PHYS 1050 Tutorial 2

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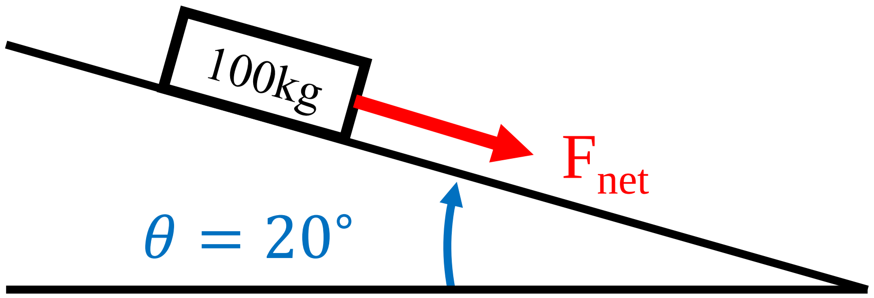


1. A 100 kg piano rolls down a 20° incline from rest. A man tries to keep it from accelerating, but only manages to keep its acceleration to 1.2 m/s^2. If the piano rolls 5 m, what is the net work done on it by all the forces acting on it?
   A) 60 J
   B) 100 J
   C) $\boxed{\text{600 J}}$
   D) 1000 J
   E) 4900 J

$$v_f^2 - v_i^2 = 2ax$$

$$v = \sqrt{2 \times 1.2m/s^2 \times 5m} = 12m/s$$

$$W = \Delta K = \frac{1}{2}m(v_f^2 - v_i^2)$$

$$W = \frac{1}{2} \times 100kg \times (12m/s)^2$$

2. An 8-N block slides down an incline. It has an initial speed of 7 m/s. The work done by the resultant force on this block is:

A) 20 J

B) 28 J

C) 56 J

D) impossible to calculate without more information

E) none of these

Work = Initial - Final

Initial state ✓

Final state ✗

3. When a certain rubber band is stretched a distance x, it exerts a restoring force $F = ax + bx^2$, where a and b are constants. The work done in stretching this rubber band from $x = 0$ to $x = L$ is:

A) $aL^2 + bLx^3$

B) $aL + 2bL^2$

C) $a + 2bL$

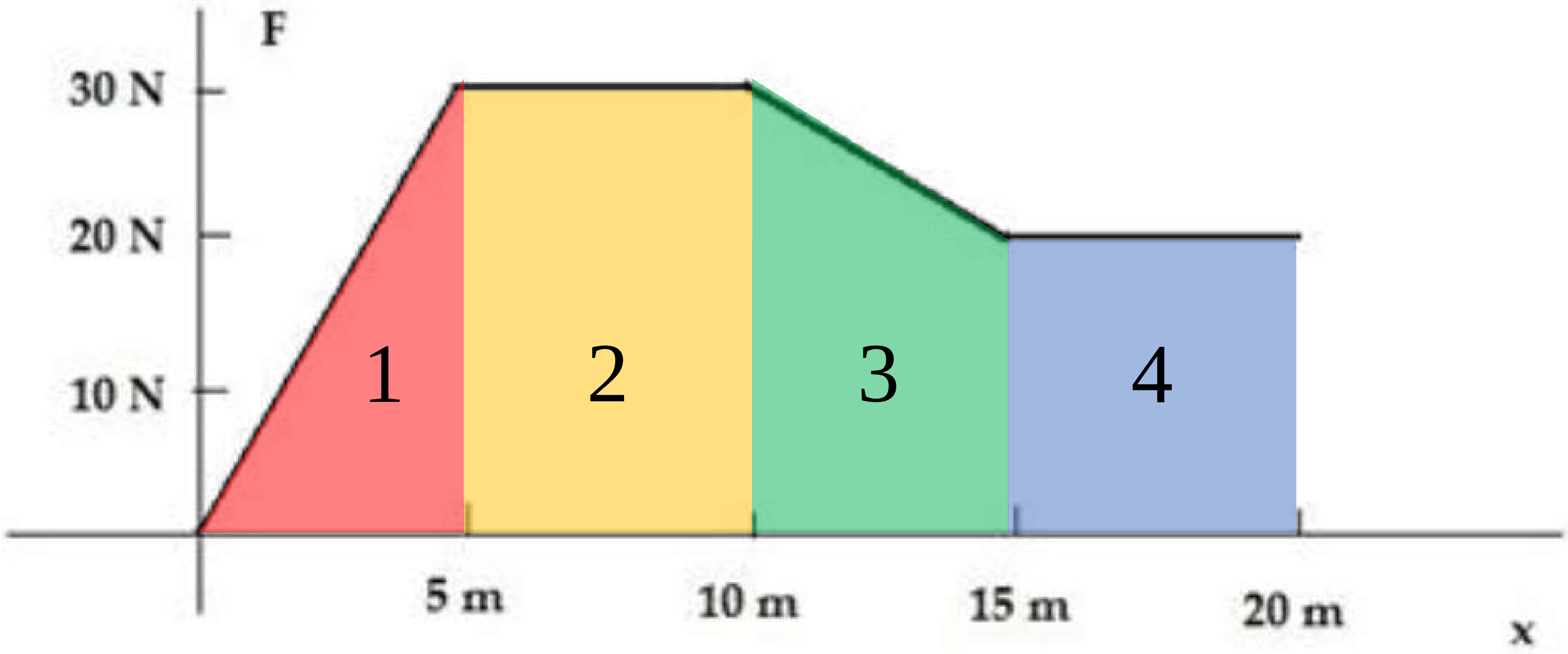
D) bL

E) $\boxed{aL^2/2 + bL^3/3}$

$$W = \int F\, dx = \int_0^L ax + bx^2 \; dx$$

$$\left(\frac{1}{2}ax^2 + \frac{1}{3}bx^3\right)\Big|_0^L = (E)$$

4. The plot shows the force on an object as it moves from $x = 0$ m to $x = 20$ m. How much work is done on the object?



A) 40 J
B) 90 J
C) 200 J
D) 450 J
E) 750 J

$$W = \int F\,dx = area\ of\ F$$

$$W = S_1 + S_3 + S_3 + S_4$$
$$= 50 + 150 + 125 + 100 = 450(J)$$

5. A 50-N force acts on a 2 kg crate that starts from rest. When the force has been acting for 2 s the rate at which it is doing work is:

A) 100 W

B) 1000 W

C) 2500 W

D) 5000 W

E) 63000 W

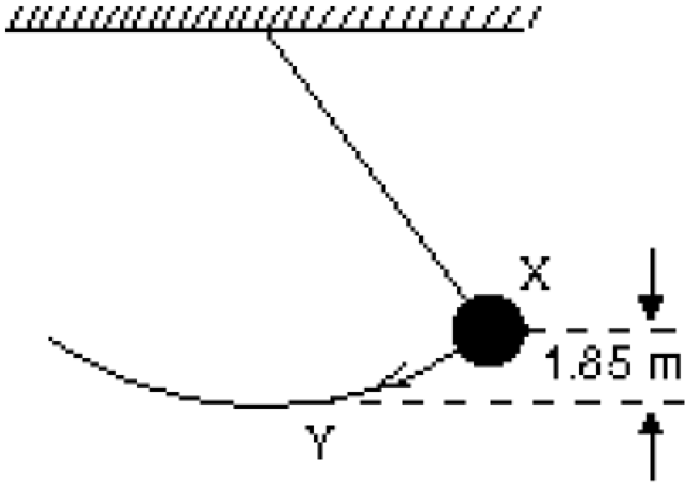
$$P = Fv$$

$$v = at = \frac{F}{m}t = 50m/s$$

$$P = 50N \times 50m/s$$

6. A force on a particle is conservative if:
   A) its work equals the change in the kinetic energy of the particle
   B) it obeys Newton's second law
   C) it obeys Newton's third law
   D) its work depends on the end points of the motion, not the path connecting them
   E) it is not a frictional force

7. 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:



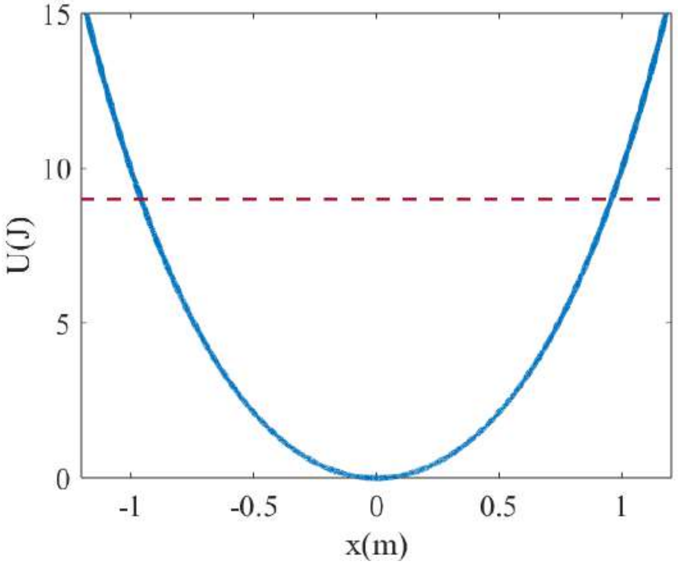
A) 1.9 m/s
B) 3.7 m/s
C) 4.4 m/s
D) 6.0 m/s
E) 36 m/s

$$\frac{1}{2}mv^2 = mg\Delta H$$

$$v = \sqrt{2g\Delta H} = \sqrt{2 \times 9.8m/s^2 \times 1.85m}$$

$$\approx 6.02m/s$$

8. The potential energy of a particle moving alon



$$U(x) = (8.0\ \text{J/m}^2)x^2 + (2.0\ \text{J/m}^4)x^4.$$

If the total mechanical energy is 9.0 J, the limits of motion are:

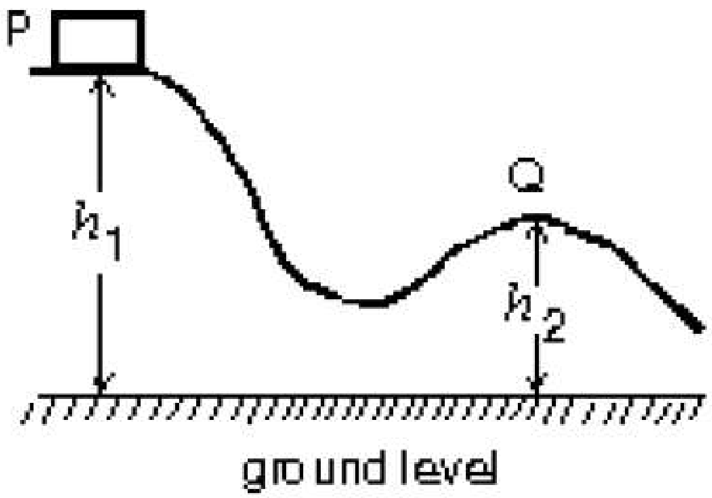
A) –0.96 m; +0.96 m
B) –2.2 m; +2.2 m
C) –1.6 m; +1.6 m
D) –0.96 m; +2.2 m
E) –0.96 m; +1.6 m

Let $t = x^2$
So we have
$U(t) = 8t + 2t^2 = 9$

$t_1 = 0.915;$
$t_2 = -4.915$ (physically no meaning)

$$x = \pm\sqrt{0.915} = \pm 0.956m$$

9. A block is released from rest at point P and slides along the frictionless track shown. At point Q, its speed is:



A) $2g\sqrt{h_1 - h_2}$

B) $2g(h_1 - h_2)$

C) $(h_1 - h_2)/2g$

D) $\boxed{\sqrt{2g(h_1 - h_2)}}$

E) $(h_1 - h_2)^2/2g$

$$\frac{1}{2}mv^2 = mg(h_1 - h_2)$$

$$v^2 = 2g(h_1 - h_2)$$

$$v = \sqrt{2g(h_1 - h_2)}$$