Solutions

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AP Physics 1 - Test 07 - Work and Energy

Score: hopefully 100?

1. Which of the following is NOT a correct unit for work?

(A) ft·lb valid
(B) watt
(C) newton·meter valid
(D) joule valid

$W = F \cdot \Delta x$

a Force multiplied by a distance.

2. The graph represents the potential energy U as a function of position r for a particle of mass m. If the particle is released from rest at position r_0, what will its speed be at position $3r_0$?

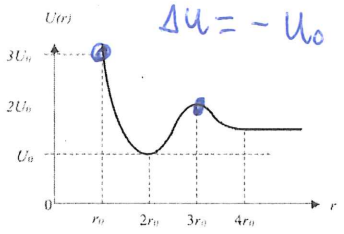
Hint: This is NOT a Force v. Displacement Graph, so don't take the area!. To find the gain in kinetic energy, simply look for the loss in potential energy from r_0 to $3r_0$. It has lost U_0 amount of potential energy, so it has gained U_0 amount of kinetic energy.

(A) sqrt($8U_0$/m)
(B) sqrt($4U_0$/m)
(C) sqrt($2U_0$/m)
(D) sqrt($6U_0$/m)

$\Delta K = U_0$

$\frac{1}{2}mv^2 = U_0$

$v = \sqrt{2U_0/m}$



$\Delta U = -U_0$

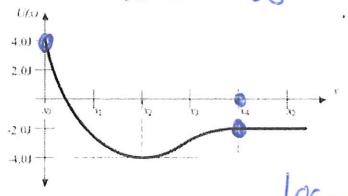
3. The potential energy function *U(x)* is associated with a force *F* and described by the graph given here. If a particle being acted upon by this force has a kinetic energy of *1 J* at position *x* what is the particle's kinetic energy at position x_4?

HINT: Just like the last problem, this is NOT a Force v. Displacement graph. So just remember that the loss in potential energy is the gain in kinetic energy. So how much energy did potential energy lose? Consider that the object has an initial kinetic energy.

(A) 6.0 J
(B) 7.0 J
(C) 2.0 J
(D) -2.0 J

$\Delta K = 6J$

$1 + 6 = 7J$



$\Delta U = -6J$

kinetic gains the same amount of energy that potential loses

4. A mass of *2 kg* is attached to the end of a light string to make a pendulum *5.0 m* in length. The mass is raised to an angle of 53° relative to the vertical, as shown, and released. The speed of the mass at the bottom of its swing is.

HINT: Use some trigonometry to find out how much the height (and thus the gravitational potential energy) has changed. This will be how much kinetic energy has been gained and the answer can be calculated.

(A) 60 m/s

(B) 7.7 m/s

(C) 40 m/s

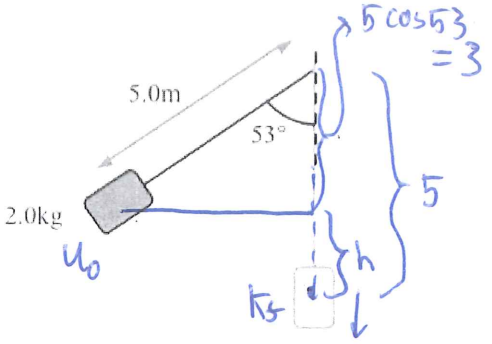
(D) 6.3 m/s

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

$v = \sqrt{2gh}$

$= \sqrt{2(9.8)(2)}$

$= 6.26\ m/s$



5. A boy holds a 40-N weight at arm's length for 10 s. His arm is 1.5m above the ground. The work done by the force of the boy on the weight while he is holding it is:

(A) 0 J

(B) 6.1 J

(C) 40 J

(D) 60 J

(E) 90 J

no displacement if it is stationary.

$W = F\Delta x = (40)(0) = 0$

6. A block of wood, initially moving along a rough surface, is pushed with an applied horizontal force $F_{applied}$ that is less than the friction force $F_{friction}$. The forces are in opposite directions. Which of the following statements is *false*?

(A) The Work being done by the applied force is negative.

(B) The net Work being done on the block is negative.

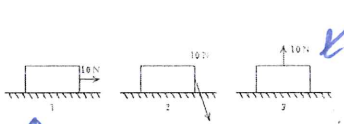
(C) The block is slowing down.

(D) The net work being done on the box decreases its kinetic energy.

Friction → negative

Applied → Positive

7. 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



zero

most

(A) 1, 2, 3

(B) 2, 1, 3

(C) 2, 3, 1

(D) 1, 3, 2

(E) 3, 2, 1

8. The work done by gravity during the descent of a projectile:

(A) is positive

(B) is negative

(C) is zero

If force and displacement are in the same direction, work is positive.

9. A moon of mass m orbits a planet of mass *M* in a perfectly circular orbit of radius r, with a force of gravitational attraction between the two bodies of F_g. How much Work is done on the moon by the planet during a single orbit of the moon?

(A) $F_g r$

B $F_g Mmr$

C $F_g 2\pi r$

D 0

Force and displacement are perpendicular

$\cos(90) = 0$

$W = F \Delta x \cos\theta$

10. A bucket of water with a total weight of 50 Newtons is lifted at constant velocity up a 10 meter deep well. If it takes 20 seconds to raise the bucket this distance, the Power required to lift the bucket is

A 25 J

B 25 W

C 2.5 J

D 500 W

$P = \frac{W}{t} = \frac{\Delta U_g}{t} = \frac{mg\Delta h}{t} = \frac{(50)(10)}{(20)} = 25\,W$ (50 = mg)

11. A 2-kg object is moving at 3m/s. A 4-N force is applied in the direction of motion and then removed after the object has traveled an additional 5m. The work done by this force is:

A 12 J

B 15 J

C 18 J

D 20 J

E 38 J

$W = F \Delta x \cos\theta$ ($\cos\theta = 1$)

$= (4)(5) = 20\,J$

12. Camping equipment weighing 6000N is pulled across a frozen lake by means of a horizontal rope. The coefficient of kinetic friction is 0.05. The work done by the campers in pulling the equipment 1000m at **constant velocity** is:

A 3.1×10^4 J

B 1.5×10^5 J

C 3.0×10^5 J

D 2.9×10^6 J

E 6.0×10^6 J

$F_{fk} = \mu F_n = (0.05)(6000) = 300\,N$

$W = F(\Delta x) = (300)(1000) = 300{,}000\,J$

13. A man pulls a 100-N crate up a frictionless 30° slope 5m high, as shown. Assuming that the crate moves at constant speed, the work done by the man is:

HINT: How long is the ramp? How much force is he pulling with? Is the block moving in the same direction as the force of his pull?

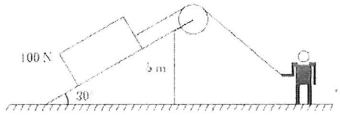
A −500 J

B −250 J

C 0

D 250 J

E 500 J



$W = \Delta U_g$

$= mg\Delta h = (100)(5) = 500\,J$ (100 = mg)

14. If the force and displacement of an object are in opposite directions, the work done on that object by that force is

(A) positive

(B) negative

(C) zero

15. Which equation best represents the kinetic energy of an object?

(A) KE = mgh

(B) KE = $0.5mv^2$

(C) KE = kx

(D) KE = $0.5\ kx^2$

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

16. A child is on a playground swing, motionless at the highest point of his arc. What energy transformation takes place as he swings back down to the lowest point of his motion?

(A) K to U_g

(B) U_g to K

(C) $E_{thermal}$ to K

(D) U_g to $E_{thermal}$

(E) K to $E_{thermal}$

17. A skier is gliding down a gentle slope at a constant speed. What energy transformation is taking place?

(A) K to U_g

(B) U_g to K

(C) $E_{thermal}$ to K

(D) U_g to $E_{thermal}$

(E) K to $E_{thermal}$

18. A crane lowers a girder into place at constant speed. Consider the work W_g done by gravity and the work W_T done by the tension in the cable. Which is true?

(A) W_g = positive and W_T = positive

(B) W_g = positive and W_T = negative

(C) W_g = negative and W_T = positive

(D) W_g = negative and W_T = negative

(E) W_g = 0 and W_T = 0

F_g is same direction as displacement → positive

F_T is opposite direction as displacement → negative

19. Please click the image and answer the provided question.

(A) A

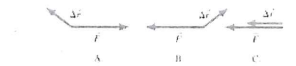
(B) B

(C) C

(D) D

(E) E

A constant force $\vec{F}$ pushes a particle through a displacement $\Delta\vec{r}$. In which of these three cases does the force do negative work?



D Both A and B
E Both A and C

20. Which force below does the most work? All three displacements are the same.

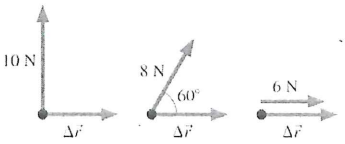
(A) The 10 N force

(B) The 8 N force

(D) The 6 N force

(D) They all do the same work.

$W = F\Delta x \cos\theta$



21. Ball A has half the mass and eight times the kinetic energy of ball B. What is the speed ratio v_A/v_B?

(A) 16

(B) 4

(C) 2

(D) 1/4

(E) 1/16

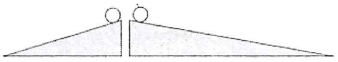
$K = \frac{1}{2}mv^2$

$v = \sqrt{\frac{2K}{m}}$

$v \propto \sqrt{\frac{K \leftarrow \times 8}{m}} \} \times\sqrt{16} \rightarrow \times 4$

$\uparrow \times \frac{1}{2}$

22. Starting from rest, a marble first rolls down a steeper hill, then down a less steep hill of the same height. For which is it going faster at the bottom?



(A) Faster at the bottom of the steeper hill

(B) Faster at the bottom of the less steep hill

(B) Same speed at the bottom of both hills

(D) Can't say without knowing the mass of the marble

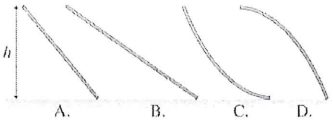
23. A small child slides down the four frictionless slides A–D. Rank in order, from largest to smallest, her speeds at the bottom.

(A) $v_D > v_A > v_B > v_C$

(B) $v_D > v_A = v_B > v_C$

(C) $v_C > v_A > v_B > v_D$

(D) $v_A = v_B = v_C = v_D$



24. A hockey puck sliding on smooth ice at 4 m/s comes to a 1-m-high hill. Will it make it to the top of the hill?

(A) Yes

(B) No

(C) Can't answer without knowing the mass of the puck

not enough energy

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

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

$U_g = mgh$

$= (1)(10)(1)$

$= 10\,J$

(D) Can't say without knowing the angle of the hill

25. A spring-loaded gun shoots a plastic ball with a launch speed of 2.0 m/s. If the spring is compressed twice as far, the ball's launch speed will be

(A) 1.0 m/s
(B) 2.0 m/s
(C) 2.8 m/s
(D) 4.0 m/s
(E) 16.0 m/s

$U_{sp} = K$ directly Proportional,

$\frac{1}{2}kx^2 = \frac{1}{2}mv^2$ so if x doubles, v doubles

$x^2 \propto v^2$

$x \propto v$

26. A spring-loaded gun shoots a plastic ball with a launch speed of 2.0 m/s. If the spring is replaced with a new spring having twice the spring constant (but still compressed the same distance), the ball's launch speed will be

(A) 1.0 m/s
(B) 2.0 m/s
(C) 2.8 m/s
(D) 4.0 m/s
(E) 16.0 m/s

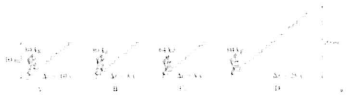
$\frac{1}{2}kx^2 = \frac{1}{2}mv^2$

$k \propto v^2$

$v \propto \sqrt{k}$ ($\times\sqrt{2}$ ↗, ↘ $\times 2$)

27. Four students run up the stairs in the time shown. Which student has the largest power output?

(A) A
(B) B
(C) C
(D) D



28. Five toy cars accelerate from rest to their top speed in a certain amount of time. The masses of the cars, the final speeds, and the time to reach this speed are noted in the table. Which car has the greatest power?

(A) A
(B) B
(C) C
(D) D
(E) E

$P = \frac{W}{t} = \frac{\Delta K}{t} = \frac{\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2}{t}$

Car	Mass (g)	Speed (m/s)	Time (s)
A	100	1	2
B	200	2	2
C	300	2	3
D	400	1	4
E	400	2	4

29. Which of the following bodies has the largest kinetic energy?

(A) Mass 3M and speed V
(B) Mass 3M and speed 2V
(C) Mass 2M and speed 3V
(D) Mass M and speed 4V

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

(E) All four of the above have the same kinetic energy

30. Two trailers, X with mass 500 kg and Y with mass 2000 kg, are being pulled at the same speed.
The ratio of the kinetic energy of Y to that of X is:

(A) 1:1
(B) 2:1
(C) 4:1
(D) 9:1
(E) 1500:1

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

$K \propto m$

x4 x4

31. A 5.0-kg cart is moving horizontally at 6.0m/s. In order to change its speed to 10.0m/s, the net work done on the cart must be:

HINT: The net work done on a body is the change of its kinetic energy.

(A) 40 J
(B) 90 J
(C) 160 J
(D) 400 J
(E) 550 J

$W = \Delta K = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 = \frac{1}{2}(5)(10)^2 - \frac{1}{2}(5)(6)^2$

$= 160\,J$

32. A 5.0-kg cart is moving horizontally at 6.0m/s. In order to change its speed to 10.0m/s is a time interval of 5 seconds. What is the power output?

(A) 8 W
(B) 18 W
(C) 32 W
(D) 80 W
(E) 110 W

$P = \frac{W}{t} = \frac{160}{5} = 32\,W$

33. On an analysis of the force vs compression of a spring. What aspect of the graph represents the spring constant?

(A) The slope
(B) The area
(C) The maximum force multiplied by the maximum compression
(D) The minimum force multiplied by the maximum compression

$F_{sp} = k\Delta x$ $\quad k = \frac{F_{sp}}{\Delta x}$

34. On an analysis of the force vs compression of a spring. What aspect of the graph represents the work performed on the spring?

(A) The slope
(B) The area
(C) The maximum force multiplied by the maximum compression

$W = F\Delta x$

(D) The minimum force multiplied by the maximum compression

35. A crane raises a 50-N weight 3m above the floor for 30 seconds at constant velocity. The power required to do this is:

(A) 150W
(B) 50W
(C) 30W
(D) 5W
(E) 0W

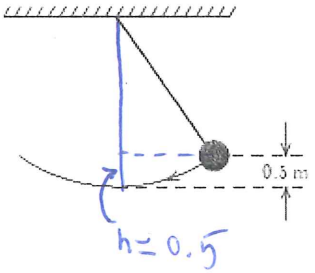
$P = \frac{W}{t} = \frac{mg\Delta h}{t} = \frac{(50)(3)}{30} = 5W$

36. A simple pendulum consists of a 2.0-kg mass attached to a string. It is released from rest at X as shown. Its speed at the lowest point Y is about:

(A) 0.90 m/s
(B) 1.90 m/s
(C) 3.1 m/s
(D) 6.0 m/s
(E) 36 m/s

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

$v = \sqrt{2gh} = 3.13\ \frac{m}{s}$



37. You toss a pebble upward with a velocity v and it obtains a height H. How fast must you throw the pebble to obtain twice the height?

(A) 2 v
(B) 4 v
(C) sqrt(2) v
(D) v

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

$v = \sqrt{2gh}$

$v \propto \sqrt{h}$

$\times\sqrt{2}$ $\times 2$

38. As a ball is thrown upwards, compare the signs of the work done by gravity while the ball goes up, and when the ball goes down.

(A) Up: Positive
Down: Positive
(B) Up: Negative
Down: Positive
(C) Up: Positive
Down: Negative
(D) Up: Negative
Down: Negative

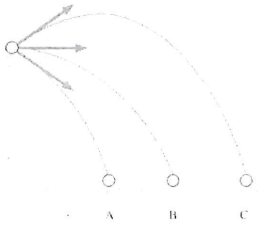
39. As a ball is thrown upwards, compare the signs of the work done by drag while the ball goes up, and when the ball goes down.

(A) Up: Positive
Down: Positive
(B) Up: Negative
Down: Positive
(C) Up: Positive
Down: Negative

Up: Negative
Down: Negative

40. Three balls are thrown from a cliff with the same speed but at different angles. Which ball has the greatest speed just before it hits the ground?

(A) Ball A
(B) Ball B
(C) Ball C
(D) All balls have the same landing speed
(E) It is situation, depending on the masses of each ball.



All have same initial kinetic and potential energy, so the will end with same kinetic.