

Unit 3 Test Review**Work & Energy****Chapters 7 - 8**

* In studying for your test, make sure to study this review sheet along with your quizzes and homework assignments.

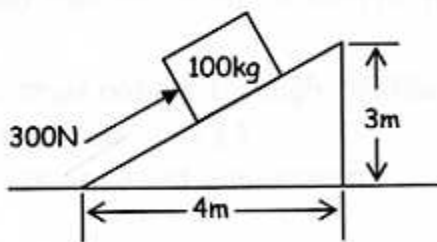
Multiple Choice: On this portion of the test, you will not be allowed to use your calculator or AP formula sheet. (You may, however, use your AP table of information.) Approximate $g=10\text{m/s}^2$ for simplicity of calculations. No partial credit will be given.

- According to the work-kinetic energy theorem, what must be true about an object if the net work done on it during some time interval is equal to zero?
 - The object is sitting still.
 - The object is not accelerating.
 - The object is slowing down.
 - The object is speeding up.
- A weight lifter lifts a mass m at constant speed to a height h in time t . How much work is done by the weight lifter?
 - mg
 - mh
 - mgh
 - $mght$
 - mgh/t
- A constant force of 300N pushes a 100kg mass up the inclined plane shown in the diagram at a constant speed of 4m/s. The work done by the 300N force in pushing the mass from the bottom of the incline all the way to the top of the incline is most nearly...

$W = \vec{F} \cdot \vec{d} = (mg)_j \cdot (h)_j$

- 0J
- 900J
- 1000J
- 1500J
- 3000J

$$W = \vec{F} \cdot \vec{d} = (300)(5\text{m})$$



4. A child pushes horizontally on a box of mass m which moves with constant speed v across a horizontal floor. The coefficient of kinetic friction between the box and floor is μ . At what rate does the child do work on the box?

a. μmgv b. $\frac{\mu mg}{v}$ c. mgv d. μmv^2 e. $\frac{v}{\mu mg}$

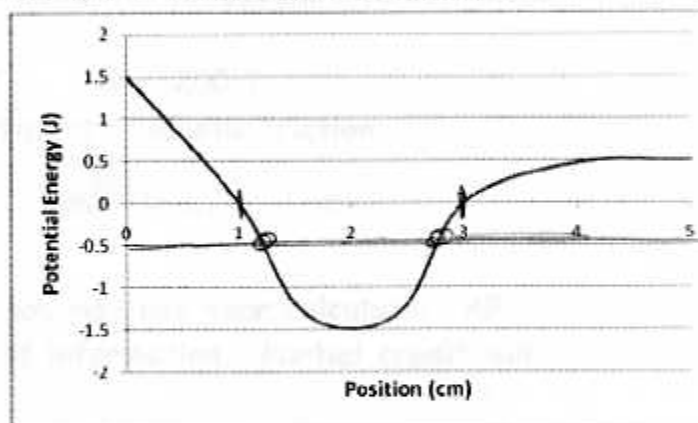
$$P = Fv = (\mu mg)(v)$$

5. A rock of mass m is thrown horizontally off a building from a height h_0 . The speed of the rock as it leaves the thrower's hand at the edge of the building is v_0 . Disregarding air resistance, what is the kinetic energy of the rock just before it hits the ground?

a. mgh_0 d. $\frac{1}{2}mv_0^2 - mgh_0$
 b. $\frac{1}{2}mv_0^2$ e. $\frac{1}{2}mv_0^2 + mgh_0$
 c. $mgh_0 - \frac{1}{2}mv_0^2$

6. A conservative force has the potential energy function $U(x)$, shown by the given graph. A particle moving along the x -axis has kinetic energy equal to 1.0J when it is at position $x=2\text{cm}$. Which of the following is a correct statement about the motion of the particle?

a. It oscillates between $x=1\text{cm}$ and 3cm .
 b. It moves to the right of $x=4\text{cm}$ and does not return.
 c. It moves to the left of $x=1\text{cm}$ and does not return.
 d. It comes to rest at $x=1\text{cm}$ and 3cm .
 e. It cannot reach either $x=1\text{cm}$ or 3cm .

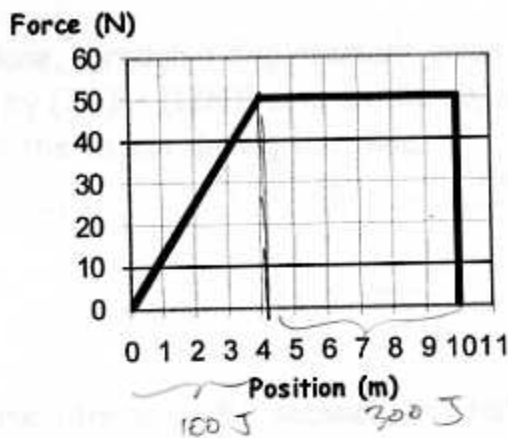


7. A mass is attached to an ideal spring on a smooth horizontal surface. It is displaced an amount A from equilibrium, and then released. Which of the following is true?

I. Kinetic energy is largest when the mass passes through equilibrium. ✓
 II. Potential energy is largest when the mass is at $\pm A$. ✓
 III. The total energy is largest when the mass is at equilibrium.

a. I only b. II only c. III only d. I and II only e. I and III only

8. The only force acting on an 8kg object varies as shown in the given graph. Determine the work done by this force to move the object from $x=0\text{m}$ to $x=10\text{m}$.



- a. zero
b. 50J
c. 300J
d. 400J
e. 500J

9. Assuming it started from rest at position 0m , the speed of the 8kg object in problem #8 at the end of the 10m displacement is closest to which one of the following?

- a. zero b. 2m/s c. 5m/s d. 7.1m/s **e. 10m/s**

$$400 = \frac{1}{2}(8)(v^2) \rightarrow v = 10$$

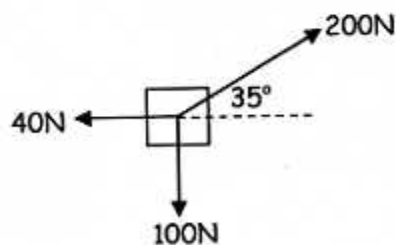
10. Starting from rest and a height of 10m, a 2kg mass slides down a 30° incline, reaching the bottom with a speed of 10m/s. What is the approximate work done by friction?

- a. zero b. $-10\sqrt{3}\text{J}$ **c. -100 J** d. -200 J
e. Cannot be determined without the coefficient of kinetic friction.

$$2(10)(10) + W_{\text{fric}} = \frac{1}{2}(2)(10^2) \rightarrow 200 + W_{\text{fric}} = 100$$

Problem Review: On this portion of the test, you may use your calculator, AP formula sheet, and AP table of information. Partial credit will be given on these problems.

11. Three forces act on a 5kg object as shown in the diagram. (Assume these are the only three forces on the object.) Calculate the net work done by the forces as the object moves 4.2 meters to the right, and then find its kinetic energy at the end of the motion, assuming it started from rest.



$$\Sigma F_x = 200 \cos 35 - 40 = 123.83\text{N}$$

$$W_{\text{net}} = (123.83)(4.2) = 520.1\text{ J}$$

$$520.1 = \frac{1}{2}(5)v_f^2 - 0$$

$$v_f = 14.42\text{ m/s}$$

12. A 3kg object slides over a frictionless xy plane, through a displacement given by $(13\text{m})\hat{i} - (5\text{m})\hat{j}$ while a constant force given by $(7\text{N})\hat{i} + (12\text{N})\hat{j}$ acts on the object.
- a. Calculate the work done by the force on the object during the slide.

$$W = \vec{F} \cdot \vec{d} = (13)(7) - (5)(12) = 91 - 60$$

$$= +31 \text{ J}$$

- b. If the previous motion occurs over a time interval of 3.2 seconds, at what rate is work done on the object?

$$P = W/t = \frac{31}{3.2} = 9.69 \text{ W}$$

13. A force acting on a 12kg block is given by $F(x) = 4x - 5x^2$, in Newtons. Calculate the work done by the force as the block moves from $x=0\text{m}$ to $x=3.5\text{m}$.

$$W = \int F dx = \int_0^{3.5} (4x - 5x^2) = \left[2x^2 - \frac{5}{3}x^3 \right]_0^{3.5}$$

$$= 2(3.5^2) - \frac{5}{3}(3.5^3) = -47.0 \text{ J}$$

14. A block of mass 8.2kg is initially 85cm above a vertically-oriented spring ($k=900\text{N/m}$). If the block is thrown down at 4.5m/s from this location, how far does it compress the spring?

$$\frac{1}{2}(8.2)(4.5)^2 + (8.2)(9.8)(.85) = \frac{1}{2}(900)x^2 + (8.2)(9.8)(-x)$$

$$83.03 + 68.31 = 450x^2 - 80.36x$$

$$450x^2 - 80.36x - 151.34 = 0$$

$$x = \frac{80.36 \pm \sqrt{80.36^2 + 4(450)(151.34)}}{900} = 0.68 \text{ m}$$

15. A 45cm-long pendulum is initially held such that it makes an angle of 25° with the vertical, and then it is thrown downward. How fast does the 1.2kg pendulum bob need to be thrown downward so that it swings down and then back up to a position vertically above its support, with a tension of exactly 6N in the string at this location?

$$\frac{1}{2}mv_i^2 + mgh_i = \frac{1}{2}mv_f^2 + mgh_f$$



$$F_T + F_g = \frac{mv^2}{r}$$

$$6 + 1.2(9.8) = 1.2 \frac{v^2}{.45}$$

$$\frac{1}{2}(v_i^2) + (9.8)(.042) = \frac{1}{2}(2.58^2) + (9.8)(.9)$$

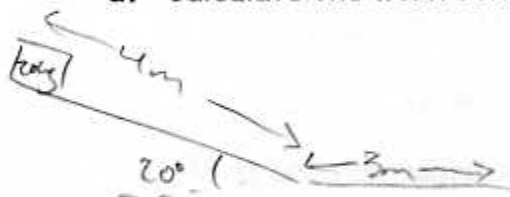
$$v = 2.58 \text{ m/s}$$

$$v_i = 4.84 \text{ m/s}$$

Q-15
 $v_i = .45 - .45 \cos 25^\circ$
 $= .042 \text{ m}$

16. Starting from rest, a 20kg block slides down 4m along a frictionless ramp that is inclined at 20° to the floor. Then the block slides another 3m along the flat, horizontal floor as it slows to a stop.

- a. Calculate the work done by gravity as the block slides down the ramp.



$$W_g = \vec{F}_g \cdot \vec{d}$$

$$= (20 \times 9.8)(4 \sin 20^\circ) = +268.1 \text{ J}$$

- b. Use work and energy considerations to find the speed of the block at the base of the ramp.

$$mgh_i = \frac{1}{2}mv_f^2$$

$$268.1 = \frac{1}{2}(20)(v_f^2) \rightarrow v_f = 5.18 \text{ m/s}$$

- c. Use work and energy ideas to find the coefficient of friction between the block and floor.

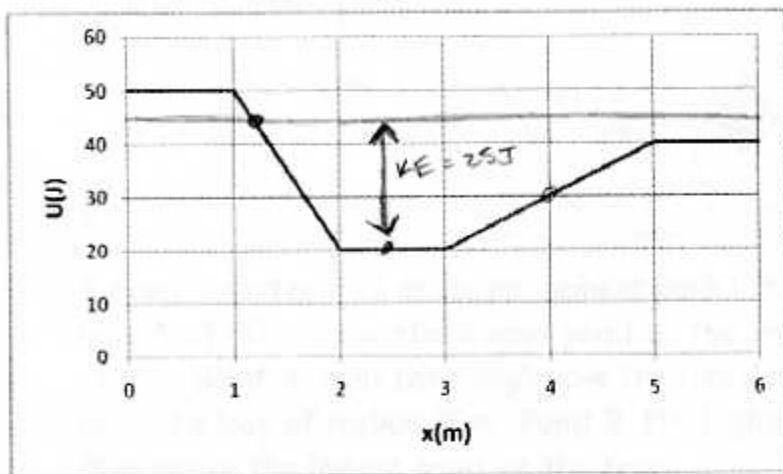
$$ME_i + W_{nc} = ME_f$$

$$268.1 - \mu F_N d = 0$$

$$268.1 - (\mu)(20 \times 9.8)(3) = 0$$

$$\mu = 0.46$$

17. The given graph shows a plot of potential energy U versus position x of a 2kg particle that can travel only along the x -axis under the influence of a conservative force. The particle is released at position $x=2.5\text{m}$ with a velocity of 5.0m/s in the negative x -direction.



- a. What is the position of the turning point on the left side of the graph? *Intersection of 2 lines*

$$\textcircled{1} U = 50 - 30(x-1)$$

$$\textcircled{2} U = 45$$

$$45 = 50 - 30(x-1)$$

$$-5 = -30x + 30$$

$$-35 = -30x$$

$$x = \frac{35}{30} = 1.17\text{m}$$

- b. What is the particle's speed at $x=6\text{m}$?

$$\text{KE } 45 = 40 + \frac{1}{2}(2)v^2$$

$$v = 2.24\text{m/s}$$

- c. What are the magnitude and direction of the force acting on the particle at $x=4\text{m}$?

$$F = -\text{slope} = -\left(\frac{20}{2}\right) = -10\text{N}$$

10N in neg x-dir

18. A block of mass 4.2kg is attached to a horizontal spring of constant $k=350\text{N/m}$. The block is initially pulled back 12cm from equilibrium and set free to slide across a horizontal floor, where the coefficient of friction between block and floor is 0.28 . If the block is released from rest, calculate its speed when it arrives back at its equilibrium position.

$$\frac{1}{2}kx^2 + W_{nc} = \frac{1}{2}mv_f^2$$

$$\frac{1}{2}(350)(.12^2) - (0.28)(4.2)(9.8)(.12) = \frac{1}{2}(4.2)v_f^2$$

$$2.52 - 0.138 = \frac{1}{2}(4.2)v_f^2$$

$$v_f = 0.74\text{m/s}$$

