HKAL Physics MC Answers

Year:1998

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

1998MC (2)

Let x be the distance

$\frac{x}{5} - \frac{x}{9} = 64$ x = 720 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)

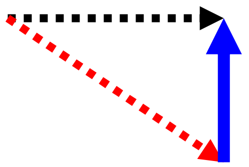
= 2m[(P-Q)/3m]

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 vector 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: $d\sin\theta = m\lambda$

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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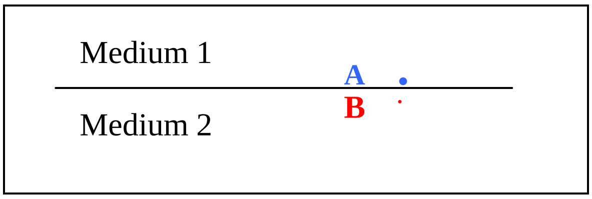
1998MC (14)

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

This is true to refraction of all waves.

Frequency is the number of oscillations. 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 the single point, while A still in medium 1 and B in medium 2.

Now, we measure the frequency of oscillation of each of them. Could we get two different values? No, they must be exactly the same. (A very small difference will accumulate with time, e.g. A oscillates at 10 Hz and B oscillates at 10.00001 Hz. If they did, A would be at a crest and B at a trough at a certain moment later ----don't forget, A and B are very close to each other).

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

1998MC (17)

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

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

R + r = 3.8×10^8 m and $R : r = 9 : 1$

So R = $\frac{9}{10}(3.8 \times 10^8) = 3.4 \times 10^8$ m (distance 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

Use L_{23} to denote the parallel combination of L_2 and L_3 by

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

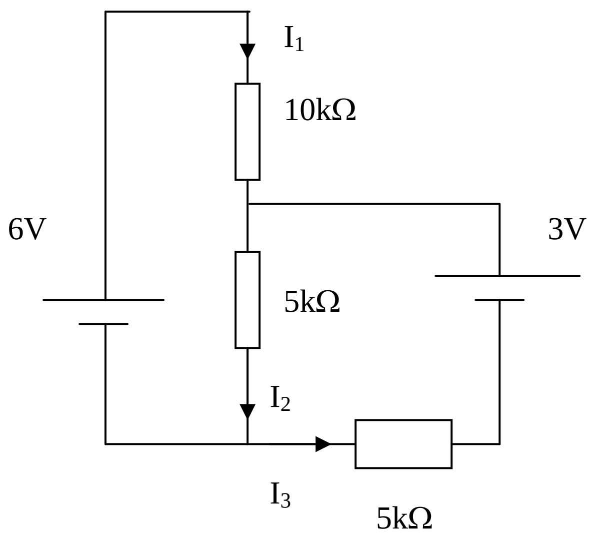
1998 MC (21)

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:

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

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

$I_2 = I_1 + I_3$

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 insulated 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. 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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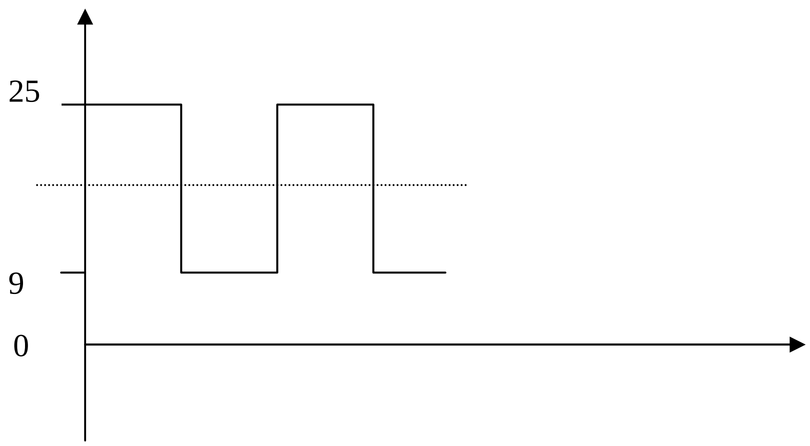
1998MC (25)

Root mean square of current



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

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

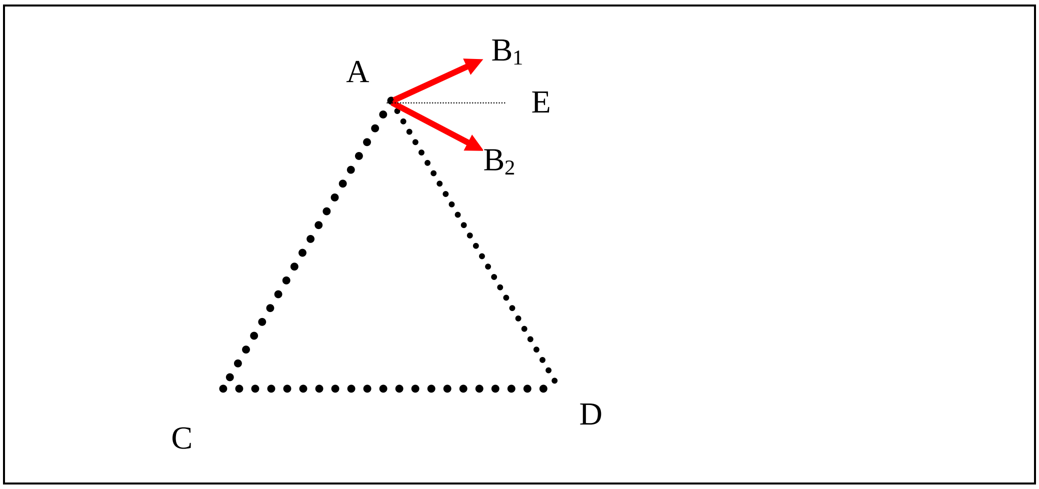
1998MC (26)

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

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

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 = $2\dfrac{\mu_0}{2\pi r} I \cos 30^0 = \dfrac{\sqrt{3}I}{2\pi r}$ (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 two forces tend 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 = $\dfrac{Q_1Q_2}{4\pi\varepsilon_o r^2}$. Both Q_1 and Q_2 are positive. PE increases when r decreases

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

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_- to a certain extent, the output voltage will be negative.

(1) Increasing R_1,,V_- will decrease

(2) Decreasing R_3, V_+ will decrease

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