Physics 3204 **Unit 1 - Total Review**

1. An object is fired with an initial velocity of 23 m/s [R30˚U]. What are the initial components of its velocity?

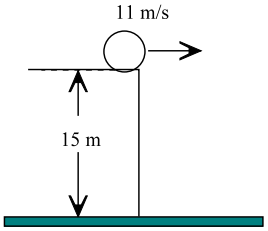
2. An object rolls off the top of a horizontal table.
   a) Sketch the trajectory of this object and label the velocity vectors at three points.
   b) Sketch the trajectory of this object and label the acceleration vector at three points.

3. An object is fired at an angle of 60˚ below the horizon. Sketch the acceleration vector for this projectile at three points in its trajectory.

4. A plane in horizontal flight at a velocity of 560 km/hr releases a projectile. From what altitude can the package be released in order to hit a target 1500 m ahead of the aircraft?

5. For each of the projectiles shown below, calculate:
   a) time in the air
   b) max range
   c) velocity when it hits the ground (magnitude and direction)
   d) max altitude for iii)

i)



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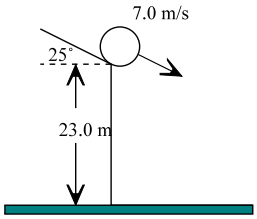

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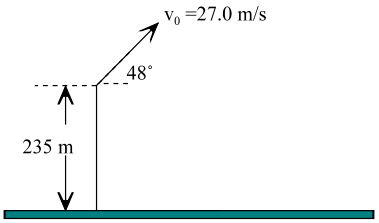
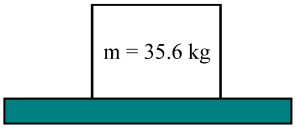


1	v_y = 11.5 m/s [up] v_x = 19.9 m/s [right]
2a	notes
2b	notes
3	all arrows same length
4	d_y = 455 m
5i	t = 1.75 s, d_x = 19.2 m v_f = 20.4 m/s [R57˚D]
5ii	t = 1.89s, d_x = 12.0 m v_f = 22.4 m/s [R74˚D]
5iii	t = 9.27 s, d_x = 168 m v_f = 73 m/s [R76˚D] $d_{Y\ max}$ = 20.6 m

1. Calculate the normal force in each of the situations below.
   a) A 25.0 kg block in a stationary elevator.
   b) A 25.0 kg block in an elevator accelerating up at 1.2 m/s/s.
   c) A 25.0 kg block in an elevator accelerating down at 1.2 m/s/s.

2. Calculate the normal force in each diagram.

a)



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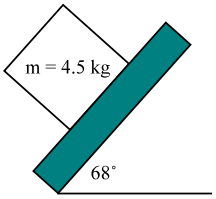
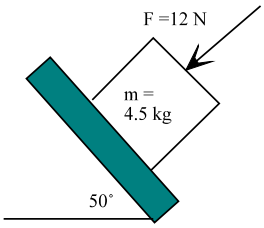


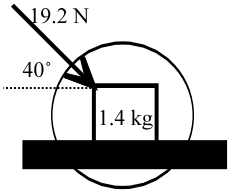
c)



3. For each of the diagrams in #2, calculate the frictional force if $\mu_k = 0.27$

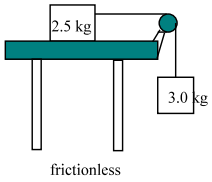
4. A rock slides from rest down a 13.5 m long ramp into a pool of water. If the ramp is inclined at an angle of 55˚ above the horizontal and the coefficient of kinetic friction between the rock and the ramp is 0.35, how long does it take the rock to hit the water?

5. Find the acceleration of the mass if $\mu_k = 0.10$



6. For each of the following diagrams calculate:
   a) acceleration of the system
   b) tension in the rope.

i)



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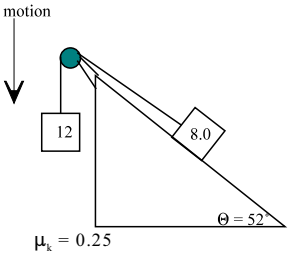
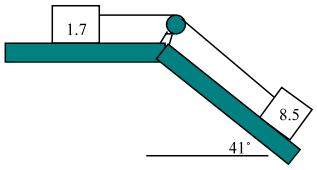
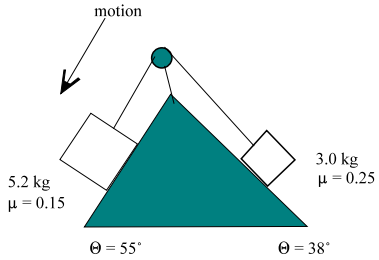


iii)



angled side is frictionless
flat top $\mu_k = 0.20$

iv)



Answers:

1a	245 N		3c	10.9 N
1b	275 N		4	t = 2.04 s
1c	215 N		5	
2a	349 N		6 (i)	a = 5.35 m.s^2, T = 13.4 N
2b	16.5 N		6 (ii)	a = 2.19 m.s^2, T = 91.3 N
2c	40.3 N		6 (iii)	a = 5.03 m.s^2, T = 11.9 N
3a	94.2 N		6 (iv)	a = 1.64 m.s^2, T = 28.8 N
3b	4.46 N			

1. Calculate the centripetal acceleration of a car travelling at 85 km/hr around a circular track of radius 0.900 km.

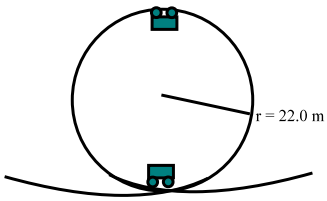
2. What centripetal force is exerted on a 2.5 kg mass spinning in a circle of radius 1.5 m at 12.0 m/s?

3. A 5.0 kg mass is attached to a wire cable spinning in a vertical circle of radius 1.2 m. If the mass is spinning at 75 km/hr; calculate:
   a) max tension
   b) min tension

4. The end of a lawnmower blade rotates with a frequency of 75 Hz.
   a) What is the centripetal acceleration if the blade is 32 cm long?
   b) How fast is the tip of the blade moving?

5. A plane flying at 475 km/hr flies over the top of a circular path.
   a) What must be the radius of the circle to just achieve weightlessness? (Normal force = 0)
   b) What would be the normal force on a 75 kg pilot in the same plane if it flies the bottom of the circular path at the same speed?

6. A roller coaster ride makes a loop-the-loop as seen below. If the radius of the coaster is 22.0 m,
   a) How fast must the coaster be going so that the people don't fall out?
   b) At the bottom of the coaster, what is the normal force on a 75 kg person if the speed is 85 km/hr?



7. A car drives around a horizontal curve with a frictional coefficient of 0.58. What is the maximum safe speed for the car if the radius of the turn is 125 m?

8. A 2.5 g raisin is sitting on a turntable of radius 12 cm. If the turntable rotates at a frequency of 77 RPM, what frictional force is required to keep the raison on the turntable?

9. A car is traveling at 120 km/hr around a frictionless turn of radius 115 m. What must be the angle of the bank to keep the car on the road?

10. A frictionless turn is banked at 35˚ to the horizontal. What is the maximum speed at which the car can stay on this road if the radius is 225m?

1	0.619 m/s^2		6a	14.7 m/s
2	240 N		6b	2636 N
3a	1852 N		7	26.7 m/s
3b	1754 N		8	0.0195 n
4a	71 061 m/s^2		9	45˚
4b	151 m/s		10	39.3 m/s
5a	1776 m			
5b	1470 N			

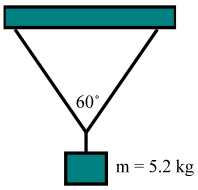
1. A lever arm 2.5 m long has a force of 175 N applied to it right angles. What is the torque generated?

2. What are the conditions for translational equilibrium?

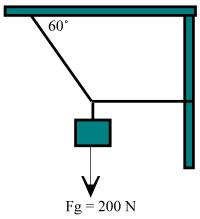
3. What are the conditions for static equilibrium?

4. What is the tension in each of the strings below? The beam in part C is massless.

a)



b)



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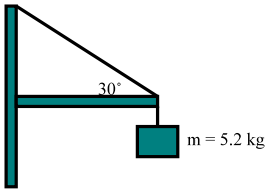
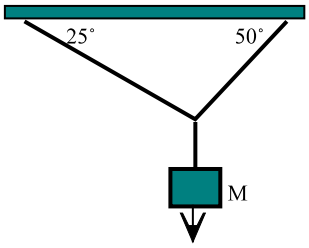
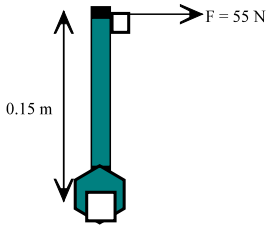


5. What must be the tension in each string if the mass M = 12 kg?

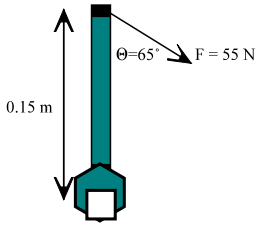


6. Calculate the torque generated about the bolt in each wrench below.

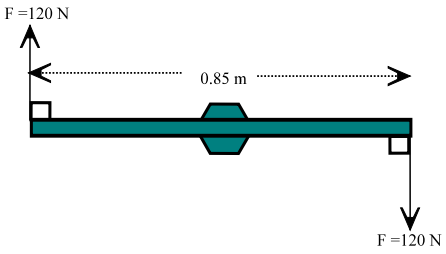
a)



b)

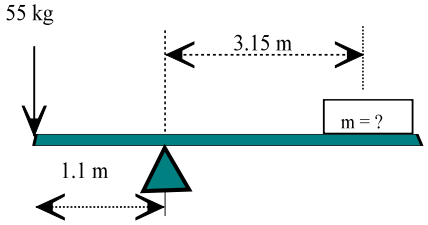


7. Calculate the total torque generated about the lug nut in the problem below.

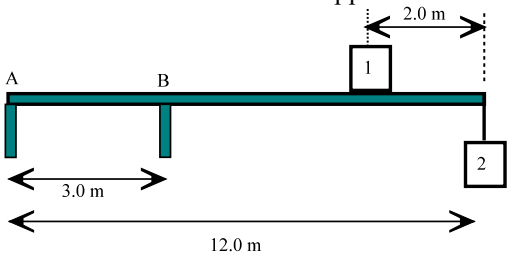


8. Kahlil (m = 125 kg) and Ghibran (m = 75 kg) are sitting on a 4.0 m long massless seesaw. If Ghibran sits on the end of the seesaw, how far from the pivot must Kahlil sit to balance him?

9. What mass must be placed on the seesaw to balance the 55 kg mass?

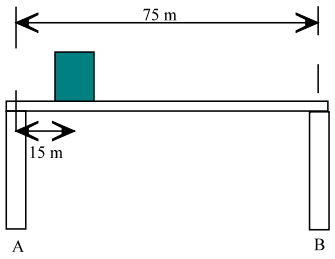


10. The 12.0 m long I-Beam (m = 650 kg) in the diagram is secured as a cantilever beam. A construction worker (m_1 = 75 kg) is sitting on the beam as indicated, with his gear hanging over the side (m_2 = 275 kg). What is the force in each support?

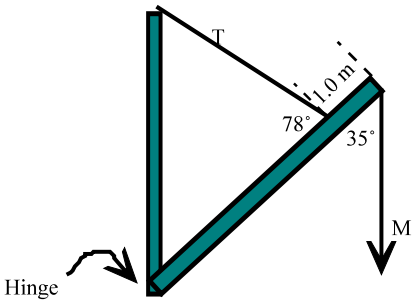


11. The wheelbarrow shown is carrying a mass of 75 kg. The centre of mass is located 55 cm behind the front wheel. What must be the force exerted by the man on the handle at a distance of 1.75 m behind the front wheel?

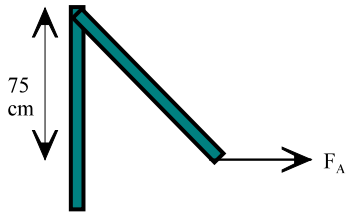
12. A truck of mass 1200 kg is at rest on a uniform bridge of mass 1700 kg. The bridge is 75 m in length. If the truck is 15 m from support "A", what is the force in each support?



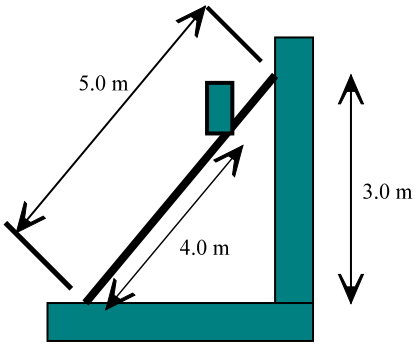
13. The crane derrick below has a mass of 125 kg and an overall length of 5.5 m. M = 2500 kg
    a) What is the Tension T, in the cable?



14. A duck holds a hanging window in static equilibrium with a horizontal force of 125 N. If the window is 95 cm long, what is the mass of the window?



15. A 5.0 m long ladder with a mass of 22 kg is leaning against a frictionless wall at a point 4.0 m above the floor. A boy of mass 42 kg is standing 4.0 m from the bottom of the ladder.
    a) What must be the force of the wall on the ladder?
    b) What must be the force of friction on the ladder?
    c) What must be the force of the floor on the ladder?



1	437.5 N		9	19.2 kg
2	$F_{NET} = 0$		10	F_a = 16 170 N [down] F_B = 25 970 N [up]
3	$F_{NET} = 0$ $T_{net} = 0$		11	231 N [up]
4a	29.4 N		12	F_a = 17 738 N F_b = 10682 N
4b	231 N 115 N		13a	T = 18331 N
4c	102 N			
5	T_1 = 78.3 N T_2 = 110 N		13c	F_y = 10 975 N [down]
6a	8.25 N		14	m = 20 kg
6b	7.47 N		15a	F_W = 580 N
7	102 N·m		15b	F_{Fr} = 580 N
8	1.20 m		15c	F_N = 627 N