浙江大学 2007－2008 学年夏季学期

《PHYSICS》课程期末考试试卷

开课学院： 理学院 ，考试形式：闭卷，允许带 计算器、字典或电子字典 入场

考试时间：2008 年 07 月 04 日,所需时间：120 分钟

考生姓名：_____学号：_____专业：_____

题序	一	二	三	四	五	六	七	八	总 分
得分									
评卷人									

When the frame *S'* move relative to the frame *S* with velocity *u* along *xx'* direction, the Lorentz transformation equations are: $x'=\frac{x-ut}{\sqrt{1-u^2/c^2}}$, $y'=y$, $z'=z$, $t'=\frac{t-ux/c^2}{\sqrt{1-u^2/c^2}}$,

The equations of velocity transformation are:

$$v'_x=\frac{v_x-u}{1-uv_x/c^2},\quad v'_y=\frac{v_y\sqrt{1-u^2/c^2}}{1-uv_x/c^2},\quad v'_z=\frac{v_z\sqrt{1-u^2/c^2}}{1-uv_x/c^2}$$

The mass, momentum and kinetic energy of a particle, with rest mass *m* and velocity *v*, are

$$m'=\frac{m}{\sqrt{1-v^2/c^2}},$$

$$p=\frac{mv}{\sqrt{1-v^2/c^2}},$$

$$K=\frac{mc^2}{\sqrt{1-v^2/c^2}}-mc^2,$$

The relationship between its momentum and energy is

$$(pc)^2=(\frac{mc^2}{\sqrt{1-v^2/c^2}})^2-(mc^2)^2$$

1. Multiple choices (There is one correct answer only):

1. Four point-like particles, each of mass *m*, are located at (0, 0), (*a*, 0), (*a*, *a*), and (0, *a*), respectively. The binding energy (the energy for separating the system) of the 4-particle system due to the gravitational force is

a) $4G\frac{m^2}{a}$ b) $-4G\frac{m^2}{a}$ c) $(4+\sqrt{2})G\frac{m^2}{a}$ d) $-(4+\sqrt{2})G\frac{m^2}{a}$

2. A solid cylinder is given a velocity v_0 on a rough horizontal surface, After pure rolling (without slipping) occurs, the speed of the cylinder is

a) $\frac{v_0}{3}$ b) $\frac{2v_0}{3}$ c) v_0 d) $\frac{4v_0}{3}$

3. An airplane flys with a certain speed, air flows over the upper wing surface at 50 *m/s* and the over the lower wing surface at 30 *m/s*, the lift force on the wing is 4×10^8 *N*. When the airplane increases its speed, air flows over the upper wing surface at 60 *m/s* and the over the lower wing surface at 40 *m/s*. Dependent on Bernoulli's Equation, the lift force on the wing is

a) 5×10^8 *N* b) 6×10^8 *N* c) 7×10^8 *N* d) 8×10^8 *N*

4. A particle is undergoing simple harmonic motion with an amplitude of 1 *cm*. If the maximum speed of the particle is 3.14 *m/s*, then the period of the oscillation motion is.

a) 0.00314 *s* b) 0.01 *s* c) 0.314 *s* d) 0.02 *s*

5. A source emits sound with a frequency of 849Hz. It is moving at 10m/s toward a stationary reflecting wall. If the speed of sound is 340m/s, an observer is at rest directly behind the source. The beat frequency heard by the observer is

a) 10Hz b) 25Hz c) 40Hz d) 50Hz

6. When a car moves in the street. A supersound wave, with frequency of *f*, is sent by a police man. The police man is at rest directly behind the car. The frequency of the reflection wave is 0.8 *f* observed by the police man. If the speed of the supersound is 340 *m/s*, the speed of the car is

a) 30 *m/s* b) 34 *m/s* c) 38 *m/s* d) 42 *m/s*

7. Which of the following function is not a solution to the wave equation?

a) y = 3cos (*x*-2*t*) b) y = sin(*x*+*t*)cos(*x*+*t*)

c) y = 2sin(*t*+2*x*) d) y = 2sin(ω *t*-5)

8. A wave $y = y_m \sin\omega(t - \frac{x}{u})$ traveling in the positive x direction, a rigid wall at $x = 2\frac{1}{4}\lambda$ from the origin point reflects it. The equation describing the reflecting wave is

a) $y = y_m \sin[\omega(t + \frac{x}{u}) - \pi]$ b) $y = y_m \sin[\omega(t + \frac{x}{u}) + \frac{\pi}{2}]$

c) $y = y_m \sin[\omega(t + \frac{x}{u}) - \frac{\pi}{2}]$ d) $y = y_m \sin\omega(t + \frac{x}{u})$

9. Two particles move in a straight line, each one has rest mass m and kinetic energy K. After totally inelastic collision between them, a new particle is produced.. The rest mass of the new particle is

a) $\frac{2m}{\sqrt{1 + K/mc^2}}$ b) $2m(1 + K/mc^2)$ c) $2m\sqrt{1 + K/mc^2}$ d) $\frac{2m}{1 + K/mc^2}$

10. A particle of mass m with a momentum of $\sqrt{3}mc$, its speed is

a) $\frac{\sqrt{3}}{2}c$ b) $\frac{\sqrt{2}}{2}c$ c) $2\sqrt{2}c$ d) $\frac{\sqrt{2}}{3}c$

11. A spaceship whose rest length is 100 m has a speed of 0.8c with respect to a certain reference frame. A light emitted from the head of the spaceship to its end. In this reference frame the time interval of the light traveling from the head of the spaceship to its end is

a) $\frac{1000}{6c}s$ b) $\frac{600}{c}s$ c) $\frac{3000}{c}s$ d) $\frac{200}{6c}s$

12. A chamber filled with nitrogen, the mean free path of nitrogen molecules is λ. An electron is accelerated in the chamber. If the diameter of the electron is much less than that of the nitrogen molecule, and its speed is much larger than that of the nitrogen molecule. The mean free path of the electron in the chamber is

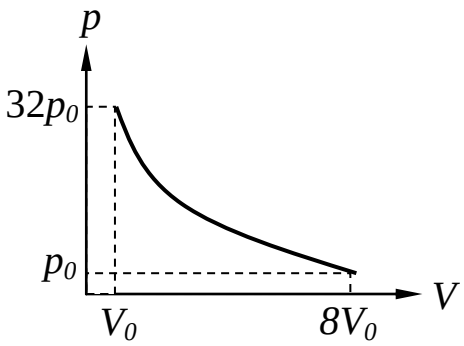
a) $\sqrt{2}\lambda/2$ b) $2\sqrt{2}\lambda$ c) $4\sqrt{2}\lambda$ d) $\sqrt{2}\lambda/4$

13. The mass of an oxygen molecule is 16 times than that of a hydrogen molecule. At room temperature, the ratio of the rms speed of an oxygen molecule to that of a hydrogen molecule is:

a) 16 b) 4 c) 1/4 d) 1/16

14. One mole of an ideal gas is expanded from V_o to 8 V_o in a reversible adiabatic process. The gas is

a) monatomic gas,
b) diatomic gas
c) polyatomic gas
d) other gas



15. The gas, same as above, is expanded from V_o to 8 V_o in a reversible constant temperature process. The change in entropy is

a) 2*R*ln2 b) 3*R*ln2 c) -3*R*ln2 d) -2*R*ln2

16. An ideal gas has molar specific heat C_p at constant pressure. When the temperature of one mole gas is increased by ΔT, the increase in the internal energy is

a)$C_p \Delta T$ b)$(C_p+R) \Delta T$ c)$(C_p-R) \Delta T$ d)$(R - C_p) \Delta T$

17. Four identical molecules are in one box, and two are in another box. The two boxes are brought together and the molecules mix together, 3 molecules are in each box. The change in entropy is

a) *k* ln6 b) *k* ln20 c) 6*k* ln2 d) 0

18. Four identical molecules are in one box, and two are in another box. The two boxes are brought together and the molecules mix together. The change in entropy is

a) *k* ln6 b) *k* ln20 c) 6*k* ln2 d) 0

19. The difference in entropy for two states A and B of a system can computed as the integral $\Delta S = \int \frac{dQ}{T}$ provided:

a) A and B have the same temperature;
b) A reversible path is used for the integral;
c) The work done on the system is first computed;
d) The system is adiabatic.

20. A real heat engine operates at 80% of the efficiency of a Carnot engine operating between the same two temperatures. The real engine extracts heat from the 500 *K* high-temperature reservoir at a rate of 500 *J/s*, and discharges heat into the 300 *K* low-temperature reservoir. The power output of this real engine is

a) 160 *W* b) 200 *W* c) 250 *W* d) 300 *W*

2. Problems:

1. The speed of electrons in a chamber is from 0 to 4, the speed distribution is $N(v) = 24v - 6v^2$, find:

(a) The most probable speed of the electrons;

(b) The average speed of the electrons;

(c) The v_{rms} of the electrons;

(d) The number of the electrons with the speed from 2 to 3

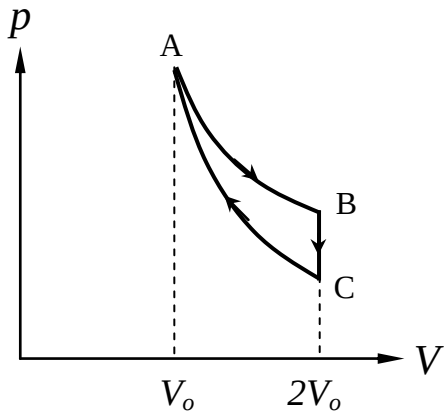
2. One mole ideal monatomic gas undergoes a cycle as shown in the *P*-*V* diagram. In the process AB, the gas expanded from V_o to $2V_o$ with constant temperature T_o. The process BC is a constant volume process and the process CA is an adiabatic process.

(1) The work done by the gas in each process;

(2) The heat absorbed by the gas in each process;

(3) The efficiency of the cycle;

(4) The change in entropy during the process BC.



3. A rest particle, with a mass of 42 m_0, decays into 2 smaller pieces. The rest mass of one of the pieces is 20 m_0 and its speed is $\frac{3}{5}c$. Please find the momentum p, kinetic energy K, and rest mass m of the other piece.

4. Block A with mass $4m$ is at rest on a frictionless table, a massless spring with a length l and force constant k is attached to it. Block B with mass m moves with velocity v, as shown in the figure. After blocks collide, block B connects with the spring. What is the angular frequency of block A and B oscillation after collision? What is the minimum length of the spring? What is maximum speed of block B?