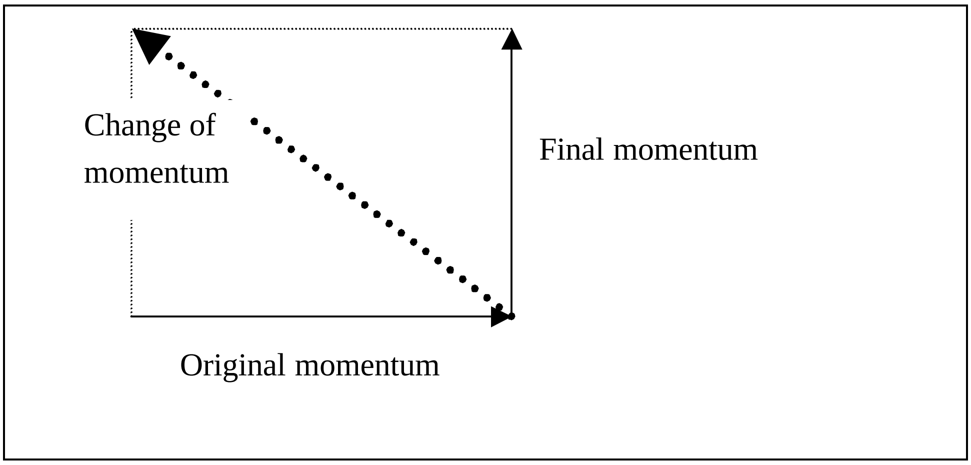
AL Physics MC Answers

Year:1994

Question Number:4,5,10,16,22,27,37,38,39

1994MC(4)

Impulse = change of momentum



The momenta are moving in different directions, so we need to do a vectorial subtraction.

Impulse = $0.5\sqrt{20^2+30^2} = 18$ kg m s^{-1}

1994MC(5)

To execute circular motion, at the top, the centripetal force required is provided by the weight

$mv^2/R = mg$ … … ……(1)

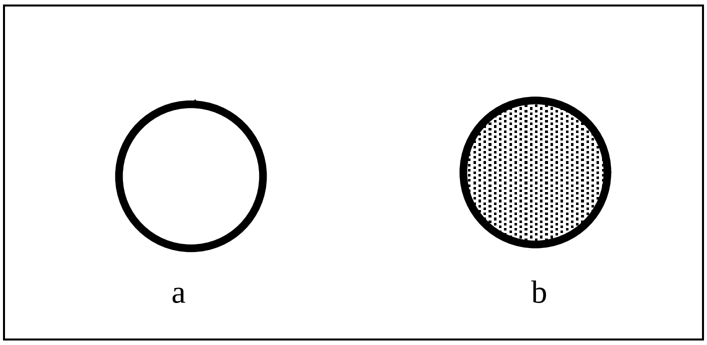
$v = \sqrt{gR}$

Let v' be the speed at the bottom.

By conservation of energy, $mv'^2/2 = mv^2/2 + mg(2R)$ … … … … ….(2)

From (1) and (2), $v' = \sqrt{5gR}$

1994MC(10)



(1) Equal mass, so (a) has a larger MI.
(2) Period is proportional to $\sqrt{I}$, so (a) has a longer period.
(3) They are released at the same height. KE at the lowest point = loss in gravitational PE = mass x g x distance from axis of rotation to center of mass. Their centers of mass are both situated at their centers.

Same PE loss, so same KE.

1994MC(16)

Beat frequency = $f_1 - f_2$

From the information, we know

$f_X - f_Y = 3$ or $f_Y - f_X = 3$ (we do not know which one is higher)

$f_X - f_Z = 1$ or $f_Z - f_X = 1$

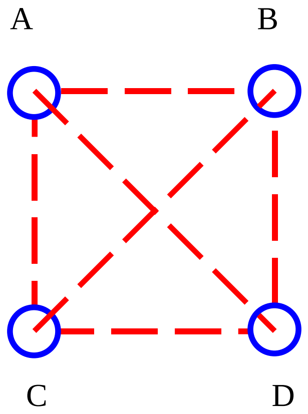
(1) Not sure although it is possible
(2) Not sure although it is possible
(3) X is the highest frequency so only $f_X - f_Y = 3$ and $f_X - f_Z = 1$ are possible. The order is $f_X > f_Y > f_Z$.

1994MC (22)

Young's modulus $E = \frac{Fl}{Ae}$, so the applied force $F = \frac{EA}{l}e$. Compare with Hooke's law, we identify $k = \frac{EA}{l}$.

A wire is cut into two and arranged side by side. Effectively, $l \to \frac{l}{2}$ and $A \to 2A$, so k is four times larger.

1994MC(27)



A=B=C=D=1C

To put the four charges together, we consider a procedure like this

(1) At the beginning, there is no charge, so no energy is needed to put A to the top-left corner.

(2) At the presence of A, B is brought to the top-right corner,

energy required = q_B (potential due to A) = $1((\frac{1}{4\pi\varepsilon_0 1}) = \frac{1}{4\pi\varepsilon_0}$

(3) At the presence of A and B, C is brought to the bottom-left corner,

energy required = q_C (potential due to A and B) = $1(\frac{1}{4\pi\varepsilon_o} + \frac{1}{4\pi\varepsilon_0(\sqrt{2})})$

(4) At the presence of A, B and C, D is brought to the bottom-right corner,

energy required = q_D (potential due to A, B and C) = $1(\frac{2}{4\pi\varepsilon_o} + \frac{1}{4\pi\varepsilon_0(\sqrt{2})})$

Total energy stored in the system = sum of the above all energies.

$$= \frac{4}{4\pi\varepsilon_0} + \frac{2}{4\pi\varepsilon_0\sqrt{2}} = \frac{1}{4\pi\varepsilon_0}(4+\sqrt{2})$$

In general, if there are charge q_1, q_2, q_3, … … , q_n and their separation are r_{12}, r_{13}, r_{23}, … …, then the total energy stored in them is

$$\frac{1}{4\pi\varepsilon_0}(\frac{q_1q_2}{r_{12}} + \frac{q_1q_3}{r_{13}} + \text{.........} + \frac{q_1q_3}{r_{13}} + \text{............})$$

Any two of them "meet" one time only.

1994MC(37)

The discrete points will match the solid line when each f is decreased by a fixed amount or V is increased by a fixed amount.

hf -ϕ = eV

A. The intensity does not affect the stopping potential

B. "A fixed zero error" → each data differs the true value by a fixed amount.

C. "read the wrong scale on his voltmeter so that his readings always double the actual readings" →

Actual reading	Wrong data
2 V	4 V
3 V	6 V
4 V	8 V

The wrong data is always larger than the true reading, but the difference is NOT a constant.

D. "wrong polarity of the d.c. supply"→ the electrons will not be stopped, so no stopping voltage V will be found.

E. If V is plotted against wavelength, the graph will not be a straight line.

$\frac{hc}{l} - \Phi = eV$ (a straight line must have the form y = mx + c)

1994 MC (38)

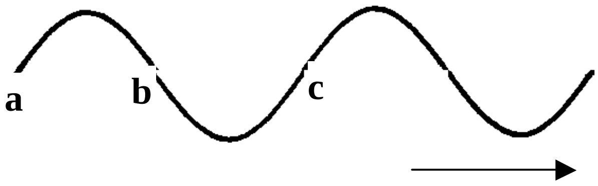
$$E_n = -\frac{X}{n^2}$$

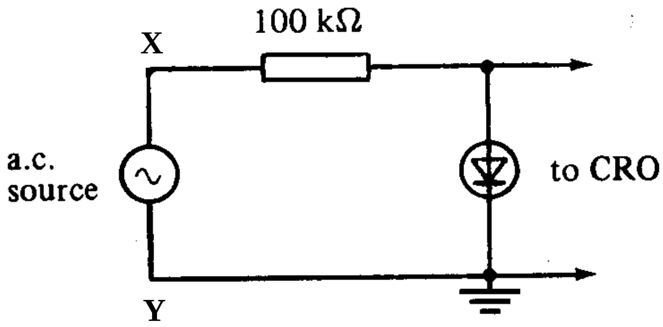
First excited state (n = 2) to the ground state (n = 1), hf = $E_2 - E_1 = \frac{3}{4}X$.

Drop from n = 3 to n = 2, hf'= $E_3 - E_2 = \frac{5}{36}X$

$\frac{f'}{f} = \frac{5}{27}$ f' = 0.19 f

1994MC(39)





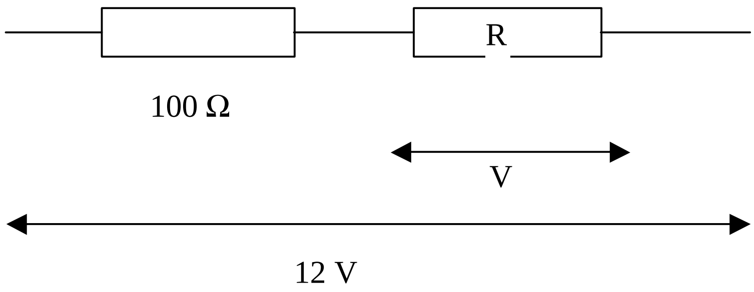
1. The diagram is assumed ideal, i.e.

   resistance of the diode = 0 (perfect conductor) when the diode is forward-biased.

   resistance of the diode = infinity (perfect insulator) when the diode is backward-biased.

2. When two resistors are connected in series, the larger the resistance, the higher the p.d.

   e.g.



When R = 100000000 Ω, $V \approx 12V$

When R = 0.000000001 Ω, $V \approx 0V$

3.

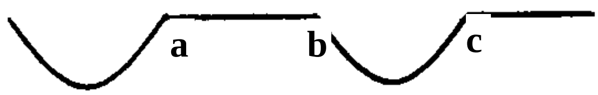
Referring to the resistor-diode circuit, the diode is forward –biased when X is positive w.r.t. Y (a to b), The resistance of the diode is much smaller than that of the resistor, so

$$p.d\ across\ the\ diode \approx 0$$

When X is negative w.r. t. Y (b to c), the diode is backward-biased, the resistance of the diode is much larger than that of the resistor, so

$$p.d.\ across\ the\ diode \approx external\ applying\ a.c$$

So, the p.d. across the diode is



1994(AS) MC (17)

Power input = 12 V x 0.5A = 6 W

Useful power output = 10 N x 0.4 ms-1 = 4 W

Power loss due to internal resistance of the armature = I^2 R = 2 W

$(0.5)^2R = 2$ R = 8 Ω