AL Physics MC Answers

Year:1991

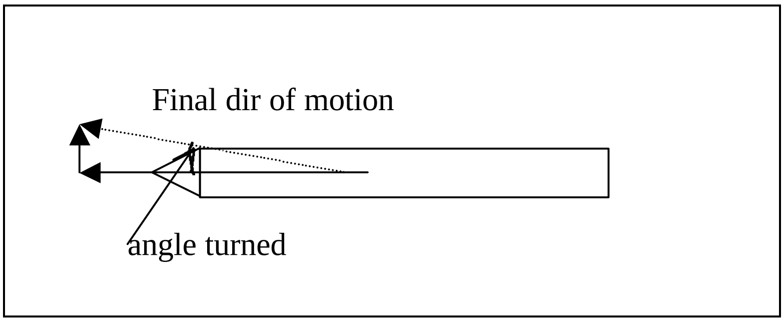
Question Number:4,6,11,15,20,25,27,31,32,35

1991MC (4)

Perpendicular momentum gained = Ft = $1.0 \times 10^5 \times 5 = 5 \times 10^5$ Ns

Perpendicular velocity after the application of the thrust = $5 \times 10^5/4 \times 10^4 = 12.5$ ms^{-1}.

Angle turned = 12.5/1500 = 0.0083 rad.



1991MC (6)

If the cart can complete the circular track safety, the forces acting on it must be adequate in view of the centripetal force required. The condition is satisfied everywhere if it is satisfied at the top. The marginal case is there when at the top the weight of the cart is totally used for centripetal acceleration, i.e.

mg = mv^2/R, where R is the radius of the circle.

Min KE at the top = $mv^2/2 = mgR/2$

By conservation of energy,

KE at the bottom

$$Mv'^2/2 = mg(2R) + mv^2/2$$
$$= 5mgR/2$$

$$v' = \sqrt{5gR} = \sqrt{5\times10\times10}$$

1991 MC (11)

Stress and strain are the quantities which are independent of the dimensions of the wire.

Wires made of the same material have the same breaking stress and the breaking strain.

(1) The breaking strain (= breaking stress/Young's modulus) is unchanged. But extension = strain x length of the wire. A longer wire has a longer breaking extension.

(2) Work done = Fe/2. Because of the same breaking stress and cross-sectional area, the force to break the wire is the same. e is longer, so W.D. is larger

(3) The breaking stress is unchanged, i.e. 5.0×10^8 N m^{-2}.

1991 MC (15)

The force required to separated a pair of atoms from x to x + Δx is k Δx, The area occupied by ONE atom on a plane is x^2. By definition, **stress = force/area = kDx/x^2**.

n molecules per unit area, so $n(x^2) = 1$, $1/x^2 = n$ and stress **= nkDx**.

1991 MC (20)

The media is air-film-air

Reflection at the first surface (air to film): π change.

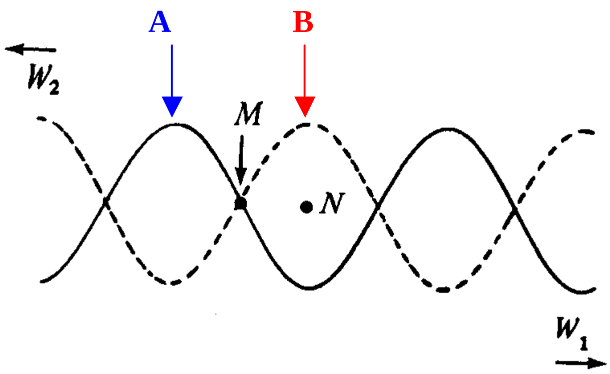
Reflection at the second surface (film to air): no π change

The two reflected rays interferes destructively when

2nd = mλ

For m = 1, d = 600nm/(2 x 1.25) = 240 nm

1991MC (25)

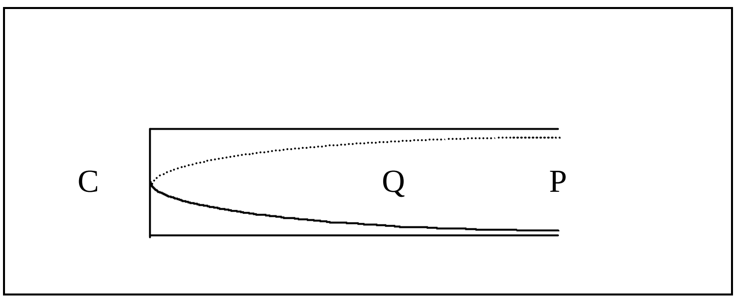


(1) λ = 4MN

(2) After a quarter of period, the crest A will arrive M and the crest B will arrive M. So at M, the amplitude is 2A.

(3) AT N, the two waves arriving are always antiphase (opposite, e.g. one is crest, the other is trough; one is + 2, the other is –2, and so on) . Point N is a displacement node (cf M is displacement antinode)

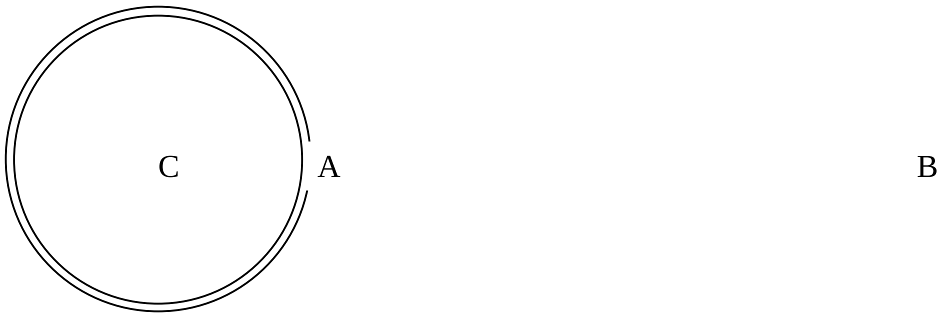
1991MC (27)



In a stationary wave, all points between two nodes are vibrating in phase

Particles Q and P are vibrating in phase. The phase difference is 0

1991MC (31)



No matter the sphere is hollow or solid, all the charges will reside at its outermost surface

Outside (A to B): All charges are concentrated at the center

$$E = \frac{Q}{4\pi\varepsilon_0 r^2} \quad \text{and} \quad V = \frac{Q}{4\pi\varepsilon_o r}$$

Inside : E = 0 and V = constant [E = $-\frac{dV}{dr}$]

What constant is V ?

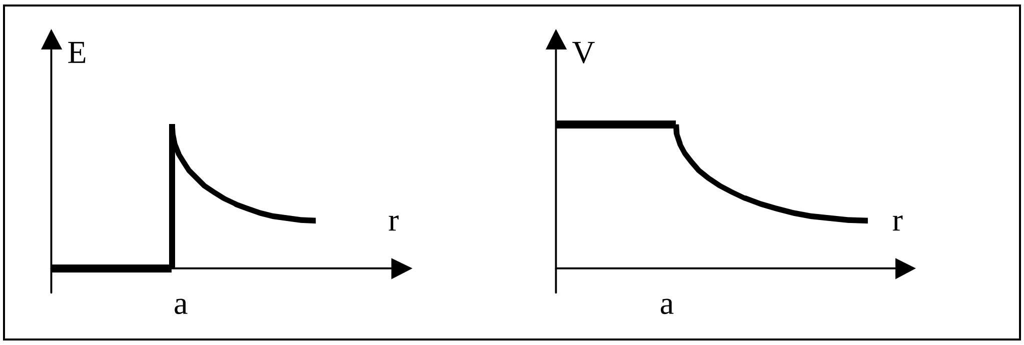
Image that a charge is brought from infinity to C, the path taken is infinity to A and then A to C. The electric field on the path A to C is zero, so no work Is done on moving this path.

$$WD(\infty \rightarrow C) = WD(\infty \rightarrow A)$$

Potential at C is defined as the work done against the electrostatic force in bringing unit charge from infinity to C.

So Potential at C = potential at A.

The potential at all points inside a hollow (or solid) conducting sphere is equal to the potential at the surface of the sphere.



B is incorrect because E = $\frac{dV}{dr} \neq 0$ inside the sphere. **In electrostatics, the electric filed inside a metal should be zero. Otherwise, the electric field will push the electron electrons to move. Internal currents appear, so it is not electrostatic**.

If the sphere is solid and made of an insulator, the charge can stay everywhere inside the sphere. The electric field inside need not zero, because the material does not contain free electrons. If the charge distribute uniformly over the whole sphere, then the potential V will

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1991MC(32)

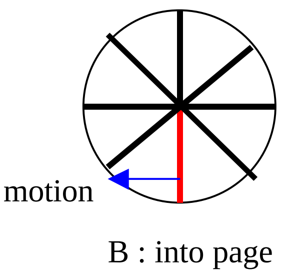
(1) Correct. By symmetry, the p.d's. across L_1 and L_2 are both 6 V. So they glow with the same brightness

(2) Correct. The operating voltage of L_2 is 6 V

(3) Incorrect. When S is opened, L_1 will take a voltage less than 6 V (because a parallel combination of 5Ω and something must be less than 5Ω; in series, V is proportional to resistance)

1991MC (35)

It is a disc generator.



The field is pointing into page.
Consider the red wire, its motion is to the left, so the induced current through it is downward
The potential at the center is negative .
Similar cases happen to other wires (they are effectively joined in parallel).
The current flows from the rim to the center via an external circuit..
Quantitatively, $\varepsilon = Br(\omega r/2)$, where r is the radius and ω is the angular speed of rotation (Can you derive it ?)
