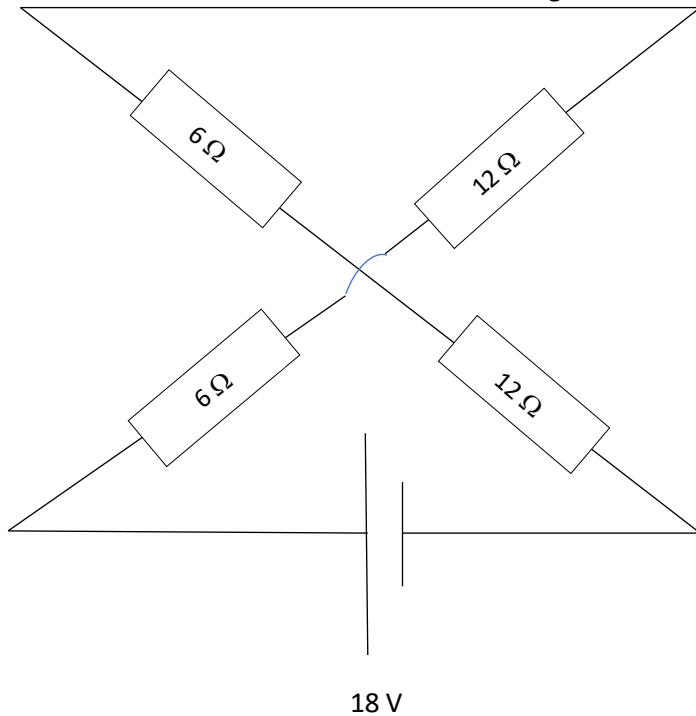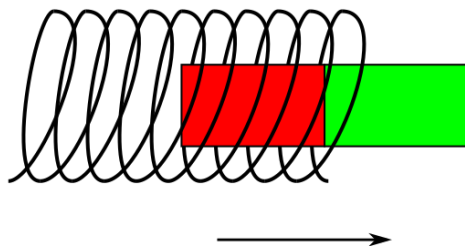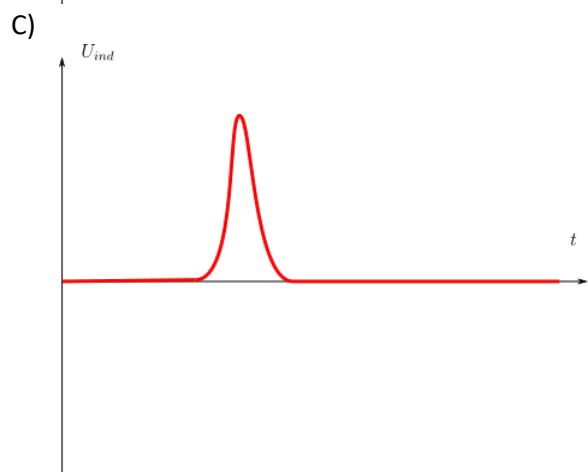# Questionnaire Qualification (EN)

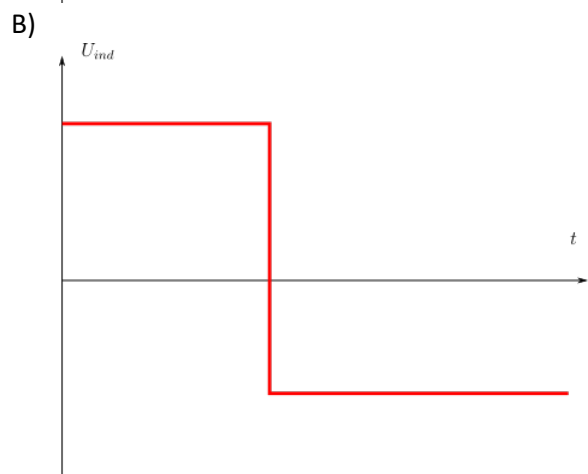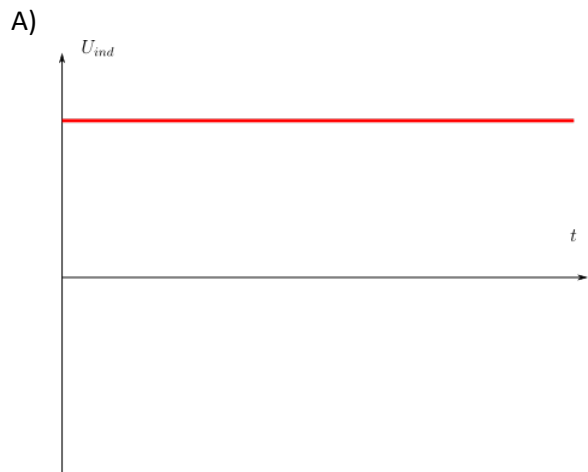1. In the circuit below the current through the battery is equal to

6 Ω

12 Ω

6 Ω

12 Ω

18 V
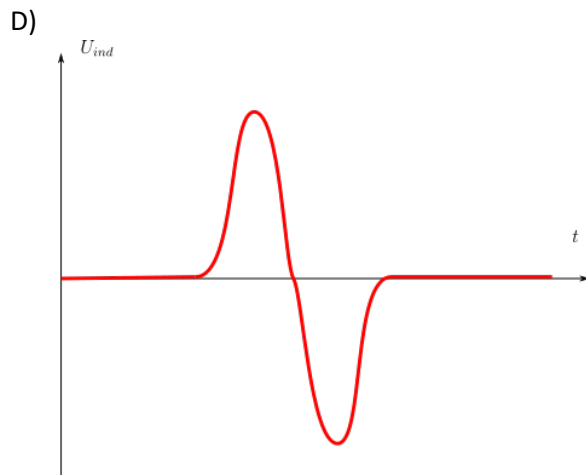
A) 0 A
B) 0,5 A
C) 1 A
D) 2 A

2. A bar magnet is lying in a solenoid as shown below. The solenoid is connected to an oscilloscope. The magnet is entirely pulled out of the solenoid. Which of the following represents the induced emf U_{ind} ?

A)

U_{ind}

t

B)

U_{ind}

t

C)

U_{ind}

t

D)

3. An electrical charge is released from rest in a region of uniform electric and magnetic field. The electric and magnetic field vectors are parallel. What is the shape of the path followed by the particle?
   A) A circle
   B) A helix
   C) A straight line
   D) A parabola

4. A hypothetical Earth satellite orbiting at sea level would have a period of 80 minutes. What is the best approximation for the orbital radius, in terms of the Earth's radius R_E, of an Earth satellite with a period of 7 hours?
   A) $2\,R_E$
   B) $3\,R_E$
   C) $4\,R_E$
   D) $5\,R_E$

5. Consider the following statements:
   1. If all the forces acting on an object compensate, the body has zero velocity.
   2. If all the forces acting on an object compensate, the body is at rest or in uniform motion.
   3. An object is thrown vertically upwards: its velocity is zero at the instant it reaches maximum height before falling back down: at that particular instant all the forces acting on it compensate.
   4. All the forces acting on a car moving on a straight slope at constant velocity compensate.

   Which of the following answers is correct:

   A) Only statement 3 is wrong
   B) Statements 1 and 4 are wrong
   C) Statements 1 and 3 are wrong
   D) Only statement 1 is wrong

6. A floating helium balloon is attached in a car. When the car accelerates forward, the balloon:
   A) **Moves forward.**
   B) Moves backward.
   C) Does not move.
   D) Depends on the mass of the balloon.

7. Batman uses a jetpack with small rockets providing a constant thrust. This machine allows the hero to float at a given height while also moving from side to side horizontally in a regular fashion. Each time he passes the center point of the trajectory, he immediately turns around and reverses the thrust. We neglect air resistance. Select the correction statement:
    A) This motion is impossible with a constant force.
    B) The motion is a harmonic oscillation.
    C) The period of oscillation does not depend on the amplitude.
    D) The horizontal component of the force does not vary over time.
8. Identify the graph of the acceleration an elevator experiences in the z direction when going up 10 m.
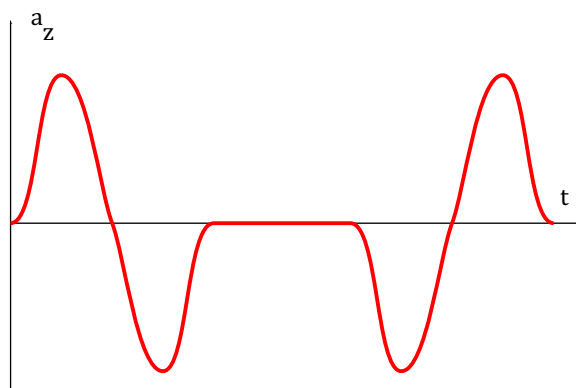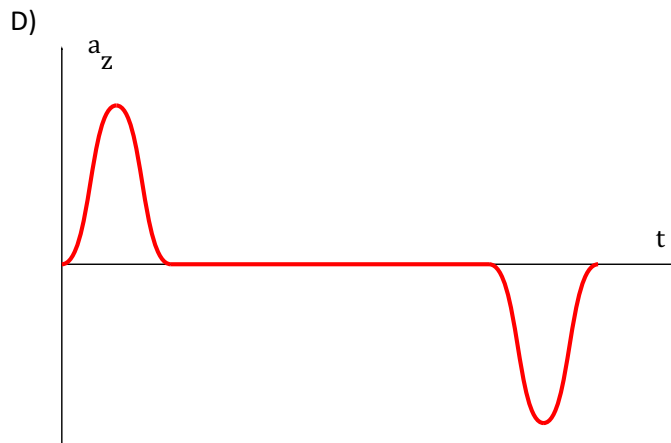
A)

B)

C)

D)
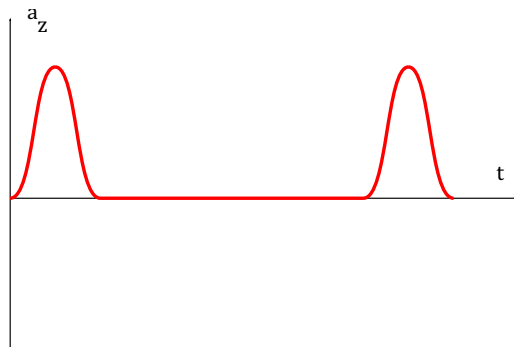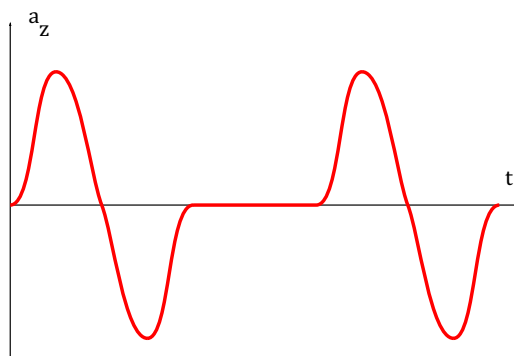
9. Two sinusoidal signals of the same frequency and of amplitude A overlap. There is a phase difference of $\frac{\pi}{3}$ between the signals. The resulting signal:

   A) Is a sinusoidal signal of the same frequency with amplitude $\sqrt{2}A$
   B) Is a sinusoidal signal of double the frequency.
   C) Is a sinusoidal signal of the same frequency with amplitude $\sqrt{3}A$
   D) Is not a sinusoidal signal.

10. A ball is launched horizontally from a tower and arrives on the ground after 2 seconds. The initial speed of the ball is :

   A) 20 m/s
   B) 10 m/s
   C) 5 m/s
   D) Impossible to determine based on the information given.

11. The planet Earth has a mass $M = 6 \times 10^{24}$ kg and revolves around the sun with a speed $v = 30$ km/s. A meteorite with mass $m = 6 \times 10^{22}$ kg moves with the same speed v perpendicular to the Earth, and hits the Earth. By which angle is the Earth deflected under the assumption that the collision is elastic and that after the collision that two objects move together?

   A) $\alpha = 0°$
   B) $\alpha = 0.6°$
   C) $\alpha = 5.2°$
   D) $\alpha = 45°$

12. A rechargeable NiMH battery contains a charge $Q = 2000$ mAh, has an internal resistance $R_{int} = 100$ mΩ, and a contact voltage $U = 1.2$ V. The battery is connected to an incandescent light bulb with resistance $R_{lamp} = 2.5$ Ω. For how long will the light bulb work and how much power will it consume?

   A) It will work for 4 hours with a power of 0.5 W.
   B) It will work for 3 hours with a power of 0.9 W.
   C) It will work for 1 hours with a power of 1.5 W.
   D) It will work for 10 hours with a power of 0.5 W.

13. A climber estimates the height of a cliff by dropping a stone and observing the time elapsed before hearing the impact of the stone on the ground. It is estimated that this time is equal to 2.5 s. Knowing that the speed of sound is 330 m / s, find the height of the cliff:

   A) 25.4 m
   B) 28.5 m
   C) 30.6 m
   D) 34.2 m

14. A 12 g projectile moving horizontally at 400 m/s hits a block of 1.6 kg at rest. After the collision, the block moves on a rough horizontal surface where the coefficient of kinetic friction is 0.22. How far does the block go before stopping? We neglect the static friction.
    A) 1.27 m
    B) 1.64 m
    C) 1.88 m
    D) 2.06 m

15. A person of 60 kg floats vertically in a swimming pool keeping only the head, which has a volume of 2.5 L, out of the water. What is its average density?
    A) 760 kg/m3
    B) 880 kg/m3
    C) 960 kg/m3
    D) 1080 kg/m3

16. A monochromatic ray of light strikes at a 45° angle the face of an equilateral prism of refractive index equal to 1.55. What is the angle with the normal of the second face of the ray when it exits the prims? The surrounding environment is air.
    A) 51.2°
    B) 53.7°
    C) 55.1°
    D) 57.3°

17. A block is attached to a spring and performs oscillations whose amplitude is equal to 20 cm. What is the position of the block when kinetic and potential energy are equal?
    A) ±8.3 cm
    B) ±10.0 cm
    C) ±12.6 cm
    D) ±14.1 cm

18. You are holding a triangular prism of negligible thickness (see figure) that you want to suspend by a piece of string. At which point x_0 on the x-axis do you need to attach the string so that the prism remains horizontal?

plafond
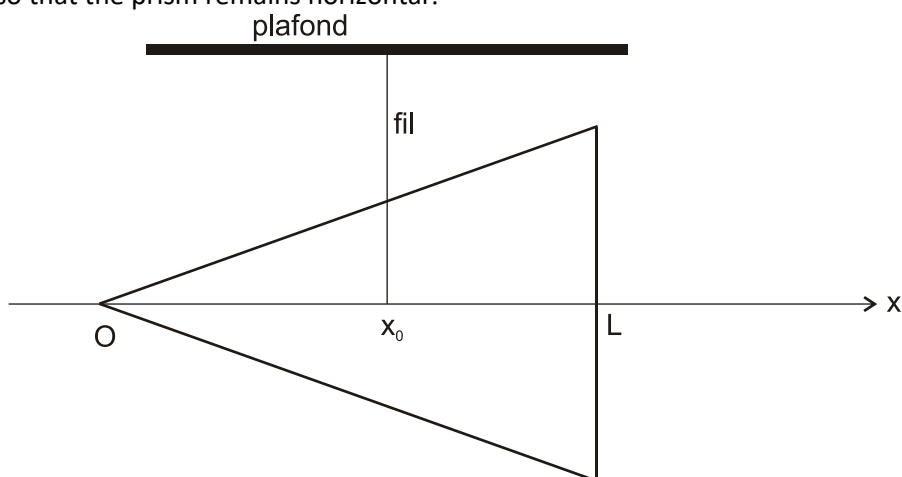
A) $\frac{1}{\sqrt{2}}L$

B) $\frac{2}{3}L$

C) $\frac{3}{4}L$

D) $\frac{\sqrt{3}}{2}L$

19. A driver is going with his car at a speed of 30 km/h. At a point A he suddenly notices a child appearing on the road. He steps on the brakes with full force and comes to a stop at a point B at a distance of 10 m from A.

    You may assume that the driver's reaction time is 0.5 s, which is very short.

    Now consider the same situation, with the difference that the driver is going at the speed of 50 km/h. As before, he sees the child when he is at A. What is his speed when he is at B, that is, at 10 m from A?
    - A) 15 km/h
    - B) 25 km/h
    - C) 35 km/h
    - **D) 45 km/h**

20. What should be the radius of a spherical helium balloon that floats in the air at a constant altitude, given that it must support the weight of its basket, amounting to 1000 N? (Density of air: $1.2 \frac{kg}{m^3}$, density of helium: $0.179 \frac{kg}{m^3}$, $g = 9.8 \frac{N}{kg}$). Neglect the mass of the envelope of the balloon.
    - **A) 2.88 m**
    - B) 4.88 m
    - C) 5.14 m
    - D) 23.8 m