新东方烹饪学校期末考试卷
大专物理 B (上)

Course Name: General Physics B (I) / A **Dept.:** PHYSICS

Exam Duration: 2 H **Exam Paper Setter:** Physics teaching team

Question No.	1	2	3	4	5	6				
Score	45	6	10	12	12	15				

This exam paper contains 6 questions and the score is 100 in total. (Please hand in your exam paper, answer sheet, and your scrap paper to the proctor when the exam ends.)

Q1. Single-answer Questions (3×15 = 45 marks)

1. A crate of 47 kg is moving along the $+x$ axis as a force of 190 N, directed at 25° below the $+x$ axis, is exerted on it. When its speed is 7.3 m/s, what is the rate at which the force is doing work?
A) 0 W B) 340 W C) 590 W D) 1300 W E) 2400 W

2. The potential energy of a body of mass m is given by $U = -mgx + kx^2/2$. The corresponding force is:
A) $-mgx^2/2 + kx^3/6$ B) $mgx^2/2 - kx^3/6$ C) $-mg + kx/2$ D) $-mg + kx$ E) $mg - kx$

3. A small object of mass m, on the end of a light cord, is held horizontally at a distance r from a fixed support as shown in Figure 1. The object is then released. What is the tension in the cord when the object is at the lowest point of its swing?
A) $mg/2$ B) mg C) $2\,mg$ D) $3\,mg$ E) mgr

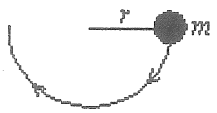

Figure 1

4. A 3.00 g bullet traveling horizontally at 400 m/s hits a 3.00 kg wooden block, which is initially at rest on a frictionless horizontal table. The bullet buries itself in the block without passing through. The speed of the block after the collision is:
A) 1.33 m/s B) 0.40 m/s C) 12.0 m/s D) 12.6 m/s E) 40.0 m/s

5. The Figure 2 shows the angular position of an object as a function of time. What is its instantaneous angular velocity at $t = 1.5$ s?
A) −6 rad/s B) 6 rad/s C) 9 rad/s
D) 12 rad/s E) 0

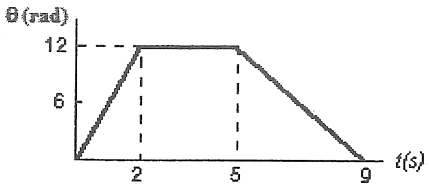

Figure 2

6. A wheel rolls without slipping along a horizontal road as shown in Figure 3. The velocity of the center of the wheel is represented by $\vec{v}$. Point P is painted on the rim of the wheel. The direction of the instantaneous velocity of point P relative to the ground is:
A) → B) ← C) ↑ D) ↗ E) The velocity is zero

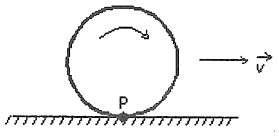

Figure 3

7. A 240 N weight is hung from two ropes as shown in Figure 4. The tension in the horizontal rope has magnitude:

A) 0 N B) 660 N C) 480 N
D) 420 N E) 140 N

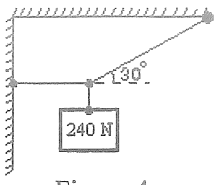

Figure 4

8. The tension in a string with a linear density of 0.0010 kg/m is 0.40 N. A 100 Hz sinusoidal wave on this string has a wavelength of:

A) 0.20 cm B) 2.0 cm C) 5.0 cm D) 20 cm E) 400 cm

9. Four particles, each with mass m, are arranged symmetrically about the origin on the x axis. The fifth particle, with mass M, is on the y axis as shown in Figure 5. The direction of the gravitational force on M due to the other four particles is:

A) ↑ B) ↓ C) ← D) → E) ↗

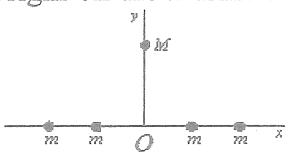

Figure 5

10. As shown in Figure 6, S is a small loudspeaker driven by an audio oscillator with a frequency that is varied from 1000 Hz to 2000 Hz, and D is a cylindrical pipe with two open ends and a length of 48.9 cm. The speed of sound in the air-filled pipe is 344 m/s. At how many frequencies does the sound from the loudspeaker set up resonance in the pipe?

A) 1 B) 2 C) 3 D) 4 E) 5

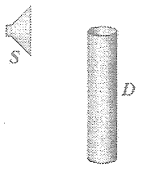

Figure 6

11. The Figure 7 shows a rectangular brass plate at 0°C in which there is cut a rectangular hole of dimensions indicated. If the temperature of the plate is raised to 150°C:

A) x will increase and y will decrease
B) both x and y will decrease
C) x will decrease and y will increase
D) both x and y will increase
E) the changes in x and y depend on the dimension z

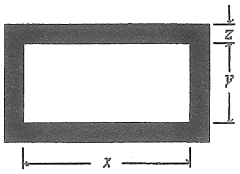

Figure 7

12. Which of the following changes when the pressure of an ideal gas is changed isothermally?

A) Mean free path
B) Root-mean-square molecular speed
C) Internal energy
D) Most probable kinetic energy
E) Average speed

13. The temperature of n moles of a gas is increased from T_i to T_f at constant pressure. If the molar specific heat at constant pressure is C_p and is independent of temperature, then change in the entropy of the gas is:

A) $nC_p \ln(T_f/T_i)$ B) $nC_p \ln(T_i/T_f)$ C) $nC_p \ln(T_f - T_i)$ D) $nC_p \ln(1 - T_i/T_f)$ E) $nC_p (T_f - T_i)$

14. The rate of heat flow through a slab is P_{cond}. If the slab thickness is doubled, its cross-sectional area is halved, and the temperature difference across it is doubled, then the rate of heat flow becomes:

A) $2P_{cond}$ B) $P_{cond}/2$ C) P_{cond} D) $P_{cond}/8$ E) $8P_{cond}$

15. An idealized diesel engine(柴油机) operates in a cycle known as the air-standard diesel cycle shown in Figure 8. Fuel is sprayed(喷射) into the cylinder at the point of maximum compression, B. Combustion(燃烧) occurs during the expansion B → C, which is modeled as an isobaric process. The full cycle is shown in the Figure 8, calculate the efficiency of an engine operating in this idealized diesel cycle in terms of T_A, T_B, T_C, T_D and γ. (where T_A represent the temperature of state A and so on, $\gamma = C_p / C_V$).

A) $1-\frac{1}{\gamma}\left(\frac{T_D-T_A}{T_C-T_B}\right)$ B) $1-\frac{2}{\gamma}\left(\frac{T_A-T_D}{T_C-T_B}\right)$ C) $1-\frac{1}{\gamma}\left(\frac{T_A-T_D}{T_C-T_B}\right)$

D) $1-\frac{2}{\gamma}\left(\frac{T_D-T_A}{T_C-T_B}\right)$ E) $\frac{2}{\gamma}\left(\frac{T_D-T_A}{T_C-T_B}\right)$

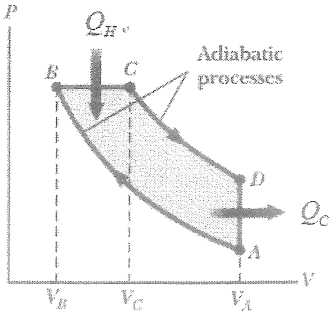

Figure 8

Q2. Fill in the Blank Questions. (Just write down the result, and the detailed process is not needed.)

1. (3 marks) As shown in Figure 9, a particle falls from rest through a tunnel(隧道) that connects the Earth's south and north poles. Assume that the Earth is a uniform sphere. Neglect(忽略) the friction in tunnel and the rotation of the Earth, find the traveling time of the particle from south to north. Write down the result in hours with three significant numbers(三位有效数字).

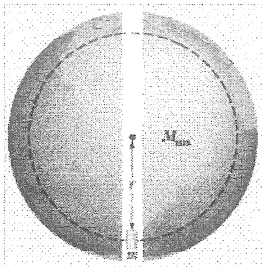

Figure 9

The traveling time is_____hours.

2. **(3 marks)** In Figure 10, a French submarine and a U.S. submarine move toward each other during maneuvers in motionless water in the North Atlantic. The French sub moves at speed $v_F = 48.00\,\text{km/h}$, and sends out a sonar signal (sound wave in water) at 1.560×10^3 Hz. Sonar waves travel at 5470 km/h in ocean. The French sub detects a signal at 1.630×10^3 Hz reflected back to it by the U.S. sub. Find the speed v_U of the U.S. sub.

The speed v_U of the U.S. sub is_____km/h

Figure 10

Text Questions: (Please write down the detailed process.)

Q3. (10 marks) In Figure 11, a massless spring (k = 200 N/m) is fixed at the top of a frictionless plane inclined at angle θ=40°. A 1.00 kg block is projected up the plane, from an initial position that is distance d = 0.600 m from the end of the relaxed spring, with an initial kinetic energy of 16.0 J. What is the kinetic energy of the block at the instant it has compressed the spring 0.200 m?

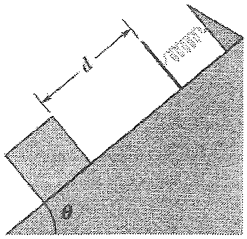

Figure 11

Q4. (12 marks) A spaceship of mass m = 1500 kg is in a circular Earth orbit as shown in Figure 12, at an altitude h of 400 km.

(a) What is the period T_0 of the ship?

(b) At point P, a thruster is fired in the forward direction to decrease the ship's speed to 99.0% of its original speed. What is the orbital period T of the resulting elliptical orbit?

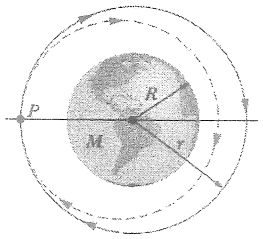

Figure 12

Q5. (12 marks) A uniform rod of length $L = 1.0$ m and mass $M = 1.0$ kg is rest vertically with one end fixed at a pivot point as shown in Figure 13. The rod is able to swing about the pivot in a vertical plane. A particle of mass $m = 0.50$ kg moves horizontally at a speed $v = 0.50$ m/s toward the other end of the rod, and collides with the rod at time $t = 0$. After collision, the particle sticks to the end of the rod and swings together with the end of the rod in SHM. The angular displacement of this SHM follows $\theta(t) = \theta_m \cos(\omega t + \varphi)$. Find:

(a) the angular speed Ω of the rod-particle system immediately after the collision.

(b) the angular frequency ω.

(c) the amplitude θ_m.

(Hint: the rotational inertia of a thin rod about axis through center perpendicular to its length $I = \frac{1}{12}ML^2$)

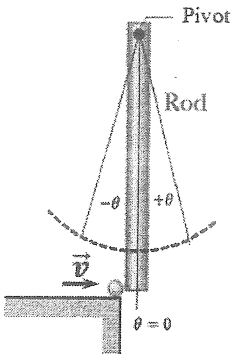

Figure 13

Q6. (15 marks) A cylinder is closed at both ends and has insulating walls. It is divided into two compartments by an insulating piston that is perpendicular to the axis of the cylinder as shown in Figure 14a. Each compartment contains 1.00 mol of oxygen that behaves as an ideal gas. Initially, the two compartments have equal volumes and their temperatures are 550 K and 250 K. The piston is then allowed to move slowly parallel to the axis of the cylinder until it comes to rest at an equilibrium position (Figure 14b). Neglect the friction between the cylinder and the piston. Find the final temperatures in the two compartments.

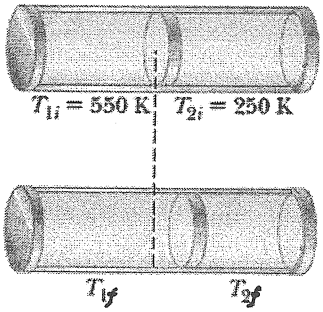

Figure 14a

Figure 14b

Figure 14