		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 account.

1. If the total angular momentum about a point P for a system of objects is conserved, which of the following statements about that system is always correct.

(a) Net torque created by external forces about point P is zero (b) Net torque created by internal forces about point P (c) Net external force is zero is nonzero (d) Net force acting on point P is zero (e) Net internal force is nonzero

2. Which of the following is true for Kepler's law of areas (planets sweep equal areas at equal times)

(a) This law is a result of conservation of linear momentum (b) This law is a result of work-energy theorem (c) This law is not valid for elliptical orbits (d) This law is a result of conservation of angular momentum (e) This law is not valid for circular orbits

Questions 3-5

An atomic nucleus of mass m traveling (along +x) with speed v collides elastically with a target particle of mass 2m (initially at rest) and is scattered at 90° relative to x axis.

3. What is the angle between the directions of atomic nucleus and the target particle after the collision?

(a) 90° (b) 135° (c) 120° (d) 150° (e) 180°

4. What is the final speed of the atomic nucleus?

(a) $\sqrt{\frac{3}{2}}v$ (b) $\frac{1}{\sqrt{3}}v$ (c) $\sqrt{\frac{2}{3}}v$ (d) $\sqrt{\frac{2}{5}}v$ (e) $\frac{2}{\sqrt{3}}v$

5. What is the final speed of the target particle?

(a) $\frac{2}{3}v$ (b) $2v$ (c) $\frac{5}{2}v$ (d) $\frac{1}{\sqrt{3}}v$ (e) $\frac{3}{4}v$

Questions 6-10

Suppose you are a 60 kg passenger in an elevator. The elevator is accelerating upward from rest at a = 1.0 m/s^2 for t=2 s, moves at the resulting velocity for 10 s,and then decelerates at a = -1.0 m/s^2 for 2 s.(g = 10 m/s^2)

6. For the entire trip, what is the work done by the normal force exerted on you by the elevator floor?

(a) 14.4 kJ (b) -8.4 kJ (c) -12.4 kJ (d) 10.4 kJ (e) -28.8 kJ

7. For the entire trip, what is the work done on you by the gravitational force?

(a) -10.4 kJ (b) 8.4 kJ (c) -14.4 kJ (d) 12.4 kJ (e) 28.8 kJ

8. What average power is delivered by the normal force for the whole motion that lasts 14.0 seconds approximately?

(a) 284 W (b) 1029 W (c) 1000 W (d) 514 W (e) 950 W

9. What instantaneous power is delivered by the normal force at 7.0 s?

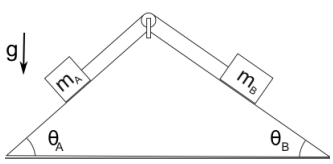
(a) 900 W (b) 400 W (c) 1100 W (d) 1200 W (e) 500 W

10. What instantaneous power is delivered by the normal force at 13.0 s?

(a) 110 W (b) 540 W (c) 220 W (d) 270 W (e) 440 W

Questions 11-15

The masses m_A =1.0 kg and m_B = 1.1 kg slide on the smooth (frictionless) triangular block as shown in the figure. The pulley and the cord have a negligible mass. The triangular block is fixed to the bottom. $\sin\theta_A = 0.60$, $\cos\theta_A = 0.80$,$\sin\theta_B = 0.50$,$\cos\theta_B = 0.87$ and g = 10 m/s^2.



11. What is the acceleration of the object of mass m_B in units of m/s^2 ?

(a) 5.75 left upwards (b) 0.24 left upwards (c) 5 right downwards (d) 5 left upwards (e) 5.75 right upwards

12. What is the tension on the cord approximately?

(a) 5.76 N (b) 11 N (c) 6.2 N (d) 11.75 N (e) 12 N

13. What is the vertical component (the direction of $\vec{g}$) of the force acting on the triangular block due to m_A ?

(a) 10 N (b) 5 N (c) 6.4 N (d) 9 N (e) 8 N

For the questions 14 and 15: θ_A and θ_B are not known.

14. When the system at rest, what would be the ratio of $\sin\theta_A / \sin\theta_B$?

(a) 1.3 (b) 1.1 (c) 0.9 (d) 1.2 (e) 1

15. When the system is at rest, what is the tension on the cord?

(a) 6.2 N (b) It can't be determined (c) 5.8 N (d) 11 N (e) 12 N

Questions 16-20

Consider that a uniform solid ball, having mass M and radius R, starts rolling without slipping until it reaches the second inclined surface which is frictionless. $I_{cm} = \frac{2}{5}MR^2$

16. What is the minimum value of the coefficient of static friction, μ_s, between the ball and the first inclined surface so that the ball will roll down the inclined surface without slipping?

(a) $\frac{2}{7}\sin\theta_1$ (b) $\frac{2}{5}\sin\theta_1$ (c) $\frac{2}{7}\tan\theta_1$ (d) $\frac{2}{5}\tan\theta_1$ (e) $\frac{2}{5}\cot\theta_1$

17. What is the linear acceleration of the center of mass of the ball, while it is rolling down without slipping?

(a) $\frac{5}{7}g\sin\theta_1$ (b) $\frac{5}{7}g\tan\theta_1$ (c) $\frac{2}{7}g\sin\theta_1$ (d) $g\sin\theta_1$ (e) $\frac{3}{7}g\sin\theta_1$

18. What is the translational speed of the center of mass of the ball when it reaches the bottom of the first inclined surface?

(a) $\sqrt{\frac{5gh_1}{7}}$ (b) $\sqrt{\frac{3gh_1}{7}}$ (c) $\sqrt{10gh_1}$ (d) $\sqrt{\frac{10gh_1}{7}}$ (e) $\sqrt{\frac{10gh_1}{3}}$

19. What is the angular speed of the ball about its center of mass when it reaches the bottom of the first inclined surface?

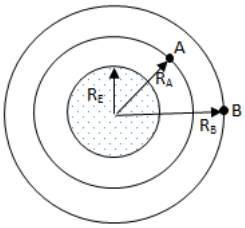
(a) $\sqrt{\frac{10gh_1}{R^2}}$ (b) $\sqrt{\frac{3gh_1}{7R^2}}$ (c) $\sqrt{\frac{10gh_1}{3R^2}}$ (d) $\sqrt{\frac{5gh_1}{7R^2}}$ (e) $\sqrt{\frac{10gh_1}{7R^2}}$

20. How high does the ball rise on the second inclined surface? (h_2=?)

(a) $\frac{5}{9}h_1$ (b) $\frac{3}{7}h_1$ (c) $\frac{10}{7}h_1$ (d) $\frac{3}{5}h_1$ (e) $\frac{5}{7}h_1$

Questions 21-25

Two satellites of masses m_A and m_B are moving in circular orbits around the Earth (mass and the radius of the Earth are M_E ve R_E, respectively). The radii of the orbits of satellites A and B are R_A and R_B, respectively. The periods of satellites A and B are T and 2T, respectively. (neglect the gravitational effect between Satellite A and Satellite B)



21. Find the R_B/R_A?

(a) $2^{1/3}$ (b) $3^{2/3}$ (c) $4^{1/3}$ (d) $2^{-1/3}$ (e) $4^{-1/3}$

22. Find the V_B/V_A?

(a) $3^{-2/3}$ (b) $2^{-2/3}$ (c) $2^{2/3}$ (d) $4^{2/3}$ (e) $2^{-1/3}$

23. What is the mechanical energy of satellite A?

(a) 0 (b) $\frac{gM_Em_A}{2R_A}$ (c) $-\frac{GM_Em_A}{2R_A}$ (d) $\frac{GM_Em_A}{2R_A}$ (e) $-\frac{gM_Em_A}{2R_A}$

24. Find the escape speed of satellite A from its orbit ?

(a) $\sqrt{\frac{GM_E}{2R_E}}$ (b) $\sqrt{\frac{GM_E}{2R_A}}$ (c) $\sqrt{\frac{GM_E}{R_A}}$ (d) $\sqrt{\frac{2GM_E}{R_E}}$ (e) $\sqrt{\frac{2GM_E}{R_A}}$

25. What is the work that must be done to move the satellite A from the orbit of radius R_A to the orbit of radius R_B?

(a) $\frac{1}{2}GM_Em_A(\frac{1}{R_B}-\frac{1}{R_E})$

(b) $\frac{1}{2}GM_Em_A(\frac{1}{R_A}-\frac{1}{R_B})$

(c) $-\frac{1}{2}GM_Em_A(\frac{1}{R_B})$

(d) $\frac{1}{2}GM_Em_A(\frac{1}{R_E}-\frac{1}{R_B})$

(e) $\frac{1}{2}GM_Em_A(\frac{1}{R_B}-\frac{1}{R_A})$