

2015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 2015

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**.

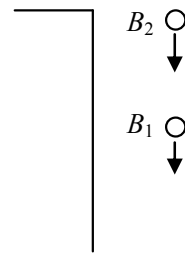
(2015)

PHYSICS

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

	Marks
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1. From the top of the building high enough from the ground, a small body B_1 is dropped from rest at time $t = 0$ s. Another body B_2 is thrown downward at a speed of 19.6 m/s at time $t = 1.0$ s from the same point. Let the gravitational acceleration be 9.8 m/s^2 . The air is considered frictionless. Round off your answers to two significant figures.



(1) What is the speed of body B_1 at time $t = 1.0$ s ?

(1)	m/s
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(2) What is the vertical distance from the top of the building to the body B_1 at time $t = 1.0$ s ?

(2)	m
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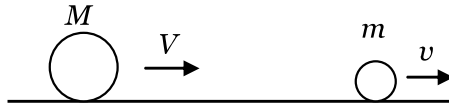
(3) When do the two bodies collide on the vertical line?

(3)	s
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(4) What is the vertical distance from the top of the building to the two bodies when the collision occurs?

(4)	m
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2. A particle of mass M [kg] with velocity V [m/s] and another particle of mass m [kg] with velocity v [m/s] are about to collide on a frictionless straight line. The arrows show the positive direction. After the perfect elastic collision with coefficient of restitution of 1.0, a particle of mass M [kg] moves with velocity v_1 [m/s] and that of mass m [kg] moves with velocity v_2 [m/s].



(1) Express $V - v$ in terms of v_1 and v_2 .

(1) $V - v =$

(2) Find v_1 and v_2 if $M = 6.0$ kg, $m = 4.0$ kg, $V = 7.5$ m/s and $v = 2.5$ m/s. Round off your answers to two significant figures.

(2) $v_1 =$ **m/s**, $v_2 =$ **m/s**

3. There are a tuning fork F_1 of frequency 660 Hz and a tuning fork F_2 of frequency 654 Hz.

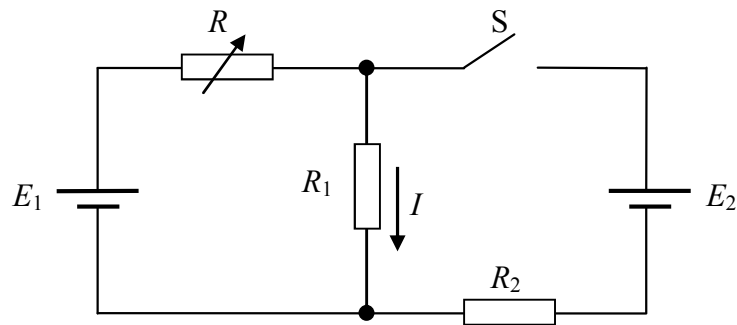
(1) What is the beat frequency made out of two sounds emitted from tuning forks F_1 and F_2 ?

(1) Hz

(2) What is the frequency of the sound heard by a fixed observer when a tuning fork F_1 is moving at a speed of 10 m/s with emitting the sound toward the observer? Let the speed of sound in windless air be 340 m/s.

(2) Hz

4. Consider an electrical circuit shown in the figure. Voltages of batteries E_1 and E_2 are 18V and 12V, respectively. Internal resistances of these batteries can be disregarded. Resistances of R_1 and R_2 are 12Ω and 4.0Ω , respectively. R is a variable resistor. Initially, a switch S is open as shown in the figure.



(1) Calculate the resistance of R if the value of the current I in the figure is 0.50 A.

(1)		Ω
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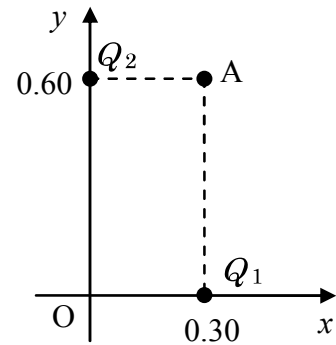
(2) Calculate the resistance of R if the switch S is closed and the value of the current in the resistor R_2 is 0.0 A.

(2)		Ω
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(3) Calculate the value of the current in the resistor R_1 if the switch S is closed and the resistance of R is 2.0Ω .

(3)		A
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5. A point charge of $Q_1 = +4.0 \times 10^{-8}$ C is placed at $x = 0.30$ m on the x -axis, and a point charge of $Q_2 = -2.0 \times 10^{-8}$ C is placed at $y = 0.60$ m on the y -axis on the x - y plane as shown in the figure. Let the proportionality constant of Coulomb's law be 9.0×10^9 N·m²/C². You can use $\sqrt{2} = 1.41$, $\sqrt{3} = 1.73$ and $\sqrt{5} = 2.24$ if you need. Round off your answers to two significant figures.



(1) Find the magnitude of the electric field at the point A (0.30, 0.60) .

(1)	N/C
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(2) Find the electric potential at the point A. Let the electric potential at infinity be zero.

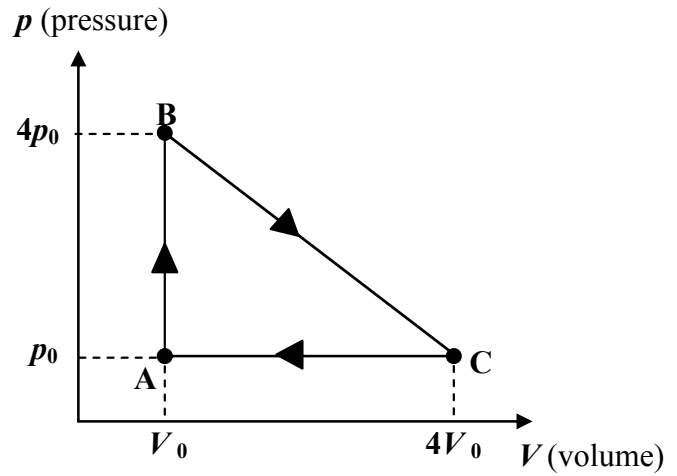
(2)	V
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(3) Find the electric potential at the origin O. Let the electric potential at infinity be zero.

(3)	V
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6. Consider a system of monoatomic ideal gas. The ideal gas is carried along the path $A \rightarrow B \rightarrow C \rightarrow A$ shown in the PV diagram.

Assume that the path $A \rightarrow B$ is an isochoric (constant volume) process and the path $C \rightarrow A$ is an isobaric (constant pressure) process. Pressure and volume of the ideal gas in an initial state are $p_0 = 1.0 \times 10^5$ Pa and $V_0 = 2.0 \times 10^{-3}$ m³. Let the gas constant be 8.3 J/(mol·K). Round off your answers to two significant figures.



(1) Temperature of the gas in the state A is 3.0×10^2 K. Calculate the temperature in the state B.

(1)	K
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(2) How much heat is added to the gas in the process from A to B?

(2)	J
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(3) How much work is done by the gas in the process from B to C?

(3)	J
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(4) How much heat is released to the outside in the process from C to A?

(4)	J
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