

5 Assumed singularity

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Question box 5.1

F1 Craftspeople often use a so-called plumb-line. Do you know what it is and what it is used for?

F2 How big was the universe before the big bang?

F3 When is a seesaw in balance (in a state of equilibrium)? Use the concept center of gravity to explain your answer.

F4 Is it possible to stack books on the edge of a table so that the top book hangs completely over the edge? How could you arrange the books? How many books can be all the way over the edge in one stack?

key words excerpt

plumb-line – das Lot

seesaw – die Wippe

center of gravity – der Schwerpunkt

to stack - stapeln

balance – die Balance

homogenous - homogen

singularity – die Singularität

edge – die Kante

common - gemeinsam

Question box 5.2

F5 ▶L Why doesn't the silverware fall to the ground in fig. 5.6? It is all the way over the edge of the table. Try it yourself.

F6 Some long jumpers run in the air while they are jumping. Why do they do so? Does it help them jump farther? Can they run through the air so to speak?

F7 Assuming a high jumper jumps a distance of 2 m on earth, how high will he be able to jump on the moon where gravity is only 1/6th as strong?

F8 Is it possible for an object to have its center of gravity outside itself?

F9 Nowadays all high jumpers use the flop technique in which they go over the bar stomach up. (fig. 5.8 left). No one uses the roll (fig. 5.8 right) anymore. Why?

key words excerpt

silverware – das Besteck

free fall – der freie Fall

flight trajectory – die Flugbahn

Question box 5.3

F10 Both blocks in the figure below are in a state of equilibrium. Which of the two is heavier?

F11 What is meant by the term potential energy? See chapter 3.4.

F12 Why does water flow downstream? Why is water's surface flat if it is not disturbed? Why does a pendulum always come to a stop at the lowest point? Why does a marble stop at the lowest point in a depression?

key words excerpt

state of equilibrium – das Gleichgewicht

potential energy – die potenzielle Energie

all forces cancel each other out – alle Kräfte heben einander auf

stable - stabil

indifferent - indifferent

labile/unstable – labil

Question box 5.4

F13 Stand next to a wall so both the outside of your right foot and your right shoulder are touching the wall. Now try to lift your left foot. Can you do it? Why or why not?

F14 Stand with your back to the wall so that your heels, bottom, and shoulders are touching the wall. Now try to pick an object off the floor that's 50 cm in front of your feet. Your heels and bottom have to stay in contact with the wall, and keep your legs straight. Can you do it? Why or why not?

F15 How far can you tip an object before it falls. Use the plumb-rule and center of gravity concepts in your answer.

F16 Which kind of equilibrium does a sprinter aim to achieve in before starting a race – as stable or instable (labil) as possible? Provide reasons for your answer.

key words excerpt

plumb-rule – das Lot

center of gravity – der Körperschwerpunkt

surface area – die Standfläche

contact surface – die Auflagefläche

Question box 5.5

F17 Why do grease drops rise to the top of soup and not sink to the bottom of the bowl? What happens after a while if you pour oil and water into a cup? Why? Explain this effect using position of center of gravity.

F18 If you shake a box of granola for a while, most of the raisins will be at the bottom of the box. What do you think the reason could be?

F19 What kind of equilibrium does a floating object have?

F20 When you hold a floating object under water and then let go, then the object will bob up and down for a while. Why does this happen?

F21 ►L If you put 1 kg iron and 1 kg feathers on a beam scale, will the scale be balanced or not? Why?

key words excerpt

position of center of gravity – die Position des Körperschwerpunkts

to float - schwimmen

to sink - sinken

mercury – das Quecksilber

liquid - flüssig

potential energy – die potenzielle Energie

water level – der Wasserspiegel

equilibrium – das Gleichgewicht

bob up and down – auf dem Wasser schaukeln

beam scale – die Balkenwaage

Task box

F22 ►L Can you put a single book on a desk so that $\frac{3}{4}$ of it goes beyond the edge of the table?

F23 ►L Explain why tall high jumpers have an advantage over short ones.

F24 ►L What state of equilibrium are the blocks (fig. 5.15) in?

F25 ►L How can you tell if a car's center of gravity lies exactly within the axle? By the way, this is called balanced.

F26 ►L Where is the center of gravity in each of the following: pendulum, swing, person doing a handstand, bicyclist, tight rope walker, weeble clown.

F27 Summarize the four ways to increase stability and provide an example for each.

F28 ►L In which state of equilibrium is a car?

F29 ►L In the figure below you see a frog with its base and center of gravity drawn in. What happens in numbers two and three? Apply this example to humans walking.

F30 ►L In which state of equilibrium is each cube below?

F31 Archimedes was appointed by King Hieron II of Syracuse to find out if his crown was made of solid gold or if the gold was cut with cheaper metals. How did Archimedes complete his task? Check your library or the internet.

F32 ►L Use a table calculation program to find the sums of the first 5, 10, and 50 terms of the sequence $1 + \frac{1}{2} + \frac{1}{4} + \frac{1}{8} \dots$ and $1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \dots$. What pattern do you see?