Physics 103 **Final Exam** June 27, 1998

Student Name: Student I.D. #:

[All questions are equally worth the same percent of the total mark]

Part A

A1- One stone is projected horizontally from a 20-m high cliff with an initial speed of 10 m/s. A second stone is simultaneously dropped from that cliff. Which of the following statement is true?

(a) Both strikes the ground below with the same velocity.
(b) Both strikes the ground below with the same speed.
(c) During the flight the change in the velocity of both stones is the same.
(d) During the flight the change in the speed of both stones is the same.
(e) None of the above is correct

A2- A mass is suspended from a string and accelerated downward with an acceleration of $0.7g$. It follows that the tension in the string is

(a) equal to the weight of the mass
(b) zero.
(c) not zero but less than the weight of the mass.
(d).greater than the weight of the mass
(e) None of the above answers is correct; my answer is_____

A3- The force required to keep an object in motion at constant velocity is

(a) proportional to its mass
(b) proportional to its weight.
(c) proportional to its speed
(d) proportional to its momentum
(e) None of the above answers is correct; my answer is_____

A4- Indicate which of the following physical quantities is a scalar [S] and which is a vector [V]:

___ Velocity	___ Work	___ Power	___ Moment of inertia
___ Coefficient of friction	___ Impulse	___ Displacement	
___ Acceleration	___ Momentum	___ Torque	

A5- A car starts from rest and travels forward with constant acceleration. Which of the following is correrct?

(a) The power delivered by the engine to the wheels is constant.
(b) The power delivered by the engine to the wheels increases as the car gains speed.
(c) The kinetic energy of the car is proportional to the time (KE $\propto$ t).
(d) The work done by the engine is proportional to the time (W $\propto$ t).
(e) None of the above is correct.

A6- Two masses are released (at the same time) from a height H above ground: M_1 slides down a frictionless inclined plane that makes an angle 30° with the horizontal; M_2 slides down a similar plane that makes an angle 45° with the horizontal. Which of the following is true?

(a) M_2 arrives at the bottom first (ahead of M_1), and with its speed v_2 larger than (that of M_1) v_1.
(b) M_2 arrives at the bottom first, but both speeds v_2 and v_1 are the same at that point.
(c) M_2 and M_1 reach the bottom at the same time and with the same speed.
(d) The answer depends on whether M_2 is larger, equal or smaller than M_1.
(e) None of the above is correct.

A7- A stone is tied to a string and swung in a horizontal circle at constant angular velocity. During the motion,

(a) linear and angular momentum are constant.
(b) angular momentum is constant but linear momentum is changing.
(c) linear momentum is constant but angular momentum is changing.
(d) linear and angular momentum are changing.
(e) none of the above is correct.

Part B

B1- An object is dropped from rest. If it falls a distance s_1 during the first second and an additional distance s_2 in the next second, the ratio s_2 / s_1 is

(a) 1 (b) 2 (c) 3 (d) 5 (e) none of the above, my answer is_____

Brief outline of solution:

B2- A stone of mass M is thrown straight up with initial velocity v_0 reaches a height H. A second stone of mass $2M$ is thrown straight up with initial velocity $2v_0$, will reach a height

(a) $H/2$ (b) H (c) $\sqrt{H}$ (d) $2H$ (e) none of the above, my answer is_____

Brief outline of solution:

B3- An object of mass m is sliding on a horizontal surface, following a push that imparted an initial velocity v in the positive x direction. If the coefficient of kinetic friction between the object and the surface is μ, the acceleration of the object is

(a) $a_x = -\mu m$ (b) $a_x = +\mu mg$ (c) $a_x = +g/\mu$ (d) $a_x = -\mu g$

(e) none of the above, my answer is_____ ***Brief outline of solution:***

B4- A 2.0-Kg mass which is at rest receives an impulse of 10 N.s. Following this impulse

(a) its speed is 20 m/s. (c) its momuntum is 10 Kg.m/s.

(b) its speed is 10 m/s. (d).its momuntum is 20 Kg.m/s.

(e) None of the above is correct. ***Brief outline of solution:***

B5- A car of mass M travelling with a velocity v strikes a car of (equal) mass M that is at rest. The two cars bodies mesh in the collision. The loss of KE in the collision is

(a) a quarter of the initial KE. (b) half of the initial KE. (c) all the initial KE.

(d) zero. (e) None of the above is correct. ***Brief outline of solution:***

B6- The angular velocity of the earth's rotation about its axis is

(a) $12/\pi$ rad/h. (b) 48π rad/h. (c) $\pi/12$ rad/h. (d) 0.5 deg/min.

(e) none of the above, my answer is_____ ***Brief outline of solution:***

B7- A rotating mass M, with moment of inertia I about the axis of rotation, has an angular momentum L. Its kinetic energy (expressed in terms of M, I and L) is

(a) $ML^2/2$ (b) $IL^2/2$ (c) $L^2/2I$ (d) $IL^2/2M^2$ (e) none of the above, my answer is_____

Brief outline of solution:

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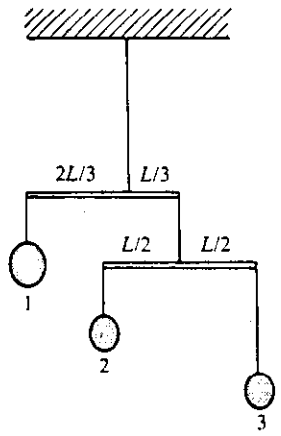
Part C

C1- Bernoulli's equation which states that $p + \rho gh + 1/2\rho v^2 = constant$, describes the hydrodynamics of fluid flow. Here p is the pressure of the fluid, ρ is its density, g is acceleration of the gravity, h is the height of the fluid above ground, and v is the speed of flow of the fluid. Show that the above expression is dimensionally homogeneous.

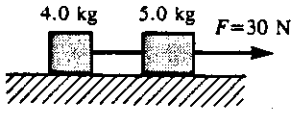
C2- A 5.1-Kg box is pulled straight across the floor at constant speed by force of 25 N, which is directed at 40° angle with the horizontal. Find the coefficient of kinetic friction between the box and the floor.

C3- The mobile shown in the figure below hangs in equilibrium. It consists of objects held by vertical strings. Object 3 weighs 1.40 N, while each of the uniform horizontal bars 0.50 N. Find (a) the weights of objects 1 and 2 and (b) the tension in the upper string.

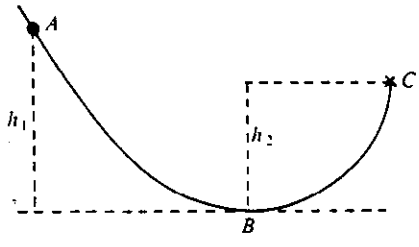


C4- A projectile is fired with a horizontal velocity of 30 m/s from the top of a cliff 80-m high.
(a) How far from the foot of the cliff will it strike the level ground? (b) With what velocity will it strike?

C5- Two blocks, with masses $m_1 = 4.0$ Kg and $m_2 = 5.0$ Kg, are connected to one another by a cord and pulled by a force $F = 30$ N, as shown below. What is the tension in the connecting cord?



C6- The figure below shows a bead sliding on a wire. There, $h_1 = 50$ cm, $h_2 = 30$ cm and the length of the wire from A to C is 400 cm. The 3.0 gram bead, released at A, coasts to point C and stops. How large an average friction force opposed its motion?



C7- A 90 gram ball moving at 100 cm/s collides head-on with a stationary 10 g ball. Determine the velocity of each ball after the impact, assuming the collision is perfectly elastic.

C8- A car moving at 5 m/s tries to round corner in a circular arc of 8m radius. The roadway is flat. How large must be the coefficient of friction between the wheels and the roadway if the car is not to skid?

C9- A neutron star is formed when an object such as our sun collapses. Suppose a uniform spherical star of mass M and radius R collapses to a uniform sphere of radius $10^{-5}R$. If the original star has a rotation of 1 rev each 25 days (as does the sun), what will be the rotation rate of the neutron star?