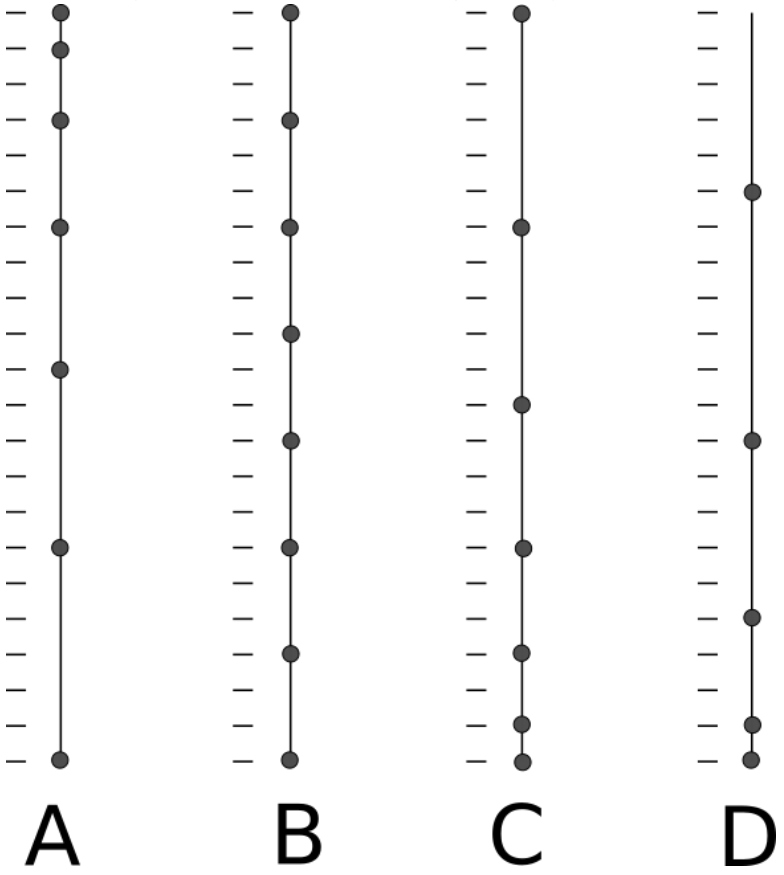
MCQ Questionnaire

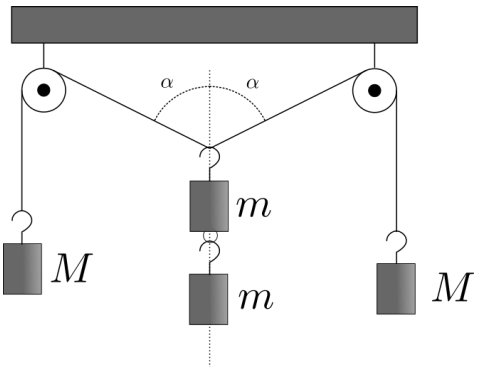
1. You have 5 different strings to which masses have been attached at different points as shown below (black dots). The strings are fixed to the ceiling and touch the floor. The strings are released and they fall vertically downwards. For which strings will impact sounds be heard at equal intervals?



   a. A
   b. B
   c. C
   d. D

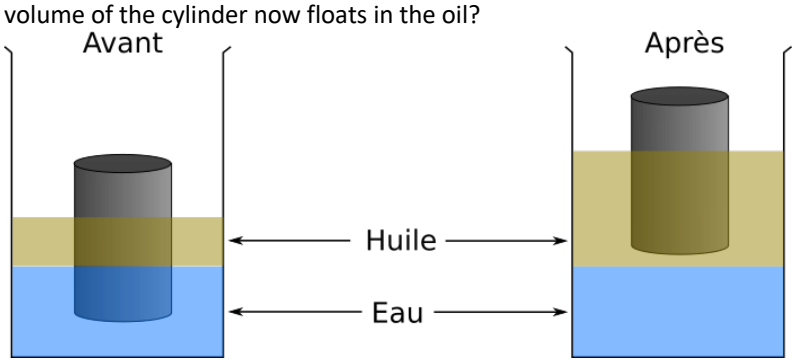
2. A constant force F_1 pulls a carriage, initially at rest, along a horizontal rail. Friction and air resistance are negligible. After a short period of time Δt_1 the carriage reaches a speed v. To achieve the same speed with a force F_2 reduced to half of the initial value it is necessary to apply the force for a time Δt_2
   a. four times longer than forF_1
   b. twice as long as for$\boldsymbol{F_1}$
   c. reduced to half that forF_1
   d. reduced to a quarter

3. The system below is in equilibrium when $\alpha = 60°$. We remove one of the 2 central masses (with $m = \frac{M}{2}$). What will be the angle for which the new system is in balance?



   a. $\boldsymbol{\cos\alpha = \frac{1}{4}}$
   b. $\cos\alpha = \frac{1}{3}$
   c. $\cos\alpha = \frac{1}{2}$
   d. $\cos\alpha = 1$

4. A container contains a layer of oil with density $\rho_{Oil} = 800\frac{kg}{m^3}$ that floats on water with density $\rho_{water} = 1000\frac{kg}{m^3}$. A homogeneous solid cylinder floats in the container. 1/3 of its volume is in water, 1/3 in oil and 1/3 in air. Oil is added until the cylinder floats only in the oil. What fraction of the volume of the cylinder now floats in the oil?



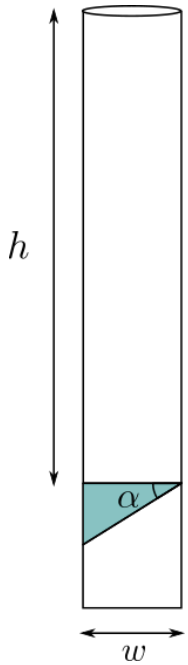
   a. $\frac{2}{3}$
   b. $\boldsymbol{\frac{3}{4}}$
   c. $\frac{8}{9}$
   d. $\frac{4}{5}$

5. We place 3 charged particles along the Ox axis. The charges are respectively $q_A = +1e$, $q_B = -1e, q_C = +4e$. Particle A is at $x_A = 0$ and particle C at $x_C = 3$ cm. Where is particle B if we know that it is in equilibrium under the combined effect of the forces exerted by the particles A and C ?
   a. $x_B = 0.75$ cm
   b. $\boldsymbol{x_B = 1}$ **cm**
   c. $x_B = 1.5$ cm
   d. $x_B = 2$ cm
   e. $x_B = 2.4$ cm
   f. $x_B = 3$ cm

6. A spacecraft starts from rest and wants to cross a distance corresponding to the Earth-Sun distance $d = 1.5 \times 10^8$ km. It accelerates first with $a_1 = g = 9.81\text{m/s}^2$. At the halfway point, it turns 180 ° and brakes with $a_2 = -g$ to arrive with zero speed. How long does the trip take? (Relativistic effects are neglected)
   a. approximately 8 minutes.

b. Approximately 15 hours.
c. Approximately 3 days.
d. Approximately 3 months.

7.

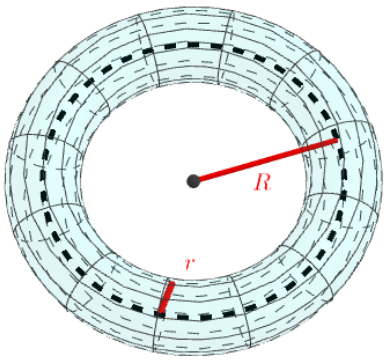


A tree must be cut down by cutting and removing a wedge with an angle α from it (see image). To simplify, it is assumed that the tree has a cylindrical shape with diameter $w = 2\ m$ and a height $h = 10$ m above the cut. What is the minimum angle to α make the tree fall.

a. It will fall over for any angle .α
b. $\alpha \approx 1^{\circ}$
c. $\alpha \approx 6^{\circ}$
d. $\boldsymbol{\alpha \approx 11^{\circ}}$.
e. $\alpha \approx 22^{\circ}$.

8. A lifeguard is overjoyed because of the improving weather. He may open up the swimming pool soon. He tells his colleague: "Today it's 15 °C and next week it will be twice as hot!" What would next week's temperature have to be for him to be right.
   a. 30 °C
   b. 30 K
   c. 288 K
   d. 303 K
   e. 303 °C
9. An object floats on the surface of the water. Salt is added to the water. Knowing that the density of salt water is 1030 kg/m$^{3:}$
   a. nothing changes.
   b. the object sinks.
   c. the submerged part of the object increases
   d. the submerged part of the object decreases
10. The lens of a camera is likened to a thin convergent lens of focal length $f = 135$ mm. We want to photograph a master painting located $3\ m$ in front of the lens. At what distance $p' > 0$, behind the lens, should the photographic film be placed to obtain a clear image of the canvas?
    a. $p' = 93$ mm
    b. $p' = 129$ mm
    c. $\boldsymbol{p' = 141}$ mm

d. $p' = 245\ \text{mm}$

11. Six identical wagons, attached to each other, are at rest on a horizontal rail. A seventh one identical to the first approaches the line with a speed of 1 m/s. On contact, it is attached to the other wagons, so that all move with the same speed which corresponds to:
    a. 1 m/s
    b. $\frac{1}{\sqrt{7}}$m /s
    c. $\frac{1}{6}$m /s
    d. $\frac{1}{7}$m /s
    e. $\frac{6}{7}$m /s
12. An electrical resistor of resistance $4{,}7\Omega \pm 2\%$ is traversed by a current of $2{,}5 \pm 0{,}05\ mA$ When calculating the power dissipated by this resistance, this value contains a relative error of:
    a. 2%
    b. 4%
    c. 6%
    d. 8%
    e. 10%
13. 

    One of the expressions below represents the volume of a Torus (donut) of outer radius R, and inner radius $r$as shown on the drawing. Identify the correct expression:
    a. $\pi^2 r^2 R^2$
    b. $2\pi^2 r^2 R$
    c. $\frac{4\pi(R^3 - r^3)}{3}$
    d. $8\,\pi^3 rR$
    e. $2\pi(rR^2 - r^2 R)$
    f. $2\pi R(R^2 + rR)$

14. A simple pendulum of length L is set to give the correct time at sea level, where $g = 9{,}81\frac{N}{kg}$. When you take it to the top of a mountain, it delays by a minute a day. What is the value of g at this altitude?

    a. 9.687 N/kg

    b. 9.725 N/kg

    c. 9.796 N/kg

d. 9.842 N/kg

15. A 10 g rifle bullet moving at 400 m/s hits a ballistic pendulum with a mass of 2.5 kg. The bullet passes completely through the pendulum and exits with a speed of 100 m/s. How high is the mass of the pendulum?

    a. 1.2 cm

    b. 3.4 cm

    c. 5.1 cm

    d. 7.3 cm

16. A 60 g block is attached to a spring ($k = 24$ N/m). The spring is elongated and the block is released at $t = 0$ without initial velocity. After 0.05 s, $v_x = -0.69$ m/s. The mechanical energy of the system is worth:

    a. 20.2 mJ

    b. 40.7 mJ

    c. 60.9 mJ

    d. 80.9 mJ

17. An electric kettle operating under 120 V heats 1.5 L of water from 20°C to 90°C in 8 min. What is the current circulating in the kettle?$\left(c_{eau} = 4{,}18\,\frac{J}{gK}\right)$

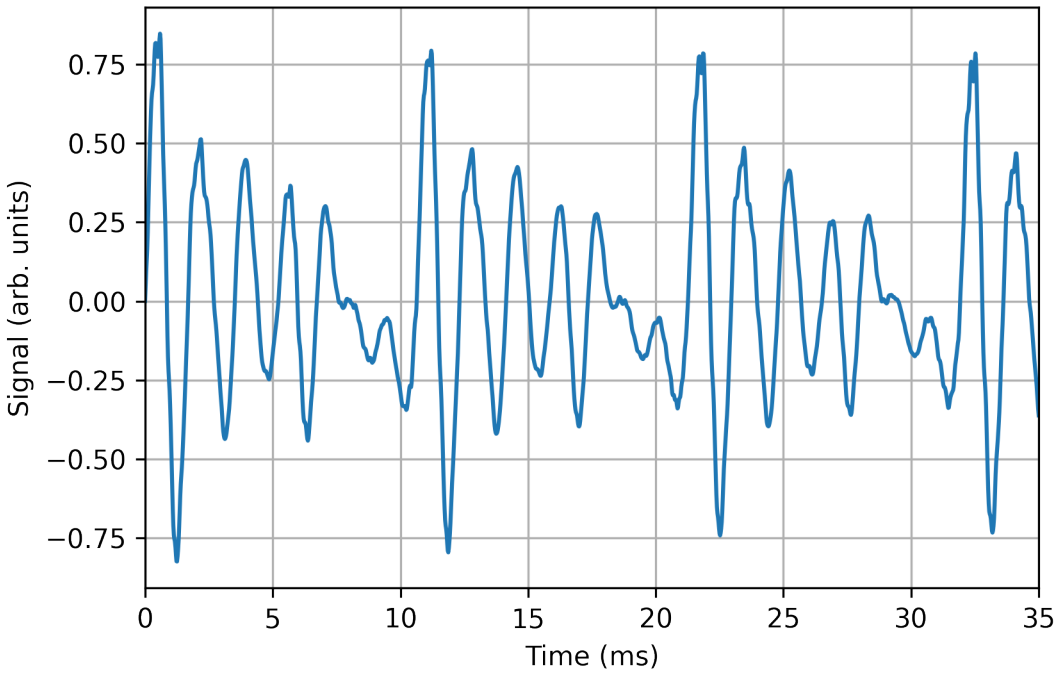
    a. 3.64 A

    b. 5.64 A

    c. 7.64 A

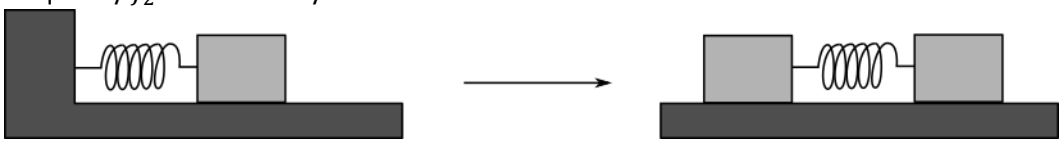
    d. 9.64 A

18. Consider the following acoustic signal. Select the frequency closest to the fundamental frequency of the signal:



a. This is not possible because it is not a sinusoid
b. 10 Hz
c. 20 Hz
d. 30Hz
e. 40 Hz
f. 100 Hz
g. 200 Hz
h. 300 Hz
i. 400 Hz
j. None of the answers are correct.

19. A system consists of a horizontal spring immobilized on one side with a mass m attached on the other side. It oscillates freely with a frequency f_1. If the fixed point is detached from the spring and a second mass identical to the first is attached to it, then the new oscillation frequency f_2 of the new system:



a. Increases by one factor 2
b. Decreases by one factor 2
c. Increases by one factor $\sqrt{2}$
d. Decreases by one factor $\sqrt{2}$
e. Does not change

20. In a $30\ \mathrm{km/h}$ zone a car driving at that speed comes to a halt right in front of an obstacle. Let's imagine that the same car has an initial speed of $50\ \mathrm{km/h}$. If all other parameters

remain constant (initial distance of the obstacle, reaction time, acceleration, ...) in what range should the car's speed be on impact?

a. $50 - 45\ \frac{km}{h}$

b. $\mathbf{50 - 40\ \frac{km}{h}}$

c. $45 - 40\ \frac{km}{h}$

d. $40 - 30\ \frac{km}{h}$

e. $50 - 30\ \frac{km}{h}$

f. $30 - 25\ \frac{km}{h}$

g. $30 - 20\ \frac{km}{h}$