		Surname		Type
Group Number		Name		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 consideration.

Questions 1-11

1. Given the two vectors $\vec{A} = 2\hat{\imath} - 3\hat{\jmath}$ and $\vec{B} = -\hat{\imath} + y\hat{\jmath}$, find the value of y such that $\vec{A}$ and $\vec{B}$ are orthogonal?
(a) -3/2 (b) -2/3 (c) 2/3 (d) 1/3 (e) 3/2

2. Pressure is force per unit area, its SI unit is Pascal (Pa). Therefore;
(a) 1Pa=1J m (b) 1Pa=1J/ m^2 (c) 1Pa=1J m^3 (d) 1Pa=1J/m^3 (e) 1Pa=1J m^2

3. In uniform circular motion, velocity is (a) perpendicular to acceleration vector. (b) parallel to acceleration vector. (c) in the opposite direction to position. (d) radially outward. (e) radially inward.

4. Which of the following is true for the instantaneous velocity?
(a) The instantaneous velocity is also called as average velocity.
(b) It equals the instaneous rate of change of its acceleration vector.
(c) It equals the limit of the average velocity as the time interval goes to infinity.
(d) The instantaneous velocity is tangent to the particle's path.
(e) Each component of a particle's instantaneous velocity is equal to each other.

5. For motion with acceleration, which of the following is correct?
(a) A body with constant acceleration can not remain stationary. (b) If the speed is negative then the acceleration is negative. (c) A body with constant acceleration can remain stationary. (d) If the speed is positive then the acceleration is positive. (e) If the speed is zero then the acceleration is zero.

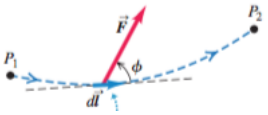
6. Consider a rock dropped from rest and falling through a fluid (e.g. water) with a fluid resistance. Which of the following is correct?

(a) The speed is always constant and is equal to the terminal speed.
(b) The speed decreases until terminal speed is reached.
(c) The speed first decreases than increases until terminal speed is reached.
(d) The speed first increases than decreases until terminal speed is reached.
(e) The speed increases until terminal speed is reached.

7. A man in an elevator drops the bag he is holding. If the bag does not fall to the floor of the elevator which of the following may be true?
I. Elevator is in free fall. II. Elevator is at constant speed. III. Elevator is accelerating downward with acceleration g. IV. Elevator is accelerating upward with g.
(a) I and IV (b) II and III (c) I and III (d) I and II (e) II and IV

8. A 10000 N automobile is pushed along a level road by four students who apply a total forward force of 500 N. Neglecting friction and taking $g = 10$ m/s^2, the acceleration of the automobile is:
(a) 0.5 m/s^2 (b) 10 m/s^2 (c) 5 m/s^2 (d) 20 m/s^2 (e) 2 m/s^2

9. According to the figure for motion along a curve, the corresponding work from P_1 to P_2 can be calculated as:



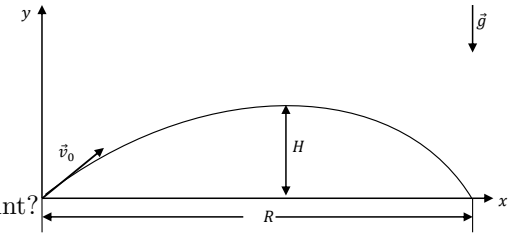
(a) $W = \int_{P_2}^{P_1} F\mathrm{d}l$ (b) $W = -\int_{P_1}^{P_2} F\sin\phi\mathrm{d}l$ (c) $W = -\int_{P_1}^{P_2} F\cos\phi\mathrm{d}l$
(d) $W = \int_{P_1}^{P_2} F\sin\phi\mathrm{d}l$ (e) $W = \int_{P_1}^{P_2} F\cos\phi\mathrm{d}l$

10. An elevator is pulled upward with a cable at constant velocity. The work done by the cable on the elevator
(a) is zero. (b) is positive. (c) is equal to the total work done on the elevator. (d) is negative. (e) is equal two times the total work done on the elevator.

11. Two objects interact only with each other. Initial speeds at the starting point are 5m/s for object A and 10m/s for object B. After some time, while they pass from their starting positions, A has a speed of 4m/s and B has a speed of 7m/s. What can be concluded?
(a) mechanical energy was increased by nonconservative force
(b) mechanical energy was increased by conservative forces
(c) mechanical energy was decreased by conservative forces
(d) the potential energy changed from the beginning to the end of the trip
(e) mechanical energy was decreased by nonconservative forces

Questions 12-16

A ball is thrown with an initial velocity $\vec{v}_0$, directed at an angle θ with the ground. The velocity vector of the ball at a height 5 m from the ground is given as $\vec{v} = (10\hat{\imath} - \sqrt{44}\hat{\jmath})$ m/s. (Take $g = 10$ m/s^2.)



12. What is the initial velocity $\vec{v}_0$ of the ball in m/s?

(a) $5\hat{\imath} + 12\hat{\jmath}$ (b) $5\hat{\imath} + 10\hat{\jmath}$ (c) $12\hat{\imath} + 5\hat{\jmath}$ (d) $10\hat{\imath} + 12\hat{\jmath}$ (e) $12\hat{\imath} + 10\hat{\jmath}$

13. What is the position vector of the ball in m when it reaches the highest point?

(a) $24\hat{\imath} + 7.2\hat{\jmath}$ (b) $12\hat{\imath} + 14.4\hat{\jmath}$ (c) $12\hat{\imath} + 7.2\hat{\jmath}$ (d) $24\hat{\imath} + 14.4\hat{\jmath}$ (e) $12\hat{\imath} + 24\hat{\jmath}$

14. What is the equation of the trajectory of the ball?

(a) $y = 1.2x - x^2/20$ (b) $y = 12x - x^2/100$ (c) $y = 12x - x^2/20$ (d) $y = 10x - x^2/20$ (e) $y = 1.2x - x^2/100$

15. How many seconds does it take for the ball to reach a height of $y = 63/20$ m?

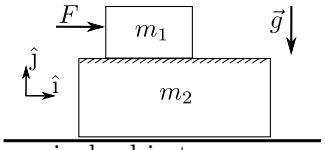
(a) 1 and 2 (b) 0.3 and 0.6 (c) 2.1 and 4.2 (d) 0.6 and 4.2 (e) 0.3 and 2.1

16. When the ball reaches the point $x = 3$ m and $y = 63/20$ m over the time interval, what is the average velocity $\Delta\vec{v}$ of the ball in m/s from the initial point?

(a) $10\hat{\imath} + 10.5\hat{\jmath}$ (b) $1.5\hat{\imath} + 1.5\hat{\jmath}$ (c) $1.6\hat{\imath} + 1.75\hat{\jmath}$ (d) $5\hat{\imath} + 5.25\hat{\jmath}$ (e) $10\hat{\imath} + 10\hat{\jmath}$

Questions 17-21

A block of $m_1 = 2.0\ kg$ is initially at rest on a slab of mass $m_2 = 4.0\ kg$, and a constant horizontal force F is applied on m_1, as shown in the figure. There is no friction between the ground and the slab but the coefficient of static and kinetic friction between the blocks are $\mu_s = 0.8$ and $\mu_k = 0.6$, respectively. (Take $g = 10.0\ m/s^2$.)



17. Find the maximum value of the force F for which m_1 will not slide off m_2 and they move as a single object.

(a) 16 N (b) 22 N (c) 24 N (d) 18 N (e) 26 N

18. If $F = 18\ N$, find the accelerations of the blocks in m/s^2.

(a) $a_1 = 2$ and $a_2 = 4$ (b) $a_1 = a_2 = 3$ (c) $a_1 = a_2 = 2$ (d) $a_1 = 3$ and $a_2 = 2$ (e) $a_1 = a_2 = 4$

19. If $F = 18\ N$, which of the following is the force applied by m_1 on m_2?

(a) $14\hat{\imath} - 18\hat{\jmath}\ N$ (b) $-12\hat{\imath} - 18\hat{\jmath}\ N$ (c) $-16\hat{\imath} + 18\hat{\jmath}\ N$ (d) $-12\hat{\imath} - 16\hat{\jmath}\ N$ (e) $12\hat{\imath} - 20\hat{\jmath}\ N$

20. If $F = 21\ N$, find the magnitude of the friction between the blocks.

(a) 16 N (b) 15 N (c) 14 N (d) 12 N (e) 13 N

21. If $F = 26\ N$, find the acceleration of m_1 relative to m_2.

(a) $-3\hat{\imath}\ m/s^2$ (b) $2\hat{\imath}\ m/s^2$ (c) $4\hat{\imath}\ m/s^2$ (d) $3\hat{\imath}\ m/s^2$ (e) $-2\hat{\imath}\ m/s^2$

Questions 22-25

22. Stretching a non-linear spring requires an amount of work given by the equation $U(x) = 15x^2 - 10x^3$, where U is in Joules and x is in meters units. How much force is required to hold this spring stretch out 2.0 m from its equilibrium position?

(a) 400 N (b) 5 N (c) 20 N (d) 120 N (e) 60 N

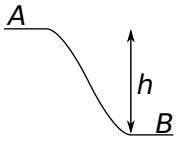
23. The behavior of a non-linear spring is described by the relationship $F = -2kx^3$, where x is the displacement from the equilibrium position and F is the force exerted by the spring. How much potential energy is stored when it is displaced a distance x from its equilibrium position?

(a) $kx^4/2$ (b) $6kx^2$ (c) $kx^3/3$ (d) $kx^4/32$ (e) $2kx^2/3$

24. An object of mass m moves horizontally, increasing in speed from 0 to v in time t. The constant power necessary to accelerate the object during this time period is

(a) $mv^2/(2t)$ (b) $v\sqrt{m/(2t)}$ (c) $2mv^2$ (d) $mv^2/2$ (e) $mv^2t/2$

25. A 55 kg skier is at the top of a slope, as shown in the figure. At the initial point A, the skier is $h = 10.0$m vertically above the final point B. Set the zero level for gravitational potential energy at A, write the gravitational potential energies of the skier at A and B, U_A and U_B respectively. (Take $g = 10$ m/s^2.)



(a) $5500\,J, 0\,J$ (b) $0\,J, -55\,J$ (c) $0\,J, -5500\,J$ (d) $0\,J, 5500\,J$ (e) $-5500\,J, 5500\,J$