		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. A CD-player turntable initially rotating at 1.50 rev/s ($1\,rev = 2\pi\,rad = 360^0$), slows down and stops in 30 s. The magnitude of its average angular acceleration in rad/s^2 for this process is:

(a) 3.0 (b) 1.50 (c) 3.0π (d) $\pi/20$ (e) $\pi/10$

2. The unit kg·m^2/s can be used for:

(a) power (b) rotational kinetic energy (c) rotational inertia (d) angular momentum (e) torque

3. Which of the following can be considered as a type of a conservative force?
I. Friction force II. Fluid resistance III. Gravity IV. Spring force

(a) II, III, IV (b) III, IV (c) III only (d) I, II, III (e) IV only

4. The position vector of a particle with mass, $m = 2$ kg, is given as $\vec{r}(t) = 3t^2\hat{i} - 5t\hat{j} + 8t^3\hat{k}$. What is the x component of the force (F_x) acting on the particle at time, $t = 1$ s. (t is measured in seconds and r is measured in meters.)

(a) 96 N (b) 48 N (c) 108 N (d) 0 N (e) 12 N

5. Magnitude of the drag force is given by $F = bv + cv^2$, where b and c are constants, v is the speed of the particle. The unit of b in basic units (kg, m, s) is,

(a) $kg\,s^2/m$ (b) kg/m (c) kg/s (d) $kg\,s/m$ (e) $kg/(m\,s)$

6. Kepler's 1^{st} law states that the planets follow closed ellipses. (The same path is followed in each orbit.) This indicates that

(a) The gravitational force is conservative and kinetic energy is constant. (b) The gravitational force is conservative and potential energy is constant. (c) The gravitational force is NOT conservative and mechanical energy is NOT constant. (d) The gravitational force is conservative and mechanical energy is constant. (e) The gravitational force is conservative and linear momentum is constant.

7. K: kinetic energy and p: linear momentum; which of the following is the linear momentum in terms of kinetic energy?

(a) $p = 2Km$ (b) $p = \sqrt{2Km}$ (c) $p = \sqrt{2K}m$ (d) $p = 2K/m$ (e) $p = \sqrt{2K/m}$

8. The coordinates of a point mass $m_1 = 4\ g$ is given as $(x, y) = (-1, 2)$ and the coordinates of another point mass $m_2 = 2\ g$ is given as $(x, y) = (2, 3)$. For this system, what is the ratio of the center of mass coordinates, $\frac{x_{cm}}{y_{cm}}$?

(a) 7/3 (b) 4/15 (c) 5/12 (d) 4/9 (e) 0

9. Moment of inertia of a rotating object about its center of mass is related to? (a) only to its mass (b) its angular velocity and its mass (c) its radius of rotation and its angular velocity (d) force on it and application point of this force (e) its mass and its radius of rotation about its center of mass

Questions 10-14

In a tape recorder, the magnetic tape moves at a constant linear speed of approximately 5 cm/s. To maintain this constant linear speed, the angular speed of the driving spool (the take-up spool) has to change accordingly. Mass of the rotating parts are negligable except the tape. The mass of the tape is 100g and the moment of inertia of a rotating hallow disk is $I = \frac{1}{2}m(r_1^2 + r_2^2)$ where r_1 is the inner and r_2 is the outer radii.

10. What is the angular speed (in rad/s) of the take-up spool when it is empty.

(a) 500 (b) 0.5 (c) 50 (d) 5 (e) 0.05

11. What is the angular speed (in rad/s) of the take-up spool when it is full.

(a) 250 (b) 0.025 (c) 25 (d) 0.25 (e) 2.5

12. What is the magnitude of the average angular acceleration (in rad/s^2) of one of the take-up spool while the tape is being played? (Remember, the spool is empty initially and it is full at the end!)

(a) $1.25\ 10^{-3}$ (b) $1.25\ 10^{-2}$ (c) $1.25\ 10^{-6}$ (d) $1.25\ 10^{-4}$ (e) $1.25\ 10^{-5}$

13. What is the moment of inertia of the tape when one spool is empty the other one is full?

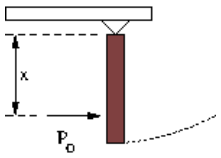
(a) $2.0\ 10^{-5}\ kgm^2$ (b) $2.5\ 10^{-5}\ kgm^2$ (c) $1.5\ 10^{-5}\ kgm^2$ (d) $1.0\ 10^{-5}\ kgm^2$ (e) $5\ 10^{-5}\ kgm^2$

14. What is the total moment of inertia of the tape when it is equally distributed between the spools?

(a) $17.5\ 10^{-6}\ kgm^2$ (b) $7.50\ 10^{-6}\ kgm^2$ (c) $12.5\ 10^{-6}\ kgm^2$ (d) $10.0\ 10^{-6}\ kgm^2$ (e) $15\ 10^{-6}\ kgm^2$

Questions 15-19

A uniform rod of mass M and length L is pivoted at one end and hangs as shown in figure such that it is free to rotate about its pivot without friction. It is struck by a horizontal force that delivers an impulse $P_0 = F_{av}.\Delta t$ at a distance x below the pivot as shown. $I_{cm} = ML^2/12$



15. What is the moment of inertia of the rod about the pivot?

(a) $I = \frac{1}{4}ML^2$ (b) $I = \frac{1}{2}ML^2$ (c) $I = \frac{3}{5}ML$ (d) $I = \frac{1}{3}ML^2$ (e) $I = \frac{2}{5}ML^2$

16. What is the magnitude of the net torque on the rod about the axis of rotation generated by the horizontal force?

(a) $\frac{P_0 x}{\Delta t}$ (b) $\frac{P_0 L}{\Delta t}$ (c) $\frac{P_0 L^2}{x\Delta t}$ (d) $\frac{P_0}{\Delta t}$ (e) $\frac{x}{\Delta t}$

17. What is the initial angular frequency of the rod after the strike? (Hint: $\vec{\tau}_{net} = I\vec{\alpha}$ and $\alpha = \frac{\Delta\omega}{\Delta t}$)

(a) $\frac{3P_0 x}{ML^2}$ (b) $\frac{2P_0 x}{ML^2}$ (c) $\frac{6P_0 x}{ML^2}$ (d) $\frac{12P_0 x}{ML^2}$ (e) 0

18. What is the speed of the center of mass after the strike?

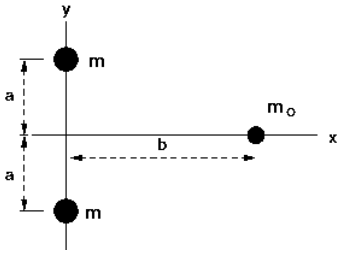
(a) $\frac{3P_0 x}{2mL}$ (b) $\frac{3x}{mL}$ (c) $\frac{3P_0}{mL^2}$ (d) $\frac{3P_0 x}{mL^2}$ (e) $\frac{3P_0}{2mL^2}$

19. How high the center of mass of the rod will go up?

(a) $\frac{21\,P_0^2\,x^2}{8\,g\,M^2\,L^2}$ (b) $\frac{21\,P_0\,x}{8\,g\,M\,L}$ (c) $\frac{21\,P_0\,x^2}{8\,g\,M^2\,L^2}$ (d) $\frac{21\,P_0^2\,x}{8\,g\,M^2\,L^2}$ (e) $\frac{21\,P_0^2\,x^2}{8\,g\,M\,L}$

Questions 20-22

Two particles with masses m has been placed at points $y = +a$ and $y = -a$ on y-axis as shown in the figure.



20. What is the force exerted by these two particles on the third particle of mass m_0 located on the x-axis at a distance b from the origin?

(a) 0 (b) $\vec{F} = -\frac{G\ m\ m_0\ b}{(b^2+a^2)^{(3/2)}}\hat{i}$ (c) $\vec{F} = -\frac{2\ G\ m\ m_0\ b}{(b^2+a^2)^{(1/2)}}\hat{i}$ (d) $\vec{F} = \frac{2\ G\ m\ m_0\ b}{(b^2+a^2)^{(1/2)}}\hat{i}$ (e) $\vec{F} = -\frac{2\ G\ m\ m_0\ b}{(b^2+a^2)^{(3/2)}}\hat{i}$

21. What is the gravitational field $\vec{g}$ at m_0 location due to particles on the y-axis?

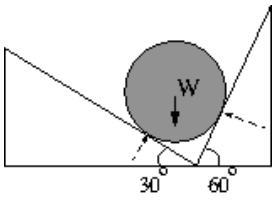
(a) $\vec{g} = -\frac{2\ G\ m\ b}{(b^2+a^2)^{(3/2)}}\hat{i}$ (b) $\vec{g} = -\frac{2\ G\ m_0\ b}{(b^2+a^2)^{(1/2)}}\hat{i}$ (c) *nullvector* (d) $\vec{g} = -\frac{G\ m\ b}{(b^2+a^2)^{(3/2)}}\hat{i}$ (e) $\vec{g} = -\frac{2\ G\ m\ b}{(b^2+a^2)^{(1/2)}}\hat{i}$

22. The maximum value of $|\ g_x\ |$ (x-component of the gravitational field) occurs at points;

(a) $x = \pm a$ (b) $x = \pm\frac{a}{\sqrt{2}}$ (c) $x = \pm a\sqrt{2}$ (d) 0 (e) $x = \pm 2a$

Questions 23-25

A cylinder of weight W=21.2 N is supported by frictionless trough formed by a plane inclined at 30^0 to the horizontal on the left and one inclined at 60^0 on the right as shown in figure. Take $\sin(30^0)=\cos(60^0)=0.5$ and $\sin(60^0)=\cos(30^0)=0.9$ for your calculations.



23. What is the force exerted by the left wedge on the cylinder?

(a) 9 N (b) 10 N (c) 18 N (d) 1.8 N (e) 1 N

24. What is the force exerted by the left wedge on the cylinder?

(a) 1.8 N (b) 5 N (c) 10 N (d) 1 N (e) 18 N

25. What is the net force on the cylinder?

(a) 27 N (b) 28 N (c) 0 N (d) 23 N (e) 15 N