

KATHMANDU UNIVERSITY
End Semester Examination [C]
June, 2018

Level : B.E./B.Sc./B. Pharm./B. Tech.
Year : I

Course : PHYS 101
Semester : I

Exam Roll No. :

Time: 30 mins.

F. M. : 15

Registration No.:

Date **JUN 12 2018**

SECTION "A"

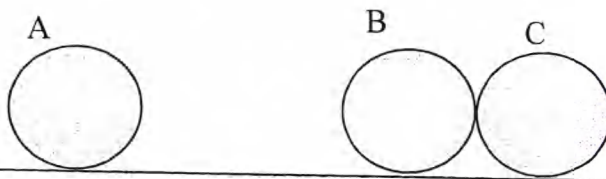
[15 Q. × 1=15 marks]

Choose and tick the most appropriate answer. The symbols, unless mentioned otherwise, have their usual meanings.

1. A heavy weight is suspended from a spring, the energy stored in the spring is 20 J. If the weight is raised till the spring comes to its non-stretched position and the work done in doing so be 15 J, then gain in gravitational potential energy of the weight will be
[a] 35 J [b] 5 J [c] 15 J [d] 20 J

2. Which one of the following statement is NOT true for the case of conservative forces?
[a] Work done by the conservative force is independent of path followed.
[b] Total mechanical energy remains conserved in the conservative force fields.
[c] Change in potential energy after completing the round trip is always zero.
[d] A conservative force can be expressed as the negative gradient of potential energy.

3. Consider a marble A which elastically collides with marble B at rest in contact with marble C as shown in figure. Let all the marbles are identical and the collision is



head-on type. After collision, which one of the following situation will be possible?

- [a] marble A comes at rest and B and C move with the initial velocity of A.
[b] marble A comes at rest and B and C move with half the initial velocity of A.
[c] marble A rebounds with its initial velocity and B and C remains at rest.
[d] marble A comes at rest, B remains at rest and C moves with the initial velocity of A.
4. T_1 and T_2 are the time periods of a compound pendulum for the physical lengths l_1 and l_2 respectively. The radius of gyration of the compound pendulum about the horizontal axis passing through the center of mass is

[a] $\sqrt{l_1 l_2 \frac{T_2 l_1 - T_1 l_2}{T_1 l_1 - T_2 l_2}}$

[b] $\sqrt{l_1 l_2 \frac{T_2 l_1^2 - T_1 l_2^2}{T_1 l_1^2 - T_2 l_2^2}}$

[c] $\sqrt{l_1 l_2 \frac{T_2^2 l_1 - T_1^2 l_2}{T_1^2 l_1 - T_2^2 l_2}}$

[d] $\sqrt{l_1 l_2}$

5. In a simple harmonic oscillation,
[a] the potential energy is maximum at the mean position.
[b] the kinetic energy is maximum at the extreme position.
[c] both potential and kinetic energies are maximum at mean position.
[d] the kinetic energy is maximum at mean and minimum at extreme position.

Level : B.E./B.Sc./B. Pharm./B. Tech.
Year : I
Time : 2 hrs. 30 mins.

Course : PHYS 101
Semester: I
F. M. : 40

SECTION "B"

[5 Q. \times 3 = 15 marks]

1. What is perfectly inelastic collision? Explain it with an example of sticking collision.

OR

What are the three types of modulus of elasticity? Explain the elastic behavior of a solid by plotting the stress-strain graph.

2. State and prove work-kinetic energy theorem for a variable force in one dimensional motion.
3. What do you mean by polarization of light? State and prove Malus' law for polarized light.

OR

What is laser? How can it be produced? Write two application of laser.

4. Starting from the Planck's formula for black body radiation, obtain the Stefan's law of radiation and show that Stefan's constant $\sigma = \frac{2\pi^5 k^4}{15h^3 c^2}$, where k is Boltzmann's constant, h is the Planck's constant and c is the velocity of light.
5. A man pushes a 27.215-kg block to a distance of 9.141 m along a level floor at a constant speed with the force directed 45° below the horizontal. If the coefficient of kinetic friction is 0.2, how much work does the man do on the block?

OR

Two identical solid spheres each of mass M and radius R are joined together, and the combination is rotated about an axis tangential to one sphere (not the point of contact) and perpendicular to the line joining them. What is the rotational inertia of the combination about the axis of rotation?

SECTION "C"

[5 Q. \times 5 = 25 marks]

6. Obtain the Newton's second law of motion for the system of variable mass and hence derive the equation of motion of a rocket.

OR

Establish the equation of motion for a damped harmonic oscillation and solve it. Explain the cases of (i) over damping, (ii) critical damping and (iii) under damping.

7. Find the moment of inertia of circular disc of radius R and uniformly distributed total mass M about (i) an axis perpendicular to the disc and passing through its center, (ii) a diameter and (iii) a tangent. Also find the radius of gyration for each of the above cases.
8. A projectile is fired from a gun at an angle of 45° with the horizontal and with a muzzle speed of 457.2 m/s. At the highest point in its flight the projectile explodes into two fragments of equal masses. One fragment, whose initial speed is zero, falls vertically. How far from the gun does the other fragment land, assuming a level terrain?

OR

In an ideal flow, a liquid of density 850 kg/m^3 moves from a horizontal tube of radius 1.00 cm into a second horizontal tube of radius 0.50 cm. A pressure difference ΔP exists between the tubes. Find the volume flow rate as a function of ΔP .

9. Explain the theory of Newton's rings experiment with schematic diagram. How can you determine the refractive index of a liquid with the help of this experiment?
10. Assuming that limits of the visible spectrum are arbitrarily chosen as 430 nm and 680 nm. Design a grating that will spread the first order spectrum through an angular range of 20° ?

OR

Unpolarized light travelling in a liquid with refractive index μ is incident on the surface of the liquid, above which there is air. If the light incident on the surface at an angle of 31.2° with respect to the normal, the light reflected back into the liquid is completely polarized.

- (a) What is the refractive index of the liquid?
- (b) What angle does the refracted light travelling in air make with the normal to the surface?