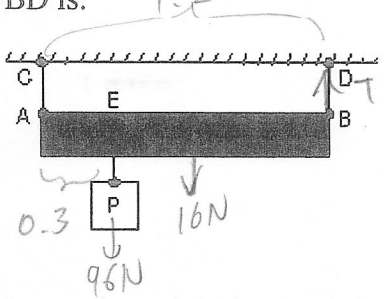
20. A uniform rod AB is 1.2 m long and weighs 16 N. It is suspended by strings AC and BD as shown. A block P weighing 96 N is attached at E, 0.30 m from A. The magnitude of the tension force in the string BD is:



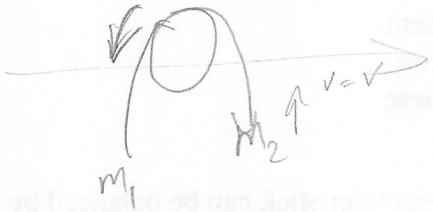
A) 8.0 N
B) 24 N
C) 32 N
D) 48 N
E) 80 N

$\sum \tau = -96 \cdot 0.3 - 16 \cdot 0.6 + F_T \cdot 1.2$

$F_T = 32$

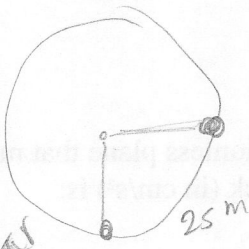
21. A pulley with radius R and rotational inertia I is free to rotate on a horizontal fixed axis through its center. A string passes over the pulley. A block of mass m_1 is attached to one end and a block of mass m_2, is attached to the other. At one time the block with mass m_1 is moving downward with speed v. If the string does not slip on the pulley, the magnitude of the total angular momentum, about the pulley center, of the blocks and pulley, considered as a system, is given by:

A) $(m_1 - m_2)vR + Iv/R$
B) $(m_1 + m_2)vR + Iv/R$
C) $(m_1 - m_2)vR - Iv/R$
D) $(m_1 + m_2)vR - Iv/R$
E) none of the above



22. A girl jogs around a horizontally circle with a constant speed. She travels one fourth of a revolution, a distance of 25 m along the circumference of the circle, in 5.0 s. The magnitude of her acceleration is:

A) 0.31 m/s²
B) 1.3 m/s²
C) 1.6 m/s²
D) 3.9 m/s²
E) 6.3 m/s²



$25 m \times \frac{1}{4} = 2\pi r$

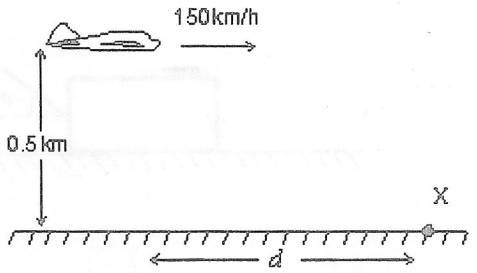
$R = \frac{25}{2\pi}$

$V = \frac{5}{4}$ m/s

$a = \frac{V^2}{R}$

$a = \frac{(\frac{5}{4})^2}{\frac{25}{2\pi}} \rightarrow \frac{\frac{25}{16}}{\frac{25}{2\pi}} \rightarrow \frac{\pi}{8}$

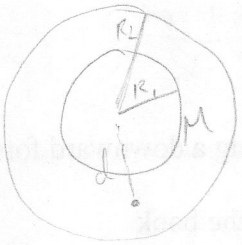
12. The airplane shown is in level flight at an altitude of 0.50 km and a speed of 150 km/h. At what distance d should it release a heavy bomb to hit the target X? Take $g = 10$ m/s^2.



A) 150 m
B) 295 m
C) 417 m
D) 2550 m
E) 15,000 m

13. A spherical shell has inner radius R_1, outer radius R_2, and mass M, distributed uniformly throughout the shell. The magnitude of the gravitational force exerted on the shell by a point mass particle of m a distance d from the center, outside the inner radius, is:

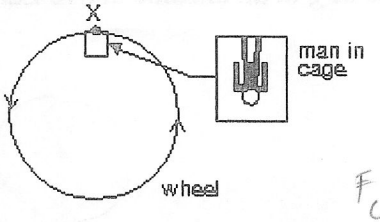
A) 0
B) GMm / R_1^2
C) GMm/d^2
D) $GMm/\left(R_2^2 - d^2\right)$
E) $GMm/(R_1 - d)^2$



14. The escape velocity at the surface of Earth is approximately 8 km/s. What is the mass, in units of Earth's mass, of a planet with twice the radius of Earth for which the escape speed is twice that for Earth?

A) 2
B) 4
C) 8
D) 1/2
E) 1/4

5. A giant wheel, 40 m in diameter, is fitted with a cage and platform on which a man can stand. The wheel rotates at such a speed that when the cage is at X (as shown) the force exerted by the man on the platform is equal to his weight. The speed of the man is:



A) 14 m/s
B) 20 m/s
C) 28 m/s
D) 80 m/s
E) 120 m/s

$F_c = 2mg = \frac{mv^2}{r}$

$\sqrt{2gr} = v$

$= 28\ m/s$

6. An object of mass m and another object of mass $2m$ are each forced to move along a circle of radius 1.0 m at a constant speed of 1.0 m/s. The magnitudes of their accelerations are:
A) equal
B) in the ratio of $\sqrt{2}$: 1
C) in the ratio of 2 : 1
D) in the ratio of 4 : 1
E) zero

$a_c = \frac{v^2}{r}$ no mass here

7. At time $t = 0$ a 2-kg particle has a velocity in m/s of $(4\ m/s)\hat{i} - (3\ m/s)\hat{j}$. At $t = 3$ s its velocity is $(2\ m/s)\hat{i} + (3\ m/s)\hat{j}$. During this time the work done on it was:
A) 4 J
B) –4 J
C) –12 J
D) –40 J
E) $(4\ J)\hat{i} + (36\ J)\hat{j}$

$W = \Delta KE = \frac{1}{2}m(2^2+3^2) - \frac{1}{2}m(4^2+3^2)$

$\sqrt{13} - 5 \qquad 13 - 25$

8. A man pushes an 80-N crate a distance of 5.0 m upward along a frictionless slope that makes an angle of 30° with the horizontal. The force he exerts is parallel to the slope. If the speed of the crate is constant, then the work done by the man is:
A) –200 J
B) 61 J
C) 140 J
D) 200 J
E) 260 J

$W = F \cdot d$

$80 \cdot 5 \sin 30$