Answers

CHAP. 5: WORK AND POWER.

$W_{INERTIA} = F \times s$, OR AREA OF A F-s GRAPH.

$W_{INERTIA} = F \times s \times \cos\theta$, WHEN $\vec{F}$ APPLIED WITH ANGLE θ FROM HORIZONTAL

$W_{FRICTION} = F_f \times s = \mu \times m \times g \times s$.

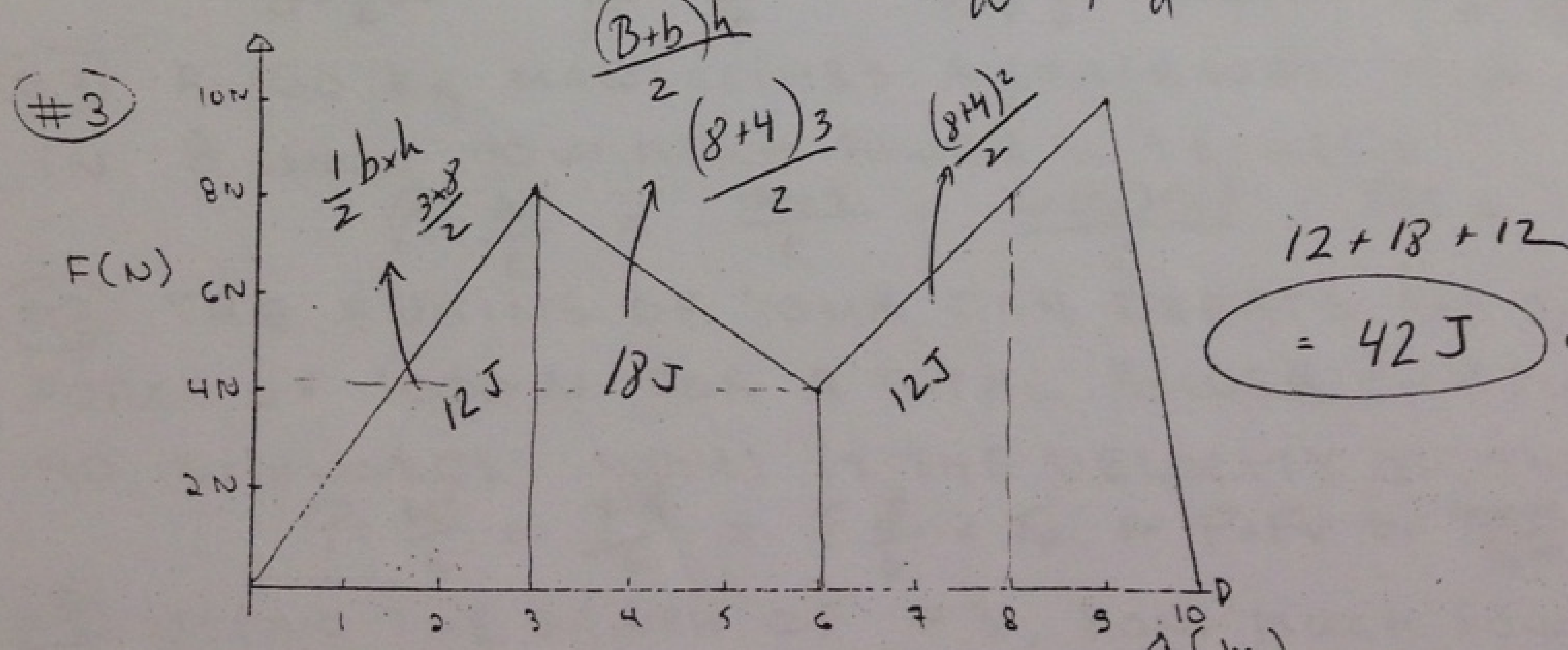
$W_{GRAVITY} = m \times g \times h$, ($Power = F \cdot v$)

$Power = \frac{Work}{t}$; W in Joules, P in Watts.

(#1) HOW MUCH WORK IS DONE IF YOU HAVE TO PUSH WITH A FORCE OF 200N, AN OBJECT OF 10 Kg OVER A DISTANCE OF 5 m? $W = Fd = 200(5) = 1000$ Joules

(#2) HOW FAR COULD YOU MOVE AN OBJECT IF YOU COULD PUSH IT WITH A FORCE OF 80N FOR A TOTAL WORK OF 4×10^2 Joules? $400 = 80(d)$ (W F d) $d = \frac{400}{80} = 5m$

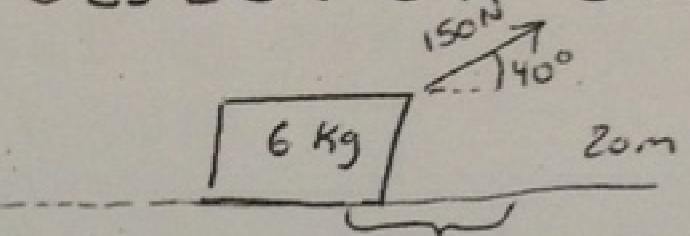
(#3)



12 + 18 + 12 = 42 J.

a) HOW MUCH WORK TO MOVE THAT OBJECT 8 m?

(#4) WITH AN ANGLE OF 40°, YOU PULL, ON A DISTANCE OF 20 m, AN OBJECT OF 6 Kg WITH A FORCE OF 150 N.



$(150 \cos 40)(20)$
$= 2298\ J$

a) HOW MUCH WORK IS DONE AGAINST INERTIA?

b) IF THERE IS A COEFFICIENT OF FRICTION OF 0,35, HOW MUCH WORK IS DONE AGAINST FRICTION.

$F_{Fr} = \mu F_n$ $\quad F_n = F_G - F_{appy} = (6 \times 9.8) - 150 \sin 40 = -37.6\ N$ object flys up!

no work!!

(#5) HOW MUCH WORK AGAINST GRAVITY IS DONE IF YOU CLIMB A STAIRWAY WITH A VERTICAL HEIGHT OF 6 m, KNOWING YOUR MASS IS 50 kg? $mgh = 50(9.8)(6) = 2940\ J$

(#6) A 0,4 kg MASS IS ACCELERATED AT A RATE OF 5 m/s² OVER A DISTANCE OF 20 m, FROM REST.

a) HOW MUCH WORK IS DONE? (REMEMBER $F = m \cdot a$.)

$F = 0.4(5) = 2$ $\quad W = Fd = 2(20) = 40\ J$

b) HOW MUCH POWER? (FIND t FIRST!)

$d = \frac{1}{2}at^2$ $\quad 20 = \frac{5}{2}t^2$ $\quad t = \sqrt{\frac{40}{5}} = 2.83\ sec$ $\quad P = \frac{W}{t} = \frac{40}{2.83} = 14.14\ W$

(#7) A 60 kg MAN CLIMBS A STAIRWAY 10 m HIGH IN 8 sec. HOW MUCH POWER WAS USED?

$P = \frac{W}{t} = \frac{mgh}{t} = \frac{60(9.8)(10)}{8} = 735\ w$

(#8) THE ENGINE OF YOUR CAR EXERTS AN AVERAGE FORCE OF 1600 N FOR A TOTAL POWER OUTPUT OF 40 kilowatts. WHAT IS THE VELOCITY OF THE CAR?

$P = \frac{W}{t} = \frac{Fd}{t} = F\frac{d}{t} = Fv$ so $P = Fv$ $\quad v = \frac{40000}{1600} = 25\ m/s$

(#9) USING THE GRAPH OF #3, HOW MUCH POWER IF IT TAKES YOU 12 sec TO COVER THE 6 FIRST METERS?

From graph = 12 J + 18 J for 6 m so. W = 30 J $\quad$ so $P = \frac{W}{t} = \frac{30}{12} = 2.5\ W$

CHAP. 6: POTENTIAL ENERGY.

$E_p = mgh$ OR $E_p = \frac{kx^2}{2}$ WHERE $k = \frac{F}{x}$.

$\Delta E_p = E_{p\,FINAL} - E_{p\,INITIAL}$

#1 WHAT IS THE POTENTIAL ENERGY OF A ROCK RESTING ON A TOP OF A MOUNTAIN 200 m HIGH, IF THE MASS OF THE ~~ROCK IS~~ 40 Kg? $PE = mgh$

$40(9.8)200$

$= 78400\,J$

#2 4.2×10^3 joules WERE USED TO LIFT AN OBJECT 6 m HIGH. WHAT IS THE MASS OF THAT OBJECT? $PE = mgh$ $m = \frac{PE}{gh} = \frac{4200}{9.8(6)} = 71.4\,Kg$

#3 A SPRING HAS A SPRING CONSTANT OF 50 N/m. WHAT IS THE CHANGE IN POTENTIAL ENERGY IF IT IS STRETCHED FROM 40 cm TO 60 cm?

$\Delta PE = PE_2 - PE_1 = \frac{1}{2}kx_2^2 - \frac{1}{2}kx_1^2 = \frac{1}{2}k(x_2^2 - x_1^2) = \frac{1}{2}(50)((0.6m)^2 - (0.4)^2) = 5J$

#4 500 joules OF ENERGY IS STORED IN A SPRING WHICH HAS A CONSTANT OF 125 N/m. WHAT IS THE EXTENSION? $PE = \frac{1}{2}kx^2$ $500 = \frac{1}{2}125x^2$

$x^2 = \frac{1000}{125} =$ $x = 2.83\,m$

#5 A FORCE OF 200 N WAS USED TO COMPRESS A SPRING 20 cm. HOW MUCH POTENTIAL ENERGY IS NOW STORED IN THE SPRING?

FIND K *first!* $F = Kx$ $K = \frac{F}{x} = \frac{200\,N}{0.2\,m} = 1000\,\frac{N}{m}$

so $PE = \frac{1}{2}Kx^2 = \frac{1}{2}1000(0.2)^2 = 20\,J$

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

$= \frac{1}{2}(0.2)(25)^2$

$= 62.5\ J$

2.) $v = \sqrt{\frac{2KE}{m}}$

$= \sqrt{\frac{2(4.5\times10^5)}{1000}}$

$v = 30\ m/s$

3A.) $W = F \cdot d$

$= 180 \times 20$

$= 3600\ J$

B.) $m = \frac{2KE}{v^2} = \frac{2(3600)}{20^2}$

$m = 18\ kg$

4.) $PE = mgh$

$= 1 \times 9.8 \times 10$

$= 98\ J$

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

$\sqrt{\frac{(TE - mgh)2}{m}} = v$

$\sqrt{\frac{(98 - (1)(9.8)(2))2}{1}} = v$

12.5

$v = 4.8326\ m/s$

CHAP. 7 : (page 2)

#5 A MASS OF 10 Kg IS COMPRESSED ON A SPRING WITH $k = 100 N/m$. IF THE COMPRESSION IS 0.2 m, AND THE SPRING IS RELEASED, FIND:

a) THE POTENTIAL ENERGY BEFORE THE SPRING WAS RELEASED. $PE = \frac{1}{2} k x^2 = \frac{1}{2} 100 (0.2)^2 = $ 2 Joules

b) THE KINETIC ENERGY THAT THE MASS POSSESSES WHEN THE SPRING IS COMPLETELY RELEASED.

All PE turns into $KE = 2 J$.

c) WHAT IS THE VELOCITY OF THE OBJECT AT THE END OF THE RELEASE? $KE = \frac{1}{2} m v^2$

$2 = \frac{1}{2} 10 v^2$ so $V = 0.633 m/s$

#6 A 5×10^4 kg PLANE IS FLYING AT AN ALTITUDE OF 2000 m WITH A VELOCITY OF 100 m/s.

$TE = 50\,000 (9.8)(2000) + \frac{1}{2} 50\,000 (100)^2$

a) WHAT IS THE TOTAL AMOUNT OF ENERGY THAT THE PLANE POSSESSES? 1230000000 J !!

$1.23 \times 10^9 J$

b) IF THE PLANE DROPS TO AN ALTITUDE OF 1000 m. WHAT ARE THE NEW AMOUNTS OF POTENTIAL ENERGY AND KINETIC ENERGY?

$1000 m \rightarrow PE = 50000 (9.8) 1000 = 4.9 \times 10^8 J$ $KE = TE - PE = 1.23 \times 10^9 - 4.9 \times 10^8 = 7.4 \times 10^8 J$

c) WHAT IS THE NEW INCREASED VELOCITY?

$7.4 \times 10^8 J = \frac{1}{2} 50000 v^2$ $= \sqrt{2.96 \times 10^4}$

$= 172.1 m/s$