HW 2

WcΔKE

1. 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:

   a) 160 J   b) 90 J   c) 40 J   d) 400 J

2. A car is traveling at 15m/s on a horizontal road. The brakes are applied and the car needs 4.0s to stop. The coefficient of kinetic friction between the tires and road is: $a = \frac{-15}{4}$ $-F_k = ma$
   $-\mu mg = ma$

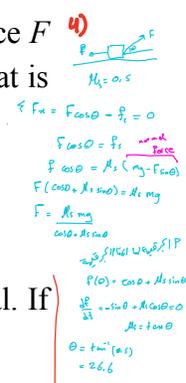   a) 0.38   b) 0.69   c) 0.76   d) 0.92 $\mu = -\frac{a}{g} = -\frac{15}{4(10)} = \frac{15}{40} \approx 0.38$

3. A 6.0-kg block is released from rest 80m above the ground. When it has fallen 60m its kinetic energy is:

   a) 4000 J   b) 3600 J   c) 1200 J   d) 120 J

4. The coefficient of static friction between a block of mass 0.8 kg and a horizontal surface is 0.5. A force F is applied to the block at an angle θ above the horizontal to set it on the verge (شفا) of slipping. What is the value of θ at which F is a minimum? $\tan\theta = \mu_s \rightarrow \theta = \tan^{-1}(\mu_s)$
   $= 26.6$

   (a) 22.5°   (b) 30°   (c) 60°   (d) 11.4°   (e) 26.6°

   معادلة الاحتكاك اذا الكتلة

   $\mu_s = 0.5$
   $\sum F_x = F\cos\theta - f_s = 0$
   $F\cos\theta = f_s$
   $F\cos\theta = \mu_s(mg - F\sin\theta)$
   $F(\cos\theta + \mu_s\sin\theta) = \mu_s mg$
   $F = \frac{\mu_s mg}{\cos\theta + \mu_s\sin\theta}$

   $\frac{dF}{d\theta} = \frac{-\mu_s mg(-\sin\theta + \mu_s\cos\theta)}{...}$
   $\mu_s = \tan\theta$
   $\theta = \tan^{-1}(\mu_s)$
   $= 26.6$

5. The Si unit of torques is

   (a) N. m   (b) N.m^2 (c) N.m/s   (d) N.s

6. A man moves a box horizontally by exerting on it a force of 90 N directed at 60° above the horizontal. If the work done on the box is 450 J, the displacement of the box is $W = Fd\cos\theta$ $450 = 90(d)\cos(60)$ $d = 10$

   a) 20 m   b) 10 m   c) 5 m   d) 15 m

7. A 1200-kg car accelerates uniformly from rest to a speed of 8 m/s in 4 s. The average power delivered by the engine in this time interval is $v_i = 0$ v_f

   $P = \frac{w}{t} = \frac{\Delta KE}{t} = \frac{\frac{1}{2}(1200)(8)^2}{4}$
   $= 4600 w$
   $P = 9.6 \text{ Kw}$

   a) 9.6 KW   b) 2.4 KW   c) 7.2 KW   d) 4.8 KW

8. A box with an initial speed of 15 m/s slides along a surface where the coefficient of sliding friction is 0.45. How long does it take for the block to come to rest? $v_f = 0$
   $-f = ma$
   $-\mu mg = \mu a$
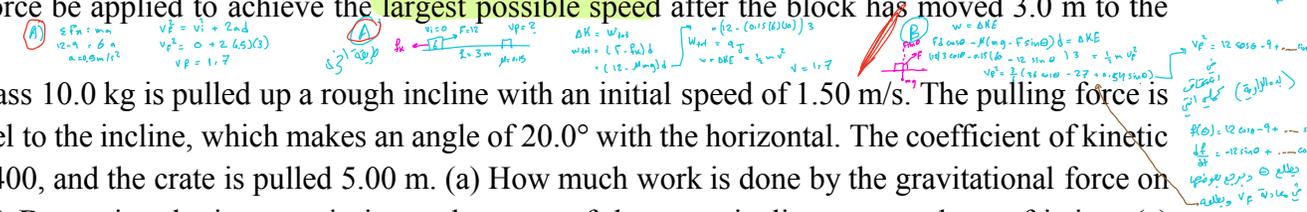
   a) 1.5 s   b) 3.3 s   c) 6.8 s   d) 8.5 s

   $a = -\mu g = -0.45(10) = -4.5$
   $v_f = v_i + at$
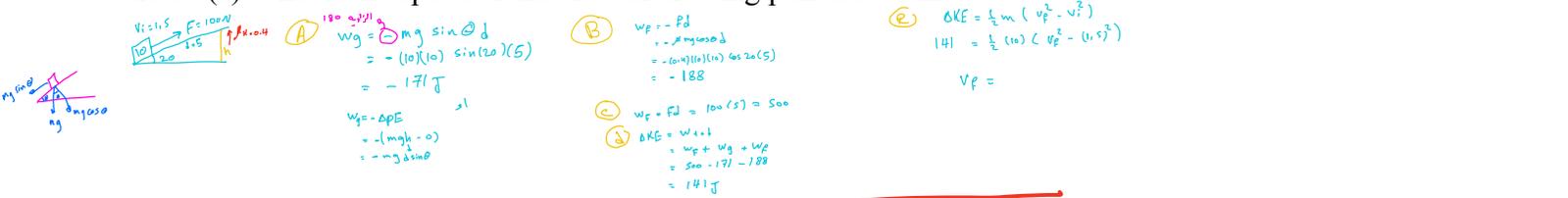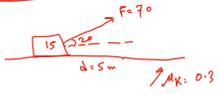 $0 = 15 - 4.5t$
   $t = 3.3 s$

9. A 6.0-kg block initially at rest is pulled to the right along a horizontal surface by a constant horizontal force of 12 N. **(A)** Find the speed of the block after it has moved 3.0 m if the surfaces in contact have a coefficient of kinetic friction of 0.15. (This is Example 7.7, modified so that the surface is no longer frictionless.) **(B)** Suppose the force F is applied at an angle ! as shown in Figure 7.18b. At what angle should the force be applied to achieve the largest possible speed after the block has moved 3.0 m to the right? $m = 6 kg$ $v_i = 0$ $F = 12 / d = 3$ $\mu_k = 0.15$

   (A) $\sum F_x = ma$
   $12 - 9 = 6a$
   $a = 0.5 m/s^2$
   $v_f^2 = v_i^2 + 2ad$
   $v_f^2 = 0 + 2(0.5)(3)$
   $v_f = 1.7$

   (A) $v_i = 0, F = 12$ $v_f = ?$ $f_k = ...$ $d = 3 m$ $\mu = 0.15$
   $\Delta K = W_{net}$
   $W_{net} = (5 - f_k)d$
   $\frac{1}{2}mv_f^2$
   $= (12 - \mu mg)d$

   $\int W_{net} = (12 - (0.15)(6)(10))3$
   $W_{net} = \frac{1}{2}mv^2$
   $W_{net} = \frac{1}{2}mv^2$
   $v = 1.7$

   (B) $W = \Delta KE$
   $Fd\cos\theta - \mu(mg - F\sin\theta)d = \Delta KE$
   $(12)3\cos\theta - 0.15(6 - 12\sin\theta)3 = \frac{1}{2}mv_f^2$
   $v_f^2 = \frac{2}{6}(36\cos\theta - 27 + 0.15(54\sin\theta))$

   $v_f^2 = 12\cos\theta - 9 + ... \sin\theta$
   $\frac{d(...)}{d\theta}$
   $f(\theta) = 12\cos\theta - 9 + ... $
   $\frac{df}{d\theta} = -12\sin\theta + ...\cos\theta$
   يطلع بعد الاشتقاق θ يساوي صفر
   عشان كذا نحسب v_f لكل زاوية

10. A crate of mass 10.0 kg is pulled up a rough incline with an initial speed of 1.50 m/s. The pulling force is 100 N parallel to the incline, which makes an angle of 20.0° with the horizontal. The coefficient of kinetic friction is 0.400, and the crate is pulled 5.00 m. (a) How much work is done by the gravitational force on the crate? (b) Determine the increase in internal energy of the crate–incline system due to friction. (c) How much work is done by the 100-N force on the crate? (d) What is the change in kinetic energy of the crate? (e) What is the speed of the crate after being pulled 5.00 m?

    $v_i = 1.5$ $F = 100N$ $\mu_k = 0.4$ زاوية $180°$

    (A) $W_g = -mg\sin\theta d$
    $= -(10)(10)\sin(20)(5)$
    $= -171 J$

    $W_g = -\Delta PE$
    $= -(mgh - 0)$
    $= -mg d\sin\theta$

    (B) $W_f = -fd$
    $= -\mu mg\cos\theta d$
    $= -(0.4)(10)(10)\cos 20(5)$
    $= -188$

    (C) $W_F = Fd = 100(5) = 500$

    (D) $\Delta KE = W_{net}$
    $= W_F + W_g + W_f$
    $= 500 - 171 - 188$
    $= 141 J$

    (E) $\Delta KE = \frac{1}{2}m(v_f^2 - v_i^2)$
    $141 = \frac{1}{2}(10)(v_f^2 - (1.5)^2)$
    $v_f =$

11. A 15.0-kg block is dragged over a rough, horizontal surface by a 70.0-N force acting at 20.0° above the horizontal. The block is displaced 5.00 m, and the coefficient of kinetic friction is 0.300. Find the work done on the block by (a) the 70-N force, (b) the normal force, and (c) the gravitational force. (d) What is the increase in internal energy of the block-surface system due to friction? (e) Find the total change in the block's kinetic energy.

12. The electric motor of a model train accelerates the train from rest to 0.620 m/s in 21.0 ms. The total mass of the train is 875 g. Find the average power delivered to the train during the acceleration. A 700-N Marine in basic training climbs a 10.0-m vertical rope at a constant speed in 8.00 s. What is his power output?

13. Make an order-of-magnitude estimate of the power a car engine contributes to speeding the car up to highway speed. For concreteness, consider your own car if you use one. In your solution state the physical quantities you take as data and the values you measure or estimate for them. The mass of the vehicle is given in the owner's manual. If you do not wish to estimate for a car, consider a bus or truck that you specify.

14. A skier of mass 70.0 kg is pulled up a slope by a motordriven cable. (a) How much work is required to pull him a distance of 60.0 m up a 30.0° slope (assumed frictionless) at a constant speed of 2.00 m/s? (b) A motor of what power is required to perform this task?

15. A 650-kg elevator starts from rest. It moves upward for 3.00 s with constant acceleration until it reaches its cruising speed of 1.75 m/s. (a) What is the average power of the elevator motor during this period? (b) How does this power compare with the motor power when the elevator moves at its cruising speed?

16. One end of a 1 m long string is fixed, the other end is attached to a 2-kg stone. The stone swings in a vertical circle, passing the bottom point at 4 m/s. The tension force of the string at this point is
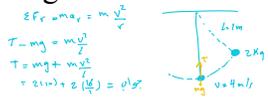
    a) 52 N   b) 32 N   c) 12 N   d) 20 N

17. A block of mass m is pulled along a rough horizontal floor by an applied force T as shown. The vertical component of the force exerted on the block by the floor is:

    A. mg   B. mg − T cos θ   C. mg + T cos θ   D. mg − T sin θ   E. mg + T sin θ
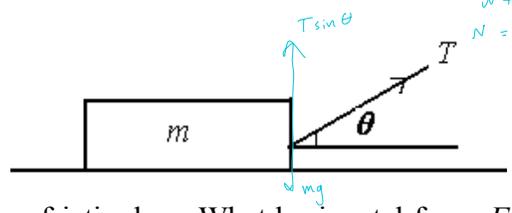
18. In the figure below, assume all surfaces, wheels, and pulley are frictionless. What horizontal force F (in N) must be applied to the cart (عربة) so that the blocks remain stationary (ساكن) relative to the cart?
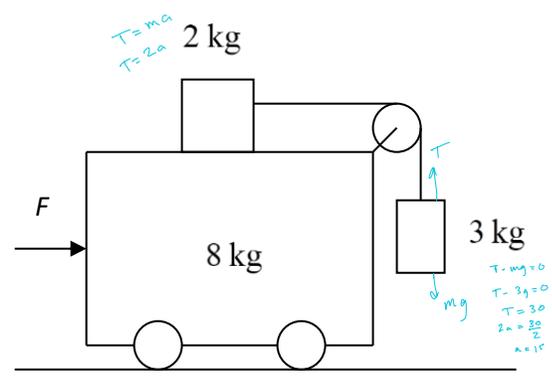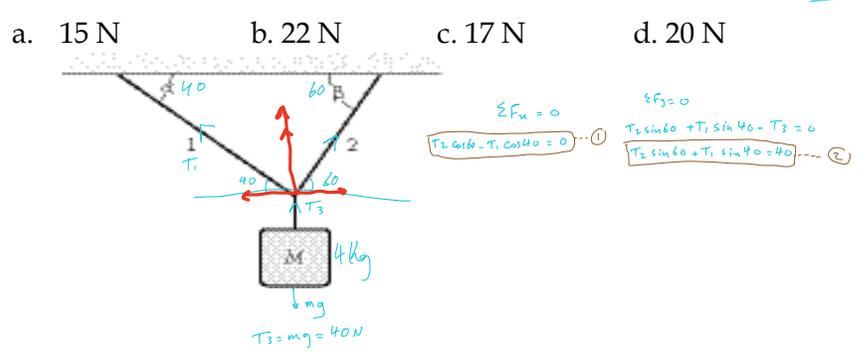   (a) 50   (b) 155   (c) 125   (d) 195   (e) 85
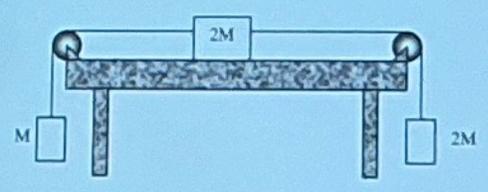
$F = ma$

$F = 13a$ ---①

$F = 13(15)$

$= 195$

2 kg

$T = ma$
$T = 2a$

F

8 kg

T

3 kg

$T - mg = 0$
$T - 3g = 0$
$T = 30$
$2a = \frac{30}{2}$
$a = 15$

الحل

19. If $\alpha = 40°$, $\beta = 60°$, and $M = 4.0$ kg, determine the tension in string 1.

a. 15 N   b. 22 N   c. 17 N   d. 20 N

$\Sigma F_u = 0$ $\Sigma F_y = 0$

$T_2 \cos 60 - T_1 \cos 40 = 0$ ---① $T_2 \sin 60 + T_1 \sin 40 - T_3 = 0$

$T_2 \sin 60 + T_1 \sin 40 = 40$ ---②

M 4 kg

mg

$T_3 = mg = 40 N$

1.5 m/s²

20. The three blocks shown are released from rest and are observed to move with accelerations that have a magnitude of 9.5 m/s². What is the magnitude of the friction force on the block that slides horizontally? Disregard any pulley mass or friction and let M = 2.0 kg. (g=9.8 m/s²)

a. 6.0 N   b. 5.1 N   c. 5.5 N   d. 4.6 N   e. 3.7 N

2M

M   2M

$a = 1.5$ m/s² $g = 1.8$

الساقط عام
الكل

إتجاه الحركة

$2 Kg$
(a)
mg

$4 Kg$
(b) mg

①
$\Sigma F_x = F_{T_1} - F_{T_2} - F_r = ma$

$F_{T_1} - F_{T_2} - F_r = (4)(1.5)$

$F_r = 15 + F_{T_2} - F_{T_1}$

$F_r = \frac{6}{15} + 22.6 - 33.2$

$= -4.6$ (D)

②
$\Sigma F_{y(a)} = ma$

$F_{T_2} - mg = ma$

$F_{T_2} = 3 + (2)(1.8) = 22.6 N$

③
$\Sigma F_{y(b)} = ma$

$mg - F_{T_1} = ma$

$F_{T_1} = mg - ma$

$F_{T_1} = (4)(1.8) - 6 = 33.2$