Question 1

a.) As the velocity of the falling object increases, the air resistance acting on it will also increase. This means that the resultant force acting on the object decreases to zero. At this stage, the upward air resistance and upthrust balances the weight. The object will fall freely to the ground with a constant or terminal velocity.

b.) $kv^2 = mg$

$(0.042)v^2 = (2.3)(9.81)$

$v = 23.2\ ms^{-1}$

c.) $F = ma$

$mg - kv^2 = ma$

$a = 7.2\ ms^{-2}$

Question 2

For picture (a) to be equilibrium;

$T_1 \sin 45° + T_1 \sin 45° = 5.0\ N$

$T_1 = 3.5\ N$

For picture (b) to be equilibrium;

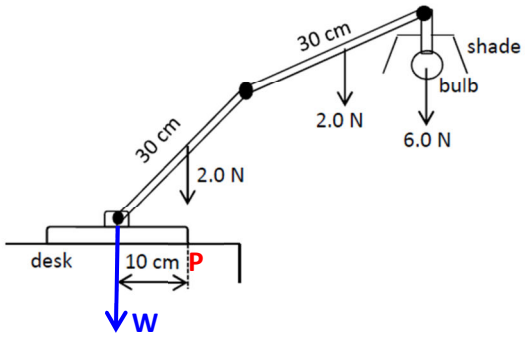
$T_2 \sin 5° + T_2 \sin 5° = 5.0\ N$

$T_2 = 28.7\ N$

The tension of the cord in (b) is greater than the breaking strength of 25.0 N. The cord will not be able to support the picture.

Question 3

a.) & b.)



c.) i.) moment of first arm about P = (2.0)(0.05) = **0.10 Nm**

ii.) moment of second arm about P = (2.0)(0.35) = **0.70 Nm**

iii.) moment of bulb and shade about P = (6.0)(0.50) = **3.0 Nm**

Question 4

a.) 15 000 – (1800 x 9.81) = (1800)a

a = - 1.48 ms^2 (downwards)

b.) v = u + at

0 = (3.8) + (- 1.48)t

t = 2.6 s

c.) 20 000 – [(1800 + 100)(9.81)] = (1900)a

a = 0.72 ms^2 (this case is upwards)

d.) For the free-body diagram of man, the forces acting on him are weight and the force of the lift.

(F_{lift} – mg) = (100)(0.72)

F_{lift} = 72 + 981

F_{lift} = 1053 N

Question 5

a.) F = ma

(F_{gnd} – mg) = (67)(17.0)

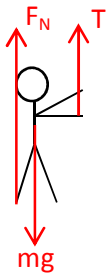
F_{gnd} = 1796 N

b.) 1796 / (67 x 9.81) = **2.73**

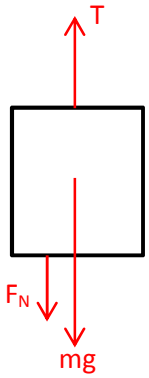
c.) The high jumper needs to exert a downward force on the ground much larger than his weight, so that the ground will also exert an upward force on the high jumper greater than his weight. This produced a resultant force that acts upwards with an acceleration of 17.0 ms^{-2}.

Question 6

a.)



b.)



c.) T + F_N – mg = ma

600 + F_N – (80)(9.81) = (80)a ---- (1)

T – (mg + F_N) = ma

600 – [(30 x 9.81) + F_N] = (30)a --- (2)

Substitute (1) to (2):

acceleration = 1.1 ms^{-2}

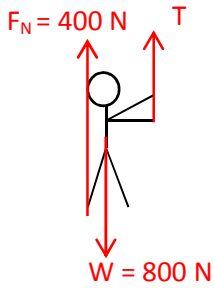
d.) $T - (mg + F_N) = ma$

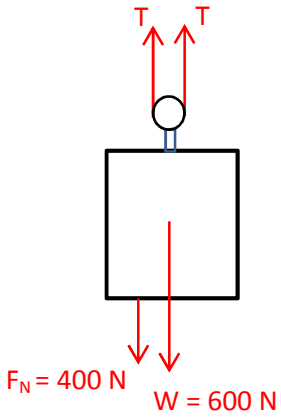
$600 - [\ (30 \times 9.81) + F_N\ ] = (30)(1.1)$

$F_N = 273$ N (downwards)

Question 7

a.) Draw free-diagram of man and crate





$(T + 400) - 800 = (800 / 9.81)a$

$T = 81.5a + 400$ --- (1)

$(2T - 400 - 600) = (600 / 9.81)a$ --- (2)

Substitute (1) into (2)

$[2(81.5a + 400) - 1000] = (61.2)a$

$a = 1.96\ ms^{-2}$

b.) $T = 81.5(1.96) + 400$

$T = 560$ N