HCMC UNIVERSITY
OF TECHNOLOGY AND EDUCATION
FACULTY OF HIGH QUALITY TRAINING
GROUP OF FUNDAMENTAL SCIENTIFIC KNOWLEDGE

FINAL TEST FOR THE 3rd SEMESTER
Academic Year: 2018-2019
Subject: Principles of Physics 1
Date: August 5th 2019
Course number: PHYS130402E
Test number: 01 (2 pages).
Duration: 90 minutes.

Note:
+ Students are allowed to use one A4 double sided paper sheet of handwritten notes.
+ Invigilators are NOT allowed to explain anything related to contents of the test.
+ The value of gravitational acceleration is $g=9.80\ m/s^2$ when needed.

Questions from 1 to 4 are multiple choice. Write the letter A, B, C, D, or E related to your choice(s) on your answer sheet.

Question 1 (0.5 marks)

A juggler throws a bowling pin straight up in the air. After the pin leaves his hand and while it is in the air, which statement is true?

A. The velocity of the pin is always in the same direction as its acceleration
B. The velocity of the pin is never in the same direction as its acceleration
C. The acceleration of the pin is zero
D. The velocity of the pin is opposite its acceleration on the way up
E. The velocity of the pin is in the same direction as its acceleration on the way up

Question 2 (0.5 marks)

A set of keys on the end of a string is swung steadily in a horizontal circle. In one trial, it moves at speed v in a circle of radius r. In a second trial, it moves at a higher speed 4v in a circle of radius 4r. In the second trial, how does the period of its motion compare with its period in the first trial?

A. It is the same as in the first trial **B.** It is 4 times larger **C.** It is 16 times larger
D. It is one-fourth as large **E.** It is one-sixteenth as large

Question 3 (0.5 marks)

A worker pushes a wheelbarrow with a horizontal force of 50 N on level ground over a distance of 5.0 m. If a friction force of 43 N acts on the wheelbarrow in a direction opposite that of the worker, what work is done on the wheelbarrow by the worker?

A. 215 J **B.** 250 J **C.** 35 J **D.** 10 J **E.** None of those answers is correct

Question 4 (0.5 marks)

Two particles of different mass start from rest. The same net force acts on both of them as they move over equal distances. How do their final kinetic energies compare?

A. The particle of larger mass has more kinetic energy.
B. The particle of larger mass has more kinetic energy.
C. The particles have equal kinetic energies.
D. Either particle might have more kinetic energy.

Question 5 (1.0 marks)

A satellite in low-Earth orbit is not truly traveling through a vacuum. Rather, it moves through very thin air. Does the resulting air friction cause the satellite to slow down?.

Question 6 (1.0 marks)

Suppose just two external forces act on a stationary, rigid object and the two forces are equal in magnitude and opposite in direction. Under what condition does the object start to rotate?

Question 7 (2.0 marks)

Consider the system shown in Figure 1 with m_1= 20.0 kg, m_2 = 7.50 kg, R = 0.20 m, α = 53.1° and the mass of the pulley M = 5.00 kg. The coefficient of kinetic friction between the block and the incline is μ_k = 0.40. The cord is light, does not stretch, and does not slip on the pulley. We assume the pulley is a uniform disk.

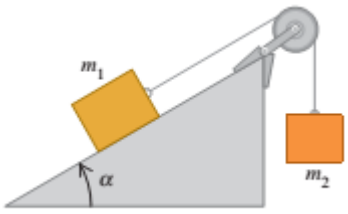

Figure 1

a. Find the magnitude of the acceleration of the objects.

b. Find the tension in the string.

Question 8 (2.0 marks)

A solid uniform ball rolls without slipping up a hill, as shown in Fig. 2. At the top of the hill, it is moving horizontally, and then it goes over the vertical cliff.

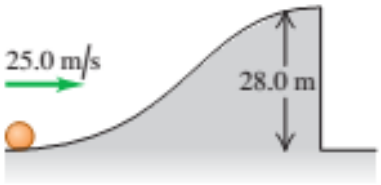

Figure 2

a. Using energy methods, determine the final speed of the sled at the edge of the cliff.

b. How far from the foot of the cliff does the ball land, and how fast is it moving just before it lands?

Question 9 (2.0 marks)

A sample of an ideal gas goes through the process shown in Figure 3. From A to B, the process is adiabatic; from B to C, it is isobaric with 345 kJ of energy entering the system by heat; from C to D, the process is isothermal; and from D to A, it is isobaric with 371 kJ of energy leaving the system by heat. Determine the difference in internal energy $E_{int,B} - E_{int,A}$

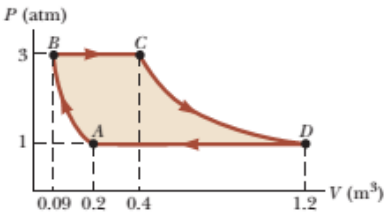

Figure 3

The end.

ELO of the subject (knowledge)	Test contents
[ELO 1.1]: Understanding various concepts, theorems, and laws related to classical mechanics, fluid mechanics and wave motion	Questions: No. 1, 2, 3, 5, 6, 7, 8
[ELO 2.1]: Applying the knowledge and skills required to solve the problems in mechanics.	Questions: No. 1, 2, 3, 4, 6, 7, 8
[ELO 2.3]: Applying the principles of thermodynamics to explain the phenomena related to the temperature as well as solving the related problems.	Question: No. 9

25th July 2019

Head of Group of Fundamental scientific knowledge

(Sign and write full name)

KEYS AND SCORES
For Questions in Final Exam of Principles of Physics 1
Edited by: Tran Thien Thanh

Question	Answer	Mark
1	**D**. The bowling pin has a constant downward acceleration while in flight. The velocity of the pin is directed upward on the ascending part of its flight and is directed downward on the descending part of its flight.	0.5
2	**A**. The period T = 2π r/v changes by a factor of 4/4 =1	0.5
3	**B.** The work done on the wheelbarrow by the worker is W=(Fcos θ)Δx=(50N)(5.0m)=+250 J	0.5
4	**C.** The masses move through the same distance under the same force. Equal net work inputs imply equal kinetic energies	0.5
5	Air resistance causes a **decrease in the energy** of the satellite-Earth system. This reduces the radius of the orbit, bringing the satellite closer to the surface of the Earth. A satellite in a smaller orbit, however, **must travel faster**. Thus, the effect of air resistance is **to speed up the satellite**!	1.0
6	If the object is **free to rotate about any axis**, the object will **start to rotate** if the **two forces act along different lines of action**. Then the torques of the forces **will not be equal in magnitude and opposite in direction**	1.0
7	a. Let T_1 represent the tension in the cord above m_1 and T_2 the tension in the cord above the lighter mass. The two blocks move with the same acceleration because the cord does not stretch, and the angular acceleration of the pulley is a/R. For the heavier mass we have: $m_1 \ : m_1 g\sin\alpha - T_1 - \mu_k m_1 g\cos\alpha = m_1 a \quad 1$ For the lighter mass: $m_2 \ : T_2 - m_2 g = m_2 a \quad 2$ We assume the pulley is a uniform disk: $I = \frac{1}{2}MR^2$ $M \ : T_1 R - T_2 R = I\alpha = \left(\frac{1}{2}MR^2\right)\left(\frac{a}{R}\right) \Rightarrow \ T_1 - T_2 \ = \frac{1}{2}Ma \quad 3$ Add up the three equations in a: $a = \frac{m_1\sin\alpha - m_2 - \mu_k m_1\cos\alpha}{m_1 + m_2 + \frac{1}{2}M} g = 0.12\, m/s^2$ b. $m_2 \ : T_2 = m_2 g + m_2 a \ = 74.4\, N$ $m_1 \ : T_1 = m_1 g\sin\alpha - \mu_k m_1 g\cos\alpha - m_1 a = 107\, N$	0.25 0.25 0.25 0.25 0.5 0.25 0.25
8	a. Use conservation of energy to find the speed of the sled at the edge of the cliff. $\Delta K + \Delta U = 0 \Rightarrow \left(\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2\right) + \left(\frac{1}{2}I\mathrm{w}_f^2 - \frac{1}{2}\mathrm{Iw}_i^2\right) + mgy = 0$ $\Rightarrow v_f = \sqrt{v_i^2 - \frac{10}{7}gy} = 15.3\, m/s$ Consider the projectile motion of the ball, from justafter it leaves the top of the cliff until just before it lands. Take y + to be downward. Use the vertical motion to find the time in the air $\begin{cases} y_f = v_{i,y}t + \frac{1}{2}a_y t^2 \\ x_f = v_{i,x}t \end{cases} and \begin{cases} v_y = v_{i,y} + a_y t \\ v_x = v_{i,x}t \end{cases} \Rightarrow v = \sqrt{v_x^2 + v_y^2}$	0.5 0.25 0.5

	$\Rightarrow t = \sqrt{\frac{2y_f}{g}} = 2.39\,s$	0.25
	$x_f = v_{i,x}t = 36.5\,m$	0.25
	$v = \sqrt{v_x^2 + v_y^2} = 28.0m/s$	0.25
9	Because the gas goes through a cycle, the overall change in internal energy must be zero	0.25
	$\Delta E_{\text{int}} = \Delta E_{\text{int},AB} + \Delta E_{\text{int},BC} + \Delta E_{\text{int},CD} + \Delta E_{\text{int},DA} = 0$ $\Rightarrow \Delta E_{\text{int},AB} = -\Delta E_{\text{int},BC} - \Delta E_{\text{int},CD} - \Delta E_{\text{int},DA}$	0.5
	Recognize that $\Delta E_{int} = 0$ for the isothermal process CD and substitute from the first law for the other internal energy changes	0.25
	$\Delta E_{\text{int},AB} = -\ Q_{BC} + W_{BC}\ -\ Q_{DA} + W_{DA}$	0.25
	$\Delta E_{\text{int},AB} = -\ Q_{BC} - P_B\Delta V_{BC}\ -\ Q_{DA} - P_D\Delta V_{DA}$ $= -\ Q_{BC} + Q_{DA}\ +\ P_B\Delta V_{BC} + P_D\Delta V_{DA}$	0.5
	$\Delta E_{\text{int},AB} = 4.29\times10^4\ J$	0.25