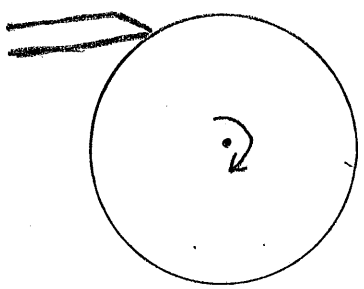
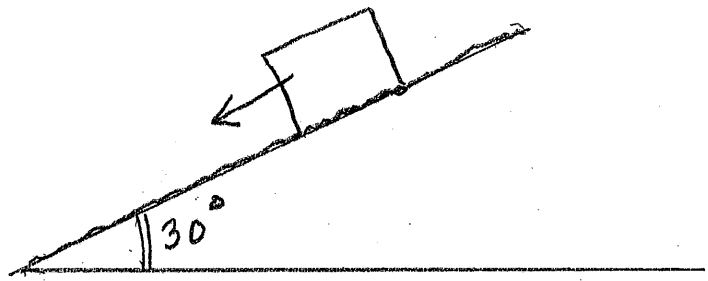
Week 7-Problems

7-1 The 5kg block is sitting on a smooth horizontal table. A person applies a force of 20N at an angle of 35° above the horizon. How much work is done by (i) $\underset{\rightarrow}{F}$ (ii) the normal force and (iii) the "weight" force, when block moves by 2m?

7-2 You are sharpening a tool by holding it against a grinding wheel. The force you exert is $-20N\hat{r}$. If the radius of the wheel is 5cm and the coefficient of kinetic friction is 0.3, how much work is done on the tool during 10 revolutions?

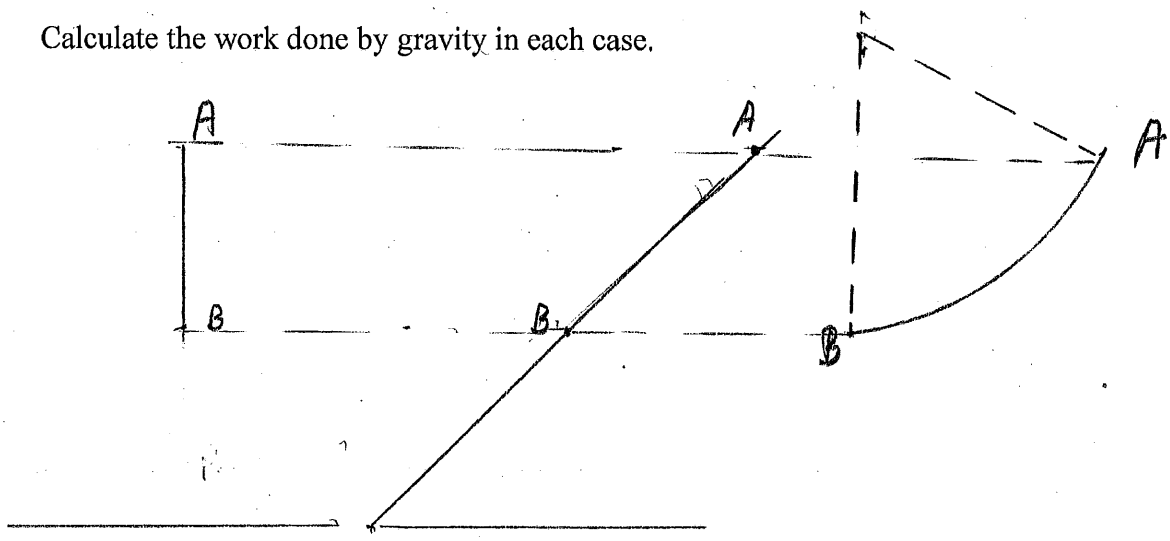


7-3 The 10kg mass is sliding down a rough incline ($\mu_k = 0.3$) tilted at 30°. In moving 1m, how much work is done by (i) normal force (ii) gravity (iii) frictional force?

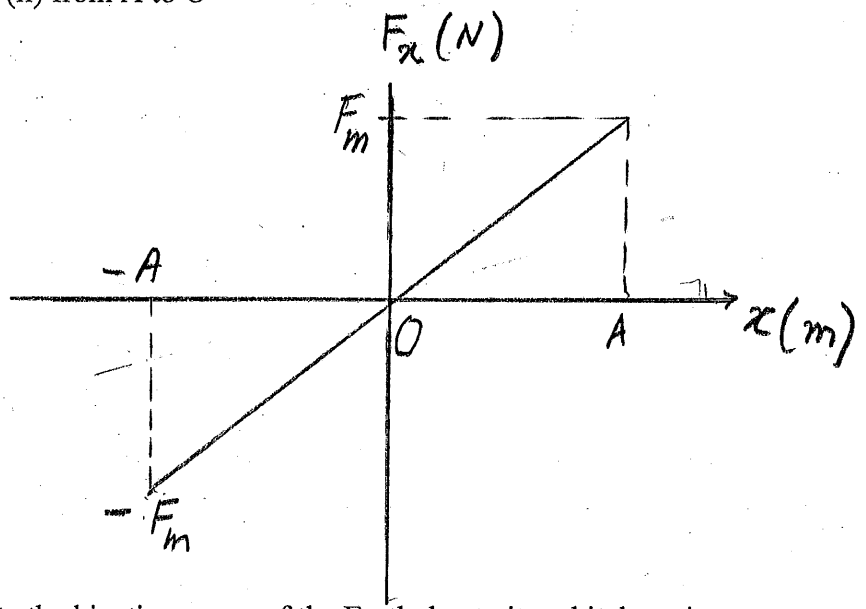


7-4 Shown are three ways in which a 1kg mass can be moved from y = 10m to y = 5m.

Calculate the work done by gravity in each case.



7-5 The variation of F_x as a function of x is shown in the figure. Calculate the work done (i) from –A to O (ii) from A to O



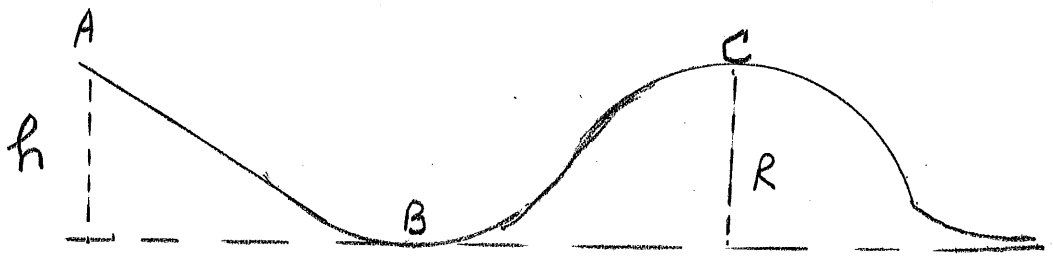
7-6 Calculate the kinetic energy of the Earth due to its orbital motion.
[*radius of orbit* $1.5x10^8$ *km*, *mass* $6x10^{24}$ *kg*]

7-7 What is a conservative force?

7-8 Why is the work done by the force of friction always negative?

7-9 What is potential energy? (DO NOT WRTIE Mgh.)

7-10 Shown is a frictionless hill track.
(i) What is the smallest value of h
that an object released at A will go over at C?
(ii) What is the largest value of h so that the
object released at A will not lose contact at C
(assume at C is semi-circle of radius R) ?



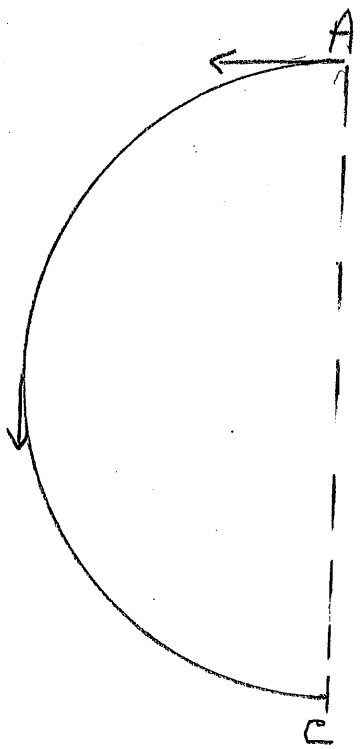
7-11 Show that for a satellite in a circular orbit, the kinetic energy (positive) is equal to one half of the potential energy (negative).

7-12 Assuming that the Earth is a sphere of radius R_E, estimate the escape velocity of an object launched straight up from its surface.

7-13 Compute the energy required to move a 10^3kg car, on a horizontal road against a constant retarding force of 200N when (i) it is traveling at 20m/s for 10s, (ii) it has a constant acceleration and goes from rest to 20m/s in 10s.

7-14 A block of mass 0.2kg is held against a spring which compressed by 10cm. Assume a frictional coefficient of $\mu_k = 0.2$ and a spring constant k = 100 N/m. When the mass is released calculate: (i) work done by spring when mass leaves spring, (ii) work done by friction when mass leaves, (iii) the speed with which block leaves spring, (iv) distance mass travels after leaving spring before stopping eventually.

7-15 Suppose a pitcher with an arm length of 1m swings on a semi-circle before releasing the ball. She applies a tangential force of 10N $\hat{\tau}$ throughout the path. If the ball has a mass of 0.2kg, what is the speed when it is released at C if it started at rest at A?



7-16 What is the average power used by you (M = 50kg9 in climbing a 15m tall ladder in 3 seconds?

7-17 The U.S. with a population of 3.2×10^6 people consumes about 6×10^{22}J per year. What is the per capita consumption in watts? The sun provides us with $1000 w/m^2$. Assuming 20% efficiency, how much area is needed to serve one U.S. citizen?