

Student's full name:

Class/programme:

Student ID number:

Signature of the exam invigilator



Chú ý: ghi đầy đủ họ và tên và MSSV vào phần trên tờ giấy này. Sử dụng phương pháp làm tròn thông thường để làm tròn đáp số. Trích trả lời ngắn gọn bằng cách tô vào phần ANSWER SHEET.

Signature of the examiner

SCORE

MCQ ANSWER SHEET

	A	B	C	D
Q1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Q2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Q3	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Q4	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Q5	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	A	B	C	D
Q6	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Q7	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Q8	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Q9	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Q10	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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Q11	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Q12	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Q13	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Q14	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Q15	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

MULTI-CHOICE QUESTIONS

Q1. Which of the following gives the correct unit of gas constant R ?

☒ A. 8.31 J/mol

B. 8.31 J

C. 8.31 J/mol

D. 8.31 mol/J

Q2. What is the unit of angular momentum L of a rotation object?

A. N

B. $\text{kg} \cdot \text{m}^2/\text{s}^2$

C. $\text{kg} \cdot \text{m}^2$

☒ D. $\text{kg} \cdot \text{m}^2/\text{s}$

Q3. A stone is thrown straight up. In which situation is the vertical velocity zero?

A. on the way up

☒ B. at the top

C. on the way back down

D. none of the above

Q4. The kinetic energy of a rocket is increased by a factor of four after its engines are fired, whereas its total mass is reduced by half through the burning of fuel. By what factor is the magnitude of its momentum changed?

A. 8

B. 4

☒ C. $\sqrt{2}$

D. $2\sqrt{2}$

Q5. A 2.0-kg object moving to the right with a speed of 5.0 m/s makes a head-on elastic collision with a 1.0-kg object that is initially at rest. The velocity of the 1.0-kg object after the collision is

A. greater than 5 m/s.

B. less than 5 m/s.

C. equal to 5 m/s.

D. impossible to say based on the information provided.

Q6. A cannon with mass $M = 450$ kg initially at rest shoots 6 kg shell with muzzle speed $v = 450$ m/s. As the shell leaves the barrel, the cannon is moved back a distance $s = 45$ cm. What is the average force put on the brake?

A. 17950 N

B. 18000 N

C. 17760 N

D. 17850 N

Q7. When you toss a ball upward with a certain initial speed, it reaches a maximum height h after it leaves your hand. If you throw the ball upward with double the initial speed, new maximum height the ball reaches is

A. $h\sqrt{2}$

B. $8h$

C. $4h$

D. $2h$

Q8. For the thermodynamic process, work is a

- A. path function. (Hàm của quá trình.) B. point function. Hàm của vị trí.
C. depends on the state. (hàm trạng thái.) D. none of the mentioned.

Q9. Two cylinders X and Y, at the same temperature, contain the same quantity of the same kind of gas. Cylinder X has three times the volume of cylinder Y. What can you conclude about the pressures the gases exert?

- A. We can conclude nothing about the pressures.
B. The pressure in X is three times the pressure in Y.
C. The pressure in X must be one-third the pressure in Y.
D. The pressures in X and Y must be equal.

Q10. If the volume of an ideal gas is doubled while its temperature is quadrupled, does the pressure

- A. remain the same B. increase by a factor of 2
C. decrease by a factor of 2 D. decrease by a factor of 4

Q11. What is the average kinetic energy of a molecule of Helium (He) at a temperature of 300 K?

- A. 2.07×10^{-21} J B. 1.035×10^{-20} J C. 4.14×10^{-21} J D. 6.21×10^{-21} J

Q12. Calculate the average velocity of oxygen (O_2) molecules at room temperature ($T=300$ K)?

- A. 49.9 m/s B. 12.5 m/s C. 394.7 m/s D. 422.0 m/s

Q13. An ideal oxygen gas drives a piston as it expands from 1.0 m^3 to 2.0 m^3 at a constant temperature of 550°C . If mass of the gas in the piston is 1.20 kg, how much work does the gas do in displacing the piston?

- A. 256.5 kJ B. 118.8 kJ C. 444. kJ D. 177.8 kJ

Q14. An engine does 15.0 kJ of work while rejecting 30.0 kJ to the cold reservoir. What is the efficiency of the engine?

- A. 30.8% B. 50.0% C. 33.3% D. 66.7%

Q15. $M = 30.0$ g of oxygen (O_2) is heated up from 27°C to 180°C through an isobaric process ($P=\text{const}$). Find the change in entropy of the gas?

- A. 51.7 J/K B. 5.57 J/K C. 11.2 J/K D. 3.21 J/K

WRITING SECTION

Problem 1. (a) The definition of (translational) momentum for a point mass and a system of point masses. Derivation of the law of momentum conservation for an isolated system.

(b) An 18.0-g bullet moving at 550 m/s penetrates a tree trunk to a depth of 5.50 cm.

(b1) Use work and energy considerations to find the average frictional force that stops the bullet.

(b2) Assuming the frictional force is constant, determine how much time elapses between the moment the bullet enters the tree and the moment it stops moving.

Problem 2. A cylinder of volume 0.30 m^3 contains 10.0 mol of helium gas (He, with the molar mass $\mu = 4 \text{ g/mol}$) at temperature 20.0°C . Assume helium behaves as an ideal gas.

(a) Calculate the pressure P , and the internal energy U of the gas.

Suppose the gas expands at constant pressure to a volume of 1.0 m^3 .

(b) How much work is done on the gas?

(c) What is the temperature of the gas at the new volume?

(d) Find the internal energy of the gas when its volume is 1.0 m^3 .

(e) Compute Q , the thermal energy transfer. State whether or not the gas loses or gains heat in the surroundings.

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Signature of the examiner

Chú ý: ghi đầy đủ tên, họ, mã lớp bài tập và SHSV vào phần trên tờ giấy này. Sử dụng phương pháp làm tròn thông thường để làm tròn đáp số.

SCORE

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MULTI-CHOICE QUESTIONS

- Q1. Which of the following gives the correct unit of Boltzmann constant k_B ?
A. 8.31 J/mol.K B. 8.31 J C. 8.31 J/K D. 8.31 mol/J
- Q2. What is the unit of angular momentum of a rotating object
A. N B. $\text{kg.m}^2/\text{s}^2$ C. kg.m^2 D. $\text{kg.m}^2/\text{s}$
- Q3. What is the average kinetic energy of a molecule of carbonic (CO_2) at a temperature of 300 K ?
A. $12.42 \times 10^{-21} \text{ J}$ B. $1.035 \times 10^{-20} \text{ J}$ C. $4.14 \times 10^{-21} \text{ J}$ D. $6.21 \times 10^{-21} \text{ J}$
- Q4. Calculate the average velocity of nitrogen (N_2) molecules at room temperature ($T=300 \text{ K}$)?
A. 49.9 m/s B. 422.0 m/s C. 394.7 m/s D. 13.3 m/s
- Q5. If two particles have equal kinetic energies, are their momenta equal?
A. yes, always. B. no, never.
C. yes, if both their masses and directions of motion are the same
D. yes, as long as their masses are equal
- Q6. A ball is thrown straight up in the air. For which situation are both the instantaneous velocity and the acceleration zero?
A. on the way up B. at the top of the flight path
C. halfway up and halfway down D. none of these
- Q7. An ideal oxygen gas drives a piston as it expands from 1.0 m^3 to 2.0 m^3 at a constant temperature of 550°C . If mass of the gas in the piston is 1.20 kg , how much work does the gas do in displacing piston?
A. $444. \text{ kJ}$ B. 177.8 kJ C. 256.5 kJ D. 118.8 kJ
- Q8. An engine does 20.0 kJ of work while rejecting the heat of 45.0 kJ to the cold reservoir. What is the efficiency of the engine?
A. 44.4% B. 55.6% C. 30.8% D. 69.2%

Q9. $M = 20$ g of nitrogen (N_2) is heated up from 27°C to 150°C through an isovolumetric process. Find the change in entropy of the gas?

- A. 5.10 J/K B. 24.45 J/K C. 2.04 J/K D. 7.13 J/K

Q10. As a block slides down a frictionless incline, which of the following statements is true?

- A. Both its speed and acceleration increase.
B. Both its speed and acceleration decrease.
C. Its speed increases and its acceleration decreases.
D. Its speed increases and its acceleration remains constant.

Q11. Two cylinders A and B at the same temperature contain the same quantity of the same kind of gas. Cylinder A has three times the volume of cylinder B. What can you conclude about the pressures the gases exert?

- A. We can conclude nothing about the pressures.
B. The pressure in A must be one-third the pressure in B.
C. The pressures in A and B must be equal.
D. The pressure in A is three times the pressure in B.

Q12. If the volume of an ideal gas is doubled while its temperature is quadrupled, does the pressure

- A. increase by a factor of 2
B. decrease by a factor of 2
C. remain the same
D. decrease by a factor of 4

Q13. The kinetic energy of a rocket is increased by a factor of eight after its engines are fired, whereas its total mass is reduced by half through the burning of fuel. By what factor is the magnitude of its momentum changed?

- A. 16 B. 2 C. 4 D. 8

Q14. A 2.0-kg object moving to the right with a speed of 5.0 m/s makes a head-on elastic collision with a 1.0-kg object that is initially at rest. The velocity of the 1.0-kg object after the collision is

- A. greater than 5 m/s.
B. less than 5 m/s.
C. equal to 5 m/s.
D. impossible to say based on the information provided.

Q15. A ball is thrown downward from the top of a 40.0 m tower with an initial speed of 12.0 m/s. Assuming negligible air resistance, what is the speed of the ball just before hitting the ground? $g = 9.81 \text{ m/s}^2$

- A. 28 m/s B. 784 m/s C. 56 m/s D. 30.47 m/s

WRITING SECTION

Problem 1. (a) The definition of (translational) momentum for a point mass and a system of point masses. Derivation of the law of momentum conservation for an isolated system.

(b) A 7.80-g bullet moving at 575 m/s penetrates a tree trunk to a depth of 5.50 cm.

(b1) Use work and energy considerations to find the average frictional force that stops the bullet.

(b2) Assuming the frictional force is constant, determine how much time elapses between the moment the bullet enters the tree and the moment it stops moving.

Problem 2. A cylinder of volume 0.30 m^3 contains 10.0 mol of helium gas (He, with the molar mass $= 4 \text{ g/mol}$) at temperature 20.0°C . Assume helium behaves as an ideal gas.

(a) Calculate the pressure P and the internal energy U of the gas.

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(d) Find the internal energy of the gas when its volume is 1.0 m^3 .

(e) Compute Q , the thermal energy transfer. State whether or not the gas loses to/from the surroundings.