2008年度日本政府(文部科学省)奨学金留学生選考試験

QUALIFYING EXAMINATION FOR APPLICANTS FOR JAPANESE GOVERNMENT (MONBUKAGAKUSHO) SCHOLARSHIPS 2008

学科試験　　問題

EXAMINATION QUESTIONS

(高等専門学校留学生)

COLLEGE OF TECHNOLOGY STUDENTS

物　　理

PHYSICS

注意　☆試験時間は60分。

PLEASE NOTE : THE TEST PERIOD IS 60 MINUTES.

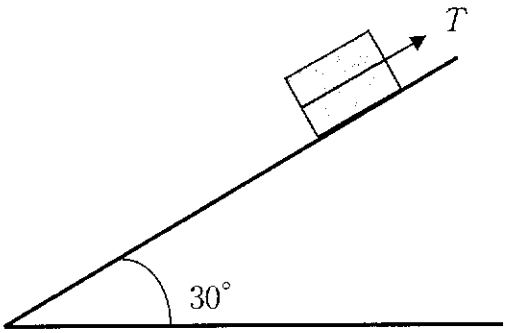
(2008)

PHYSICS

Nationality		No.	
Name	(Please print full name, underlining family name)		

Marks	

1 A body of mass 4.0[kg] is at rest on a frictionless slope at an angle of 30° to the horizontal due to a force T[N] acting on it along the slope. Let the gravitational acceleration be 9.8[m/s^2].



(1) Find the magnitude of the force T[N].

[N]

When we stop supporting the body (T[N] is 0), the body slides down.

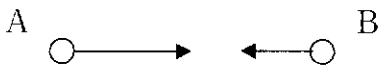
(2) Find the magnitude of the acceleration of the body.

[m/s^2]

(3) Find the speed of the body when it has slid down a distance of 5.0[m] along the slope.

[m/s]

2 A body A of mass 2.0[kg] moves at a speed of 10[m/s] to the right and a body B of mass 4.0[kg] moves at a speed of 4.0[m/s] to the left along a straight line. Then the two bodies collide and move along the line. Let the coefficient of restitution be 0.50.



(1) Calculate the velocities of the bodies A and B after the collision, where the right direction is positive.

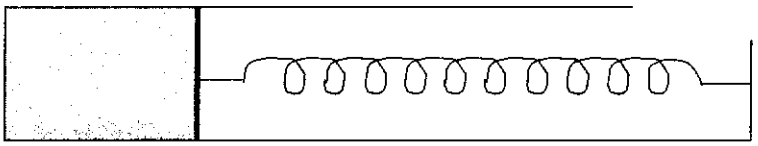
$v_A =$ [m/s]

$v_B =$ [m/s]

(2) Calculate the kinetic energy lost during the collision.

[J]

3 A cylinder is equipped with a smoothly movable piston which is connected by a spring to the bottom of the cylinder as shown in the figure. An ideal gas of 0.10[mol] is confined in the space on the left side of the cylinder at a temperature of 300[K]. The atmospheric pressure is 1.0×10^{5}[Pa]. Take the cross-section-area of the piston to be 1.0×10^{-3}[m^2], the spring constant to be 500[N/m] and the gas constant to be 8.3[J/mol·K].



(1) Initially the spring is at its natural length. Calculate the volume of the gas.

[m^3]

By heating the gas, the piston moves to the right a distance of 0.20[m].

(2) Calculate the pressure of the gas after the change.

[Pa]

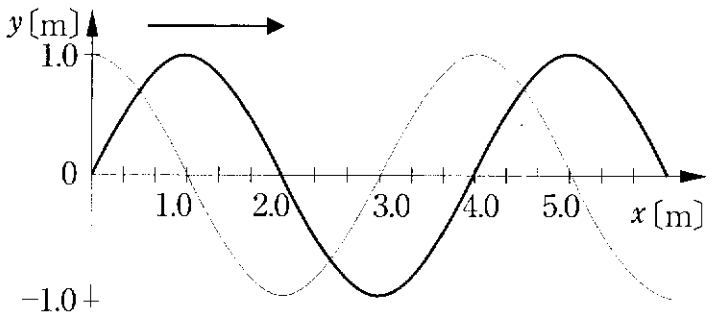
(3) Calculate the temperature of the gas after the change.

[K]

(4) Calculate the work done by the gas during the change.

[J]

4 In the figure the thick curved line expresses the wave form at time $t=0$[s] of a sine wave propagating to the right. It takes 0.30[s] for the wave form of the thick line to first become the wave form represented by the thin line.



(1) Find the wavelength[m] of the wave.

[m]

(2) Find the velocity[m/s] and the period[s] of the wave.

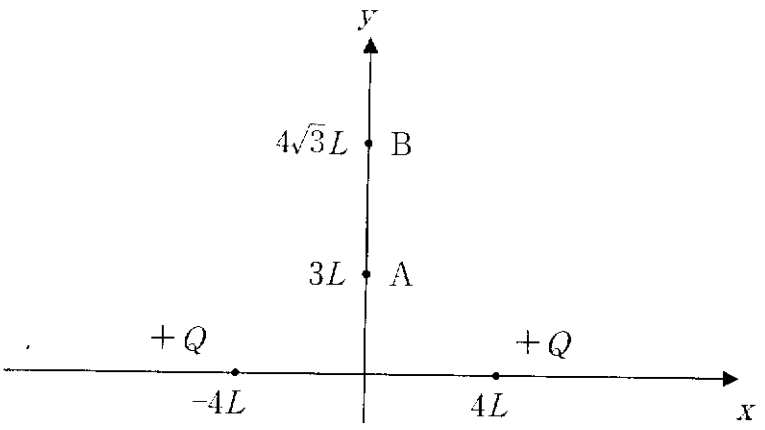
$v=$ [m/s]

$T=$ [s]

(3) Express the simple harmonic oscillation of the medium at $x=2.0$[m]. Let π denote the circle ratio.

$y(t)=$ [m]

5 Two positive charges of Q[C] are placed at $x=-4L$[m] and $x=4L$[m] of the x-axis. Let the constant of proportionality in Coulomb's law be k[N·m^2/C^2].



(1) Find the magnitude of the electric force acting on a positive charge of q[C] which is placed at the position A at $y=3L$[m] on the y-axis.

[N]

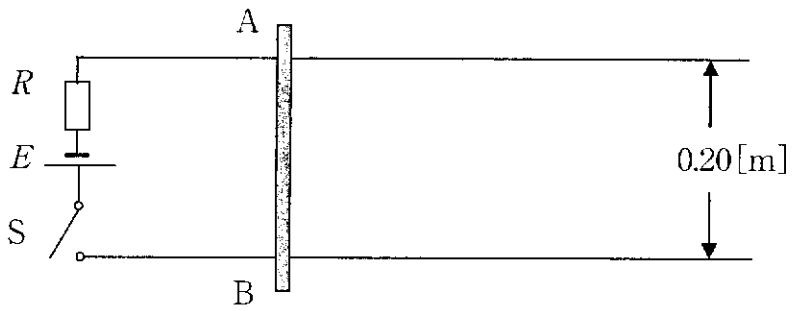
(2) Find the electric potential at A. Let the electric potential at infinity be zero.

[V]

(3) Let B denote the position $y=4\sqrt{3}L$[m] on the y-axis. The positive charge of q[C] and of mass m[kg] rests at A initially, moves due to the electric force and passes B. Find the speed of the charge at B.

[m/s]

6 As shown in the figure, a conducting rod AB makes contact with parallel rails whose separation is 0.20[m]. A resistance R of 5.0[Ω], a battery E of electromotive force 1.5[V] and a switch S are connected with the rails at their left ends. The apparatus is in a uniform magnetic field of flux density 3.0[T], perpendicular to the plane of the diagram and directed towards the reader. Neglect the electric resistance of both the rod and the rails. Neglect the magnetic field due to the electric current flowing in the circuit, and the friction between the rod and the rails.



Immediately after closing S,

(1) Calculate the magnitude of the electric current flowing in the circuit.

[A]

(2) Calculate the magnitude of the force acting on the rod AB due to the magnetic field.

[N]

When the velocity of the rod AB becomes 1.5[m/s],

(3) Calculate the magnitude of the electromotive force induced in the circuit.

[V]

(4) Calculate the magnitude of the electric current flowing in the circuit.

[A]