AL Physics MC Answers

Year:1986

Question Number: 1,21,25,26,31,34,37,42,46

1986MC (1)

Let T be the tension

Motion of the 2 kg mass: mg - T = ma

Motion of the 3 kg mass : T – Mgsinθ = Ma

Find T and a from the above equations

If a is found positive, the 2 kg mass is really falling down.

If a is found negative, the motion is opposite to that we assumed

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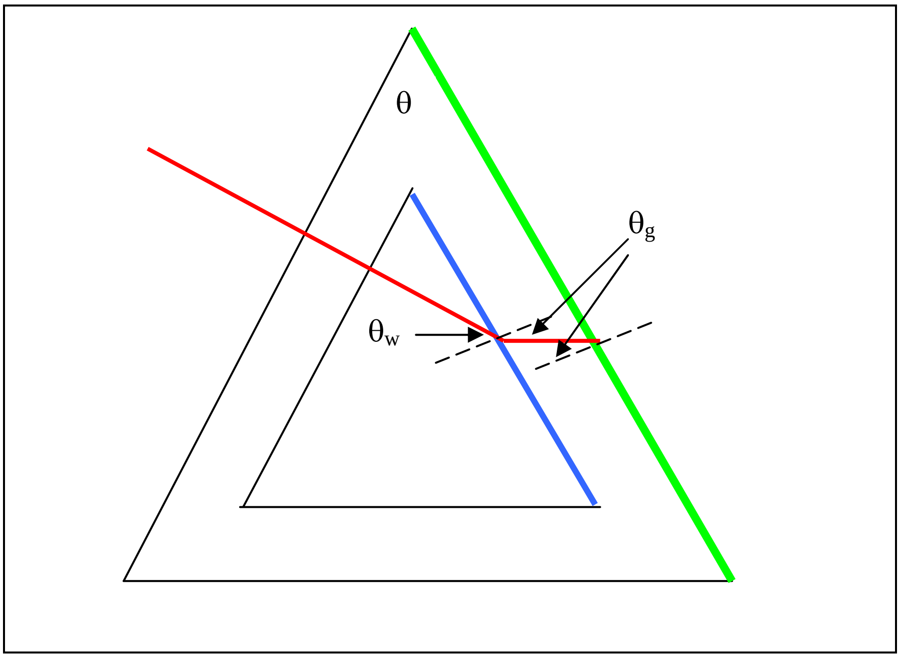
1986MC(21)



Refraction at the blue interface

$$n_w \sin\theta_w = n_g \sin\theta_g$$

$$(4/3)\sin\theta_w = (3/2)\sin\theta_g$$

Since $\theta = \theta_w$,

$$\sin\theta_g = (8/9)\sin\theta$$

Refraction at the green interface

The green surface is parallel to the blue surface, so the angle of incidence at the green interface = θ_g

Total internal reflection occurs when

$$\sin\theta_g = 1/n_g$$

$(8/9)\sin\theta = 2/3$

$\sin\theta = 3/4$

1986MC(25)

Speed of transverse wave in a stretched string $\propto \sqrt{tension\ in\ the\ string}$

When the tension is increased by 1 %, the new speed is therefore $\sqrt{1.01} = 1.005$ times the old speed (we talk about the waves in string, not the sound in air).

In string, wavelength of fundamental is fixed
speed is 1.005 times higher,
freq is 1.005 times higher.

In air, freq of the sound generated = freq of vibration of string
So freq of sound heard is 1.005 higher.

Beat frequency = difference in frequency = 0.005 (old freq) = 0.005(1200) = 6 Hz.

1986MC (26)

Doppler effect

When the aeroplane is approaching $f_1 = \dfrac{c}{c-v} f$

When the aeroplane is leaving, $f_2 = \dfrac{c}{c+v} f$

Their difference $f_1 - f_2 = \dfrac{2vc}{c^2 - v^2} f \approx \dfrac{2v}{c} f = \dfrac{2(300)}{3\times 10^8} 30\times 10^6 = 60 Hz$

[Radio waves travel at the speed of light]

1986MC (31)

We use "$\frac{1}{2}mv^2 = eV$".

However, we need to treat the signs carefully. $\frac{1}{2}mv^2$ is the gain in kinetic energy and eV is the loss in electrical potential energy. For simplicity, we may take the absolute values of both sides.

A good approach to writing the principle of conservation of energy is

$$\frac{1}{2}mv_A^2 + eV_A = \frac{1}{2}mv_B^2 + eV_B$$

A is the point of r = 1m and B is a point on the surface.
We will get the correct answer whenever we we use the correct formulae [Note: e and V must bear correct signs]..

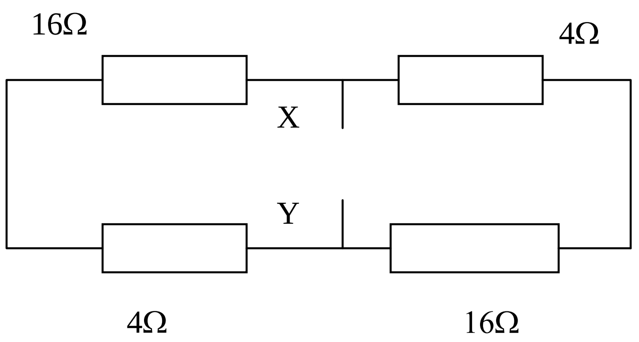
$$0 + (-10^{-10})[\frac{10^{-4}}{4\pi\varepsilon_0(1)}] = \frac{1}{2}(2\times10^{-5})v^2 + (-10^{-10})[\frac{10^{-4}}{4\pi\varepsilon_0(0.1)}]$$

where

$$\frac{1}{4\pi\varepsilon_0} = 9\times10^9$$

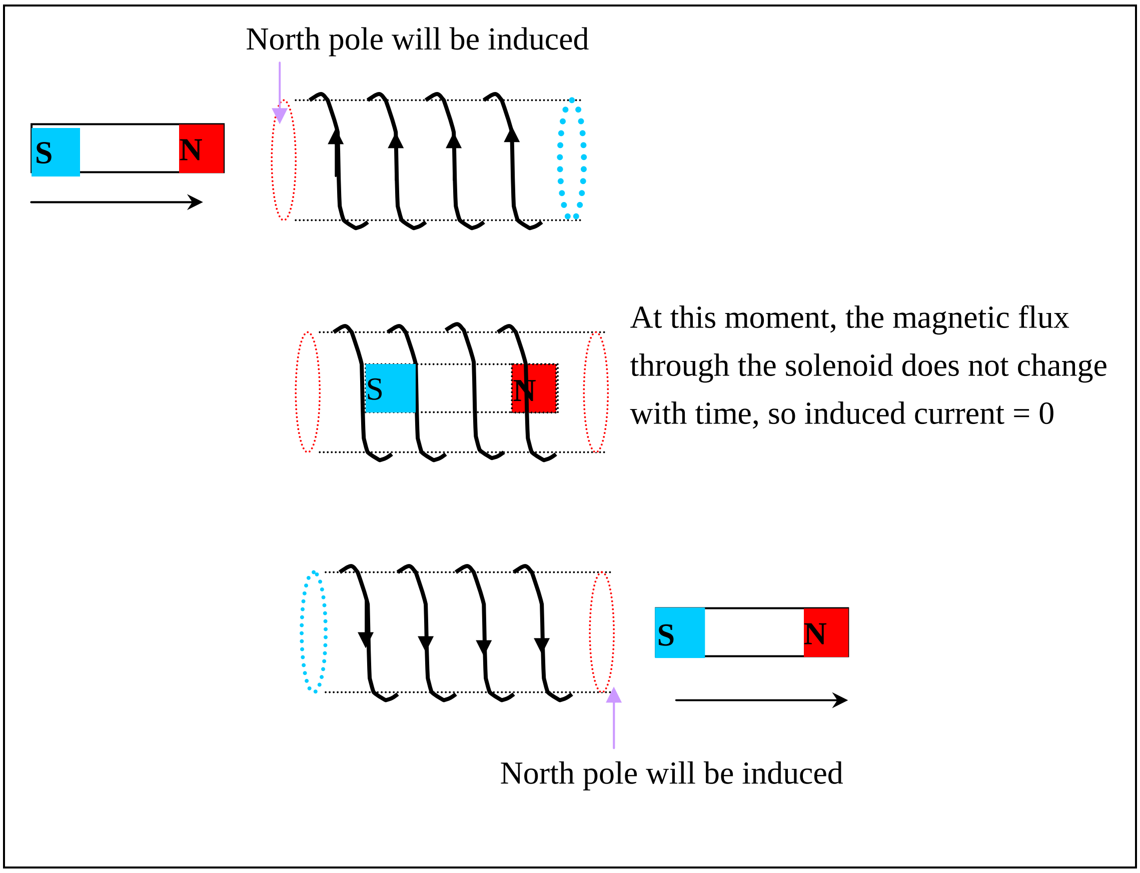
Finally, we get v = 9 ms^{-1}.

1986MC (34)
The original circuit can be changed to



The total resistance is $(\frac{1}{16+4} + \frac{1}{16+4})^{-1} = 10\Omega$

1986 MC(37)



More about the middle figure: To the right end of the solenoid, the "N" of the bar magnet is approaching, so a north pole is induced there.

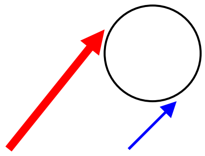
To the left end of the solenoid, the "S" of the bar magnet is leaving, so also a north pole is induced there.

Cancellation occurs, no net current is flowing

The induced current flows in one direction first, it rises and drops to zero and then flows in the opposite direction.

1996MC (40)

At the top , the air blows at a faster speed (lower pressure). This part of air tends to drag the ball to rotate clockwise.



At the bottom, the air blows at a slower speed (higher pressure). This part of air tends to drag the ball to rotate anti-clockwise.

The effect of the upper force is bigger, so the ball finally rotates clockwise.

When the angle θ increases, the difference between the two dragging forces becomes smaller, so the ball spins more slowly.

1986MC (42)

A. R, diode and CRO are in series, the voltage will drop across that having the infinite resistance. In forward bias, the CRO unquestionably displays the waveform of the input source. But in reverse bias, the result is unknown because we do not exactly know which one, the diode or the CRO, has a larger internal resistance (both are assumed infinite, but which one is "more infinite"?). Nevertheless, (A) is not the best answer.

B. The CRO always connects to the source, so the CRO displays the waveform of the input a.c. signal.

C. The current passing through the resistor is rectified, but the CRO is not connected across the resistor. As in (B), it is connected to the terminals of the source.

D. The upper diode blocks the current when the upper terminal is positive. The lower diode blocks the current when the lower terminal is positive. No current flows at all times!

E. Yes, the CRO displays a half-rectified waveform

1986 MC (46)

For convenience, let $E_\infty = 0$, so the energy level of a hydrogen atom is $E_n = \dfrac{E_1}{n^2}$ because

$E_n = E_1$ when n = 1. From the graph, E_1 is below “0” by 8 units, so E_1 = - 8 units. When n = 2 (first excitation), $E_2 = -8/2^2 = -2$ units, so E_2 is below “0” by 2 units.