AL Physics MC Answers

Year:1990

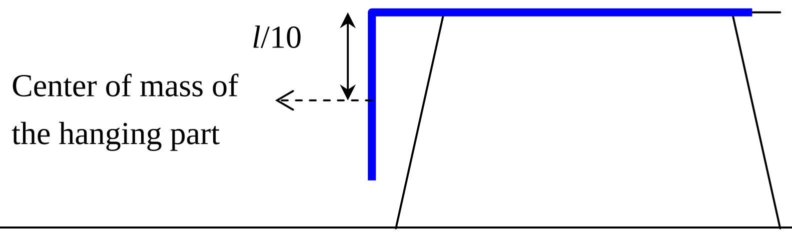
Question Number: 3,5,7,15,17,23,31,32,35,36,38,39,49

1990MC (3)

Mass of rope hanging = m/5

If the whole rope is pulled to lie on the horizontal table, the increase of the potential energy of the rope is $(\frac{m}{5})g(\frac{l/5}{2}) = \frac{mgl}{50} = 0.02mgl$

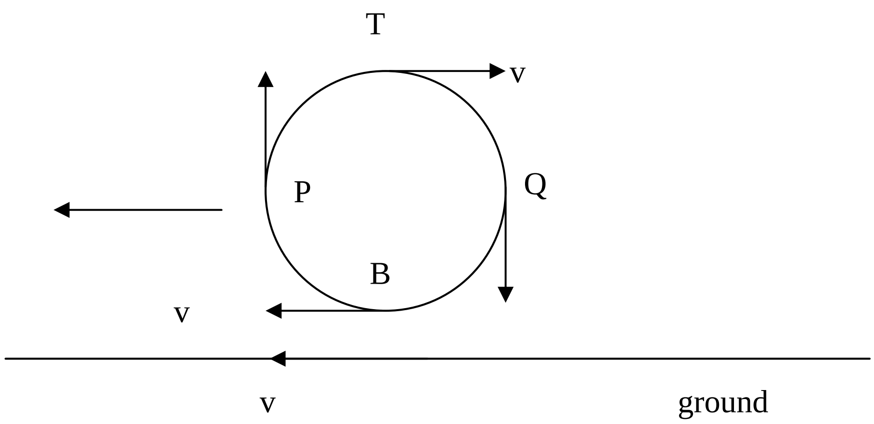
The whole mass of the hanging part is regarded as a point mass placed at the center of this part, i.e *l*/10 below the table.



So the minimum energy required is *0.02mgl*

1990 MC (5)

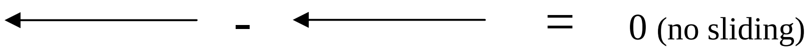
The velocities of the wheel at different parts relative to the center of the wheel is



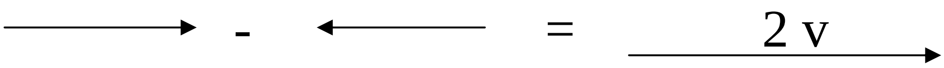
Relative to centre, velocity of A is $\vec{v_A}$ and velocity of ground is $\vec{v_G}$.

Then the velocity of A relative to ground is $\vec{v_A} - \vec{v_G}$

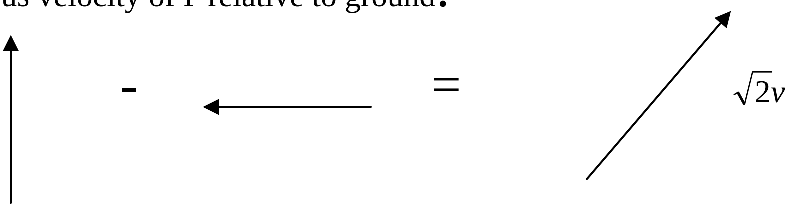
Instantaneous of B relative to ground:



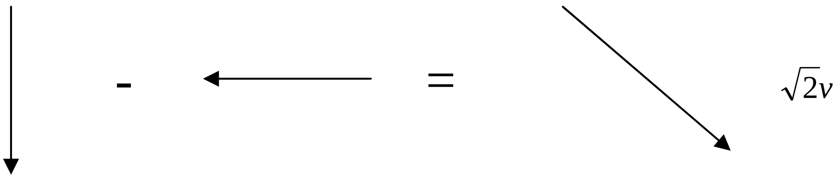
Instantaneous velocity of T relative to G:



Instantaneous velocity of P relative to ground:



Instantaneous velocity of Q relative to ground:



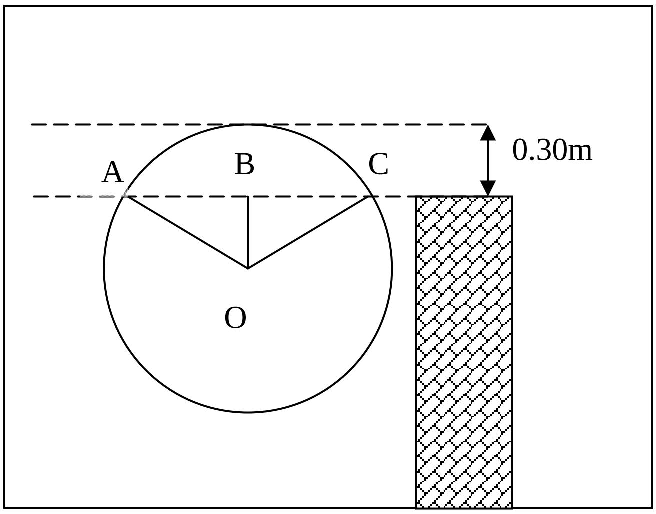
1990MC(7)

This question has been discussed in S6.

Move from A to C along major arc AC , the ball is hidden, the time is 6s, Move from C to A along minor arc AC, the ball is seen, the time is 2 s. The total time is 8 s.

$\angle AOC = \frac{2}{8}(360^0) = 90^0$, so

$\angle AOB = 45^0$



Let the radius (i.e. the amplitude of SHM) be A

In ΔAOB, $\cos 45^0 = \frac{A - 0.3}{A}$. Finally, we get A = 1.02 m

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1990MC (15)

Speed of transverse wave along a stretched string

$v = \sqrt{\dfrac{T}{\mu}}$, where T is the tension in the string and μ is its mass per unit length.

Original length = l

The string is stretched to 2l. By Hooke's law, the tension then is k(2 l- l) = kl and

μ = m/2l, where m is the total mass of the string

$$v = \sqrt{\frac{kl}{m/2l}} = \sqrt{\frac{2kl^2}{m}}.$$

Now, the string is stretched to 3l, tension becomes and k(2l), m = m/3l

New speed $v' = \sqrt{\dfrac{k2l}{m/3l}} = \sqrt{\dfrac{6kl^2}{m}} = \sqrt{3}v$

1990MC (17)

Why are there two spots? The disc is seen in every 1/8 second.

First flash, the spot is at the top,

Second flash (1/8 second later), the spot is at the bottom

Third flash (2/8 second later), the spot is at the top, ………….. so on.

In other words, the disc rotates at the period 1/4 second (frequency = 4 Hz).

Now, the flashing rate is reduced to 2Hz (period = ½ s).

Time	Bright/dark	Position of the spot
0	**Bright**	**Top**
1/8 s	Dark	Bottom
1/4 s	Dark	Top
3/8 s	Dark	Bottom
1/2 s	**Bright**	**Top**

Simply speaking, the disc completes exactly two revolutions between two flashes.

The spot is always at the top when the disc is seen

1990MC(23)

(1) d sinθ = mλ

If d, the separation between the two loudspeaker, is less than λ.,

sinθ > 1 for m > 0. Except the central maximum, we cannot detect other maxima.

(2) Freq increases, λ decreases. θ for the same order will decrease. The pattern shrinks.

(3) If the two lousdpeaker are vibrating in antiphase, nothing change except the interchange of the positions of maxima and minima

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1990MC (31)

Both bulbs are resistors in nature.

The effect of a.c. 12V r.m.s is equivalent to to d,c, of 12 V

B_1's brightness does not change resistance does nor depend of frequency

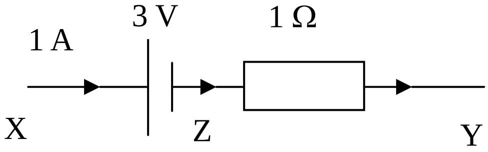
B's brightness will decrease

D.C.: the inductor just behave a wire of no resistance, so the 12 V d.c. will be entirely applied to B_2.

A.C.: the inductance has its own reactance. Only part of the 12 V is applied |across B_2.

$$(V_{rms,supply})^2 = (V_{rms,R})^2 + (V_{rms,L} - V_{rms,C})^2$$

1990MC (32)

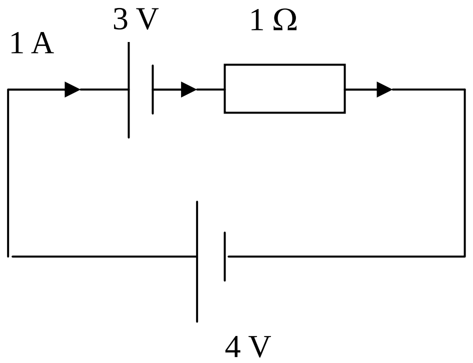


From X to Z, the potential is lowered by 3 V (from the positive terminal to the negative potential of the battery)

From Z to Y, the potential is lowered by 1 V (the current-leaving terminal has a lower potential w.r.t. the current-entering terminal of a resistor)

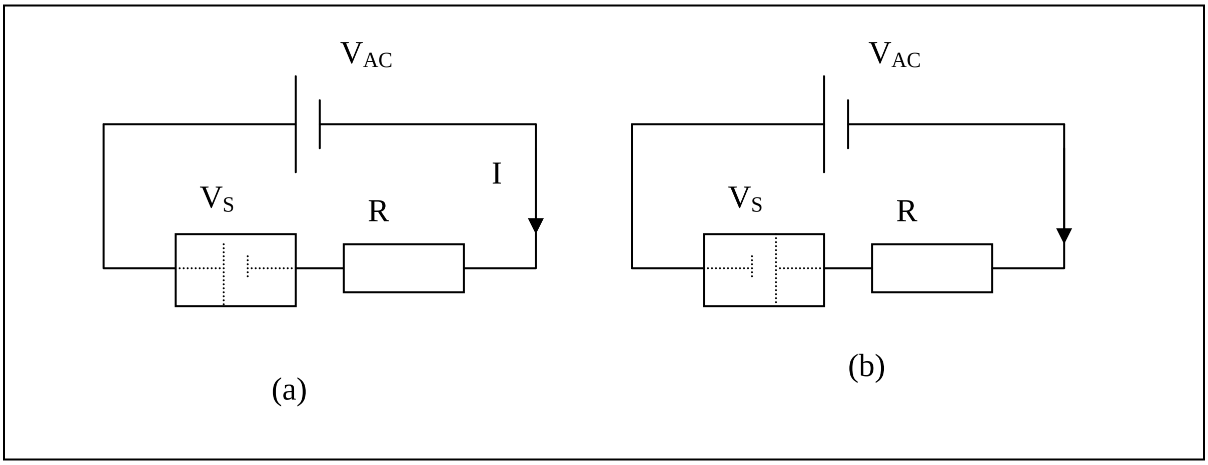
So, the total p.d. is 4 V.

The whole problem relies on the direction of the current. If the current flows from Y to X, the total p.d. is, of course, 3V-1V = 2V. The current flows in this direction because there is a source of larger EMF outside, e.g



1990MC (35)

When the slider is moved from A to B, V_{AC} increases.



In circuit (a), the current I is $(V_S - V_{AC})/R$, so I will cease to zero when $V_{AC} = V_S$

But in circuit (b), $I = (V_S + V_{AC})/R$. As V_{AC} increases, I will increase.

According to the description " maximum deflection at B and minimum deflection at A", we deduce that the only possible reason is "S is connected with wrong polarity", as that in Fig (b).

1990 MC (36)

(1) Incorrect. As the motor gains speed, the back emf increases, so current drops. ($\varepsilon = NBA\omega$)

(2) Correct. Torque is proportional to current (NBAI)

(3) Correct Efficiency = $\frac{output\ power}{input\ power}100\% = \frac{\varepsilon I}{VI}100\%$.

$\varepsilon/V = 0.75$ $\varepsilon = 12 \times 0.75 = 9$ V

1990 MC (38)

Inductance of a coil depends on the coils only. It does not depend on the circuit in which the coil is connected.

You have a coil which is marked “1 mH”.
Under all circumstances the inductance of the coil is “1 mH”.

1990MC(39)

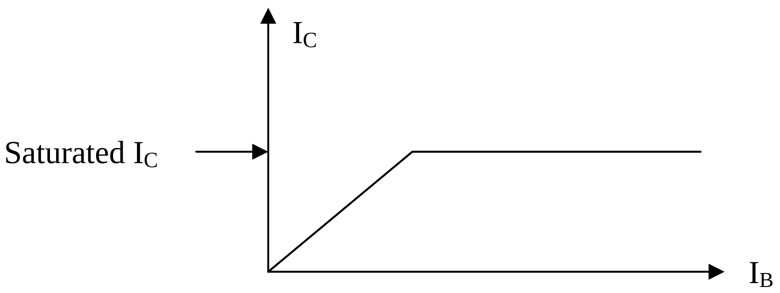
Suppose V_{BE} = 0.6V, $I_B = \frac{5-0.6}{10\,000} = 0.44\ mA$

$I_C = \beta I_B$ = 100 x 0.44mA = 0.044 A = 44 mA

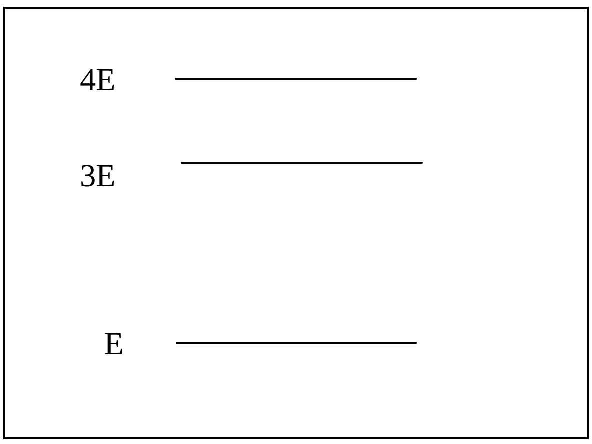
The above calculation is wrong because the transistor has already been saturated!

The answer is 5 mA, not 44 mA

In saturation, $V_{CE} \approx 0$, so the +5V is entirely applied across the collector resistor 1 kΩ. The saturated collector current is therefore 5/1000 = 5 mA.
In other words, I_C will not exceed 5 mA.



1990MC (49)



Energy released E = hf = hc/λ

Drop from 4E to E, $4E - E = hc/\lambda$, so $\lambda = hc/3E$

Drop from 4E to 3 E, $4E - 3E = hc/\lambda'$, so $\lambda' = hc/E = 3(hc/3E) = 3\lambda$

Drop from 3E to E, $3E - E = hc/\lambda''$, so $\lambda'' = hc/2E = (3/2)(hc/3E) = 3\lambda/2$

The possible wavelengths emitted are 3λ and $3\lambda/2$.