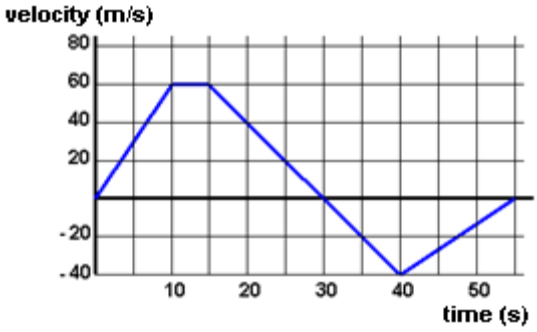
Physics 12 Midterm Review

Unit 1: Kinematics



1. From the graph, find
a) the velocity at 7 seconds
b) the acceleration at 10.2 seconds
c) the acceleration at 41.3 seconds
d) the displacement for the whole 55 s
e) the average velocity for the first 40 seconds
f) describe the motion of the object in detail

2. The stopping distance of a certain car on a certain road is 150 m if the initial velocity is 25 m/s. Find the stopping distance if
a) the initial velocity is doubled.
b) the coefficient of friction is reduced to half its original value.

3. Two balls are dropped from the top of a very high building 1.5 seconds apart. How long after the first ball is dropped are they 25 m apart? Ignore air resistance.

4. A runner in a 200 m race accelerated uniformly over the first 45 m, reaching a final maximum speed of 11 m/s. What is his time for the race?

5. What is the magnitude of the resultant force if the following forces act on the same object: 120 N, 30^{O} N of E and 65 N 30^{O} E of N

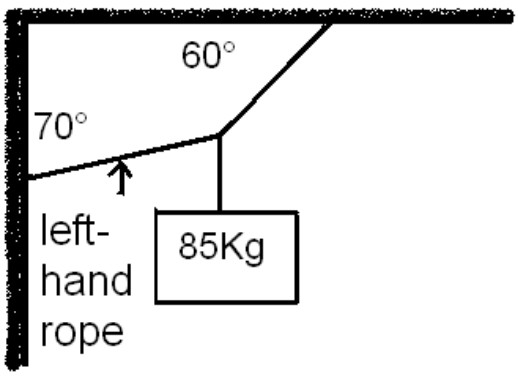
6. A yellow hummer is driven off a cliff at 47 m/s. It lands 141 m from the base. Find
a) the height of the cliff
b) the velocity at impact
c) the velocity 1.5 seconds after it leaves the cliff-edge
d) when the speed through the air is 55 m/s

7. A catapult launches a projectile which spends 13.5 seconds in the air and lands 365 m away.
a) find the initial velocity
b) find the maximum height
c) could it have cleared a castle wall 220 m away if the wall is 56 m high?

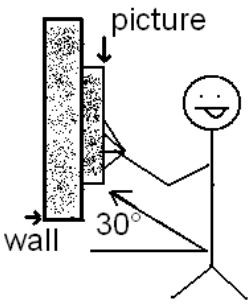
8. An aircraft heads due north with a speed relative to the air of 54 m/s. Its resultant speed over the ground is 67 m/s. The wind blows towards the west.
a) What is the speed of the wind?
b) How far from the starting point is the aircraft 2.0 hours into the flight?

Unit 2: Statics

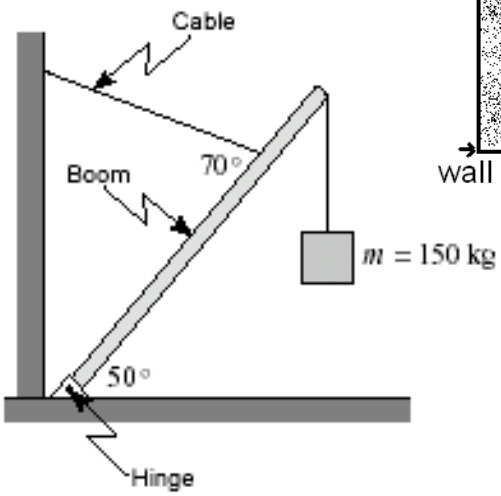
1. Find the tension in the left-hand rope



2. A person exerts a minimum force of
85 N at an angle of 30^O to hold a picture against a wall with μ = 0.30. Find the mass of the picture.



3. A uniform 6.0 m-long boom has a mass of 55 kg. It is kept in position by a restraining cable attached Two thirds of the way along the boom.
a) What is the tension in this cable when the boom supports a 150 kg mass as shown?
b) find the force exerted by the hinge



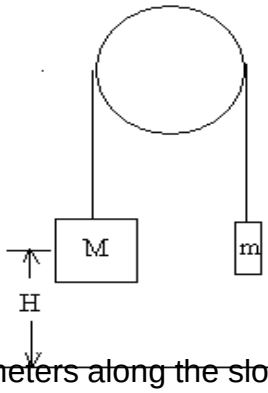
4. A uniform 7.0 m long 35 kg ladder leans against a frictionless wall, making an angle of 24^O with the wall. There is a 76 kg worker located 5.7 m up the ladder. Find
a) the minimum coefficient of friction between the ladder and the floor.
b) how far up the ladder a 120 kg worker could go before the ladder slips, assuming the value of μ calculated in part a.

<u>Unit 3 Dynamics</u>

1. A helicopter has an upwards acceleration of 2.5 m/s^2 when the lift force exerted by the rotor blades is 20 000 N. What is the lift force required to allow the helicopter to accelerate downwards at 3.7 m/s^2?

2. The stopping distance of a 870 kg car going 35 m/s on an icy road is 130 m. Find the stopping distance under the same conditions on a hill sloped downwards at 4.5^O.

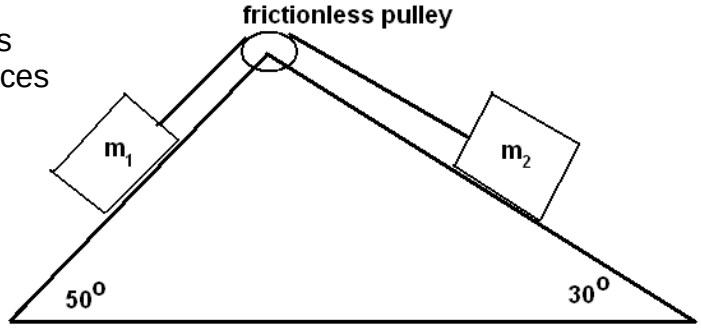
3. In the pulley system shown, the mass "M" is released from rest from a height H. What is the velocity of mass "m" when mass "M" hits the ground? Find the answer in terms of M, m, H and g, then assume M = 8.0 kg and m = 5.0 kg, and H = 2.0 m



4. A 30 kg box is being pulled up a 12^O ramp with a force of 450 N at an angle of 25^O upwards from the ramp. If μ = 0.2, find the acceleration.

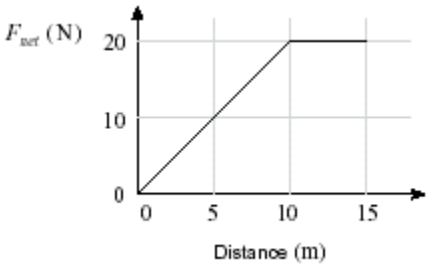
5. A child on a toboggan slides from rest down a snowy 30^O hill, covering 30 meters along the slope, then continues to slide along the flat snow-field at the bottom of the hill, coming to rest 40 meters from the bottom. What is the coefficient of friction between the toboggan and the snow?

6. a) Find the mass m2 if m1 is 25 kg and m2 accelerates up the slope at 2.5 m/s^2 assuming μ = 0.15 on both surfaces



Unit 4 Energy and Momentum

1. A 250 kg roller coaster car passes a point A 18.0 m above the ground at a speed of 12.0 m/s. What is the speed of the roller coaster car at Point B at a height of 3.5 m if 7300 J of heat energy is produced by the frictional forces?



2. A force is applied to an 9.0 kg object initially at rest. The magnitude of the net force varies with distance as shown. What is the speed of the object after moving 15 m, assuming the process is 65% efficient?

3. How much power must be generated by the engine to accelerate a 94 tonne steam locomotive from rest to 12 m/s in one minute while gaining 15 m in elevation if the engine is 17% efficient at delivering power to the drive train of the locomotive?

4. A 3.0 kg object slides 2.0 m along a horizontal surface with an initial velocity of 7.5 m/s and encounters a ramp inclined at 30^O. How far up the ramp does the object slide before coming momentarily to rest if the coefficient of friction is 0.20 on both the horizontal surface and the ramp?

5. A 450 kg spaceship and a 250 kg satellite are attached together and drift along at 56m/s. The satellite is launched so that it's path is perpendicular to the original path of the spaceship and its initial speed is 25 m/s in this direction. Find the final speed of the spaceship and the angle of its path with the original path.

6. A 240 gram baseball traveling east at 15 m/s is struck by bat, giving it a velocity of 25 m/s, 30^O N of W. What are the magnitude and direction of the impulse absorbed to the ball?

7. A 360 000 kg meteor is heading directly towards the space shuttle at 35 m/s. It is pushed for a period of 45 seconds after which its velocity is 27 m/s and it has veered 22^o from its original course. a) Find the impulse given to the meteor (magnitude and direction). b) Find the magnitude of the force applied

8. A roller coaster car of mass 250 kg starts with a velocity of 9.4 m/s on top of a 5.5-m-high hill, rolls down the frictionless track, and collides with a second, 350 kg car at the bottom of the hill at rest. The cars link together and roll up a second hill 1.5 m high. How fast are the cars going when they reach the top of the second hill?

Unit 5: Circular Motion and Orbits

1. A ride at the PNE has 3500 kg cars hung from 12-m-long cable. The cars are spun in a horizontal circle so that the cable makes a 25^O angle with vertical. Find the period of rotation of the ride.

2. A 6.0×10^3 kg satellite with an orbital radius of 4.20×10^7 m orbits the earth at an altitude of 3.56×10^7 m. What is its velocity?

~~3. A 5.2×10^4 kg rocket is initially at rest on the surface of the earth. If 3.0×10^{11} J of work is done on this rocket, what maximum altitude *h* will the rocket reach? (Assume the rocket's mass does not change.)~~

4. A black hole has a mass equal to 30 solar masses. Find the distance from the center at which the escape velocity equals the speed of light. (This is the Schwarzschild radius or "event horizon")

~~5. How much energy is required to boost a 1000 kg satellite in an orbit around Earth with a period of 36 hours to an orbit with a period of 48 hours?~~

6. A Ferris wheel with a radius of 16 m rotates 3 times every minute. Find the force exerted by the seat against a 40 kg child when the c`hild is at a point halfway between the top and bottom (ie at "3 o-clock").

7. A road is banked so that a car traveling 60km/h can round a curve of radius 30m even if the road is so icy that the coefficient of friction is approximately zero. Find the maximum speed at which a car can safely travel if the coefficient of friction between the road and the tires is 0.3.

Answers:

Kinematics:

1. A) 42m/s B) 0 C) 2.7 d) 550m e) 21.25m/s f) Speed up forward – uniform forward – slow down forward – stop – speed up backward – slow down backward – stop.

2. a) 600m b) 300m

3. 2.45s

4. 22.3s

5. 180N 40.4° N of E

6. a) 44.1m b) 55.4m/s c) 49.2m/s d) 2.9s

7. a) 71.5m/s 68° up b) 223m c) Yes 8. a) 39.7m/s b) 482km

Statics:

1. 648N

2. 6.6kg

3. a) 1785N b) 2184N 40°

4. a) 0.32 b) 5.48m

Dynamics:

1. 9900N

2. 156 m

3. 3m/s

4. 10.9m/s^2

5. 0.23

6. 11.7kg

Energy & Momentum:

1. 19.2m/s

2. 5.4m/s

3. $1.2\times10^5 kJ$, 2.0x10^6 W (time of 1.0 minutes)

4. 1.8m high, 3.7 m along ramp

5. 88.2m/s 9°

6. 9.3kgm/s 18.8°

7. a) 5.1x10^6 kgm/s

b) 1.1x10^5 N

8. 2.16m/s

Circular Motion:

1. 6.62s

2. 3100m/s

3. 6.5x10^5 m

4. 8.9x10^4 m

5. 6.3x10^8 J

6. 397N 9.2°

7. 22.6m/s = 81km/h