COURSE NO.: PHYS 1050 TIME: 3 hours

EXAMINATION: Physics 1: Mechanics EXAMINER: C-M. Hu, F. Lin, S. Page

All questions are of equal value. Answer all questions. No marks are subtracted for wrong answers.

Record all answers on the computer score sheet provided. USE PENCIL ONLY! Black pen will look good but may not be read reliably by the scoring machine. Mark only <u>one</u> answer for each question! Select the answer that is closest to yours.

A formula sheet is provided for your use; you may not use your own formula sheet or any other materials or notes. Calculators of any type are allowed, but not devices that store text or that can communicate with other such devices.

Be sure your name and student number are printed on the score sheet and the student number correctly coded in the box at the top right-hand side of the sheet.

1. An electric car starts from rest and accelerates at a rate of 2.0 m/s^2 in a straight line until it reaches a speed of 10 m/s. The car then slows down at a constant rate of 1.0 m/s^2 until it stops. How much time elapses from start to stop?

(a) 3.2 s (b) 5.0 s (c) 8.2 s (d) 10 s (e) 15 s

2. The owner of the "Pet Food International" store chain decides to introduce a new system of basic units, which he refers to as "PFI" units. In this system, mass is measured in bags (B), length is measured in chains (C), and time is measured in days (D). In terms of these new units, what is the PFI unit of work?

(a) BCD^{-2} (b) BC^2D^{-2} (c) BCD (d) $BC^{-2}D^2$ (e) B^2CD

3. A force $\vec{F} = (0.5\hat{i} + 1.0\hat{k})$ N does work on an object of mass m while it is moved from position $\vec{r}_1 = 1.0\hat{k}$ m to $\vec{r}_2 = (2.0\hat{i} + 0.4\hat{j})$ m. The work done by the force $\vec{F}$ during this process is:

(a) 0 J (b) $1.0\hat{k}$ J (c) 1.4 J (d) 1.0 J (e) 0.4 J

4. The magnetic force on a charged particle is given by $\vec{F} = q(\vec{v} \times \vec{B})$, where q is the charge, $\vec{v}$ is the velocity, and $\vec{B}$ is the magnetic field. A certain particle has a charge q, velocity $\vec{v} = v\hat{i}$ m/s and experiences a magnetic field $\vec{B} = B\cos\theta\hat{k} + B\sin\theta\hat{i}$. The magnetic force on the particle is:

(a) $qvB\cos\theta\hat{i}$ (b) $-qvB\cos\theta\,\hat{j}$ (c) $qvB\sin\theta\hat{i}$ (d) $qvB\sin\theta\,\hat{j}$
(e) $qvB\cos\theta\,\hat{k}$

5. A toy racing car moves with constant speed around the circle shown below. When it is at point A its coordinates are x = 0, y = 3 m and its velocity is 6 m/s $\hat{i}$. When it is at point B its velocity and acceleration are:

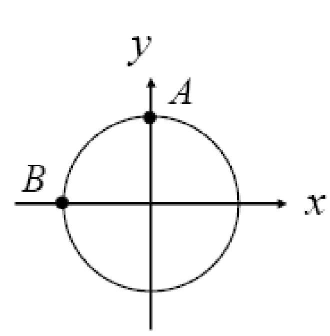
(a) – 6 m/s $\hat{j}$ and 12 m/s^2 $\hat{i}$, respectively

(b) 6 m/s $\hat{i}$ and –12 m/s^2 $\hat{i}$, respectively

(c) 6 m/s $\hat{j}$ and 12 m/s^2 $\hat{i}$, respectively

(d) 6 m/s $\hat{i}$ and 12 m/s^2 $\hat{j}$, respectively

(e) 6 m/s $\hat{j}$ and 0, respectively



6. A person walks up a stationary escalator of length 20 m in 100 s. When he rides up the same escalator without walking, the same trip takes 50 s. How much time would the person take to walk up the moving escalator?

(a) 33 s (b) 50 s (c) 66 s (d) 100 s (e) 150 s

7. A gun is aimed directly at a target, a horizontal distance 20 meters away. The bullet strikes the target 1 cm below the aiming point. With what horizontal speed did the bullet leave the gun?

(a) 9.8 m/s (b) 22 m/s (c) 144 m/s (d) 443 m/s (e) 626 m/s

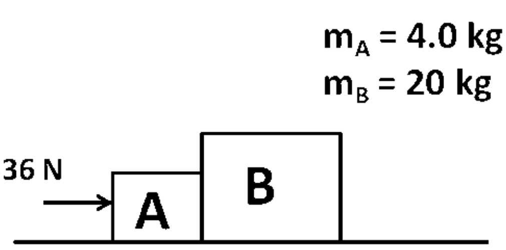
8. Two boats are traveling at constant velocity in still water. The velocity of the first boat is $\vec{v}_1 = 10\,\hat{j}$ m/s. At time $t = 0$, the separation between the two boats is given by $\vec{r}_2 - \vec{r}_1 = 50\,\hat{i}$ m. The boats collide at $t = 10$ s. The speed of the second boat, v_2, before the collision, is:

(a) 5 m/s (b) 10 m/s (c) 11 m/s (d) 110 m/s (e) 150 m/s

9. A boat is able to move through still water at 20 m/s. It makes a round trip to a town 3.0 km directly upstream. If the river flows at 5 m/s, the time required for this round trip is:

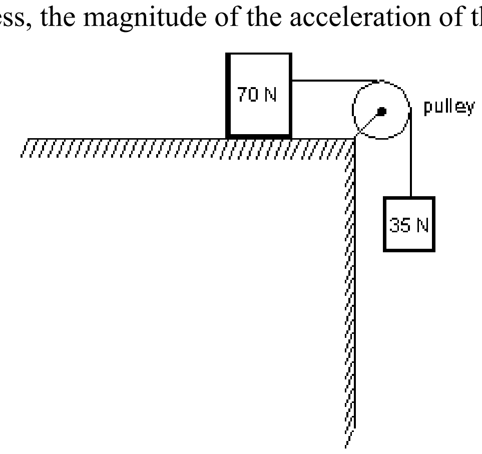
(a) 120 s (b) 150 s (c) 200 s (d) 300 s (e) 320 s

10. Two blocks (A and B) are in contact on a horizontal frictionless surface. A 36-N constant force is applied to A as shown. The acceleration of block B is:



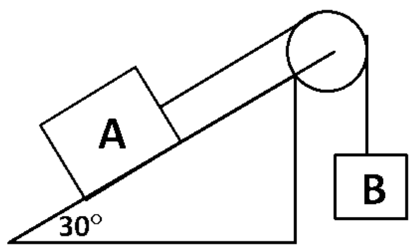
(a) 0 (b) 9.0 m/s^2 (c) 1.8 m/s^2 (d) 1.5 m/s^2 (e) 2.3 m/s^2

11. A 70-N block and a 35-N block are connected by a string as shown. If the pulley is massless and the surface is frictionless, the magnitude of the acceleration of the 70-N block is:



(a) 1.6 m/s^2 (b) 3.3 m/s^2 (c) 4.9 m/s^2 (d) 6.7 m/s^2 (e) 9.8 m/s^2

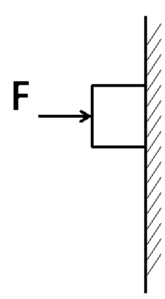
12. Block A, with a mass of 12 kg, rests on a 30º incline. The coefficient of kinetic friction is 0.20. The attached string is parallel to the incline and passes over a massless, frictionless pulley at the top. Block B, with a mass of 2.0 kg, is attached to the dangling end of the string. The acceleration of B is:



(a) 1.35 m/s^2, up (b) 1.35 m/s^2, down (c) 2.8 m/s^2, up (d) 2.8 m/s^2, down

(e) 0

13. A horizontal force of 10.0 N pushes a 0.50-kg block against a vertical wall. If μ_s = 0.80 and μ_k = 0.60, the acceleration of the block in m/s^2 is:



(a) 0 (b) 1.8 (c) 6.0 (d) 8.0 (e) 9.8

14. An ideal spring is hung vertically from the ceiling. When a 2.0-kg mass hangs at rest from it, the spring is extended 6.0 cm from its relaxed length. An upward external force is then applied to the block to move it upward a distance of 10 cm. While the block is being moved by the force, the work done by the spring is

(a) –0.33 J (b) –0.52 J (c) –0.26 J (d) 0.52 J (e) 0.33 J

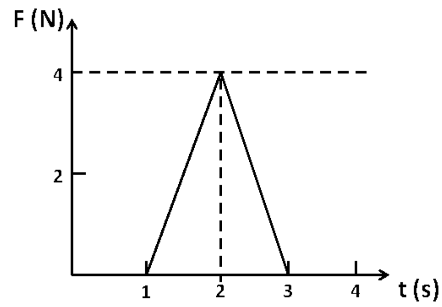
15. A 0.50-kg block attached to an ideal spring with a spring constant of 80 N/m oscillates on a horizontal frictionless surface. When the spring is 4.0 cm longer than its equilibrium length, the speed of the block is 0.50 m/s. The maximal extension of the spring from its equilibrium length during the oscillation is:

(a) 4.0 cm (b) 2.0 cm (c) 2.8 cm (d) 5.6 cm (e) 11.2 cm

16. Two spacemen are floating together with zero speed in a gravity-free region of space. The mass of spaceman A is 110 kg and that of spaceman B is 70 kg. Spaceman A suddenly pushes B away from him with B attaining a final speed of 0.5 m/s. The final recoil speed of A is:

(a) 0 (b) 0.32 m/s (c) 0.5 m/s (d) 0.64 m/s (e) 1.0 m/s

17. A 5-kg object starts from rest at $t = 0$ and moves along the x axis subjected to a force $\vec{F}$ in the positive x direction; a graph of F as a function of time t is shown below. At $t = 4$ s, the object's velocity is:



(a) 0.8 m/s (b) 1.1 m/s (c) 1.6 m/s (d) 2.3 m/s (e) 4.0 m/s

18. At t = 0, a wheel rotating about a fixed axis at a constant angular acceleration has an angular velocity of 2.0 rad/s. Two seconds later it has turned through 5.0 complete revolutions. What is the angular acceleration of this wheel?

(a) 17 rad/s^2 (b) 14 rad/s^2 (c) 20 rad/s^2 (d) 23 rad/s^2 (e) 12 rad/s^2

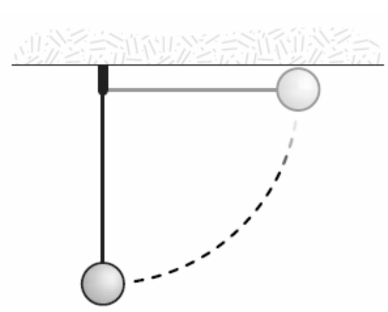
19. A wheel rotates about a fixed axis with a constant angular acceleration of 4.0 rad/s^2. The radius of the wheel is 0.2 m. What is the linear speed of a point on the rim of this wheel at an instant when that point has a total linear acceleration with a magnitude of 1.2 m/s^2?

(a) 0.39 m/s (b) 0.42 m/s (c) 0.45 m/s (d) 0.35 m/s (e) 0.53 m/s

20. Two particles (m_1 = 0.20 kg, m_2 = 0.30 kg) are positioned at the ends of a 2.0-m long rod of negligible mass. What is the rotational inertial (I) of this system about an axis perpendicular to the rod and through the center of mass?

(a) 0.48 kg · m^2 (b) 0.50 kg · m^2 (c) 1.2 kg · m^2 (d) 0.80 kg · m^2
(e) 0.70 kg · m^2

21. In the figure, a 4-kg weight swings in a vertical circle at the end of a massless string. The string is 2 m long. If the weight is released with zero initial velocity from a horizontal position, the magnitude of its angular momentum at the lowest point of its path relative to the center of the circle is:



(a) 40 kg · m^2/s

(b) 10 kg · m^2/s

(c) 30 kg · m^2/s

(d) 20 kg · m^2/s

(e) 50 kg · m^2/s

22. A 2.0-kg block starts from rest on the positive x axis 3.0m from the origin and thereafter has an acceleration in m/s^2 given by $\vec{a} = 4.0\ \hat{i} - 3.0\hat{j}$. The torque, relative to the origin, acting on it at the end of 2.0 s is:

(a) 0 (b) −18 Nm $\hat{k}$ (c) 24 N m $\hat{k}$ (d) −144 Nm $\hat{k}$
(e) 144 Nm $\hat{k}$

23. A pulley with radius R and rotational inertia I is free to rotate on a horizontal fixed axis through its center. A string passes over the pulley. A block of mass m_1 is attached to one end and a block of mass m_2 is attached to the other. At one time the block with mass m_1 is moving downward with speed v. If the string does not slip on the pulley, the magnitude of the total angular momentum, about the pulley center, of the blocks and pulley, considered as a system, is given by:

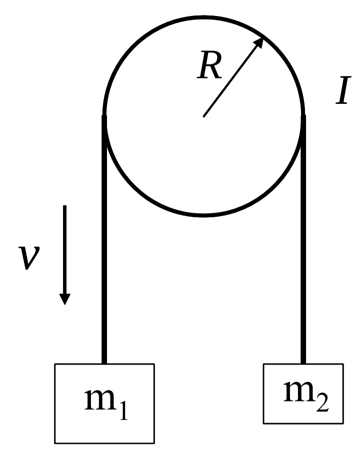
(a) $(m_1 - m_2)vR + Iv/R$

(b) $(m_1 + m_2)vR + Iv/R$

(c) $(m_1 - m_2)vR + Iv/R^2$

(d) $(m_1 + m_2)vR + Iv/R^2$

(e) none of the above



24. An event occurs at x = 500 m, t = 0.90 μs in reference frame A. Reference frame B is moving at 0.90 c in the positive x direction relative to A. The origins coincide at t = 0 and clocks in the frame B are zeroed when the origins coincide. The coordinate and time of the event in the frame B are:

(a) 500 m, 0.90 μs (b) 1700 m, 5.5 μs (c) 740 m, 2.4 μs (d) 260 m, −0.60 μs

(e) 590 m, −1.4 μs

25. Two electrons move in opposite directions with an identical speed of 0.70 c as measured in the laboratory. The speed of one electron as measured from the other is:

(a) 0.35 c (b) 0.70 c (c) 0.94 c (d) 1.00 c (e) 1.40 c