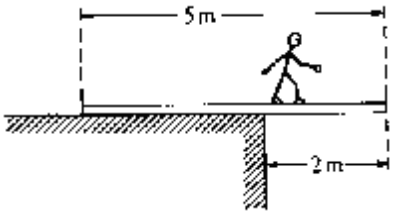
Physics 2 – Summer Session 2009
Quiz # 2

Question 1

A 5-meter uniform plank of mass 100 kilograms rests on the top of a building with 2 meters extended over the edge as shown above. How far can a 50-kilogram person venture past the edge of the building on the plank before the plank just begins to tip?

(a) 0.5 m
(b) 1 m
(c) 2/3 m
(d) 2 m
(e) It is impossible to make the plank tip since the person would have to he more than 2 meters from the edge of the building.



The center of gravity cannot extend past the edge. Let x be the distance between the man and the left end of the plank. Let X be the center of gravity, L=5 m the length of the plank. Also, M=100 Kg and m=50 Kg

$X = (1/2\ M\ L + m\ x)/(M + m)$

Want $X < X0 = 3m$

$1/2\ M\ L + m\ x < x0\ (M+m)$

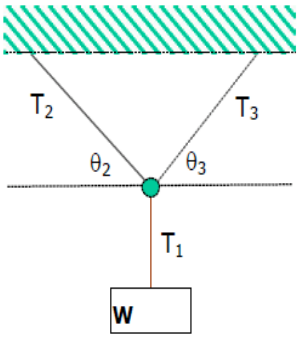
$x < (X0\ (M+m) – 1/2\ M\ L)/m = (450 – 250)/50 = 4$ m

Since we want distance from edge, 5-4=1 → **Correct answer is (b)**

Question 2

Find the tension T_2 in the left hand rope shown in the figure, for the case where $\theta_2 = 60^o$, $\theta_3 = 30^o$, and W= mg = 50 N.

(a) 50 N
(b) 100 N
(c) 43 N
(d) 87 N
(e) 29 N



$T_2 \cos\theta_2 = T_3 \cos\theta_3$
$T_2 \sin\theta_2 + T_3 \sin\theta_3 = W$
Some algebra gives $T_2 = W / (\sin\theta_2 + \cos\theta_2 \tan\theta_3) = 43$ N → **Correct answer is (c)**

Question 3

A starship of mass m is traveling between a pair of stars that are a distance R apart. The mass of star 2 is exactly twice the mass of star 1. How far from star 1 will the gravitational force on the starship be equal to zero? Express the answer in terms of R.

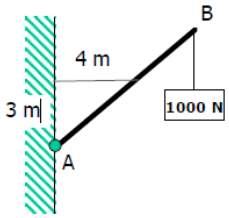
(a) 0.41R
(b) R/4
(c) R/1.41
(d) R/2
(e) R/2.41

xR = distance from star 1
(1-x)R = distance from star 2
$GmM/(xR)^2 = Gm(2M)/((1-x)R)^2$
$x^2 R^2 = (1-x)^2 R^2 /2$
Solving this equation gives x = sqrt(2)-1 = 0.41 → **Correct answer is (a)**

Question 4

A 1000- N block is suspended as shown. The beam AB is weightless and is hinged to the wall at A. The beam is 10 m long. The 4-m-long horizontal cable is attached to the midpoint of the beam AB from a point 3 m above point A on the wall. Find the tension in the horizontal cable.

(a) 667 N
(b) 2000 N
(c) 375 N
(d) 2670 N
(e) 1000 N



θ = angle that the beam makes with the vertical
$\sin\theta=4/5$ and $\cos\theta=3/5$ and $\tan\theta=4/3$
L = 10 m
Torques about hinge must balance:
$LW \sin\theta = 1/2\ L\ F \cos\theta$
$F = 2\ W \tan\theta = 2670$ N → **Correct answer is (d)**

Question 5

A cable is 100 m long and has a cross-sectional area of 1 mm^2. It is tied at one end to a wall. At the other end it is pulled by a 1000 N force. Young's modulus is 1.0 10^{11} Nm^2. By how much does the cable stretch?

(a) 0.01 m
(b) 0.10 m
(c) 1.0 m
(d) 10 m

$(F/A)/(\Delta l/l) = Y$
$Dl = (F/A)\ (1/Y)\ l = (10^3 / 10^{-6})\ 10^{-11}\ 10^2$ m = 1 m → **Correct answer is (c)**

Question 6

As it travels through its elliptical orbit, a planet moves farther away from the sun. Its speed

(a) increases
(b) decreases
(c) remains the same
(d) increases or decreases, depending on the angular momentum value

The potential energy increases ($U = -GmM/r$ …. Pay attention to the minus sign!), therefore the kinetic energy decreases → **Correct answer is (b)**

Question 7

At Earth's surface, the force of gravity on a certain black bear is 1440 N. The bear is transported by rocket and placed in orbit at a distance of 3 earth radii from the earth's surface. What is the force of gravity on the bear while it is in orbit?

(a) 90 N
(b) 160 N
(c) 360 N
(d) 480 N
(e) 1440 N

On earth: $W=GmM/R^2$. On satellite, $W=GmM/(4R)^2$.
Therefore weight decreases by factor of 16, 1440/16=90 → **Correct answer is (a)**