

6 Straight Motions

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Question box 6.1

F1 What is meant by a frame of reference? See chapter 4.2 if you need to.

F2 The car in fig. 6.2 drives constantly at 10 m/s over a hill. Is this motion accelerated or not?

F3 You are sitting in a windowless box moving along at constant speed, i.e. unaccelerated (fig. 6.3 left). Can you determine whether you are moving or not? What about if the motion is accelerated (fig. 6.3 right)?

F4 Which of the following concepts are relative and which are absolute: big, light, fast, long, thin, speed, acceleration?

F5 You are flying in space in a spaceship. All around you is nothing. Can you tell how fast you are traveling? And if you see another spaceship fly by you, are you then able to tell how fast you are flying and how fast the other is?

key words excerpt

uniform - gleichförmig

accelerated - beschleunigt

negative acceleration – die negative Beschleunigung

non-uniform - ungleichförmig

frame of reference – das Bezugssystem

comparison – der Vergleich

absolute - absolut

relative - relativ

inertial frame of reference – das Inertialsystem

Question box 6.2

F6 Two bicyclists are riding at 10 km/h towards each other. Once they are exactly 10 km apart, a fly starts flying from the front tire of the right bicycle at 30 km/h towards the front tire of the left bicycle, then back to the front tire of the first bicycle, and so on until the bicycles meet. How far will the fly fly until the bicycles meet?

F7 ►L Mr. Smith takes his dog for a walk. In which direction (sideways, forwards, backwards, etc.). How does he have to throw the stick so that his dog runs as much as possible during their walk?

F8 If you count the seconds between a flash of lightning and thunder and then divide that number by 3, you know how far away (in km) the lightning was before. Figure out how fast the speed of sound is.

F9 If you drive a convertible at 5 m/s and throw a ball forward at 10 m/s (fig. 6.7a), how fast is the ball for someone standing still on the sidewalk? You are flying at half light speed in a spaceship and send a light signal out the front of the spaceship (b). How fast is the beam of light for someone standing on earth?

key words excerpt

flash of lightning – der Blitz

speedometer – der Tachometer

beam of light – der Lichtstrahl

pendulum – das Pendel

Question box 6.3

F11 ►L A racing bug runs along a wall. His movement is graphed in a time-distance diagram. First describe how the bug moves. Next describe at what speed the bug moves in each part (component). How can you graphically demonstrate that the bug will be back at his starting point after 8 seconds?

key words excerpt

velocity-time diagram – das Geschwindigkeits-Zeit-Diagramm

time-distance diagram – das Weg-Zeit-Diagramm

Question box 6.4.1

F12 A roofer drops his hammer. It takes one second for the hammer to fall one floor down. How far does it fall after two and three seconds?

F13 You drop a stone from the first floor balcony (be careful!), and it falls to the ground at a certain velocity. From which floor would you have to drop the stone for the impact to have twice the velocity? And if there were buildings on the moon, how would the velocity of the falling stone work there?

key words excerpt

roofer – der Dachdecker

increment – die Erhöhung, die Vergrößerung

unit of time – die Einheit der Zeit

air resistance – der Luftwiderstand

non-linear - nichtlinear

square of time – das Quadrat der Zeit

floors – das Stockwerke

gravitational acceleration – die Erdbeschleunigung

Question box 6.4.2

F14 You made a three second film of a stone falling and play it backwards. Which way is the acceleration, up or down?

F15 There is an explosion and a stone is propelled straight up in the air. After 6 seconds, it hits the ground. How high was the stone propelled? How big was its acceleration when the stone was still at its highest point - zero?

F16 You stop short at 50 km/h and measure the braking distance. How much further does it increase at a speed of 100 km/h or 150 km/h?

F17 How much longer is the braking distance at 50 km/h compared to 30 km/h? Guess!

F18 Why do we use a soft mat in gym class? Why are helmets padded? Why do cars have a crumple zone? Why does a small woodpecker have such a strong beak?

key words excerpt

negative acceleration (deceleration) – die negative Beschleunigung

rising/falling – aufsteigen/fallen

increasing/decreasing – zunehmen/abnehmen

to stop short - vollbremsen

braking distance – der Bremsweg

braking distance increases by the square of speed – der Bremsweg wächst mit dem Quadrat der Geschwindigkeit

barrier – das Hindernis

by the square – mit dem Quadrat

padded – gepolstert

crumple zone – die Knautschzone

woodpecker – der Specht

beak – der Schnabel

Question box 6.5

F19 Sometimes raindrops really hurt when they hit your head. Why is that? Is it because they fall from higher up? Are rain drops from lower clouds slower? What shape are falling drops?

F20 If a mouse were to fall in a shaft 1000 m deep, it will suffer a shock, but not any injuries. A rat, on the other hand, has no chance of surviving. What could be the reason why the rat dies.

F21 Ever since 1987 all ski jumpers have used the V-technique and haven't used the classic technique anymore. Why? And how do ski jumper ski suits differ from downhill suits?

key words excerpt

sound barrier – die Schallmauer

air resistance – der Luftwiderstand

gravity – die Gravitation

weight – das Gewicht

acceleration – die Beschleunigung

gravitational acceleration – die Erdbeschleunigung

reference area – die Anströmfläche

to collide - zusammenstoßen

collision – der Zusammenstoß

terminal velocity – die Endgeschwindigkeit

Question box 6.6

F22 ►L You cycle uphill one hour long from A to B. Your average speed is 10 km/h. How fast would you have to cycle back from B to A to increase your total average to 20 km/h?

F23 There are radar measuring devices and section control mechanisms to prevent speeding in traffic. A vehicle's speed is measured in both cases, but there is a huge difference between the two methods. What is the difference?

F24 Sometimes you read that a sprinter was able to run a 200 m race faster than a 100 m race. Can this be possible? If so, then explain how.

F25 If you run 5 m/s, how fast are your feet moving?

key words excerpt

instantaneous velocity – die Momentangeschwindigkeit

average velocity – die Durchschnittsgeschwindigkeit

linear - linear

non-linear - nichtlinear

Task box

F26 ►L Two trucks each with a device for measuring light speed drive away from each other at 10 m/s. What value will they measure for c ? Is fig. 6.44 labeled correctly? If not, can you correct it?

F27 ►L Use table 6.1 to estimate the world records for marathon times for men and women. The distance is 42,195 km.

F28 ►L How often can a light beam whoosh around the earth each second (for earth's circumference, see chapter 2.3)?

F29 Explain why acceleration's unit is measure is m/s^2 .

F30 ►L Acceleration due to gravity is 3.72 m/s^2 on mars. Calculate how far an object will fall in the first 6 seconds.

F31 Make a diagram depicting the relationship between speed and braking distance for the following decelerations: 5 m/s^2 , 7 m/s^2 und 9 m/s^2 (siehe Abb. 6.26).

F32 ►L After a car accident, a Ferrari made skid marks which were 280 m long. The driver claims to have been going about 150 km/h. Can this claim be proved wrong?

F33 Make a velocity-time diagram and time-distance diagram for the following movements: 2 seconds at 1 m/s, 2 seconds at 2 m/s, 2 seconds at 3 m/s, 2 seconds at -5,5 m/s.