Lebanese University **Entrance Exam 2021-2022** **August 2021**
Faculty of Agronomy **Physics LS** **Duration 60 min**

SPECIFIC INSTRUCTIONS

يتضمن كل سؤال إجابة صحيحة. ضع علامة (✓) في المربع المناسب لكل سؤال على ورقة الأجابة المرفقة **(Answer sheet)**

- All of the blank pages on the back of this topic can be used for drafting if you wish. No draft will be distributed to you.
- The use of the non-programmable calculator is authorized
- In order to eliminate random answer strategies, each correct answer is rewarded with **3 points**, while each wrong answer is penalized by the withdrawal of **1 point**.

Verification of Newton's second law

We consider an inclined plane forming an angle $\alpha = 30^\circ$ with the horizontal plane. A particle (S), of mass m = 0.5 kg, is launched from O, the lowest point of the plane, at the instant $t_0 = 0$, with a velocity $\vec{V}_0 = V_0\,\vec{i}$ along the line of greatest slope (OB) of the inclined plane. Let A be a point of (OB) such that OA = 5 m (fig. 1). The position of (S), at an instant t, is given by $\overrightarrow{OM} = x\,\vec{i}$ where x = f(t).

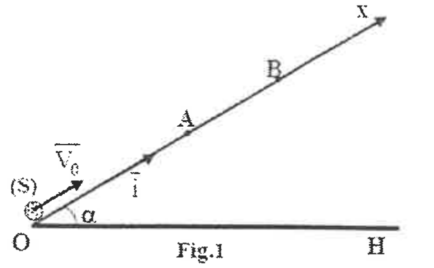

Fig.1

The variation of the mechanical energy of the system [(S), Earth], as a function of x, is represented by the graph in Figure 2.

Take:
- The horizontal plane passing through OH as the reference level for the gravitational potential energy;
- $g = 10\ m.s^{-2}$.

1. Referring to the graph in Figure 2, the variation ΔE_m of the mechanical energy of the system [(S), Earth] between the dates of passage of (S) through the points O and A is:

a) $\Delta E_m = -20$ J.
b) $\Delta E_m = +10$ J.
c) $\Delta E_m = -10$ J.

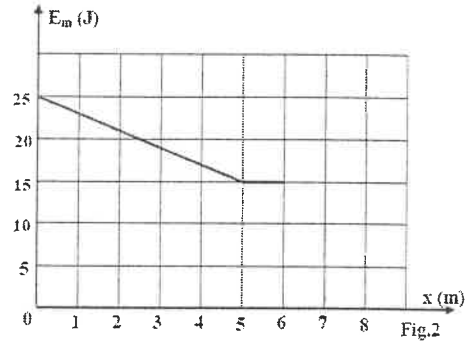

Fig.2

2. The magnitude of the force of friction, supposed constant between O and A, is equal to:

a) f = 2 N
b) f = 3 N
c) f = 5 N

3. For $0 \le x \le 5$ m, the expression of the mechanical energy E_m of the system [(S), Earth] is:

a) $E_m = -3x + 25$. (E_m in J; x in m);
b) $E_m = -2x + 25$. (E_m in J; x in m);
c) $E_m = -5x + 15$. (E_m in J; x in m).

4. The speed of (S) at the point of abscissa x = 6 m is:

a) v = 3.5 m/s;
b) v = 0 m/s;
c) None of the two answers.

Let v be the speed of (S) when it passes through the point M of abscissa x such that $0 \le x \le 5$ m.

5. The relation between v and x is given by:

a) $0.25\ v + 4.5\ x - 25 = 0$;
b) $0.5\ v^2 + 4.5\ x - 25 = 0$;
c) $v^2 + 18\ x - 100 = 0$.

6. The algebraic value a of the acceleration of (S) is constant at any time and it is equal to:
a) $a = -9\ m.s^{-2}$;
b) $a = +9\ m.s^{-2}$;
c) $a = -4.5\ m.s^{-2}$.

7. The speed of (S) at O is:
a) v(at O) = 9 m/s;
b) v(at O) = 10 m/s;
c) v(at O) = 4.5 m/s.

8. The speed of (S) at A is:
a) v (at A) = 3.16 m/s;
b) v (at A) = 2.56 m/s;
c) v (at A) = 2.24 m/s.

9. Knowing that $V_0 = 10\ m.s^{-1}$ and that the speed of (S), at an instant t, is given by $v = at + v_0$, then the duration $\Delta t = t_A - t_0$ of the displacement of (S) during its climb from O to A is:
a) $\Delta t = 1.11$ s;
b) $\Delta t = 1.52$ s;
c) $\Delta t = 0.76$ s.

10. Knowing that the linear momentum of (S) at A is 1.58 kg.m/s, then the sum of the external forces applied to (S), $\vec{F} = \Sigma\vec{F}_{ext}$, which is constant at any time, is equal to:
a) $\vec{F} = -9\,\vec{i}$ (F in N);
b) $\vec{F} = -4.5\,\vec{i}$ (F in N);
c) $\vec{F} = -3.10\,\vec{i}$ (F in N).

Determination of the characteristics of an unknown component

An electric component (D), of unknown nature, can be a resistor of resistance R', a coil of inductance L and of resistance r or a capacitor of capacitance C. To determine its nature and characteristics, it is connected in series with a resistor of resistance R = 10 Ω across a generator G as shown in Figure 1. Using an oscilloscope, we can measure the voltage $u_g = u_{AM}$ across the generator and the voltage $u_R = u_{BM}$ across the resistor.

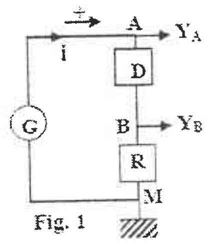

Fig. 1

Case of a DC voltage

The generator G delivers a DC voltage U_0. On the screen of the oscilloscope, we observe the waveforms of figure 2.

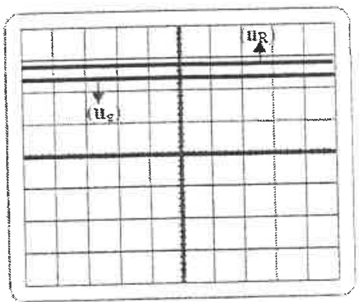

Fig.2
Ch A: S_V = 5 V/div
Ch B: S_V = 2 V/div

11. In steady state, the value of the voltage U_0 delivered by the generator and that of I, the current in the circuit are:
a) U_0 = 12 V and I = 0.28 A;
b) U_0 = 4.8 V and I = 0.56 A;
c) U_0 = 12 V and I = 0.56 A.

12. The electric component (D) can be:
a) a coil;
b) a resistor;
c) a coil or a resistor.

13. The resistance R_D of the component (D) is:
a) R_D = 11.43 Ω.
b) R_D = 21.37 Ω.
c) R_D = 10.12 Ω.

Case of an alternating voltage

The generator G delivers now an alternating sinusoidal voltage.

On the screen of the oscilloscope, we observe the waveforms of figure 3.

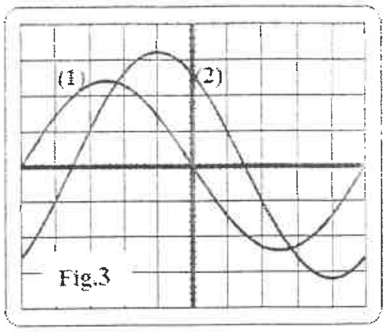

Fig.3

Ch A: $S_V = 5$ V/div

Ch B: $S_V = 1$ V/div

Horizontal sensitivity: $S_h = 2$ ms/div

14. Referring to these waveforms, we can say that (D) is:

a) a coil;

b) a resistor;

c) a coil or a resistor.

15. The waveform (2) represents the variation of the voltage:

a) $u_{AB} = u_D$ across (D);

b) $u_{BM} = u_R$ across the resistor;

c) $u_{AM} = u_g$ across the generator.

16. In steady state, the expression of the voltage u_g is given by:

a) $u_g = 3.2 \sin(50\pi t)$ (u in V);

b) $u_g = 3.2 \cos(100\pi t)$ (u in V);

c) $u_g = 12 \sin(100\pi t)$ (u in V).

17. In steady state, the expression of the current i as a function of time is given by:

a) $i = 0.32 \sin(50\pi t + 0.942)$ (i in A)'

b) $i = 0.32 \sin(100\pi t - 0.942)$ (i in A);

c) $i = 1.6 \cos(100\pi t + 0.942)$ (i in A).

18. By applying the law of addition of voltages and by giving ωt the two values 0 and $\pi/2$ rad, we find the two following relations:

a) For $\omega t = 0$: $59.1\,L - 0.259\,(R + r) = 0$ and for $\omega t = \pi/2$: $12 = 0.188L + 81.3\,(R + r)$;

b) For $\omega t = 0$: $59.1\,L - 0.259\,(R + r) = 0$ and for $\omega t = \pi/2$: $12 = 81.30L + 0.188\,(R + r)$;

c) For $\omega t = 0$: $0.259L - 59.1\,(R + r) = 0$ and for $\omega t = \pi/2$: $12 = 81.30L + 0.188\,(R + r)$.

19. The value of the inductance L of (D) is:

a) $L \approx 0.097$ H;

b) $L \approx 0.063$ H;

c) $L \approx 0.086$ H.

20. The value of the resistance r of (D) is:

a) $r \approx 22\ \Omega$;

b) $r \approx 12\ \Omega$;

c) $r \approx 18\ \Omega$.

Answer sheet

	a)	b)	c)
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