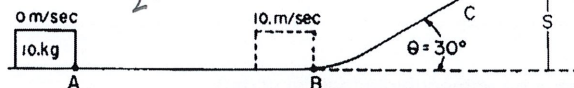


1. Base your answer to the following question on the diagram below which represents a 10-kilogram object at rest at point A. The object accelerates uniformly from point A to point B in 4 seconds, attaining a maximum speed of 10 meters per second at point B. The object then moves up the incline. [Neglect friction.]

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

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



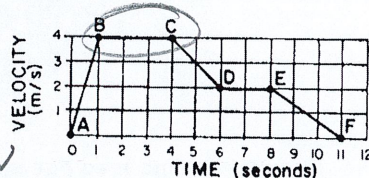
The kinetic energy of the object at point B is

- (1) 1,000 J (3) 100 J
(2) 500 J (4) 50 J

2. When the speed of an object is halved, its kinetic energy is

- (1) quartered (3) the same
(2) halved (4) doubled

3. Base your answer to the following question on the graph below which represents the velocity-time relationship for a 2.0-kilogram mass moving along a horizontal frictionless surface.



The kinetic energy of the mass is greatest during interval

- (1) AB (3) CD
(2) BC (4) DE

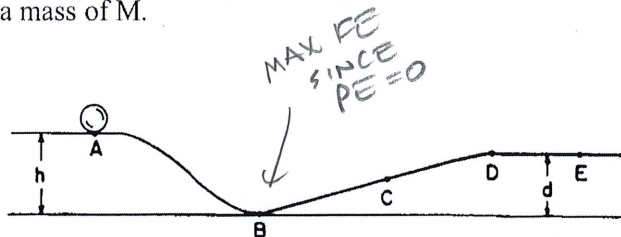
4. An object with a speed of 20. meters per second has a kinetic energy of 400. joules. The mass of the object is

- (1) 1.0 kg (3) 0.50 kg
(2) 2.0 kg (4) 40. kg

$$KE = \frac{1}{2}mv^2 \rightarrow M = \frac{2KE}{v^2}$$

$$M = \frac{2(400)}{(20)^2}$$

Base your answers to questions 5 and 6 on the diagram below that shows an object at A that moves over a frictionless surface from A to E. The object has a mass of M.



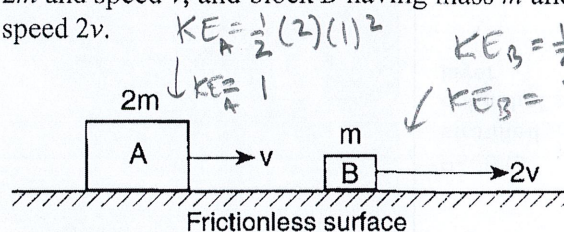
5. The object's kinetic energy at point C is less than its kinetic energy at point

- (1) A (3) D
(2) B (4) E

6. The object will have a minimum gravitational potential energy at point

- (1) A (3) C
(2) B (4) D

7. The diagram below shows block A, having mass $2m$ and speed v , and block B having mass m and speed $2v$.



Compared to the kinetic energy of block A, the kinetic energy of block B is

- (1) the same (3) one-half as great
(2) twice as great (4) four times as great

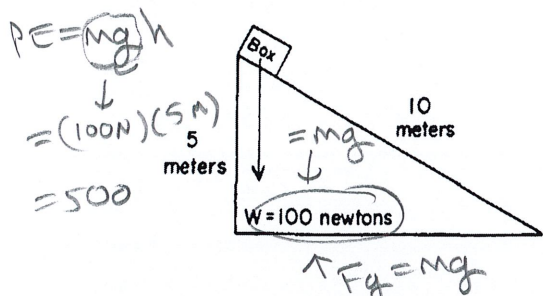
8. A ball is thrown upward from the Earth's surface. While the ball is rising, its gravitational potential energy will

- (1) decrease (3) remain the same
(2) increase

$$PE = mgh$$

9. Base your answer to the following question on the information and diagram below:

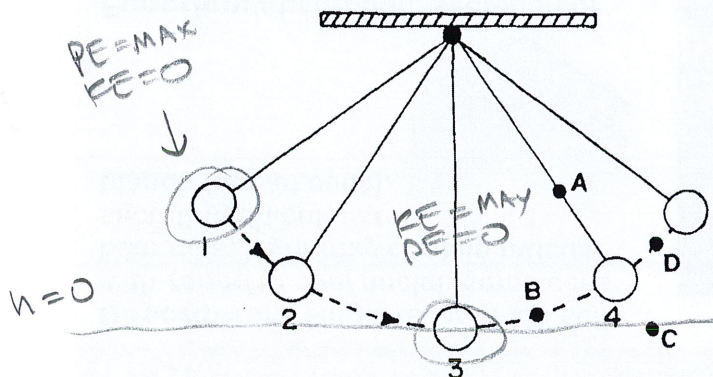
An inclined plane is 10 meters long and is elevated 5 meters on one end as shown. Starting from rest at the top of the incline, a box weighing 100 Newtons accelerates down the incline at a rate of 2.5 meters per second².



The potential energy of the box at the top of the incline was approximately

- (1) 1,000 J (3) 50 J
~~(2) 500 J~~ (4) 0 J

10. Base your answer to the following question on the diagram below which represents a simple pendulum with a 2.0-kilogram bob and a length of 10. meters. The pendulum is released from rest at position 1 and swings without friction through position 4. At position 3, its lowest point, the speed of the bob is 6.0 meters per second.

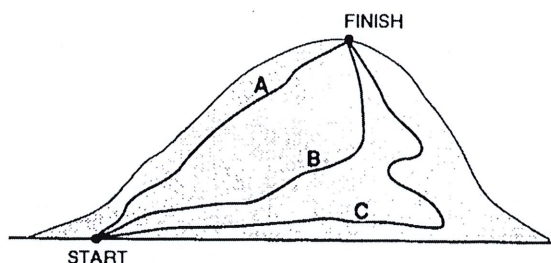


What is the potential energy of the bob at position 1 in relation to position 3?

- (1) 18 J (3) 72 J
~~(2) 36 J~~ (4) 180 J

Handwritten calculation:
 $KE_1 + PE_1 = KE_3 + PE_3$
 $0 + PE_1 = \frac{1}{2}(2)(6)^2 + 0$
 $PE_1 = \frac{1}{2}(2)(6)^2$
 $= 36$

11. Three people of equal mass climb a mountain using paths A, B, and C shown in the diagram below.



Along which path(s) does a person gain the greatest amount of gravitational potential energy from start to finish?

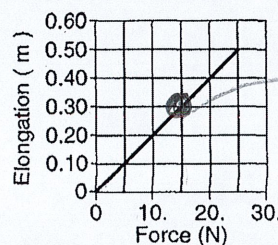
- (1) A, only
 (2) B, only
 (3) C, only
~~(4) The gain is the same along all paths.~~

Handwritten note:
 $PE = mgh$

Handwritten note:
 SAME NO MATTER WHAT PATH

12. The graph below shows the relationship between the elongation of a spring and the force applied to the spring causing it to stretch.

Elongation vs. Applied Force



Handwritten notes:
 $F_s = kx$
 $15 = k(3)$

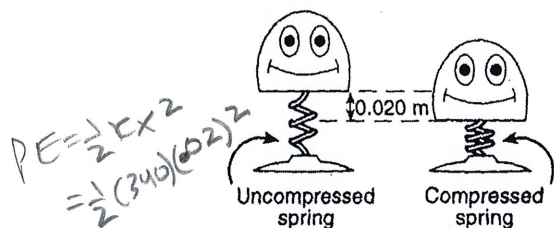
What is the spring constant for this spring?

- (1) 0.020 N/m (3) 25 N/m
 (2) 2.0 N/m ~~(4) 50. N/m~~

13. A catapult with a spring constant of 1.0×10^4 newtons per meter is required to launch an airplane from the deck of an aircraft carrier. The plane is released when it has been displaced 0.50 meter from its equilibrium position by the catapult. The energy acquired by the airplane from the catapult during takeoff is approximately
- ~~(1) 1.3×10^3 J~~ (3) 2.5×10^3 J
 (2) 2.0×10^4 J (4) 1.0×10^4 J

Handwritten calculation:
 $PE = \frac{1}{2}kx^2 = \frac{1}{2}(1 \times 10^4)(0.5)^2$

14. In the diagram below, a student compresses the spring in a pop-up toy 0.020 meter.



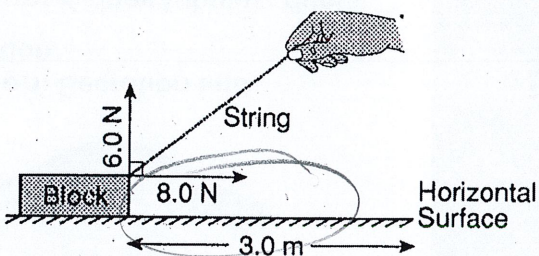
If the spring has a spring constant of 340 newtons per meter, how much energy is being stored in the spring?

- (1) 0.068 J (3) 3.4 J
(2) 0.14 J (4) 6.8 J

15. A cart weighing 20 Newtons is pushed 10 meters on a level surface by a force of 5 Newtons. How much work was done on the cart?

- (1) 15 J (3) 100 J
(2) 50 J (4) 200 J

16. A student pulls a block 3.0 meters along a horizontal surface at constant velocity. The diagram below shows the components of the force exerted on the block by the student.



How much work is done against friction?

- (1) 18 J (3) 30. J
(2) 24 J (4) 42 J

$$W = F_{\parallel} d = (8N)(3m)$$

17. A force of 70 Newtons must be exerted to keep a car moving with a constant speed of 10 meters per second. What is the rate at which energy must be supplied?

- (1) 1/7 W
(2) 7.0 W

$$P = Fv = (70)(10) = 700 \text{ W}$$

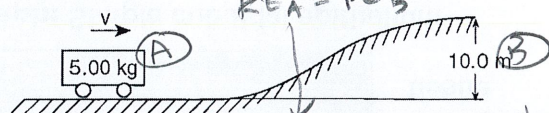
18. A 10.-newton force is required to move a 3.0-kilogram box at constant speed. How much power is required to move the box 8.0 meters in 2.0 seconds?

- (1) 40. W
(2) 20. W

- (3) 15 W
(4) 12 W

$$P = \frac{Fd}{t} = \frac{(10)(8)}{2}$$

19. The diagram below shows a moving, 5.00-kilogram cart at the foot of a hill 10.0 meters high. For the cart to reach the top of the hill, what is the minimum kinetic energy of the cart in the position shown? [Neglect energy loss due to friction.]



- (1) 4.91 J
(2) 50.0 J

- (3) 250. J
(4) 491 J

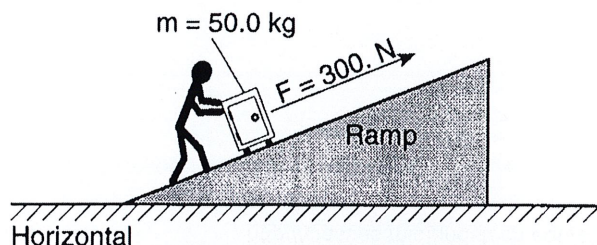
20. A girl rides an escalator that moves her upward at constant speed. As the girl rises, how do her gravitational potential energy and kinetic energy change?

- (1) Gravitational potential energy decreases and kinetic energy decreases.
(2) Gravitational potential energy decreases and kinetic energy remains the same.
(3) Gravitational potential energy increases and kinetic energy decreases.
(4) Gravitational potential energy increases and kinetic energy remains the same.

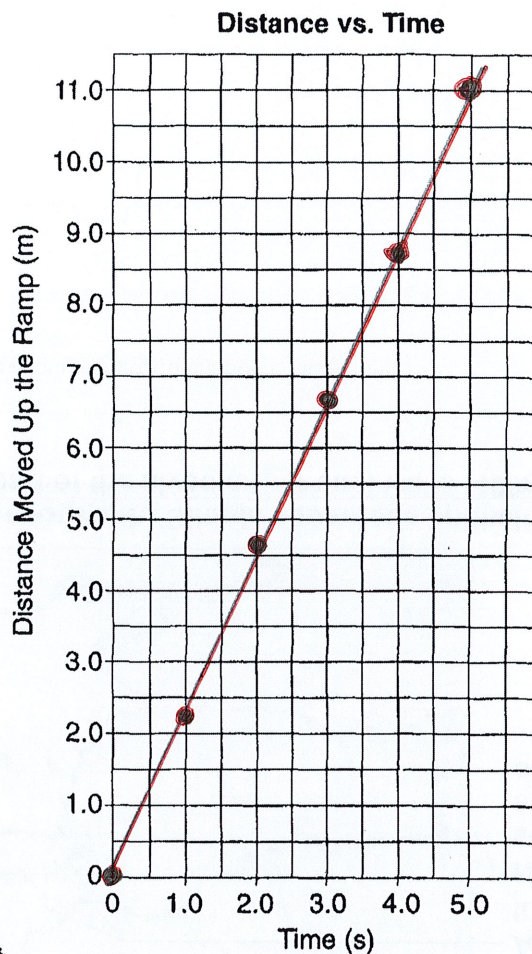
↑ h & v const.
∴ PE ↑ KE const.

Base your answers to questions 21 through 23 on the diagram and data table below.

The diagram shows a worker moving a 50.0 kilogram safe up a ramp by applying a constant force of 300. Newtons parallel to the ramp. The data table shows the position of the safe as a function of time.



| Time (s) | Distance Moved up the Ramp (m) |
|----------|--------------------------------|
| 0.0 | 0.0 |
| 1.0 | 2.2 |
| 2.0 | 4.6 |
| 3.0 | 6.6 |
| 4.0 | 8.6 |
| 5.0 | 11.0 |



USE NEXT PAGE

($K = 8,000 \text{ N/m}$)

26. A 0.500 kg SPRING LOADED TOY IS COMPRESSED 0.05 m AND FIRED ON A FLAT SURFACE. FIND SPEED IT IS RELEASED WITH. (3) IF IT APPROACHES A HILL, FIND THE MAX. HEIGHT IT CAN CLIMB

21. Using the information in the data table, construct a line graph on the grid. Then draw data points and draw the best-fit line.

22. Using one or more complete sentences, explain the physical significance of the slope of the graph.

THE SLOPE REPRESENTS THE AVERAGE SPEED/VELOCITY. (SLOPE = $\frac{\Delta y}{\Delta x} = \frac{d}{t} = v$)

23. Calculate the work done by the worker in the first 3.0 seconds. [Show all calculations, including the equation and substitution with units.]

24. A 200 kg OBJECT MOVING AT 10 m/s AT A HEIGHT OF 20 m, FALLS TO A NEW HEIGHT OF 5 m. FIND ITS NEW SPEED

25. A 60 N FORCE ACTS AT AN ANGLE OF 25° OVER A DISTANCE OF 10 m IN A TIME OF 20 s. FIND THE POWER USED BY THE OBJECT.

$$23.) W = Fd$$

$$= (300\text{N})(6.6\text{m})$$

$$\boxed{W = 1980\text{J}}$$

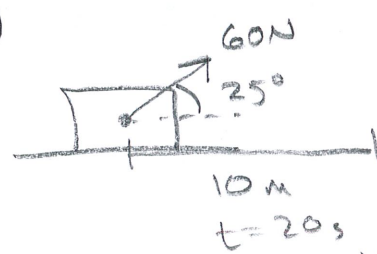
$$24.) KE_A + PE_A = KE_B + PE_B$$

$$\downarrow \quad \downarrow \quad \downarrow \quad \downarrow$$

$$\frac{1}{2}mV_A^2 + mgh_A = \frac{1}{2}mV_B^2 + mgh_B$$

$$\frac{1}{2}(10\text{m/s})^2 + (9.81\frac{\text{m}}{\text{s}^2})(20\text{m}) = \frac{1}{2}(V_B)^2 + (9.81\frac{\text{m}}{\text{s}^2})(5\text{m})$$

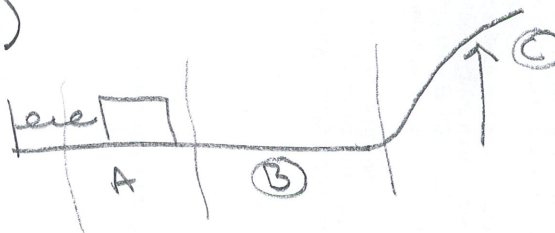
$$\boxed{V_B = 19.9\text{m/s}}$$

$$25.)$$


$$P = \frac{W}{t} = \frac{F \cos \theta}{t} = \frac{(60\text{N}) \cos 25^\circ (10\text{m})}{20\text{s}}$$

$$\boxed{P = 27.2\text{W}}$$

$$W = F_{\parallel} d = F \cos \theta d$$

$$26.)$$


$$A) KE_A + PE_A = KE_B + PE_B$$

$$\downarrow$$

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

$$(8,000\text{N/m})(0.05\text{m})^2 = (0.500\text{kg})V_B^2$$

$$\boxed{V_B = 6.32\text{m/s}}$$

$$B) KE_B + PE_B = KE_C + PE_C$$

$$\frac{1}{2}mV_B^2 = mgh_C$$

$$\frac{1}{2}(6.32\text{m/s})^2 = (9.81\text{m/s}^2)h_C$$

$$\boxed{h_C = 2.04\text{m}}$$