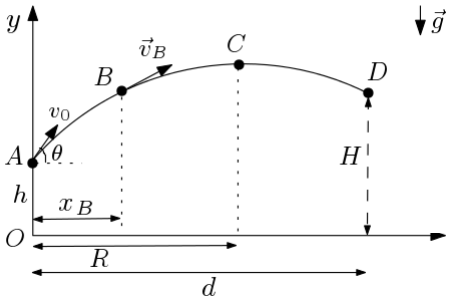
Group Number		Name		Type
List Number		Surname		A
Student ID		Signature		
E-mail				

ATTENTION: Each question has only one correct answer and is worth one point. Be sure to fill in completely the circle that corresponds to your answer on the answer sheet. Use a pencil (not a pen). Only the answers on your answer sheet will be taken into account.

Questions 1-5

An object of mass m is thrown from point A at $t = 0$ with an initial speed $v_0 = 10\ m/s$ from a height $h = 1\ m$ over the ground making an angle $\theta = 53^o$ with the horizontal, and following the trajectory shown in the figure, it hits the point D which is at height $H = 7/4\ m$ over the ground.

Take $g = 10\ m/s^2$ **and** $\sin 53^o = \cos 37^o = 4/5$ **.**



1. In the given Cartesian coordinate system, which of the followings is the $y(t)$ of the object in meters?

(a) $1 + 8t + 5t^2$ (b) $1 + 6t - 5t^2$ (c) $1 - 8t - 5t^2$ (d) $1 + 8t - 5t^2$ (e) $1 - 6t + 5t^2$

2. What is the time to reach point D in seconds?

(a) 2 (b) 5/3 (c) 4/3 (d) 1 (e) 3/2

3. If C is the highest point of the trajectory over the ground, what is the ratio R/d?

(a) 4/5 (b) 3/5 (c) 7/15 (d) 8/15 (e) 11/15

4. Assuming that B and D are at the same height, what is x_B in meters?

(a) 3/5 (b) 4/3 (c) 2/5 (d) 1 (e) 3/4

5. What is the velocity $\vec{v}_B$ at point B in units of m/s?

(a) $6\hat{\imath} - 6\hat{\jmath}$ (b) $6\hat{\imath} + 7\hat{\jmath}$ (c) $8\hat{\imath} + 7\hat{\jmath}$ (d) $6\hat{\imath} - 7\hat{\jmath}$ (e) $8\hat{\imath} + 6\hat{\jmath}$

Questions 6-8

Consider a particle moving in the xy-plane with a constant acceleration. At $t = 0$ the particle's initial position is $(2\ m)\hat{\imath} - (3\ \mathrm{m})\hat{\jmath}$ and at that instant its initial velocity is $(10\ m/s)\hat{\imath}$. At $t = 3\ s$ its velocity is $(4\ m/s)\hat{\imath} + (3\ \mathrm{m/s})\hat{\jmath}$.

6. What is the acceleration of this particle?

(a) $(2\ m/s^2)\hat{\imath} - (1\ \mathrm{m/s^2})\hat{\jmath}$ (b) $(3\ m/s^2)\hat{\imath} + (2\ \mathrm{m/s^2})\hat{\jmath}$ (c) $(-2\ m/s^2)\hat{\imath} + (3\ \mathrm{m/s^2})\hat{\jmath}$ (d) $(-3\ m/s^2)\hat{\imath} + (2\ \mathrm{m/s^2})\hat{\jmath}$
(e) $(-2\ m/s^2)\hat{\imath} + (1\ \mathrm{m/s^2})\hat{\jmath}$

7. What is the position vector of the particle at $t = 3\ s$?

(a) $(5\ m)\hat{\imath} + (2\ \mathrm{m})\hat{\jmath}$ (b) $(17\ m)\hat{\imath} + (5/2\ \mathrm{m})\hat{\jmath}$ (c) $(23\ m)\hat{\imath} + (3/2\ \mathrm{m})\hat{\jmath}$ (d) $(13\ m)\hat{\imath} + (5/2\ \mathrm{m})\hat{\jmath}$
(e) $(3\ m)\hat{\imath} + (4\ \mathrm{m})\hat{\jmath}$

8. During the time interval $t_i = 0$ and $t_f = 3\ s$ what is the average velocity of the particle?

(a) $(4\ m)\hat{\imath} + (5/2\ \mathrm{m})\hat{\jmath}$ (b) $(7\ m)\hat{\imath} + (3/2\ \mathrm{m})\hat{\jmath}$ (c) $(5\ m)\hat{\imath} + (5/2\ \mathrm{m})\hat{\jmath}$ (d) $(4\ m)\hat{\imath} + (7/2\ \mathrm{m})\hat{\jmath}$ (e) $(5\ m)\hat{\imath} + (3\ \mathrm{m})\hat{\jmath}$

Questions 9-10

A block of mass m is at rest at the origin at $t = 0$. It is pushed with constant force F_0 from $x = 0$ to $x = L$ across a horizontal surface whose coefficient of kinetic friction is $\mu_k = \mu_0(1 - x/L)$, that is, the coefficient of friction decreases from μ_0 at $x = 0$ to zero at $x = L$.

9. What is the net work done by the net force to bring the block from $x = 0$ to $x = L$?

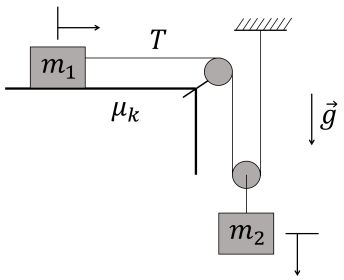
(a) $\left(F_0 - \frac{3}{2}mg\mu_0\right)L$ (b) $\left(2F_0 - \frac{1}{2}mg\mu_0\right)L$ (c) $\left(F_0 + \frac{3}{2}mg\mu_0\right)L$ (d) $\left(3F_0 + \frac{5}{2}mg\mu_0\right)L$ (e) $\left(F_0 - \frac{1}{2}mg\mu_0\right)L$

10. What is the block's speed as it reaches position L?

(a) $\sqrt{\left(\frac{F_0}{m} - 4\mu_0 g\right)L}$ (b) $\sqrt{\left(\frac{F_0}{m} - 3\mu_0 g\right)L}$ (c) $\sqrt{\left(\frac{2F_0}{m} + 3\mu_0 g\right)L}$ (d) $\sqrt{\left(\frac{2F_0}{m} - 3\mu_0 g\right)L}$ (e) $\sqrt{\left(\frac{2F_0}{m} - \mu_0 g\right)L}$

Questions 11-13

Consider the system shown in the figure. The pulleys are assumed to be frictionless and massless. The coefficient of kinetic friction between m_1 and the horizontal surface is $\mu_k = 0.25$. Take $m_1 = 2\ kg$ and $m_2 = 4\ kg$, $g = 10\ m/s^2$.



11. What is the relation between the manitudes of the accelerations of the blocks?

(a) $3a_1 = 2a_2$ (b) $a_1 = a_2$ (c) $a_1 = 3a_2$ (d) $a_1 = 2a_2$ (e) $2a_1 = a_2$

12. What is the acceleration of the block m_1?

(a) $3\ m/s^2$ (b) $4.5\ m/s^2$ (c) $3.5\ m/s^2$ (d) $5\ m/s^2$ (e) $4\ m/s^2$

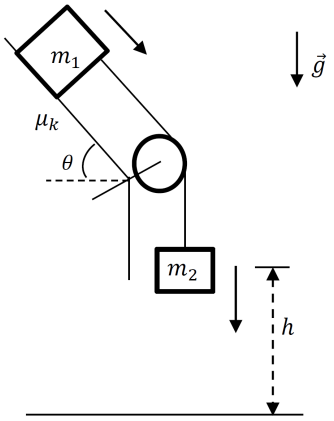
13. What is the tension T in the rope?

(a) $13\ N$ (b) $11\ N$ (c) $19\ N$ (d) $17\ N$ (e) $15\ N$

Questions 14-16

Two blocks of masses $m_1 = 5\ kg$ and $m_2 = 10\ kg$ are connected by a string of negligible mass, as shown in the figure. The coefficient of kinetic friction between the block m_1 and the inclined plane is given by $\mu_k = 0.25$ and the angle of inclanation is $\theta = 37^o$.

Take $g = 10\ m/s^2$ **and** $\sin 37^o = \cos 53^o = 3/5$ **.**



14. What is the acceleration of the blocks?

(a) $6.5\ m/s^2$ (b) $8\ m/s^2$ (c) $6\ m/s^2$ (d) $7\ m/s^2$ (e) $7.5\ m/s^2$

15. What is the tension in the string?

(a) $25\ N$ (b) $30\ N$ (c) $15\ N$ (d) $35\ N$ (e) $20\ N$

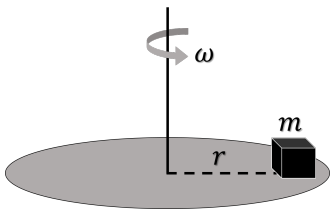
16. What is the work done by gravity when m_2 falls a distance $h = 0.5\ m$?

(a) $55\ J$ (b) $65\ J$ (c) $60\ J$ (d) $50\ J$ (e) $45\ J$

Questions 17-18

A disk shaped platform of radius R is being rotated with a constant angular speed $\omega = 3\ rad/s$ about the axis passing through its center of mass, as shown in the figure. A block of mass $m = 500\ g$ is at rest relative to the platform at a distance $r = 25\ cm$ from the axis of rotation. The coefficient of static and kinetic frictions between the block and the platform are $\mu_s = 0.7$ and $\mu_k = 0.4$, respectively.

Take $g = 10\ m/s^2$.



17. What is the magnitude and direction of the friction force on m?

(a) $11/8\ N$, away from the rotation axis
(b) $9/5\ N$, towards the rotation axis
(c) $9/8\ N$, towards the rotation axis
(d) $11/8\ N$, towards the rotation axis
(e) $9/8\ N$, away from the rotation axis

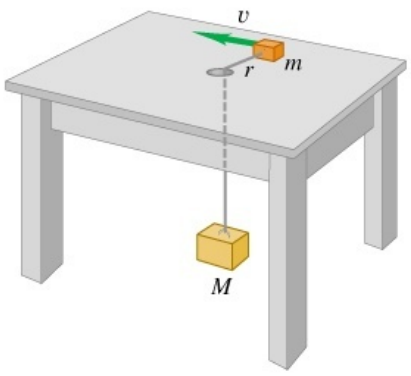
18. What is the maximum value of ω to keep the block at rest relative to the platform in units of rad/s?

(a) $3\sqrt{7}$ (b) $2\sqrt{7}$ (c) $4\sqrt{2}$ (d) $3\sqrt{5}$ (e) $2\sqrt{5}$

Questions 19-20

A small block of mass $m = 0.5\ kg$ is set into a uniform circular motion on a horizontal frictionless table at a distance $r = 50\ cm$ from a hole in the center of the table, as shown in the figure. A string tied to m passes down through the hole, and a larger block of mass M is suspended from the free end of the string. If the small block m makes 4 turns in a second, the height of M is not changing.

Take $g = 10\ m/s^2$, $\pi \approx 3$.



19. For this given configuration of the system, what is the magnitude of the acceleration of m?

(a) $328\ m/s^2$ (b) $148\ m/s^2$ (c) $288\ m/s^2$ (d) $178\ m/s^2$ (e) $258\ m/s^2$

20. What is the value of M?

(a) $72/5\ kg$ (b) $18\ kg$ (c) $17\ kg$ (d) $76/7\ kg$ (e) $72/7\ kg$