Physics of Astronomy – week 7 – Giancoli Ch 7 & 8
Phys A Work & Energy

(b) E/Z

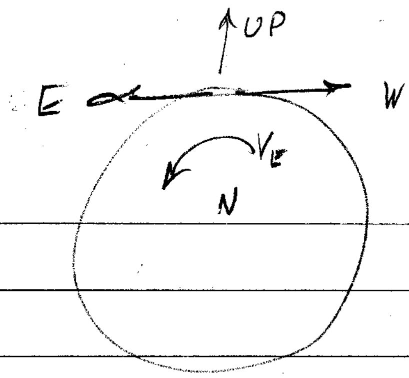
Ch 7 # 4, 6; 21, 34, 39, 41, 52 / Ch 8 # 10, ~~32~~, 45, 47

4. (I) A 1200-N crate rests on the floor. How much work is required to move it at constant speed (*a*) 4.0 m along the floor against a friction force of 230 N, and (*b*) 4.0 m vertically?

6. (I) How high will a 1.85-kg rock go if thrown straight up by someone who does 80.0 J of work on it? Neglect air resistance.

Ch8 #

45. (II) Take into account the Earth's rotational sp (1 rev/day) and determine the necessary speed, with res to Earth, for a rocket to escape if fired from the Earth at equator in a direction (*a*) eastward; (*b*) westward; (*c*) ve cally upward.



Sun rises East → west

So Earth turns west → east

What is the speed of the earth at the equator?

$V_{EARTH} = V_E = \frac{2\pi R}{T} =$

What is the escape speed, ignoring Earth's motion?
Last week we derived this: $K = U$

$\frac{1}{2} m v_e^2 = \frac{GmM}{R_E}$

$V_{escape} = V_e =$

(a) Consider a rocket fired EASTward with a speed V_0 RELATIVE to Earth. It's like throwing a ball out a car window; the ball goes faster if the car is moving.

EAST V_0 V_E $V_0 + V_E$ effective speed

$V_{escape} = V_e = V_0 + V_E$ → Solve for V_0 = rocket speed.

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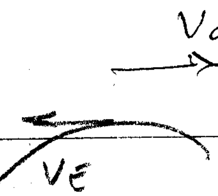
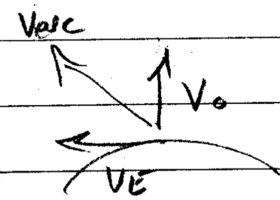
45 (b) Consider a rocket launched WESTWARD



The rocket must overcome Earth's motion

$V_{escape} = V_o - V_E \rightarrow$ Solve for V_o

(c) Consider a rocket launched UP



$V_{escape}^2 = V_E^2 + V_o^2$. Solve for V_o.

47. (II) (*a*) Determine the rate at which the escape velo from the Earth changes with height above the Earth's s face, dv_{esc}/dr. (*b*) Use the approximation $\Delta v \approx (dv/dr)\Delta r$ to determine the escape velocity for a spacecraft orbit the Earth at a height of 300 km. $= \Delta r$

Re-derive escape speed:

$K = U$

$\frac{1}{2} m V_e^2 = \frac{GmM}{R_E}$

$V_e =$

In general, at some distance r from Earth's center

$V_e(r) =$

(a) $\frac{\partial V_e}{\partial r} =$

(b) We know from #45 that $V_e =$
at Earth's surface ($r = R_E$). Above the surface
$V(r) \approx V_e + \Delta V$ where $\Delta V \approx \Delta r \frac{\partial V_e}{\partial r}$

At a height of $\Delta r = 300\,km$, $\Delta V =$

Then $V(300\,km) =$