		Surname		Type
Group Number		Name		A
List Number		e-mail		
Student ID		Signature		

ATTENTION: There is normally only one correct answer for each question and each correct answer is worth the same point. Only the answers on your answer sheet will be graded. Please be sure that you have marked all of your answers on the answer sheet by using a pencil (*not* pen).

Questions 1-4

The position of a particle moving along the x-axis is given by $x(t) = 3 + Bt^3 - Ct^2$ where x is in meters and t is in seconds, B and C are constants.

1. What is the SI unit of the constant B?
(a) m^2/s^2 (b) m^2/s^3 (c) m/s^2 (d) m/s (e) m/s^3

2. If the particle comes to rest at $x = 24\ m$ when $t = 3\ s$, what are the numerical values of the constants B and C?
(a) $-12/7$ and 3 (b) 4 and -5 (c) $-14/9$ and -7 (d) 6 and 5 (e) $13/6$ and -3

3. When is the particle's acceleration zero?
(a) at $3.0\ s$ (b) at $1.5\ s$ (c) at $1.0\ s$ (d) at $2.0\ s$ (e) at $2.5\ s$

4. Which of the following is the average acceleration vector $\vec{a}_{av}$ between $t = 1\ s$ and $t = 3\ s$?
(a) $-8\hat{\imath}\ m/s^2$ (b) $-24/5\ \hat{\imath}\ m/s^2$ (c) $-14/3\ \hat{\imath}\ m/s^2$ (d) $8\hat{\imath}\ m/s^2$ (e) $25/4\ \hat{\imath}\ m/s^2$

Questions 5-7

A particle starts moving from the origin with an initial velocity $\vec{v}_0 = -8\hat{\jmath}\ m/s$ and its acceleration $\vec{a} = (4\hat{\imath} + 2\hat{\jmath})\ m/s^2$.

5. What is the velocity of the particle as a function of time?
(a) $\vec{v}(t) = [(4t)\hat{\imath} + (3t)\hat{\jmath}]\ m/s$ (b) $\vec{v}(t) = [(2t)\hat{\imath} + (6t-8)\hat{\jmath}]\ m/s$ (c) $\vec{v}(t) = [(4t)\hat{\imath} + (2t-8)\hat{\jmath}]\ m/s$
(d) $\vec{v}(t) = [(3t)\hat{\imath} + (2t^2-8)\hat{\jmath}]\ m/s$ (e) $\vec{v}(t) = [(2t)\hat{\imath} + (4t-8)\hat{\jmath}]\ m/s$

6. When does the particle reach its minimum y-coordinate?
(a) $t = 6\ s$ (b) at $t = 4\ s$ (c) $t = 3\ s$ (d) $t = 5\ s$ (e) $t = 8\ s$

7. Assuming that there is a second particle moving with constant velocity $\vec{v}_2 = 2\hat{\imath} + 3\hat{\jmath}\ m/s$, what is the velocity of the *first particle relative to the second particle* at $t = 2\ s$?
(a) $-6\hat{\imath} + 7\hat{\jmath}\ m/s$ (b) $5\hat{\imath} - 4\hat{\jmath}\ m/s$ (c) $6\hat{\imath} - 7\hat{\jmath}\ m/s$ (d) $6\hat{\imath} - 8\hat{\jmath}\ m/s$ (e) $6\hat{\imath} + 6\hat{\jmath}\ m/s$

Questions 8-10

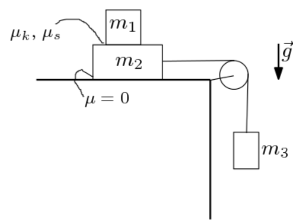
A particle is moving along the x-axis under the action of a variable force $\vec{F}(x) = (Cx - 3x^2)\hat{\imath}\ N$, where x is in meters and C is a constant. There is no friction.

8. What is the *dimension* of the constant C?
(a) $[ML/T^3]$ (b) $[ML/T^2]$ (c) $[M/T^3]$ (d) $[M/T^2]$ (e) $[ML^2/T^2]$

9. What is the work done by the force to move the particle from $x = 0$ to $x = 3\ m$?
(a) $(9C/2 + 24)\ J$ (b) $(7C/2 - 25)\ J$ (c) $(9C/2 - 27)\ J$ (d) $(9C/2 - 25)\ J$ (e) $(5C/2 + 27)\ J$

10. At $x = 0$, the particle's kinetic energy is $20\ J$ and at $x = 3\ m$ it is $11\ J$. What is the numerical value of the constant C?
(a) 3 (b) 5 (c) 2 (d) 7 (e) 4

Questions 11-13



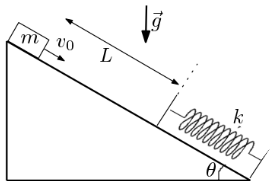
Consider the system shown in the figure: The coefficient of kinetic and static frictions between $m_1 = 2\ kg$ and $m_2 = 4\ kg$ are $\mu_k = 0.5$ and $\mu_s = 0.7$, respectively, and there is no friction between m_2 and the table. Take $g = 10\ m/s^2$.

11. If the blocks are moving in such a way that m_1 and m_2 are not sliding relative to each other (that is, they are moving as a single block), what is the magnitude of the force of friction between m_1 and m_2? Take $m_3 = 8\ kg$.
(a) $75/7\ N$ (b) $80/7\ N$ (c) $85/7\ N$ (d) $82/7\ N$ (e) $78/7\ N$

12. What is the **maximum** value of m_3 such that m_1 and m_2 does not slide relative to each other, that is, they move as a single object?
(a) 12 kg (b) 15 kg (c) 10 kg (d) 14 kg (e) 11 kg

13. If $m_3 = 21\ kg$, what are the accelerations of the blocks relative to the observer at rest on the table? (a_1 is the acceleration of m_1 and a_2 is the acceleration of m_2 and m_3.)
(a) $a_1 = 4\ m/^2$ and $a_2 = 15/2\ m/^2$ (b) $a_1 = 5\ m/^2$ and $a_2 = 8\ m/^2$ (c) $a_1 = 5\ m/^2$ and $a_2 = 17/2\ m/^2$
(d) $a_1 = 5\ m/^2$ and $a_2 = 7\ m/^2$ (e) $a_1 = 4\ m/^2$ and $a_2 = 10\ m/^2$

Questions 14-17



Consider the system shown in the figure: The coefficient of kinetic and static frictions between the block $m = 3\ kg$ and the inclined plane, of angle $\theta = 53^0$, are $\mu_k = 0.6$ and μ_s, respectively. The massles spring of force constant $k = 300\ N/m$ is fastened to the bottom of the inclined plane and it is initially unstretched. The block starts sliding down the incline with an initial speed v_0 and the initial distance between the block and the spring is $L = 70\ cm$. The amount of maximum compression of the spring by the block is $d = 30\ cm$. Take $g = 10\ m/s^2$. ($\sin 37 = \cos 53 = 3/5$ and $\cos 37 = \sin 53 = 4/5$.)

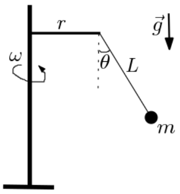
14. What is the *work done by the spring* until the block comes to rest at the maximum compression?
(a) $27/2\ J$ (b) $-27/2\ J$ (c) $-29/2\ J$ (d) $25/2\ J$ (e) $-25/2\ J$

15. What is the *work done by the friction* until the block comes to rest at the maximum compression?
(a) $-57/5\ J$ (b) $-59/5\ J$ (c) $-64/5\ J$ (d) $-51/5\ J$ (e) $-54/5\ J$

16. What is the value of v_0?
(a) $\sqrt{7}/5\ m/s$ (b) $\sqrt{3}/5\ m/s$ (c) $\sqrt{7}\ m/s$ (d) $\sqrt{5}/5\ m/s$ (e) $\sqrt{5}\ m/s$

17. What is **minimum** value of the μ_s such that the block can not rebound up the incline after the maximum compression?
(a) 11/4 (b) 12/5 (c) 13/3 (d) 11/3 (e) 13/6

Questions 18-20



A block of mass m is connected by a massless cord of length $L = 1\ m$ to a horizontal rod of length $r = 60\ cm$ which is being rotated about a vertical central shaft with a constant angular speed ω, as shown in the figure. Take $g = 10\ m/s^2$ and $\theta = 37^0$. ($\sin 37 = \cos 53 = 3/5$ and $\cos 37 = \sin 53 = 4/5$.)

18. What is the linear speed of the block m?
(a) $v = 2\ m/s$ (b) $v = 3\ m/s$ (c) $v = 3.5\ m/s$ (d) $v = 4.5\ m/s$ (e) $v = 4\ m/s$

19. What is angular speed ω of the rotating assembly?
(a) $\omega = 7/2\ rad/s$ (b) $\omega = 7\ rad/s$ (c) $\omega = 5/2\ rad/s$ (d) $\omega = 4\ rad/s$ (e) $\omega = 5\ rad/s$

20. If $m = 2\ kg$ and the maximum tension that the cord can stand without breaking is $T_{max} = 64\ N$, what is the maximum value that the ω can take without the cord breaks?
(a) $\omega_{max} = 5\ rad/s$ (b) $\omega_{max} = 3\ rad/s$ (c) $\omega_{max} = 8\ rad/s$ (d) $\omega_{max} = 6\ rad/s$ (e) $\omega_{max} = 4\ rad/s$