

AL Physics MC Answers

Year:1993

Question Number: 1,3,7,11,15,16,18,26,27,30,31,39,45

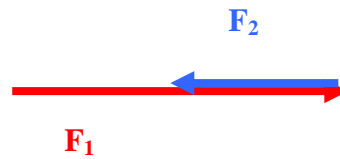
1993MC (1)

Get the maximum resultant force when the two forces are parallel

$$F_1 + F_2 = 7\text{N} \dots (1)$$



Get the minimum resultant force when they are anti-parallel



$$F_1 - F_2 = 1\text{N} \dots (2)$$

[By cosine law, magnitude of the resultant = $\sqrt{F_1^2 + F_2^2 - 2F_1F_2\cos\theta}$, which is the greatest when $\theta = 180^\circ$ and the smallest when $\theta = 0^\circ$]

By solving (1) and (2), $F_1 = 4\text{ N}$, $F_2 = 3\text{ N}$

So the resultant force when they are perpendicular is 5 N

1993MC (3)

Strictly speaking, Newton's Second Law is not " $F = ma$."

The exact wording of Newton's Second law is "**The resultant force acting on an object is proportional (equal) to its rate of change of momentum**"

The box moves at a uniform velocity of 2 ms^{-2} , but its mass increases by $90\text{kg}/60 = 1.5\text{ kg}$ in one second (sand dropped in one second). In one second, the momentum of the system increases by $1.5 \times 2 = 3\text{ kg ms}^{-1}$, so the force required is 3 N.

1993MC(7)

An important SHM equation $x^2 + \left(\frac{v}{\omega}\right)^2 = A^2$

At $x = A/2$, $v = u$.

$$\left(\frac{A}{2}\right)^2 + \left(\frac{u}{\omega}\right)^2 = A^2, \text{ so } u = \frac{\sqrt{3}}{2}\omega A$$

At the equilibrium position, the speed is the maximum, i.e. ωA

$$\text{Max speed} = \frac{2u}{\sqrt{3}}$$

1993MC (11)

From $\frac{GMm}{r^2} = \frac{mv^2}{r}$ and $T = \frac{2\pi r}{v}$, we get $T^2 = \left(\frac{4\pi^2}{GM}\right)r^3$, so $k = \frac{4\pi^2}{GM}$

- (A) k is NOT a dimensionless constant. Its unit should be the same as T^2/r^3 .
 (B), (C) k depends on M, so it is not a universal constant. M is the mass of the central body.
 (D) k is the same for all bodies revolving around the sun
 (E) Planets around the Sun ----- M is the mass of the Sun
 Satellites around the Earth ----- M is the mass of the Earth.
 They are different, of course!

1993MC(15)

It is a Pitot-static tube.

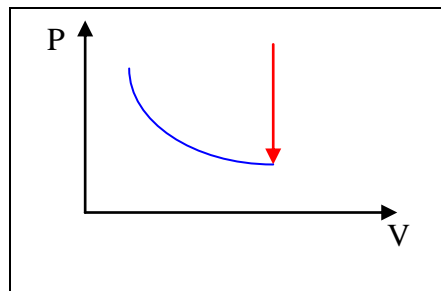
The manometer measure the kinetic pressure $\frac{1}{2}\rho v^2$

The pressure difference of the two arms of the manometer is ρgh

$$\frac{1}{2}\rho v^2 = \rho gh, \text{ so } v^2 = 2gh \quad (\text{A})$$

1993MC (16)

First stage: The piston is held fixed (**constant V**) and the gas is cooled (lower the temperature).
 Hence the **pressure is decreased** ($PV = nRT$.)

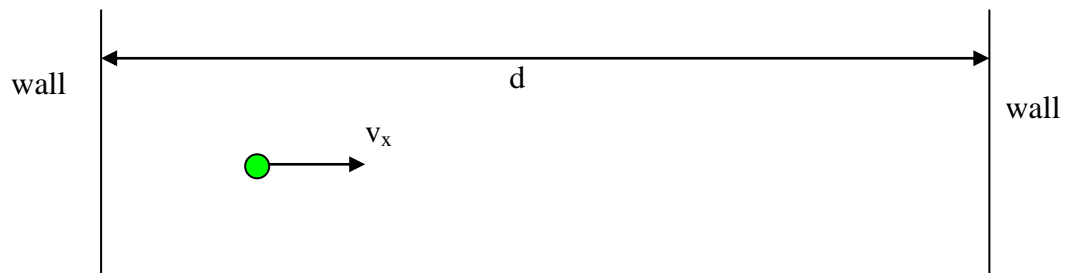


Second stage: The piston is pushed inwards slowly.

Slow process \longrightarrow isothermal process

No change in temperature and the volume is reduced (pressure so becomes higher), the curve moves upwards to the left along an isotherm.

1993MC (18)

(1) Correct $PV = nRT$, same P , V and T , so same n (2) $P = \frac{1}{3} \rho \overline{c^2}$ where density $\rho = \text{mass/volume}$.Same volume but different mass, so different ρ .Same T , but different ρ , so different r.m.s. speed.(3) Incorrect. One molecule makes $v_x/2d$ collisions with one wall of the container in one second.Hence, the frequency of collisions of gas molecules with the walls of container is proportional to v_{rms} . From (2), v_{rms} are different

Total distance traveled in one second = v_x . A molecule collides a wall again after travelling a distance of $2d$.

1993MC (26)

Using $f' = \frac{c}{c+v} f$, we get $\lambda' = \frac{c}{f'} = \frac{c+v}{f} = (1 + \frac{v}{c})\lambda$ Apparent wavelength $\lambda' = \lambda(1 + \frac{v}{c}) = 656.3(1 + \frac{200000}{3 \times 10^8}) = 656.7 \text{ nm}$

1993MC (27)

(1) Incorrect. The variation in the loudness of sound (formation of stationary waves) is due to interference

(2) Incorrect. Wavelength = $v/f = 340/1000 = 0.34 \text{ m}$. Separation between two consecutive positions of soft sound (nodes) = half of wavelength

(3) Correct. Wavelength will be shortened when the frequency is increased.

1993MC (30)

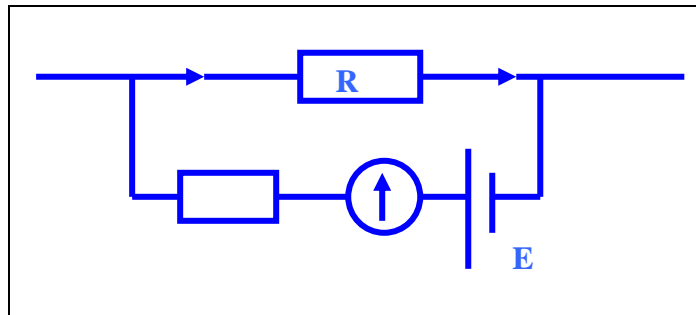
By definition, **a battery of emf E volts means E joules of energy is converted from other forms of energy into electrical energy when 1 C of charge passes through it.** The final charge stored in the capacitor is Q , so Q coulombs of charge pass through the battery during the whole process.

Therefore the energy delivered by the battery is $QE = (CE)E = CE^2$. The energy stored in the capacitor is $CE^2/2$. In other words, **half of the energy delivered by the battery is dissipated in the**

resistor. This is a general result.

1993MC (31)

A question similar to 1992(29), 1996(24) and 1998(21)



P.d. across the right 6Ω resistor = $(\frac{12}{6+6+3})6 = 4.8 \text{ V}$

Now, the galvanometer shows null deflection, so emf of Y = 4.8 V

Only one big idea:

When the galvanometer shows null deflection, p.d. across R = E

1993MC (39)

Faraday's law of induction: $\mathcal{E} = -\frac{d(N\Phi)}{dt}$

The flux linkage is produced and proportional to the current in the primary coil, I_p .

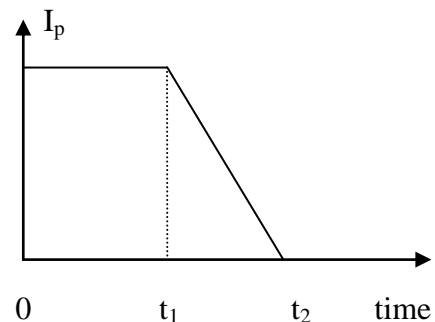
So the induced emf is proportional to the negative of the rate of change of I_p , i.e. the slope of the graph.

So the V_{AB} is

$0 - t_1$: 0 V

$t_1 - t_2$: a positive constant voltage

$t > t_2$: 0 V



1993MC (45)

Fraunhofer lines

A solar spectrum with these dark lines is exactly an absorption spectrum. When white light passes through the sun's relatively cool atmosphere, some frequencies are absorbed and re-radiated in all directions.