No Math: $W = KE$ $\quad F \cdot d = \frac{1}{2}mv^2 \Rightarrow$ So if v becomes 2v, then $Fd = \frac{1}{2}m(2v)^2$ $\quad Fd = \frac{1}{2}m\,4\,v^2$

Physics
Quiz #1- Quarter 2
Work, Energy, and Momentum

Name: Key ______________________ Date: ______________________ Period: ____________

Factor of 4! So 100m x 4 = 400 m

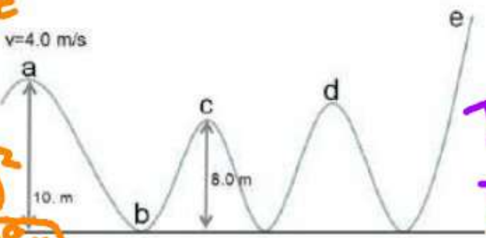
C 1. It takes 100 m to stop a 5000 kg car initially moving at 25.0 m/s. Under the same conditions, how far would it take a car traveling 50.0 m/s to stop? **HINT 1: WORK is EQUAL to KINETIC ENERGY! HINT 2: What is changing, and by what factor?**

a. 25 m b. 100 m c. 400 m d. 200 m e. 1300 m

If you do all the steps, find F (force of breaks) and then use F and your new v to find d.

C 2. Consider this figure. A cart starts at point A with a speed of 4.0 m/s. If the cart comes to rest at point "e," what is the height at "e?" **HINT: What type(s) of energy are present at points A and E, and how are these totals related?**

Step 1: Total Energy = PE + KE
At pt. A,
$TE = mgh + \frac{1}{2}mv^2$
$TE = m(10)(10) + \frac{1}{2}m(4)^2$
$TE = 100m + 8m = 108m$



Step 2: At pt. E:
$TE = mgh + \frac{1}{2}mv^2$
$TE = m(10)(h) + \frac{1}{2}m(0)^2$ (at rest!)
$TE = 10mh$

a. 8 m b. 10. m c. 11 m d. 13 m e. 15 m

Since $TE = 108m$ & $TE = 10mh$; $108m = 10mh$, $108 = 10h$, $10.8 = h \approx 11 m$

D 3. Consider the figure in problem #2. A cart starts at point A with a speed of 4 m/s. Which of the following statements best describes the cart's **energy at point (c)?** (Let the ground be h=0.)

a. At point (c), PE = 0 and KE = 0.
b. At point (c), PE > 0 and KE = 0.
c. At point (c), PE = 0 and KE > 0.
d. At point (c), PE > 0 and KE > 0.
e. It depends on the mass of the cart.

At pt. C: $PE = mgh = m(10)(8) = 80m > 0$! (It exists!)

At pt. c: $KE = \frac{1}{2}mv^2$, $KE = \frac{1}{2}mv^2 > 0$ because it does NOT say $v = 0$ at pt. c. Only at pt. E!

A 4. Which of these statements is/are true? **HINT: What does it mean to be conservative?**

I. ✗ Conservative forces require contact between 2 objects.
✓ II. Field forces conserve energy.
III. ✗ Friction is a conservative force.
IV. ✗ Conservative forces are path-dependent. → they are independent

a. II only b. II & IV c. I, III, and IV d. all are true

$PE_s = \frac{1}{2}kx^2$ * must be in kg and m!

$KE_s = \frac{1}{2}mv^2$

Physics

Quiz #1- Quarter 2

Work, Energy, and Momentum

E

5. A spring-loaded gun shoots a 0.020 kg steel ball. To load the gun, one compresses the spring by 0.030 m; the spring has a spring constant of 250 N/m. What is the initial speed of the steel ball, just after leaving the gun? **HINT: Potential energy is immediately converted to kinetic energy when using a spring.**

a. 8.2 m/s b. 0.15 m/s c. 11 m/s d. 15 m/s [✓ e. 3.4 m/s]

$PE_s = \frac{1}{2}(250)(.03)^2 = 0.1125$; $0.1125 = \frac{1}{2}(0.02)(v)^2$

$v = \sqrt{11.25}$

$v = 3.35$

$\approx \boxed{3.4\ m/s}$

D

6. A father pushes his child on a swing. He pushes with a force of 30N for a distance of 2m. How much **work** did the father do?

a. 15 joules b. 0.07 joules c. 120 joules [✓ d. 60 joules]

$W = F \cdot d$; $W = 30N \cdot 2m = 60J$

① ②

B

7. A 10-kg kid comes down a slide. The slide is 3 meters high and 5 meters long. The slide also has a frictional force of 10 N that acts along the entire length of the slide. How fast is the kid going when he reaches the bottom? **HINT 1: What is the total amount of energy that the kid has at the top and should have at the bottom? HINT 2: By how much does friction change that energy? HINT 3: What type of energy does the kid have at the bottom vs. the top?**

a. 12 m/s [✓ b. 7 m/s] c. 10 m/s d. 14 m/s

$TE = mgh + \frac{1}{2}mv^2$

$TE = (10)(10)(3) + 0$

TE = 300J at top!

② Friction "works" along the entire slide (takes energy away)

$W = 10N \cdot 5m = 50J$ from friction

③ $300J - 50J = 250J$ Left $= KE$

④ $250 = \frac{1}{2}mv^2$

$250 = \frac{1}{2}(10)v^2$

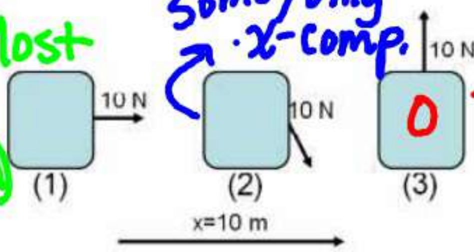
$\sqrt{\frac{250}{5}} = \sqrt{v^2}$

$\boxed{7\ m/s = v}$

A

8. A crate moves 10m to the right on a horizontal surface as a woman pulls on it with a 10-N force. Rank the situations shown below according to the work done by her force, **least to greatest.**

Most (Parallel) Some; only x-comp. 0 → 90°



[✓ a. 3,2,1] b. 1,3,2 c. 1,2,3 d. 2,1,3 e. 2,3,1

Physics

Quiz #1- Quarter 2

Work, Energy, and Momentum

B

$\vec{P}_i = \vec{P}_f$

9. In an elastic collision, an object with mass 3kg collides with an object of mass 5kg. The initial velocities of both are 12m/s and 25m/s respectively. If the final velocity of the first object is 20m/s, what is the final velocity of the second? **<u>HINT 1: Assume that all quantities are positive! HINT 2: What is the initial and final momentum?</u>**

a. 24 m/s b. 20 m/s c. 29 m/s d. 17 m/s

$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$

$(3)(12) + (5)(25) = (3)(20) + (5)(v_{2f})$

$161 = 60 + 5v_{2f}$

$101 = 5v_{2f}$

$\frac{101}{5} = v_{2f}$ ~~20 m/s~~

D

10. Which of these is the basic SI unit for work? **<u>HINT: Think about the formula for work!</u>**

a. $\frac{m\,kg}{s^2}$

b. $\frac{kg\,m}{s}$

c. $\left(\frac{m\,kg}{s}\right)^2$

d. $\frac{m^2 kg}{s^2}$

$W = F \cdot d$

$W = (m \cdot a) \cdot d$

$W = \left(kg \cdot \frac{m}{s^2}\right) \cdot m$

$= \frac{kg\,m^2}{s^2}$

A

11. An **<u>inelastic collision</u>** is one in which

a. only momentum is conserved
b. only energy is conserved
c. both energy and momentum are conserved
d. neither energy or momentum are conserved

* Momentum is ALWAYS CONSERVED!

B

12. Which of these bodies has the **<u>largest momentum</u>**? **<u>HINT: What is the formula for momentum?</u>**

$\vec{p} = m \cdot \vec{v}$

I. Mass 3M and speed V = 3
II. Mass M and speed 4V = 4
III. Mass 3M and speed 2V = 6 ✓
IV. Mass 2M and speed 3V = 6 ✓

a. II & III b. III & IV c. IV alone d. I and II e. III alone

* If I ask for energy, recall $KE = \frac{1}{2}mv^2$.

So, I: $\frac{1}{2}(3)(1)^2 = \frac{3}{2} = 1.5\,J$

II: $\frac{1}{2}(1)(4)^2 = 8\,J$

III: $\frac{1}{2}(3)(2)^2 = 6\,J$

IV: $\frac{1}{2}(2)(3)^2 = 9\,J$

Physics
Quiz #1- Quarter 2
Work, Energy, and Momentum

Formulas:

1. W = Fd cosθ (Work = Force x Distance x cosθ)

2. KE = $\frac{1}{2}mv^2$ (Kinetic Energy = ½ x mass x velocity squared)

3. PE = mgh (Potential energy = mass x gravity x height)

4. Elastic KE = $\frac{1}{2}mv^2$ (for springs)

5. Elastic PE = $\frac{1}{2}kx^2$ (for springs) (k = spring constant; x = displacement)

6. $\vec{p} = mv$ (momentum = mass x velocity)

7. $\vec{p}_i = \vec{p}_f$ (initial momentum = final momentum)