AL Physics MC Answers

Year:1998

Question Number:2,3,4,5,9,12,14,16,17,18,21,22,23,24,25,26,27,30,31,32,39,40

1998MC (2)

Let x be the distance

$$\frac{x}{5}-\frac{x}{9}=64 \qquad x = 720 \text{ km}$$

1998MC (3)

Let the mass of A be m

The mass of B is therefore 2 m

Net force on the whole system (A and B) = P - Q

Acceleration of the system a = (P-Q)/3m

Let the force acting on B by A be F.

Net force on B = F – Q

Consider the motion of B

F - Q = 2m(a)

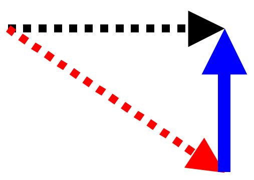
= 2m[(P-Q)/3m]

Hence, F is found.

1998MC (4)

Force = rate of change of momentum.

In vector form $\vec{F}=\frac{d(m\vec{v})}{dt}$



Change of momentum = final momentum – initial momentum. Of course, it is a vectorial subtraction !

Magnitude of change in momentum = $[(\sqrt{2})^2-1^2]^{1/2}=1N$

Force = 1/0.5 = 2 N

Direction of change of momentum = due north, so force is due north

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1998MC (5)

(1) F causes acceleration. F is nonzero, so a is nonzero.

(2) Join a straight line between "4" and "5". The area = 5 x 4/2 = 10 Ns.

Area = change of momentum= 1(v) - 1(0)

Area < 10 Ns, so v < 10 ms-1

(3) After accelerating, the final speed of the object is nonzero

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1998MC (9)

Many students will choose E, because it looks like the "resonance curve"

Resonance curve: horizontal axis ----- driving frequency

Vertical axis ------- amplitude of the responder

But now, the vertical axis is the final frequency of oscillation of the responder.

The final frequency of oscillation of the responder (f) is always equal to the driving frequency (f_a) no matter it is equal to the natural frequency of the responder (f_0) or not.

The answer is D

1998MC (12)

Grating formula dsin θ= mλ

From the central, the orders are

2(400)=800, 3(400)=1200, 2(700) = 1400, 3(700) =2100,

.i.e. second order of violet, third order of violet, second order of red, third order of red

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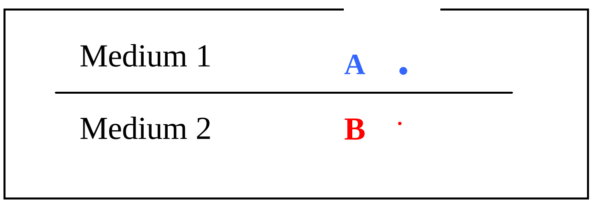
1998MC (14)

. (1) The frequency does not change when crossing an interface

This is common to refraction of all waves. AL does not require the explanation, but a simple argument is given here.

Frequency is the number of oscillations in one second. Consider two points along an interface, one is in medium 1 and one in medium 2.



Now, A and B are made to as close as possible . A and B become essentially one single point, with A still in medium 1 and B in medium 2.

Now, we measure the frequencies at these two points. Could you measure two different values ? No, they must be exactly the same. (Any slight difference would accumulate with time, e.g. A oscillates 100 times and B oscillates 100.5 times. If it did happen, A would be at a crest and B at a trough -----don't forget, A and B are very close to each other and essentially can be treated as the same point!).

1998MC (16)

One end is open, one end is closed

Resonant condition: L= nλ/4, where n = 1, 3, 5, … …

(2) Correct . L is increased by 3 times. Same λ is obtained. if n = 3.

(3) Incorrect. Twice the frequency, so half the wavelength.

If λ is halved, only n = 2 can result the same L. But n must be odd

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1998MC (17)

Gravitational potential is maximum, so the net gravitational force is zero

$$\frac{GM}{R^2} = \frac{Gm}{r^2},\ so\ \frac{R}{r} = \sqrt{\frac{M}{m}} = \sqrt{\frac{81}{1}} = 9$$

R + r = $3.8\times10^8 m\ \ and\ R:r = 9:1$

So R = $\frac{9}{10}(3.8\times10^8) = 3.4\times10^8 m\ (dis\tan ce\ \ from\ earth)$

1998MC (18)

L_2 and L_3 are in parallel. P = V^2/R, so P $\propto \frac{1}{R}$

Resistance of L_3 is R and P_2 : P_3 = 1: 3, so R_2 = 3R

The equivalent resistance of L_2 and L_3 is therefore 3R/4

Denote the parallel combination of L_2 and L_3 by L_{23}

L_1 and L_{23} are in series, P = I^2R, so P $\propto$ R

P_1 and P_{23} are in the ratio 1 : 4, so R_1 = R_{23}/4 = (3R/4)/4 = 3R/16

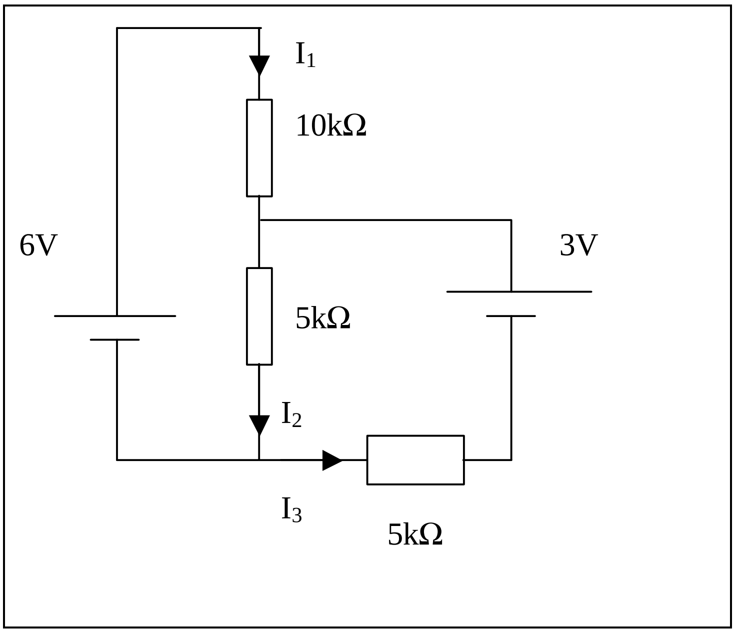
1998 MC (21)

If the "2V" battery and the voltmeter is removed, the p.d. across the 5 kΩ is 6V[5/(5+10)] =2 V.

After the connection of the "2V" battery and the voltmeter, the two sides of the voltmeter are both 2 V.

No current passes through the voltmeter, so its p.d. is 0V

You may ask if the "2V" battery is replaced by another one of "3V", what is the result ? Then, we can solve it by using Kirchhoff's rules



Solve I_1, I_2 and I_3 from:

$6\text{ V} = I_1(10\text{k}\Omega) + I_2(5\text{ k}\Omega)$

$3\text{ V} = I_2(5\text{k}\Omega) + I_3(5\text{ k}\Omega)$

$I_2 = I_1 + I_3$

[It is Maths, not Phy--- not likely to appear in AL]

1998MC (22)

"isolated conducting sphere" means

(i) the sphere is made of a conductor

(ii) the sphere is isolated from its surroundings, e.g. it is suspended by an insulate thread.

With reference to infinity, the potential on the surface of a charged sphere is $V = \dfrac{Q}{4\pi\varepsilon_0 a}$. The sphere can be regarded as a capacitor. Compare with V = Q/C, we can identify the capacitance of a charged sphere as $4\pi\varepsilon_0 a$. The energy stored in the sphere can thus be found by apply the energy stored in a capacitor $Q^2/2C$.

1998MC (23)

P.d across C is proportional to Q.

P.d.across R is proportional to I.

I is the rate of change of Q.

The graph shows V_{AC} against t, so its variation is identical to Q against t.

V_R –t graph is therefore the slope of the graph of V_{AC}-t graph

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1998MC (24)

Finally, same p.d.

C = Q/V.

Different C, so different Q.

Energy = CV2/2

In the process of charge sharing, unavoidably there is energy loss. This is a well -known fact. We have spent a lot of time to discuss this issue on class.

The loss of energy is dissipated in the connecting wires. If the wires have no resistance, the "final stage" will never be reached

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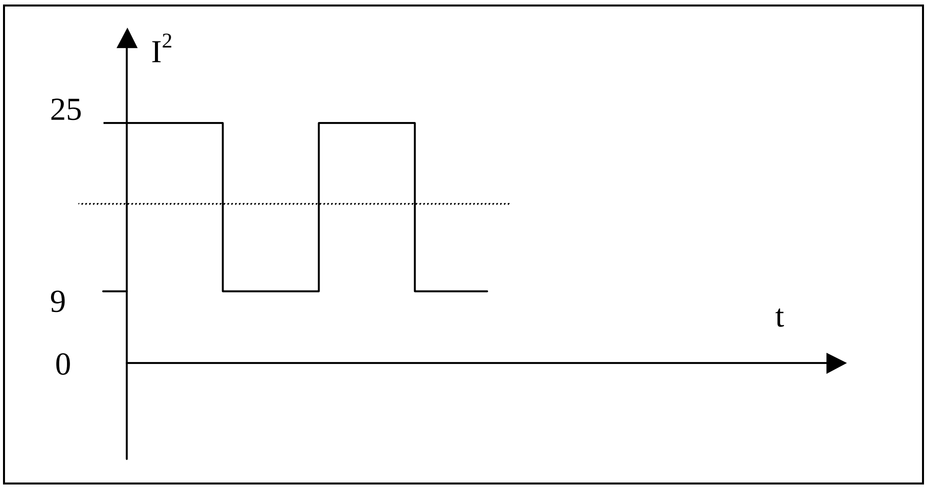
1998MC (25)

Root mean square of current



Mean of the square = (25+9)/2 = 17

Root of the mean of the square = $\sqrt{17} = 4.1A$

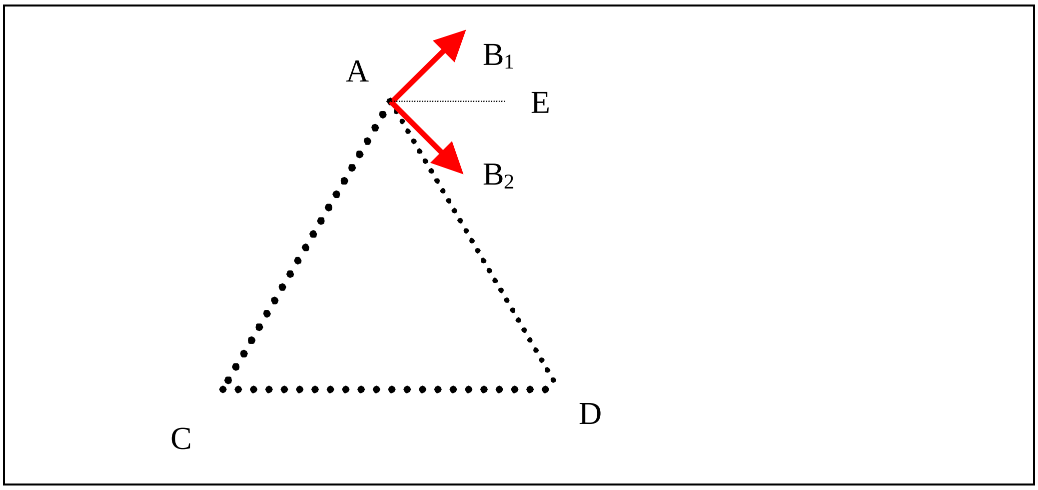
1998MC (26)

When a charged particle undergoes circular motion in a uniform field, its <u>period is independent of speed</u>.

$\frac{mv^2}{r} = Bqv$, so $\frac{v}{r} = \frac{Bq}{m}$. Period T = $\frac{2pr}{v} = \frac{2pm}{Bq}$

T is independent of v.

1998MC (27)



B field is perpendicular to radius.

So $\angle CAB_2 = 90^0, \angle DAB_1 = 90^0 \quad \angle B_1AE = \angle B_2AE = 30^0$

Resultant B = $2\frac{m_0}{2pr} I \cos 30^0 = \frac{\sqrt{3}I}{2pr}$ (to the right)

1998MC (30)

The force on BC is out of page.

The force acting on AB is downward, the force acting on DC is upward. Such forces tends to reduce the area of the coil.

If the coil is rotated slightly clockwise, the forces on AB and on DC will produce a clockwise moment. So the coil will not return to its original vertical position.

1998MC (31)

(2) Electrical PE = $\frac{Q_1Q_2}{4pe_o r^2}$. Both Q_1 and Q_2 are positive. PE increases when r decreases

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1998MC (32)

(3) Fire an α particle at a specified direction towards a gold nucleus. . It rebounds after striking the gold nucleus. Everything can be determined without any uncertainties (classically). The process is deterministic, not probabilistic

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1998MC(39)

When S is open, the two resistors are in series. The voltmeter should read half of the emf of the battery.

When S is closed, the resistor is shorted, the voltmeter then measures directly the emf of the battery. So $V_{S\ open}$ should be half of $V_{S\ closed}$.

1998MC (40)

The output voltage is positive, so $V_+ > V_-$.

By decreasing V_+ or increasing V_-, the output voltage may be made to be negative.

(1) Increasing R_1,,V_- will decrease

(2) .Decrease R_3, V_+ will decrease

Resistance of LDR increases if less light falls onto it, V_+ will decrease.