APPC, Mechanics: Unit α HW 3

Name: _____
Hr: ___ Due at beg of hr on: _____

Uα, HW3, P1
Reference Video: "A Fast, Intuitive Approach for Projectile Motion Problems"
YouTube, lasseviren1, KINEMATICS playlist

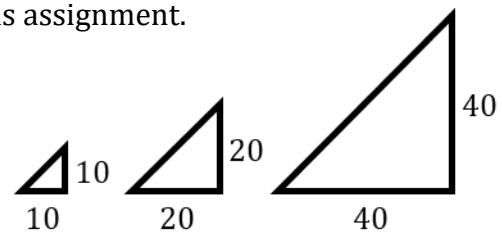
Here, we tackle solving projectile motion problems intuitively, without a calculator.

A. To do this, what two assumptions must we make (on Earth)?

i.

ii.

B. To TWO sig figs, write the length of the hypotenuse of each 45-45-90 right triangle below. You may use a calculator for the first triangle, but not anymore, for the rest of this assignment.



C. This isn't in the video, but you MUST know this…

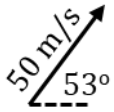
What is the significance of, i.e., what is special about, a 37-53-90 right triangle?

D. Solve each problem. You may show minimal or no work at all, if you wish.

i.

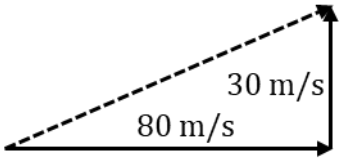
time to top =
maximum height =
time in air =
range =

ii.



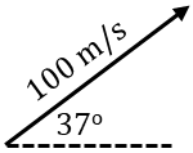
time to top =
maximum height =
time in air =
range =

iii.



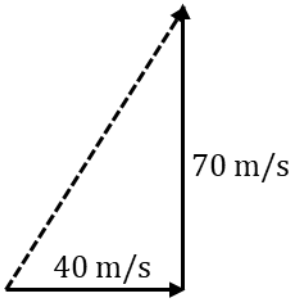
time to top =
maximum height =
time in air =
range =

iv.



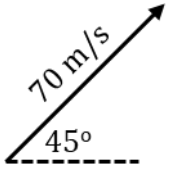
time to top =
maximum height =
time in air =
range =

v.



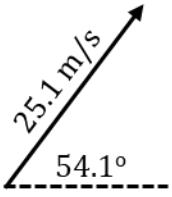
time to top =
maximum height =
time in air =
range =

vi.



time to top =
maximum height =
time in air =
range =

E. **Estimate** the same four quantities that you did in Parts Di-Dvi. Do NOT use a calculator.



Uα, HW3, P2
Reference Video: "The Big Picture in AP Physics C Mechanics"
YouTube, lasseviren1

A. Write the typical variable symbol – AND equation,
if given in the video – for the following seven forces.

i. gravity near the Earth:

ii. universal gravity:

iii. static friction:

iv. kinetic friction:

v. elastic force in a spring:

vi. tension:

vii. normal force:

B. What do the (–) signs indicate, in your answers to Parts Ai and Aii?

C. What does the (–) sign indicate, in your answer to Part Av?
(This is DIFFERENT, as compared to your Part B answer.)

D. Write the typical variable symbol AND equation for the following energies.

i. gravitational potential energy, near the Earth:

ii. gravitational potential energy, universal:

iii. elastic potential energy, in a spring:

iv. kinetic energy:

It is an extremely huge deal that you know that:

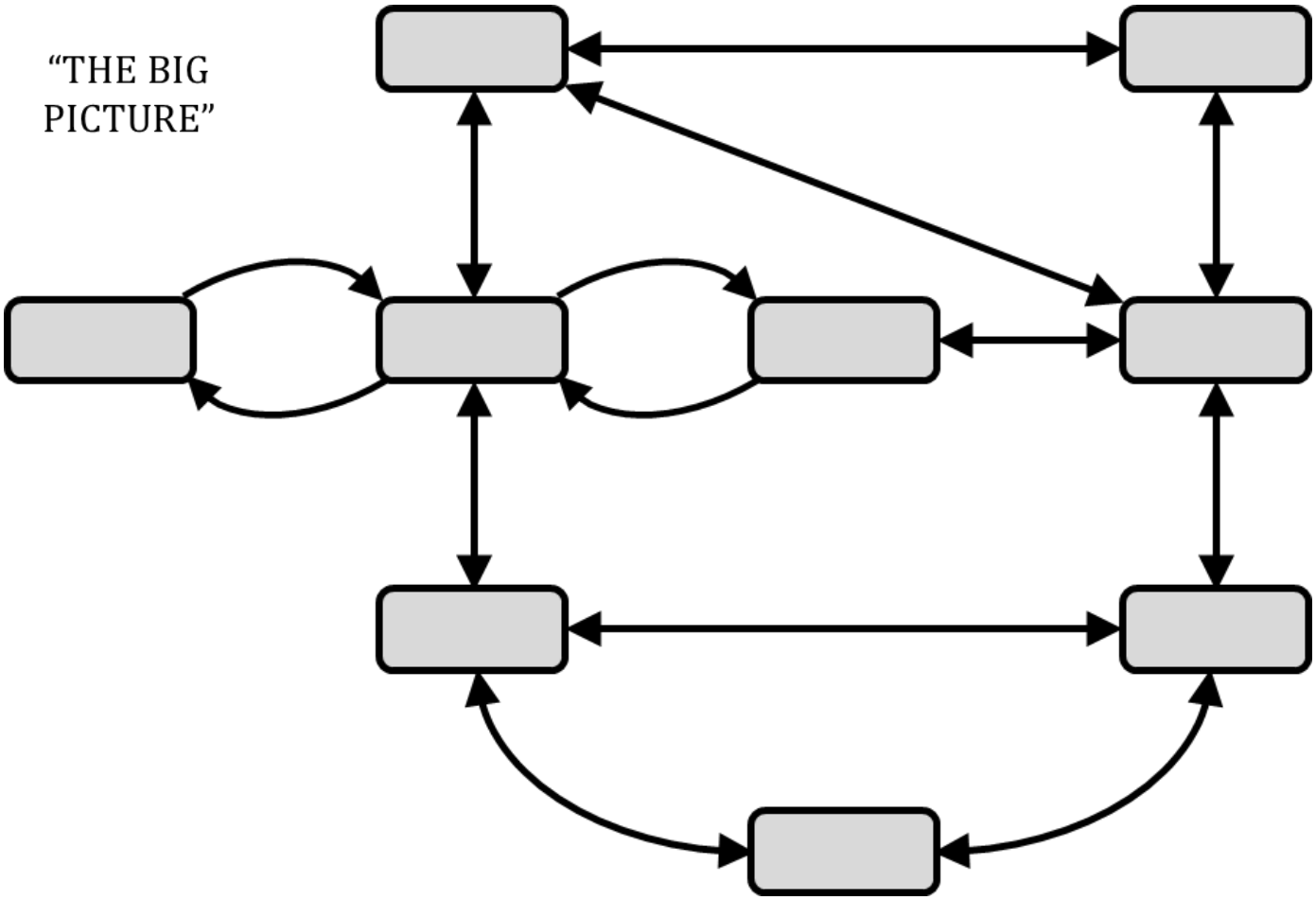
"The negative derivative of a potential energy *U* with respect to position *x* equals…the force associated with that type of potential energy."

E. Write the equation that expresses the boldfaced statement above.

F. Write equations (shown in the video) into the six empty boxes below.

POTENTIAL ENERGY	TYPE	FORCE
	gravitational, near the Earth	
	gravitational, universal	
	elastic potential	

Uα, HW3, P3
Reference Video: "VID00009 (Big Picture, Part II)"
YouTube, lasseviren1



A. Write the name of the correct physical quantity into the appropriate box in the diagram.

ACCELERATION	MOMENTUM	POSITION
IMPULSE	NET FORCE	POWER
KINETIC ENERGY	NET WORK	VELOCITY

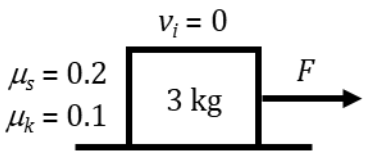
B. Write the correct equation next to the appropriate arrow in the diagram.

	$K = \frac{1}{2}mv^2$	$\vec{J} = \int \vec{F}_{net}\, dt$
$\vec{p} = m\vec{v}$	$\Delta\vec{x} = \int \vec{v}\, dt$	$P = \frac{dE}{dt}$
$\vec{v} = \frac{d\vec{x}}{dt}$	$\vec{F}_{net} = m\vec{a}$	$\Delta\vec{v} = \int \vec{a}\, dt$
$P = \frac{dW}{dt}$	$\Delta\vec{p} = m\Delta\vec{v} = \vec{J}$	$\vec{F}_{net} = \frac{d\vec{p}}{dt}$
$W_{net} = \int \vec{F}_{net} \cdot d\vec{x}$	$\vec{a} = \frac{d\vec{v}}{dt}$	$W_{net} = \Delta K$

Uα, HW3, P4
Reference Video: "VID00108 (Review of Big Picture, Part I)"
YouTube, lasseviren1

Solve the following problems. Because you are free to use 10 m/s^2 as the magnitude of the gravitational acceleration, you should NOT need a calculator for this assignment.

A.



Find the force of friction if the applied force F is…

i. 2 N ii. 4 N iii. 9 N

B. Find the acceleration of the mass for each case above. i. ii. iii.

C. $\vec{p}(t) = (3t^2)\hat{\imath} - (9t)\hat{\jmath} + 4\hat{k}$ At a time of 2 s, determine the net force, in unit-vector form.

D. Assuming the function in Part C applies to a mass of 5 kg, find the magnitude of the mass's acceleration at a time of 2 s.

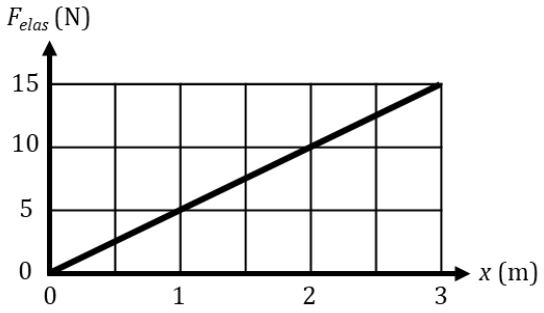
E. $U(x) = 3x^3 - 3.5x^2 - 10x + 4$ At a time of 3 s, determine the magnitude of the net force.

F. Assuming the function in Part E applies to a mass of 5 kg, find the magnitude of the mass's acceleration at a time of 3 s.

G. Using the graph, determine the:

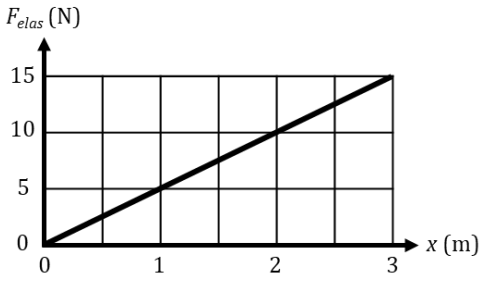
i. spring constant

ii. amount of elastic potential energy stored in the spring when it is stretched to position 2 m



Uα, HW3, P5

Reference Videos: (1) "VID00109 (Review of Big Picture, Part II)"
(2) "VID00110 (Review of Big Picture, Part III)
YouTube, lasseviren1



We continue with the graph you were working with on the last assignment. The graph is reproduced at right. (You're welcome. ☺)

A. Determine the work associated with the spring when its position changes from:

i. x = 1 m to x = 3 m

ii. x = 3 m to x = 0 m

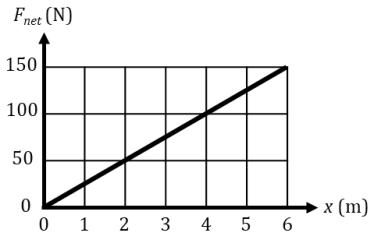
B. Your Part A answers…Which property of the graph do they correspond to? (i.e., WHAT ARE THEY, on the graph?)

C. Circle your answers.

i. In Part Ai, work is done: ON THE SPRING BY THE SPRING

ii. In Part Aii, work is done: ON THE SPRING BY THE SPRING

D. Using the graph at right, find the change in the object's kinetic energy between x = 0 m and x = 4 m.

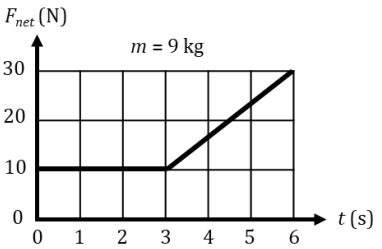


E. If the object has a mass of 2 kg and starts from rest, find its speed when it reaches position x = 4 m.

F. Based on the graph at right, determine the:

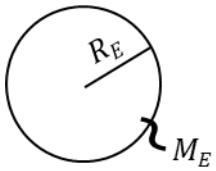
i. acceleration at t = 5.5 s

ii. impulse delivered between t = 3 s and t = 6 s



iii. change in the object's velocity between t = 0 s and t = 6 s

G. At right, the radius and mass of the Earth are designated. Assume the magnitude of g at the surface is 10 m/s². Find the magnitude of g at a distance $2R_E$ from Earth's center.



H. If we now put a mass m_o at a distance $2R_E$ from Earth's center, determine an expression for the total amount of gravitational potential energy stored in the Earth-mass system.

I. With regard to the mass m_o , what does it mean, that your Part H answer is negative?