PHYSICS

BOOKS - PRINCETON PHYSICS (ENGLISH)

WORK, ENERGY, AND POWER

Example

1. You slowly lift a book of mass 2 kg at constant velocity a distance of 3m. How much

work did you do on the book?

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2. A 30 kg crate is moved along a horizontal floor by a warehouse worker who's pulling on it with a rope that makes a 60° angle with the horizontal. The tension in the rope is 200 N and the crate slides a distance of 10 m. how much work is done on the crate by the worker?

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3. A box slides down an inclined plane (incline angle $= 40^\circ$). The mass of the block, m, is 40 kg, the coefficient of kinetic friction between the box and the ramp, μ_k, is 0.3, and the length of the ramp, d, is 10m. (Use: $\sin 40^\circ = 0.6$ and $\cos 40^\circ = 0.8$).

Q. how much work is done by gravity?

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Q. How much work is done by the normal force?

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Q. How much work is done by friction?

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Q. What is the total work done?

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7. The force exerted by a spring when it's displaced by x from its natural length is given by the equation $F(x) = -kx$, where k is a positive constant. What is the work done by a spring as it pushes out from $x = -x_2$ to $x = -x_1$ (where $x_2 > x_1$)?

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8. What is the kinetic energy of a baseball (mass=0.15kg) moving with a speed of 20 m/s?

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9. How much work would it take to stop an object that has 30 J of kinetic energy?

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10. An object starting from rest has two forces acting on it: one performing 40 J of work and the other (friction) performing -20J. What is the final kinetic energy of this object?

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11. A pool cue striking a stationary billiard ball (mass=0.25kg) gives the ball a speed of 2 m/s. If the force of the cue on the ball was 25N, over what distance did this force act?

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12. A stuntwoman (mass=60kg) scales a 20-meter-tall rock face. What is her gravitational potential energy (relative to the ground)?

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13. A ball of mass 2 kg is gently pushed off the edge of a tabletop that is 1.8 m above the floor. Find the speed of the ball as it strikes the floor.

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14. A box is projected up a long ramp (incline angle with the horizontal=30°) with an initial speed of 8m/s. if the surface of the ramp is

very smooth (essentially frictionless), how high up the ramp will the box go? What distance along the ramp will it slide?

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15. Wile E. Coyote (mass=40 kg) falls off a 50-meter-high cliff. On the way down, the force of air resistance has an average strength of 40 N. find the speed with which he crashes into the ground.

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16. Find an expression for the minimum speed at which an object of mass m must be launched in order to escape Earth's gravitational field. (this is called escape speed).

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17. A mover pushes a large crate (mass m=75 kg) from the inside of the truck to the back end (a distance of 6 m), exerting a steady push of 300 N. if he moves the crate this distance in

20 s, what is his power output during this time?

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Comprehensive Drill

1. A vertical force F of strength 20 N acts on an object of mass 3 kg as it moves a horizontal distance of 4 m. the work done by the vertical force is equal to

A. 0J

B. 60J

C. 80J

D. 600J

Answer: A

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2. Under the influence of a force, an object of mass 4 kg accelerates from 3 m/s to 6 m/s in

8s. How much work was done on the object during this time?

A. 27J

B. 54J

C. 72J

D. 96J

Answer: B

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3. A box of mass m slides down a frictionless inclined plane of length L and vertical height h. what is the change in its gravitational potential energy?

A. $-mgL$

B. $-mgh$

C. $-mgL/h$

D. $-mgh/L$

Answer: B

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4. While a person lifts a book of mass 2 kg from the floor to a tabletop, 1.5 m above the floor, how much work does the gravitational force do on the booK?

A. $-30J$

B. $-15J$

C. 0J

D. 15J

Answer: A

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5. A block mass 3 kg slides down a frictionless inclined plane of length 6 m and height 4 m. if the block is released from rest at the top of the incline, what is its speed at the bottom?

A. 5m/s

B. 6m/s

C. 8m/s

D. 9m/s

Answer: D

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6. A block of mass 3 kg slides down an inclined plane of length 6 m and height 4 m. if the force of friction on the block is a constant 16 N as it slides from rest at the top of the incline, what is its speed at the bottom?

A. 2m/s

B. 3m/s

C. 4m/s

D. 5m/s

Answer: C

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7. As a rock of mass 4 kg drops from the edge of a 40-meter-high cliff, it experiences air resistance, whose average strength during the

descent is 20 N. at what speed will the rock hit the ground?

A. 8m/s

B. 10m/s

C. 12m/s

D. 20m/s

Answer: D

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8. An astronaut drops a rock from the top of a crater on the moon. When the rock is halfway down to the bottom of the crater, its speed is what fraction of its final impact speed?

A. $\frac{1}{4\sqrt{2}}$

B. $\frac{1}{4}$

C. $\frac{1}{2\sqrt{2}}$

D. $\frac{1}{\sqrt{2}}$

Answer: D

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9. A force of 200N is required to keep an object sliding at a constant speed of 2 m/s across a rough floor. How much power is being expended to maintain this motion?

A. 50W

B. 100W

C. 200W

D. 400W

Answer: D

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10. The moon has mass M and radius R. A small object is dropped from a distance of 3R from the moon's center. The object's impact speed when it strikes the surface of the moon is equal to $\sqrt{kGM/R}$ for k=

A. $\frac{1}{3}$

B. $\frac{2}{3}$

C. $\frac{3}{4}$

D. $\frac{4}{3}$

Answer: D

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