Angular momentum conservation

1. child and merry go round

Lo = Lf Lomgr = Iwo LOkid = mvR Lof = (1/2mR2 + MR2)

½ MR2(0) + mvR = (1/2mR2 + MR2) ωf

509.6(0) + 219.5/(509.6 + 181.4) = ωf = 0.318 rad/s

ΔKE = KEf – KEo = 1/2(509.6 + 181.4)(0.318)2 - ½ (34)(2.80)2 = -98.4 J

1. find vo of kid from above given ωf 1 rev /22.5 s = 0.279 rad/s

(0.279)(Isystem) = mvrsinΘ

(0.279)(509.6 + 181.4)/34 kg)(2.31m) = 2.45 m/s

1. τ = Iα about x axis I = 9.0 )(1 m) (1.2 rad/s2 = 10.8 N●m

about y axis I = 2.5)(22)(1.2rad/s2) = 12 N●m

about z axis I = (9.0 + 10)(1.2 rad/s2) = 22.8 N●m

1. L = Iω = 2/5 (MR2)ω = 2/5 (5.97 x 1024 kg)(63802)(7.27 x 10-5 rad/s)

1 rev/day (24hrs/day)(3600 s/hr) = 7.27 x 10-5 rad/s)

L = 7.07 x 1027

1. Disc shaped merry go round

0.64 rev/s = 0.403 rad/s

Lo person = mvR = 532.7 Imgr  = ½ 155 (2.622) = 536.1 Iperson = MR2 = 410.9

536.1 (.403) + 532.7/(536.1 +410.9) = ωf = 0.791 rad/s

1. ∑F = 2a = 2g –T T = TR = Iα = 1/2Ma

a = 2g/(2+ ½ (1.375)) = 7.29 m/s2 T = ½ (1.372)(7.29) = 5.01 N

1. Solid disc with sand dropped

Lo = Lf = (0.1)(0.067) = (0.1 +MR2)ωf= (.1+ 0.08) ωf= 0.037 rad/s

1. Thin walled cylinder on ramp

mgh = ½ mv2 + ½ Iω2 I = MR2 = (0.03375)

mgh = ½ mv2 + ½ (MR2)(v/r)2 ω = v/r

1.5 )(9.8)(0.5) = ½ (1.5)(v2) + ½ (1.5r2)v2/r2 = 1/2 mv2 + ½ mv2

7.35 = mv2 so (7.35 /1.5)1/2  = v = 2.21m/s ω = v/r= 14.7 rad/s

1. Two discs rotate opposite directions and joined.  
   7.2)(3.4) –(9.8)(IB) = (3.4 + IB)(-2.4)

IB = 4.4 kg m2

1. man on turntable

(Iman + Idb)ωo = (Iman + Idbf)ωf 1 rev /2 s = 3.14 rad/s

6.0 + MR2) = (6.0 + MRf2) ωf

11(3.14) = (6.0 + 0.4)ωf

ωf= 5.39 rad/s

1. Bullet and door

mvR = (Idoor + Ibullet)ωf

(0.010)(400)(0.5)/[(1/3)(15)(1)2 + 0.100(0.50)2] = ωf

2/5.0025 = ωf = 0.40 rad/s

KEo = ½ (0.010)(400)2 = 800 J

KEf= ½ Iω2 = ½ (5.0025)(0.400)2 = 0.400 J

1. Atwood with different discs

∑τ = Tr – Tl = Iα

(0.025 kg)g(0.30m) – (0.035kg)g(0.1) = Iα

Ismall = ½ (0.050)(0.10)2 = 0.00025

Ilarge = ½ (0.200)((0.3)2 = 0.009

(0.025 kg)g(0.30m) – (0.035kg)g(0.1)/0.00925

0.004/0.00925 = α= 4.23 rad/s2

ωf = ωo+ αt = (04.32)(4.0) = 16.9 rad/s

KE4 = ½ Iω2 = ½ ((0.00925)(16.93))2 = 1.32 J

L4 = Iω = (0.00925)(16.9rad/s) = 0.156

1. pulley from string energy conservation

mgh = ½ mv2 + ½ Iω2

0.2 )(9.8)(3.0m) = ½ mv2 + ½ (1/2 mR2)(v/R)2

5.88 = ½ mv2 + ¼ mv2 = ¾ mv2

(4)(5.88)/3)1/2 = v = 6.26 m/s

1. ∑F = ma = Mg – T ∑τ = TR = Iα = ½ MR2α

∑F = Ma = Mg – T ∑τ = TR = Iα = ½ MR2 (a/R) so T = ½ Ma

∑F = Ma = Mg – ½ Ma ; 3/2 Ma = Mg so a = 2/3 g and

T = ½ (M(2g/3) = 1/3 Mg = 1/3 (0.200)(9.8)= 0.653 N

a = 2/3 g = 6.53 m/s2 T =

Vf2 = Vo2 – 2 a h [2(6.53)(3)]1/2 = Vf = 6.26 m/s

1. momentum conservation

m2Vo  = m2(-v/2) + MVcm’

Vcm’ = 3m2Vo/2M = 3)(0.250)(3.0m/s)/(0.500(2.kg) = 2.25 m/s

Lball = (Lball) + Lrod

mVoR = mVfbalR + 1/12 ML2ωf

(0.250)(3.0)(0.8/3) = (0.250)(-1.5m/s)((.8/3) + 1/12(0.500)(0.8)2ωf

0.2 + 0.1 = 0.3/0.0266 = ωf= 11.3 rad/s