}{6}$

2025 IUT 2nd Admission Test (SOCIE Pre–University)

Solution

(1) When $a = \frac{\sqrt{5} + \sqrt{3}}{\sqrt{5} - \sqrt{3}}$, find $a^2 + \frac{1}{a^2}$.

(SOL) We note that $a^2 + \frac{1}{a^2} = \left(a + \frac{1}{a}\right)^2 - 2a \cdot \frac{1}{a} = \left(a + \frac{1}{a}\right)^2 - 2$.

Since $a + \frac{1}{a} = \frac{\sqrt{5} + \sqrt{3}}{\sqrt{5} - \sqrt{3}} + \frac{\sqrt{5} - \sqrt{3}}{\sqrt{5} + \sqrt{3}} = \frac{(\sqrt{5} + \sqrt{3})^2 + (\sqrt{5} - \sqrt{3})^2}{5 - 3} = \frac{16}{2} = 8$,

it follows that $a^2 + \frac{1}{a^2} = 64 - 2 = 62$.

(2) When α, β, γ are solutions of $x^3 - 5x^2 + 4x + 3 = 0$, find $\frac{\alpha^2 + \beta^2 + \gamma^2}{\alpha\beta\gamma}$.

(SOL) Since $\alpha + \beta + \gamma = 5$, $\alpha\beta + \beta\gamma + \gamma\alpha = 4$ and $\alpha\beta\gamma = -3$, it follows that

$$\frac{\alpha^2 + \beta^2 + \gamma^2}{\alpha\beta\gamma} = \frac{(\alpha + \beta + \gamma)^2 - 2(\alpha\beta + \beta\gamma + \gamma\alpha)}{\alpha\beta\gamma} = \frac{25 - 8}{-3} = -\frac{17}{3}.$$

(3) When $39^x = 81$ and $13^y = \frac{1}{9}$, find $\frac{2}{x} + \frac{1}{y}$.

(SOL) Since $x = \frac{\log 81}{\log 39} = \frac{4 \log 3}{\log 39}$ and $y = \frac{\log \frac{1}{9}}{\log 13} = \frac{-2 \log 3}{\log 13} = -\frac{2 \log 3}{\log 13}$, it

follows that $\frac{2}{x} + \frac{1}{y} = \frac{2 \log 39}{4 \log 3} - \frac{\log 13}{2 \log 3} = \frac{\log 39 - \log 13}{2 \log 3} = \frac{\log 3}{2 \log 3} = \frac{1}{2}$.

(4) Find the sum of all solutions of $9^x - 3^{x+1} + \frac{12}{3^x} = 4$.

(SOL) Setting $X = 3^x$, it follows that $X^2 - 3X + \frac{12}{X} - 4 = 0$. Multiplying by X , we

obtain $X^3 - 3X^2 - 4X + 12 = 0$, which is $(X-3)(X-2)(X+2) = 0$. Since

$X = 3^x > 0$, it follows that $X = 3^x = 3, 2$. Hence, $x = 1$ or $x = \log_3 2$. The sum of solutions is $1 + \log_3 2 = \log_3 3 + \log_3 2 = \log_3 6$.

(5) When $\sin 2\theta = \frac{3}{4}$ for $0 \leq \theta \leq \frac{\pi}{2}$, find $\sin \theta + \cos \theta$.

(SOL) Since $0 \leq \theta \leq \frac{\pi}{2}$, it follows that $\sin \theta \geq 0$ and $\cos \theta \geq 0$. Since

$$\sin 2\theta = \frac{3}{4} \text{ and}$$

$$(\sin \theta + \cos \theta)^2 = \sin^2 \theta + \cos^2 \theta + 2\sin \theta \cos \theta = 1 + \sin 2\theta = 1 + \frac{3}{4} = \frac{7}{4},$$

$$\text{it follows that } \sin \theta + \cos \theta = \sqrt{(\sin \theta + \cos \theta)^2} = \sqrt{\frac{7}{4}} = \frac{\sqrt{7}}{2}.$$

(6) Find the sum of all solutions of $\cos 2x + 5\sin^2 x = 8\cos x + 1$, $0 \leq \theta \leq 2\pi$.

(SOL) Since $\cos 2x = 2\cos^2 x - 1$ and $\sin^2 x = 1 - \cos^2 x$, it follows that

$$2\cos^2 x - 1 + 5 - 5\cos^2 x = 8\cos x + 1, \text{ which is } 3\cos^2 x + 8\cos x - 3 = 0.$$

Since $(3\cos x - 1)(\cos x + 3) = 0$ and $-1 \leq \cos x \leq 1$, it follows that $\cos x = \frac{1}{3}$.

If $\cos \theta = \frac{1}{3}$ with $0 \leq \theta \leq \frac{\pi}{2}$, then it follows that $x = \theta, 2\pi - \theta$ and the sum of solutions is 2π .

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

(SOL) The derivative $f'(x)$ is given as follows.

$$f'(x) = \frac{2\sqrt{x^2-x+3} - (2x-1) \cdot \frac{2x-1}{2\sqrt{x^2-x+3}}}{x^2-x+3} = \frac{2(x^2-x+3) - \frac{1}{2}(2x-1)^2}{\sqrt{x^2-x+3}^3}.$$

$$\text{Hence, } f'(3) = \frac{18 - \frac{25}{2}}{27} = \frac{36-25}{54} = \frac{11}{54}.$$

(8) When M and m are the maximum and minimum values of

$f(x) = x^3 - 6x^2 - 15x + 12$, $(-2 \leq x \leq 2)$, find $M + m$.

(SOL) Since $f'(x) = 3x^2 - 12x - 15 = 3(x^2 - 4x - 5) = 3(x-5)(x+1)$, $f(x)$ has critical points at $x = -1, 5$. Since $f(-2) = -8 - 24 + 30 + 12 = 10$,

$f(2) = 8 - 24 - 30 + 12 = -34$ and $f(-1) = -1 - 6 + 15 + 12 = 20$, it follows that $M = 20$, $m = -34$ and hence, $M + m = -14$.

(9) Find $\int_1^e x \ln x \, dx$.

(SOL) Using integration by parts, it follows that

$$\int x \ln x \, dx = \frac{1}{2} x^2 \ln x - \int \frac{1}{2} x^2 \frac{1}{x} \, dx = \frac{x^2}{2} \ln x - \int \frac{x}{2} \, dx = \frac{x^2}{2} \ln x - \frac{x^2}{4} + C.$$

Hence, it follows that

$$\int_1^e x \ln x \, dx = \left[\frac{x^2}{2} \ln x - \frac{x^2}{4} \right]_1^e = \frac{e^2}{2} - \frac{e^2}{4} + \frac{1}{4} = \frac{e^2 + 1}{4}.$$

(10) Find the volume of the solid obtained by rotating the region enclosed by $y = x$ and $y = \sqrt{2x^2 - 5x + 6}$ about the x -axis.

(SOL) From $x = \sqrt{2x^2 - 5x + 6}$, it follows that $x^2 - 5x + 6 = (x - 2)(x - 3) = 0$.

Hence, two graphs meet at $x = 2, 3$. The volume is given by

$$\begin{aligned} \int_2^3 \pi (x^2 - \sqrt{2x^2 - 5x + 6})^2 \, dx &= \pi \int_2^3 (-x^2 + 5x - 6) \, dx = \pi \left[-\frac{1}{3} x^3 + \frac{5}{2} x^2 - 6x \right]_2^3 \\ &= \pi \left(-9 + \frac{45}{2} - 18 - \left(-\frac{8}{3} + 10 - 12 \right) \right) = \frac{\pi}{6}. \end{aligned}$$

2025 IUT Admission Test (SOCIE, Pre–University)

Math Examination (B TYPE)

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1. [8 points]

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2. [8 points]

When $\sin 2\theta = \frac{3}{4}$ for $0 \leq \theta \leq \frac{\pi}{2}$.

find $\sin \theta + \cos \theta$.

- ① $\frac{\sqrt{2}}{2}$ ② $\frac{\sqrt{3}}{2}$ ③ $\frac{\sqrt{5}}{2}$
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3. [8 points]

When $a = \frac{\sqrt{5} + \sqrt{3}}{\sqrt{5} - \sqrt{3}}$, find $a^2 + \frac{1}{a^2}$.

- ① 60 ② 62 ③ 64 ④ 66 ⑤ 68

4. [10 points]

When $39^x = 81$ and $13^y = \frac{1}{9}$, find $\frac{2}{x} + \frac{1}{y}$.

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5. [10 points]

Find the sum of all solutions of

$$\cos 2x + 5 \sin^2 x = 8 \cos x + 1, \quad 0 \leq \theta \leq 2\pi.$$

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

6. [10 points]

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

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When $\sin 2\theta = \frac{3}{4}$ for $0 \leq \theta \leq \frac{\pi}{2}$.

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2. [8 points]

When $a = \frac{\sqrt{5} + \sqrt{3}}{\sqrt{5} - \sqrt{3}}$, find $a^2 + \frac{1}{a^2}$.

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4. [10 points]

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5. [10 points]

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Math Examination (D TYPE)

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1. [8 points]

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4. [10 points]

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

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5. [10 points]

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7. [10 points]

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- ① -12 ② -14 ③ -16 ④ -18 ⑤ -20

2025 IUT 2nd Pre-SOCIE Answer Sheets

[TypeA]

No.	1	2	3	4	5	6	7	8	9	10
Ans.	②	④	⑤	③	①	①	③	②	④	⑤

[TypeB]

No.	1	2	3	4	5	6	7	8	9	10
Ans.	④	⑤	②	①	①	③	③	④	⑤	②

[TypeC]

No.	1	2	3	4	5	6	7	8	9	10
Ans.	⑤	②	④	①	③	③	①	⑤	②	④

[TypeD]

No.	1	2	3	4	5	6	7	8	9	10
Ans.	④	②	⑤	③	③	①	①	④	⑤	②

2025 IUT Admission Test(SOCIE)
Physics Examination(A TYPE)

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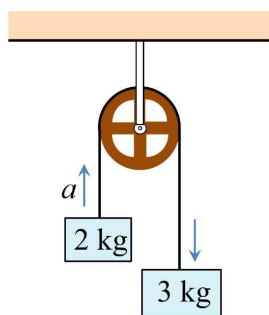
1. [8 points]

A train of length l runs on a straight rail with constant acceleration. The front of the train passes a certain point at a speed of v_0 , and the rear of the train passes the point at a speed of v . Find the acceleration of the train.

- ① $\frac{v - v_0}{2l}$ ② $\frac{v - v_0}{l}$ ③ $\frac{v^2 - v_0^2}{2l}$
 ④ $\frac{v^2 - v_0^2}{l}$ ⑤ $\frac{2(v^2 - v_0^2)}{l}$

2. [10 points]

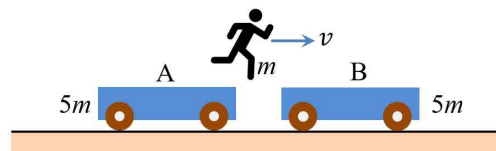
The figure shows objects with masses of 2 kg and 3 kg connected by a string through a pulley. Find the magnitude of the acceleration a of the two objects. (Ignore the mass of the pulley and string, and assume that there is no friction and the magnitude of gravitational acceleration is 10 m/s^2 .)



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

3. [12 points]

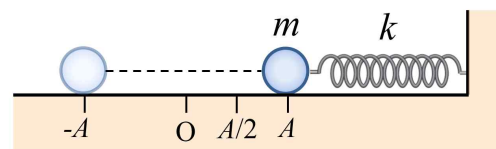
The figure below shows two carts A and B, each of mass $5m$, at rest on a frictionless horizontal surface. A person of mass m riding on cart A was also initially at rest. Now, the person jumps from cart A onto cart B with a horizontal velocity v . After landing on cart B, the person moves together with cart B. Find the ratio ($v_A : v_B$) of the velocity of cart A and the velocity of cart B at the final stage.



- ① $-1 : 1$ ② $1 : 1$ ③ $-5 : 6$
 ④ $-6 : 5$ ⑤ $5 : 6$

4. [12 points]

As shown in the figure, an object hanging from a spring with one end fixed on a frictionless horizontal surface is pulled by an distance A and then released. The object undergoes a simple oscillation with an amplitude A . The spring constant is k , and the mass of the object is m . What is the speed of the object when it passes the position $x = A/2$, which is half the amplitude?



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

5. [10 points]

When a 0.1 kg copper ball at 100°C is placed in an oil with mass of 0.2 kg at 10°C , the temperature becomes 30°C . What is the specific heat of this oil? (However, the specific heat of copper is $400\text{ J/kg}\cdot^\circ\text{C}$ and assume that no heat is released to the outside.)

- ① $300\text{ J/kg}\cdot^\circ\text{C}$ ② $400\text{ J/kg}\cdot^\circ\text{C}$
 ③ $500\text{ J/kg}\cdot^\circ\text{C}$ ④ $600\text{ J/kg}\cdot^\circ\text{C}$
 ⑤ $700\text{ J/kg}\cdot^\circ\text{C}$

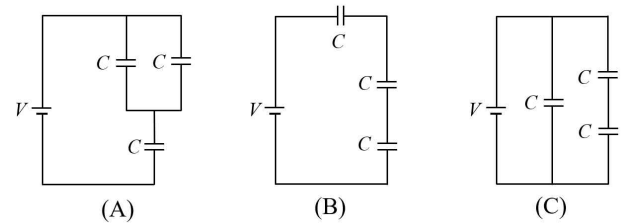
6. [12 points]

An ideal gas at absolute temperature 100 K is contained in a cylinder with a piston that moves without friction. The pressure of the gas is 1 atm and its volume is 1.0 m^3 . Now, while maintaining the pressure at 1 atm , the temperature is raised from 100 K to 300 K by heating from the outside. How much work did the gas do on the outside during the heating? (Note that 1 atm is $1.0\times 10^5\text{ Pa}$.)

- ① $1.0\times 10^5\text{ J}$ ② $2.0\times 10^5\text{ J}$ ③ $3.0\times 10^5\text{ J}$
 ④ $4.0\times 10^5\text{ J}$ ⑤ $5.0\times 10^5\text{ J}$

7. [10 points]

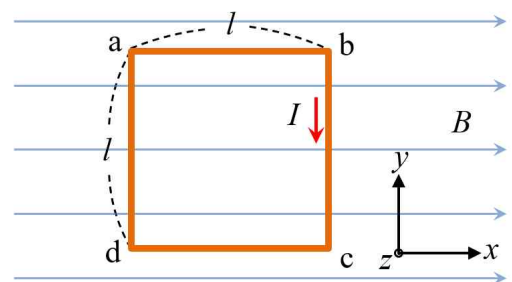
Three capacitors, each with a capacitance of C , are connected to a power source with the same voltage of V , as shown in Figures (A), (B), and (C). When the combined capacitances of (A), (B), and (C) are C_A , C_B , and C_C , which is the correct comparison of their sizes?



- ① $C_A > C_B > C_C$ ② $C_B > C_A > C_C$
 ③ $C_B > C_C > C_A$ ④ $C_C > C_A > C_B$
 ⑤ $C_C > C_B > C_A$

8. [12 points]

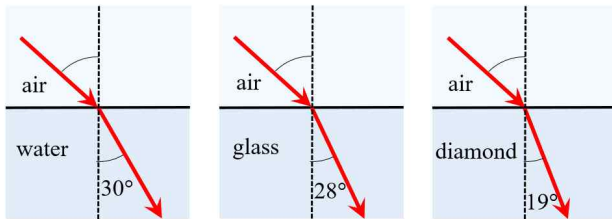
As shown in the figure below, a square wire with a side length of l is placed in a uniform magnetic field B along the x -axis, and a current of I flows clockwise through the wire. What will be the magnitude and direction of the force acting on wires \overline{ab} and \overline{bc} ? (In the figure, the direction of the z -axis is the direction coming out of the page.)



- | | | |
|---|---------------------------|---------------------------|
| | \overline{ab} | \overline{bc} |
| ① | 0 | BI^2l ($-z$ direction) |
| ② | BIl ($+x$ direction) | 0 |
| ③ | 0 | BIl ($+z$ direction) |
| ④ | BIl ($-x$ direction) | 0 |
| ⑤ | BI^2l ($-x$ direction) | BI^2l ($-y$ direction) |

9. [8 points]

The figure below shows how light refracts as it enters water, glass, and diamond from air at the same angle of incidence. Which of the following correctly compares the magnitude of the refractive index in each medium? (Here, n_w , n_g , and n_d represent the refractive indices of water, glass, and diamond, respectively.)



- ① $n_w < n_g < n_d$ ② $n_w < n_d < n_g$
③ $n_g < n_w < n_d$ ④ $n_g < n_d < n_w$
⑤ $n_d < n_g < n_w$

10. [8 points]

Below are statements about the properties of an electromagnetic wave.

- (a) It is a transverse wave.
(b) It travels without a medium.
(c) The speed in a vacuum is faster as the frequency increases.
(d) It causes interference and diffraction phenomena.

Choose all the correct statements among the above statements.

- ① (a), (b), (c) ② (b), (c), (d) ③ (a), (c), (d)
④ (a), (b) ⑤ (a), (b), (d)

2025 IUT Admission Test(SOCIE)
Physics Examination(A TYPE)

Answers

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

2025 IUT Admission Test(SOCIE)

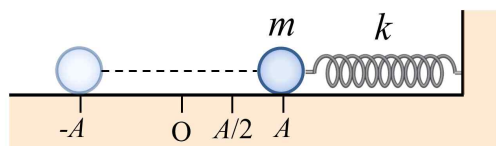
Physics Examination(B TYPE)

<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. [12 points]

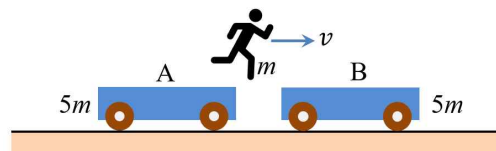
As shown in the figure, an object hanging from a spring with one end fixed on a frictionless horizontal surface is pulled by a distance A and then released. The object undergoes a simple oscillation with an amplitude A . The spring constant is k , and the mass of the object is m . What is the speed of the object when it passes the position $x = A/2$, which is half the amplitude?



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

2. [12 points]

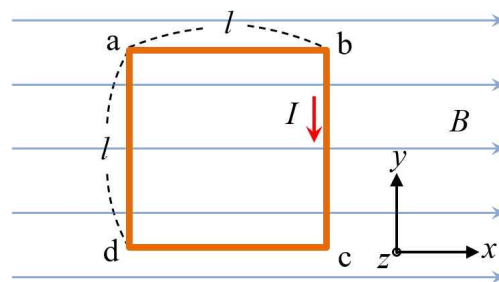
The figure below shows two carts A and B, each of mass $5m$, at rest on a frictionless horizontal surface. A person of mass m riding on cart A was also initially at rest. Now, the person jumps from cart A onto cart B with a horizontal velocity v . After landing on cart B, the person moves together with cart B. Find the ratio ($v_A : v_B$) of the velocity of cart A and the velocity of cart B at the final stage.



- ① $-1 : 1$
- ② $1 : 1$
- ③ $-5 : 6$
- ④ $-6 : 5$
- ⑤ $5 : 6$

3. [12 points]

As shown in the figure below, a square wire with a side length of l is placed in a uniform magnetic field B along the x -axis, and a current of I flows clockwise through the wire. What will be the magnitude and direction of the force acting on wires \overline{ab} and \overline{bc} ? (In the figure, the direction of the z -axis is the direction coming out of the page.)



- | | \overline{ab} | \overline{bc} |
|---|---------------------------|---------------------------|
| ① | 0 | BI^2l ($-z$ direction) |
| ② | BIl ($+x$ direction) | 0 |
| ③ | 0 | BIl ($+z$ direction) |
| ④ | BIl ($-x$ direction) | 0 |
| ⑤ | BI^2l ($-x$ direction) | BI^2l ($-y$ direction) |

4. [8 points]

Below are statements about the properties of an electromagnetic wave.

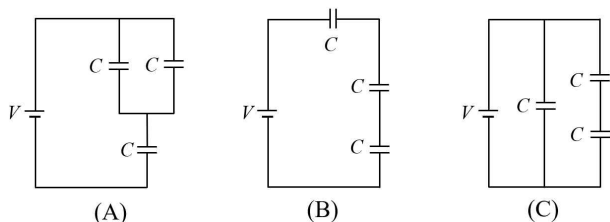
- (a) It is a transverse wave.
- (b) It travels without a medium.
- (c) The speed in a vacuum is faster as the frequency increases.
- (d) It causes interference and diffraction phenomena.

Choose all the correct statements among the above statements.

- ① (a), (b), (c) ② (b), (c), (d) ③ (a), (c), (d)
- ④ (a), (b) ⑤ (a), (b), (d)

5. [10 points]

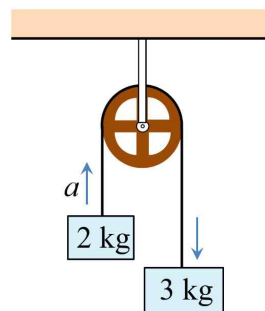
Three capacitors, each with a capacitance of C , are connected to a power source with the same voltage of V , as shown in Figures (A), (B), and (C). When the combined capacitances of (A), (B), and (C) are C_A , C_B , and C_C , which is the correct comparison of their sizes?



- ① $C_A > C_B > C_C$ ② $C_B > C_A > C_C$
- ③ $C_B > C_C > C_A$ ④ $C_C > C_A > C_B$
- ⑤ $C_C > C_B > C_A$

6. [10 points]

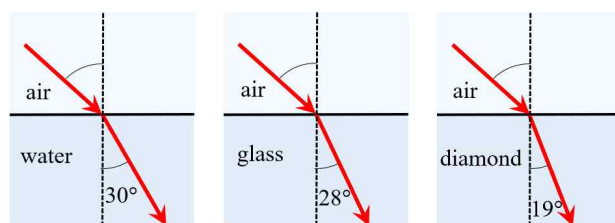
The figure shows objects with masses of 2 kg and 3 kg connected by a string through a pulley. Find the magnitude of the acceleration a of the two objects. (Ignore the mass of the pulley and string, and assume that there is no friction and the magnitude of gravitational acceleration is 10 m/s^2 .)



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

7. [8 points]

The figure below shows how light refracts as it enters water, glass, and diamond from air at the same angle of incidence. Which of the following correctly compares the magnitude of the refractive index in each medium? (Here, n_w , n_g , and n_d represent the refractive indices of water, glass, and diamond, respectively.)



- ① $n_w < n_g < n_d$ ② $n_w < n_d < n_g$
- ③ $n_g < n_w < n_d$ ④ $n_g < n_d < n_w$
- ⑤ $n_d < n_g < n_w$

8. [10 points]

When a 0.1 kg copper ball at $100\text{ }^\circ\text{C}$ is placed in an oil with mass of 0.2 kg at $10\text{ }^\circ\text{C}$, the temperature becomes $30\text{ }^\circ\text{C}$. What is the specific heat of this oil? (However, the specific heat of copper is $400\text{ J/kg}\cdot^\circ\text{C}$ and assume that no heat is released to the outside.)

- ① $300\text{ J/kg}\cdot^\circ\text{C}$ ② $400\text{ J/kg}\cdot^\circ\text{C}$
③ $500\text{ J/kg}\cdot^\circ\text{C}$ ④ $600\text{ J/kg}\cdot^\circ\text{C}$
⑤ $700\text{ J/kg}\cdot^\circ\text{C}$

9. [8 points]

A train of length l runs on a straight rail with constant acceleration. The front of the train passes a certain point at a speed of v_0 , and the rear of the train passes the point at a speed of v . Find the acceleration of the train.

- ① $\frac{v-v_0}{2l}$ ② $\frac{v-v_0}{l}$ ③ $\frac{v^2-v_0^2}{2l}$
④ $\frac{v^2-v_0^2}{l}$ ⑤ $\frac{2(v^2-v_0^2)}{l}$

10. [12 points]

An ideal gas at absolute temperature 100 K is contained in a cylinder with a piston that moves without friction. The pressure of the gas is 1 atm and its volume is 1.0 m^3 . Now, while maintaining the pressure at 1 atm , the temperature is raised from 100 K to 300 K by heating from the outside. How much work did the gas do on the outside during the heating? (Note that 1 atm is $1.0\times 10^5\text{ Pa}$.)

- ① $1.0\times 10^5\text{ J}$ ② $2.0\times 10^5\text{ J}$ ③ $3.0\times 10^5\text{ J}$
④ $4.0\times 10^5\text{ J}$ ⑤ $5.0\times 10^5\text{ J}$

2025 IUT Admission Test(SOCIE)
Physics Examination(B TYPE)

Answers

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

2025 IUT Admission Test(SOCIE)

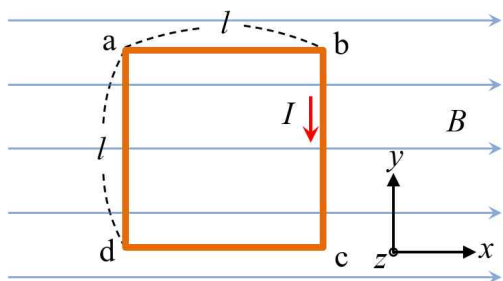
Physics Examination(C TYPE)

<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. [12 points]

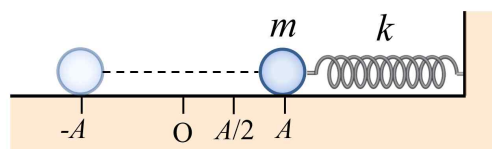
As shown in the figure below, a square wire with a side length of l is placed in a uniform magnetic field B along the x -axis, and a current of I flows clockwise through the wire. What will be the magnitude and direction of the force acting on wires \overline{ab} and \overline{bc} ? (In the figure, the direction of the z -axis is the direction coming out of the page.)



- | | \overline{ab} | \overline{bc} |
|---|---------------------------|---------------------------|
| ① | 0 | BI^2l ($-z$ direction) |
| ② | BIl ($+x$ direction) | 0 |
| ③ | 0 | BIl ($+z$ direction) |
| ④ | BIl ($-x$ direction) | 0 |
| ⑤ | BI^2l ($-x$ direction) | BI^2l ($-y$ direction) |

2. [12 points]

As shown in the figure, an object hanging from a spring with one end fixed on a frictionless horizontal surface is pulled by an distance A and then released. The object undergoes a simple oscillation with an amplitude A . The spring constant is k , and the mass of the object is m . What is the speed of the object when it passes the position $x = A/2$, which is half the amplitude?



- | | | |
|-------------------------------------|-------------------------------------|---------------------------|
| ① $\sqrt{\frac{3k}{m}} \frac{A}{2}$ | ② $\sqrt{\frac{k}{m}} \frac{A}{2}$ | ③ $\sqrt{\frac{2k}{m}} A$ |
| ④ $\sqrt{\frac{3k}{m}} A$ | ⑤ $\sqrt{\frac{2k}{m}} \frac{A}{3}$ | |

3. [8 points]

Below are statements about the properties of an electromagnetic wave.

- (a) It is a transverse wave.
 - (b) It travels without a medium.
 - (c) The speed in a vacuum is faster as the frequency increases.
 - (d) It causes interference and diffraction phenomena.
- Choose all the correct statements among the above statements.

- | | | | |
|-----------------|-----------------|-----------------|--|
| ① (a), (b), (c) | ② (b), (c), (d) | ③ (a), (c), (d) | |
| ④ (a), (b) | ⑤ (a), (b), (d) | | |

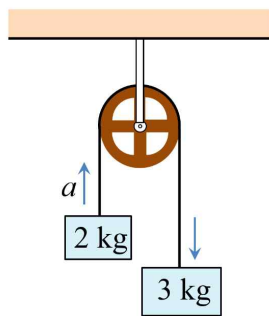
4. [12 points]

An ideal gas at absolute temperature 100 K is contained in a cylinder with a piston that moves without friction. The pressure of the gas is 1 atm and its volume is 1.0 m^3 . Now, while maintaining the pressure at 1 atm, the temperature is raised from 100 K to 300 K by heating from the outside. How much work did the gas do on the outside during the heating? (Note that 1 atm is $1.0 \times 10^5 \text{ Pa}$.)

- ① $1.0 \times 10^5 \text{ J}$ ② $2.0 \times 10^5 \text{ J}$ ③ $3.0 \times 10^5 \text{ J}$
 ④ $4.0 \times 10^5 \text{ J}$ ⑤ $5.0 \times 10^5 \text{ J}$

5. [10 points]

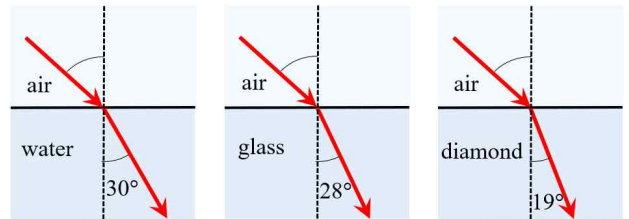
The figure shows objects with masses of 2 kg and 3 kg connected by a string through a pulley. Find the magnitude of the acceleration a of the two objects. (Ignore the mass of the pulley and string, and assume that there is no friction and the magnitude of gravitational acceleration is 10 m/s^2 .)



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

6. [8 points]

The figure below shows how light refracts as it enters water, glass, and diamond from air at the same angle of incidence. Which of the following correctly compares the magnitude of the refractive index in each medium? (Here, n_w , n_g , and n_d represent the refractive indices of water, glass, and diamond, respectively.)



- ① $n_w < n_g < n_d$ ② $n_w < n_d < n_g$
 ③ $n_g < n_w < n_d$ ④ $n_g < n_d < n_w$
 ⑤ $n_d < n_g < n_w$

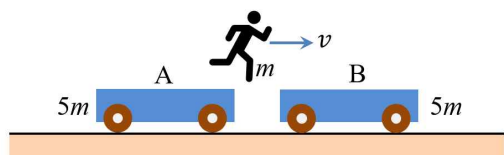
7. [8 points]

A train of length l runs on a straight rail with constant acceleration. The front of the train passes a certain point at a speed of v_0 , and the rear of the train passes the point at a speed of v . Find the acceleration of the train.

- ① $\frac{v - v_0}{2l}$ ② $\frac{v - v_0}{l}$ ③ $\frac{v^2 - v_0^2}{2l}$
 ④ $\frac{v^2 - v_0^2}{l}$ ⑤ $\frac{2(v^2 - v_0^2)}{l}$

8. [12 points]

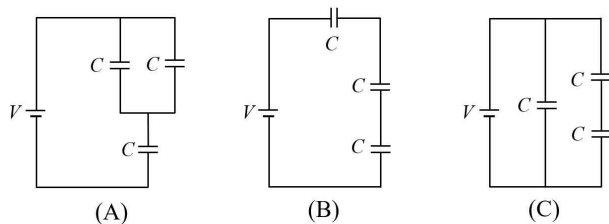
The figure below shows two carts A and B, each of mass $5m$, at rest on a frictionless horizontal surface. A person of mass m riding on cart A was also initially at rest. Now, the person jumps from cart A onto cart B with a horizontal velocity v . After landing on cart B, the person moves together with cart B. Find the ratio ($v_A : v_B$) of the velocity of cart A and the velocity of cart B at the final stage.



- ① $-1:1$ ② $1:1$ ③ $-5:6$
 ④ $-6:5$ ⑤ $5:6$

9. [10 points]

Three capacitors, each with a capacitance of C , are connected to a power source with the same voltage of V , as shown in Figures (A), (B), and (C). When the combined capacitances of (A), (B), and (C) are C_A , C_B , and C_C , which is the correct comparison of their sizes?



- ① $C_A > C_B > C_C$ ② $C_B > C_A > C_C$
 ③ $C_B > C_C > C_A$ ④ $C_C > C_A > C_B$
 ⑤ $C_C > C_B > C_A$

10. [10 points]

When a 0.1 kg copper ball at 100°C is placed in an oil with mass of 0.2 kg at 10°C , the temperature becomes 30°C . What is the specific heat of this oil? (However, the specific heat of copper is $400 \text{ J/kg} \cdot ^\circ\text{C}$ and assume that no heat is released to the outside.)

- ① $300 \text{ J/kg} \cdot ^\circ\text{C}$ ② $400 \text{ J/kg} \cdot ^\circ\text{C}$
 ③ $500 \text{ J/kg} \cdot ^\circ\text{C}$ ④ $600 \text{ J/kg} \cdot ^\circ\text{C}$
 ⑤ $700 \text{ J/kg} \cdot ^\circ\text{C}$

2025 IUT Admission Test(SOCIE)
Physics Examination(C TYPE)

Answers

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

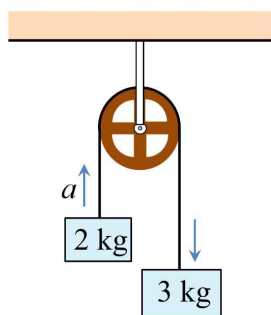
2025 IUT Admission Test(SOCIE)
Physics Examination(D TYPE)

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

- 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 points]

The figure shows objects with masses of 2 kg and 3 kg connected by a string through a pulley. Find the magnitude of the acceleration a of the two objects. (Ignore the mass of the pulley and string, and assume that there is no friction and the magnitude of gravitational acceleration is 10 m/s^2 .)



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

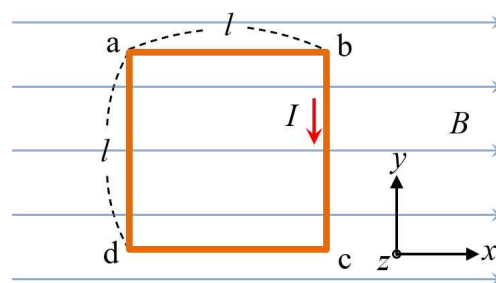
2. [12 points]

An ideal gas at absolute temperature 100 K is contained in a cylinder with a piston that moves without friction. The pressure of the gas is 1 atm and its volume is 1.0 m^3 . Now, while maintaining the pressure at 1 atm , the temperature is raised from 100 K to 300 K by heating from the outside. How much work did the gas do on the outside during the heating? (Note that 1 atm is $1.0 \times 10^5 \text{ Pa}$.)

- ① $1.0 \times 10^5 \text{ J}$ ② $2.0 \times 10^5 \text{ J}$ ③ $3.0 \times 10^5 \text{ J}$
 ④ $4.0 \times 10^5 \text{ J}$ ⑤ $5.0 \times 10^5 \text{ J}$

3. [12 points]

As shown in the figure below, a square wire with a side length of l is placed in a uniform magnetic field B along the x -axis, and a current of I flows clockwise through the wire. What will be the magnitude and direction of the force acting on wires \overline{ab} and \overline{bc} ? (In the figure, the direction of the z -axis is the direction coming out of the page.)



- | | \overline{ab} | \overline{bc} |
|---|---------------------------|---------------------------|
| ① | 0 | BI^2l ($-z$ direction) |
| ② | BIl ($+x$ direction) | 0 |
| ③ | 0 | BIl ($+z$ direction) |
| ④ | BIl ($-x$ direction) | 0 |
| ⑤ | BI^2l ($-x$ direction) | BI^2l ($-y$ direction) |

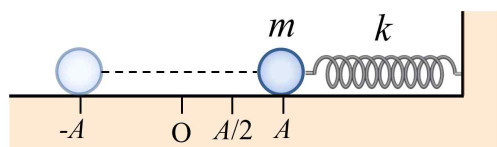
4. [10 points]

When a 0.1 kg copper ball at 100°C is placed in an oil with mass of 0.2 kg at 10°C , the temperature becomes 30°C . What is the specific heat of this oil? (However, the specific heat of copper is $400 \text{ J/kg} \cdot ^\circ\text{C}$ and assume that no heat is released to the outside.)

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 ③ $500 \text{ J/kg} \cdot ^\circ\text{C}$ ④ $600 \text{ J/kg} \cdot ^\circ\text{C}$
 ⑤ $700 \text{ J/kg} \cdot ^\circ\text{C}$

5. [12 points]

As shown in the figure, an object hanging from a spring with one end fixed on a frictionless horizontal surface is pulled by an distance A and then released. The object undergoes a simple oscillation with an amplitude A . The spring constant is k , and the mass of the object is m . What is the speed of the object when it passes the position $x = A/2$, which is half the amplitude?



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

6. [8 points]

Below are statements about the properties of an electromagnetic wave.

- (a) It is a transverse wave.
 (b) It travels without a medium.
 (c) The speed in a vacuum is faster as the frequency increases.
 (d) It causes interference and diffraction phenomena.
 Choose all the correct statements among the above statements.

- ① (a), (b), (c) ② (b), (c), (d) ③ (a), (c), (d)
 ④ (a), (b) ⑤ (a), (b), (d)

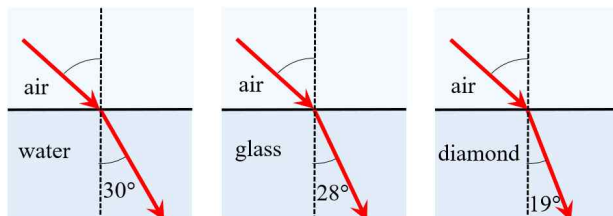
7. [8 points]

A train of length l runs on a straight rail with constant acceleration. The front of the train passes a certain point at a speed of v_0 , and the rear of the train passes the point at a speed of v . Find the acceleration of the train.

- ① $\frac{v - v_0}{2l}$ ② $\frac{v - v_0}{l}$ ③ $\frac{v^2 - v_0^2}{2l}$
 ④ $\frac{v^2 - v_0^2}{l}$ ⑤ $\frac{2(v^2 - v_0^2)}{l}$

8. [8 points]

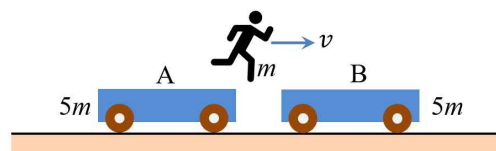
The figure below shows how light refracts as it enters water, glass, and diamond from air at the same angle of incidence. Which of the following correctly compares the magnitude of the refractive index in each medium? (Here, n_w , n_g , and n_d represent the refractive indices of water, glass, and diamond, respectively.)



- ① $n_w < n_g < n_d$ ② $n_w < n_d < n_g$
 ③ $n_g < n_w < n_d$ ④ $n_g < n_d < n_w$
 ⑤ $n_d < n_g < n_w$

9. [12 points]

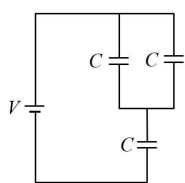
The figure below shows two carts A and B, each of mass $5m$, at rest on a frictionless horizontal surface. A person of mass m riding on cart A was also initially at rest. Now, the person jumps from cart A onto cart B with a horizontal velocity v . After landing on cart B, the person moves together with cart B. Find the ratio ($v_A : v_B$) of the velocity of cart A and the velocity of cart B at the final stage.



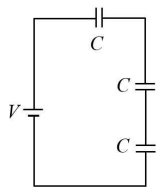
- ① $-1 : 1$ ② $1 : 1$ ③ $-5 : 6$
 ④ $-6 : 5$ ⑤ $5 : 6$

10. [10 points]

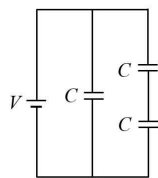
Three capacitors, each with a capacitance of C , are connected to a power source with the same voltage of V , as shown in Figures (A), (B), and (C). When the combined capacitances of (A), (B), and (C) are C_A , C_B , and C_C , which is the correct comparison of their sizes?



(A)



(B)



(C)

- ① $C_A > C_B > C_C$ ② $C_B > C_A > C_C$
③ $C_B > C_C > C_A$ ④ $C_C > C_A > C_B$
⑤ $C_C > C_B > C_A$

2025 IUT Admission Test(SOCIE)
Physics Examination(D TYPE)

Answers

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

2025 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. [8 points]

Using the equation for linear uniform acceleration motion, $2as = v^2 - v_0^2$, acceleration a is calculated

$$a = \frac{v^2 - v_0^2}{2l}.$$

Answer) ③ $\frac{v^2 - v_0^2}{2l}$

2. [10 points]

The net force acting on two objects is the difference between the gravitational forces acting on each object, so the net force is

$$F = (3 \text{ kg})(10 \text{ m/s}^2) - (2 \text{ kg})(10 \text{ m/s}^2) = 10 \text{ N}.$$

Since the total mass of the objects is 5 kg,

$$F = 10 \text{ N} = (5 \text{ kg})a.$$

Therefore, the acceleration is $a = 2 \text{ m/s}^2$.

Answer) ② 2 m/s^2

3. [12 points]

If we apply the law of conservation of momentum before and after the person jumps from cart A with horizontal speed v , $0 = mv + 5mv_A$. Therefore,

$$v_A = -\frac{1}{5}v.$$

If we apply the law of conservation of momentum before and after the person lands onto cart B, $mv = (m + 5m)v_B$. Therefore, $v_B = \frac{1}{6}v$.

$$\text{Therefore, } v_A : v_B = -\frac{1}{5} : \frac{1}{6} = -6 : 5.$$

Answer) ④ $-6 : 5$

4. [12 points]

In simple vibration of a spring, the mechanical energy

$$E = \frac{1}{2}kA^2 = \frac{1}{2}mv^2 + \frac{1}{2}kx^2.$$

The speed v can be

found when $x = \frac{A}{2}$. From

$$\frac{1}{2}kA^2 = \frac{1}{2}mv^2 + \frac{1}{2}k\left(\frac{A}{2}\right)^2, \quad v = \sqrt{\frac{3k}{m}} \frac{A}{2}.$$

Answer) ① $\sqrt{\frac{3k}{m}} \frac{A}{2}$

5. [10 points]

The amount of heat required to change the temperature of a substance with mass m and specific heat c by ΔT is $Q = mc\Delta T$. Since the heat lost by the copper ball is equal to the heat gained by the oil,

$$(0.1 \text{ kg})(400 \text{ J/kg} \cdot ^\circ\text{C})(100^\circ\text{C} - 30^\circ\text{C}) = (0.2 \text{ kg})(30^\circ\text{C} - 10^\circ\text{C})c.$$

Therefore, $c = 700 \text{ J/kg} \cdot ^\circ\text{C}$.

Answer) ⑤ $700 \text{ J/kg} \cdot ^\circ\text{C}$

6. [12 points]

From the ideal gas equation $PV = nRT$, when the pressure P is kept constant, the volume V is proportional to the absolute temperature T . Therefore, if the temperature is increased from 100 K to 300 K, the volume triples to 3.0 m^3 . Therefore, the work done by the gas on the outside is

$$W = \int P dV = P \Delta V = (1.0 \times 10^5 \text{ Pa})(3.0 \text{ m}^3 - 1.0 \text{ m}^3) = 2.0 \times 10^5 \text{ J}.$$

Answer) ② $2.0 \times 10^5 \text{ J}$

7. [10 points]

The combined capacitance C of the capacitances C_1 and C_2 is $\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2}$ in the case of a series connection and $C = C_1 + C_2$ in the case of a parallel connection, so the combined capacitances of Figures (A), (B), and (C) are as follows.

$$(A) C_A = \frac{1}{\frac{1}{2C} + \frac{1}{C}} = \frac{2}{3} C$$

$$(B) C_B = \frac{1}{\frac{1}{C} + \frac{1}{C} + \frac{1}{C}} = \frac{1}{3} C$$

$$(C) C_C = \frac{1}{\frac{1}{C} + \frac{1}{C}} + C = \frac{3}{2} C$$

Therefore, $C_C > C_A > C_B$.

Answer) ④ $C_C > C_A > C_B$

8. [12 points]

The force acting on a wire of length l carrying a current I in a magnetic field B is $F = BIl \sin \theta$.

Therefore, the conductor \overline{ab} is parallel to the magnetic field, so the force $F = 0$, and the conductor \overline{bc} is perpendicular to the magnetic field, so $F = BIl$ and the direction is $+z$ direction.

Answer) ③ \overline{ab} : 0, \overline{bc} : BIl ($+z$ direction)

9. [8 points]

From Snell's law $n_1 \sin \theta_1 = n_2 \sin \theta_2$, when n_1 and θ_1 are equal, n_2 is inversely proportional to $\sin \theta_2$. That is, the smaller the refraction angle, the higher the refractive index. Therefore, $n_w < n_g < n_d$.

Answer) ① $n_w < n_g < n_d$

10. [8 points]

(c) The speed of electromagnetic waves in a vacuum is constant, independent of frequency. All other statements are correct.

Answer) ⑤ (a), (b), (d)