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

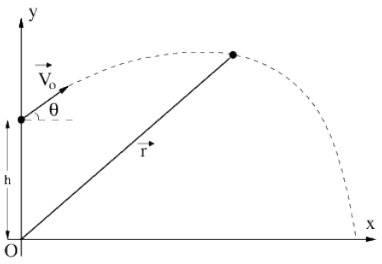
ATTENTION: Each question has only one correct answer and is worth one point. Be sure to fill in completely the circle that corresponds to your answer on the answer sheet. Use a pencil (not a pen). Only the answers on your answer sheet will be taken into account.

1. For what value of d is the vector $\vec{A} = 2\hat{\imath} + 2\hat{\jmath} + d\hat{k}$ perpendicular to the vector $\vec{B} = 4\hat{\imath} + 4\hat{\jmath} - 2\hat{k}$?

(a) 4 (b) 8 (c) -4 (d) -1 (e) 0

2. A particle is projected from y_0=h at t=0 with $\vec{V_0}$ velocity making an angle θ with the horizontal as shown in the figure. Take the magnitude of the gravitational acceleration as g. What is its maximum height of the object with respect to origin?

(a) $h + \frac{V_0^2 sin(2\theta)}{2g}$ (b) h (c) $\frac{V_0^2 sin(2\theta)}{2g}$ (d) $h + \frac{V_0^2 sin^2\theta}{2g}$ (e) $\frac{V_0^2 sin^2\theta}{2g}$



Questions 3-6

An object on a horizontal plane has an initial velocity $\vec{V_0} = 4.0\hat{\imath} + 1.0\hat{\jmath}$ (m/s) at a point where its position vector is $\vec{r_0} = 10\hat{\imath} - 4.0\hat{\jmath}$ (m) relative to an origin. The object moves with constant acceleration and after t=20 s, its velocity becomes $\vec{V} = 20\hat{\imath} - 5.0\hat{\jmath}$ (m/s).

3. What is the magnitude of its acceleration in m/s^2?

(a) -0.3 (b) 1.0 (c) $\sqrt{1.16}$ (d) 0.8 (e) $\sqrt{73}/10$

4. What is its position vector at $t = 2$ s?

(a) $18\hat{\imath} - 2\hat{\jmath}$ (b) $-18\hat{\imath} + 2\hat{\jmath}$ (c) $19.6\hat{\imath} - 2.6\hat{\jmath}$ (d) $9.6\hat{\imath} + 1.4\hat{\jmath}$ (e) $19.6\hat{\imath}$

5. What is the velocity of the object at $t = 2$ s?

(a) $0.6\hat{\imath} + 1.6\hat{\jmath}$ (b) $1.6\hat{\imath} - 0.6\hat{\jmath}$ (c) $1.6\hat{\imath} + 0.6\hat{\jmath}$ (d) $5.6\hat{\imath} + 2.6\hat{\jmath}$ (e) $5.6\hat{\imath} + 0.4\hat{\jmath}$

6. At what time, x coordinate of the object becomes zero?

(a) 2 s (b) 5 s (c) $\sqrt{5/2.2}$ s (d) never (e) ∞

Questions 7-10

In Fig, a 1.5 kg ball is connected by means of two massless strings, each of length L= 2.0 m, to a vertical, rotating rod. The strings are tied to the rod with separation d = 2.0 m and are taut. The tension in the upper string is 35 N.

Take $g = 10$ m/s^2, $sin30 = 0.5$, $cos30 = 0.9$, $tan30 = 0.6$.

7. What is the tension in the lower string?

(a) 5.0 N (b) 16.4 N (c) 13.6 N (d) 18.3 N (e) 5.8 N

8. What is the magnitude of the net force on the ball?

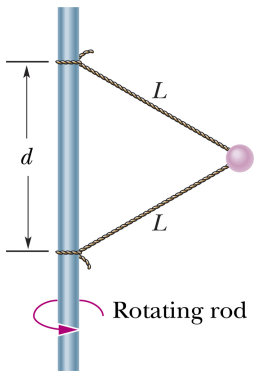
(a) 36.0 N (b) 18.6 N (c) 26.6 N (d) 48.0 N (e) 54.6 N

9. What is the speed of the ball?

(a) $\sqrt{14.2}$ m/s (b) $\sqrt{32.4}$ m/s (c) $\sqrt{24.3}$ m/s (d) $\sqrt{26.7}$ m/s (e) $\sqrt{40.0}$ m/s

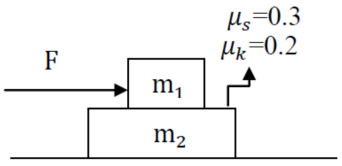
10. What is the direction of the net force on the ball?

(a) downward (b) radially towards the rod (c) upward (d) none of these (e) radially away from the rod



Questions 11-14

Two blocks of masses $m_1 = 4$ kg and $m_2 = 6$ kg are standing one on the top of the other, as shown in the figure. The coefficients of static and kinetic friction between the blocks are $\mu_s = 0.3$ and $\mu_k = 0.2$ respectively. The surface between m_2 and the floor is frictionless. A horizontal force F is applied on the m_1 as shown in the figure. ($g = 10$ m/s^2)



11. What is the maximum value for F so that m_1 and m_2 move together, without m_1 sliding on the surface of m_2?

(a) 50 N (b) 40 N (c) 15 N (d) 20 N (e) 25 N

12. If $F = 16$ N, what are the accelerations a_1 and a_2 for m_1 and m_2, respectively?

(a) $a_1 = a_2 = 1.6$ m/s^2 (b) $a_1 = a_2 = 1$ m/s^2 (c) $a_1 = a_2 = 2$ m/s^2 (d) $a_1 = a_2 = 0.16$ m/s^2 (e) $a_1 = a_2 = 3.2$ m/s^2

13. If $F = 16$ N, what is the magnitude of the static frictional force?

(a) 10 N (b) 16 N (c) 20 N (d) 30 N (e) 48/5 N

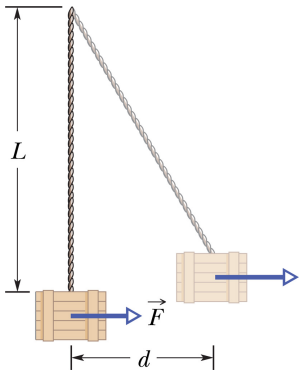
14. If $F = 24$ N, what are the accelerations a_1 and a_2?

(a) $a_1 = 10$ m/s^2 ; $a_2 = 4/3$ m/s^2
(b) $a_1 = 4$ m/s^2 ; $a_2 = 10/3$ m/s^2
(c) $a_1 = 4$ m/s^2 ; $a_2 = 4/3$ m/s^2
(d) $a_1 = 2$ m/s^2 ; $a_2 = 2/3$ m/s^2
(e) $a_1 = 5$ m/s^2 ; $a_2 = 5/3$ m/s^2

Questions 15-17

A 280 kg crate hangs from the end of a rope of length $L = 15.0$ m. You push the crate horizontally with a varying force F to move it a distance of $d = 5.0$ m to the side. The crate is at rest before and after its displacement.

Take $g = 10$ m/s^2, $\sqrt{2} = 1.4$.



15. What is the magnitude of F when the crate is in this final position?

(a) 1000 N (b) 1200 N (c) 7840 N (d) 800 N (e) 2640 N

16. During the crate's displacement, what is the work done by the gravitational force on the crate?

(a) 1400 J (b) 2800 J (c) −1400 J (d) 0 J (e) −2800 J

17. What is the work done on the crate by the tension in the rope?

(a) 1400 J (b) −1400 J (c) −2800 J (d) 0 J (e) 2800 J

Questions 18-20

A net force $\vec{F} = (Ax - 6x^2)\hat{\imath}$ acts on a particle as the particle moves along the x-axis, with $\vec{F}$ in newtons, x in meters, and A a constant.

18. What is the SI unit of the constant A?

(a) N/m^2 (b) N·m (c) N/m (d) N (e) N·m^2

19. What is the work done in moving the particle from the origin, $x = 0$ to $x = 2$ m?

(a) $3A - 27$ (b) $2A - 16$ (c) $4A + 27$ (d) $10A + 27$ (e) $9A - 27$

20. At $x = 0$, the particle's kinetic energy is 12 J; at $x = 2$ m, it is 32 J. What is the value of the constant A?

(a) −16 (b) 18 (c) −12 (d) 2 (e) 6