AL Physics MC Answers

Year:1993

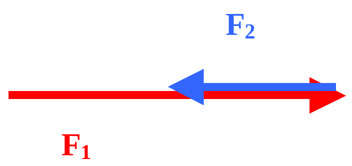
Question Number:1,3,7,11,15,16,18,26,27,30,31,39,45

1993MC (1)

Get the maximum resultant force when they are parallel

$F_1 + F_2 = 7N$ …..(1)

Get the minimum resultant force when they are anti-parallel



$F_1 – F_2 = 1N$ … …..(2)

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

By solving (1) and (2), $F_1 = 4$ N, $F_2 = 3$ 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 wordings 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 90kg/60 = 1.5 kg in one second (sand dropped in one second). In one second, the momentum of the system increases by 1.5 x 2 =3 kg ms^{-1}, so the force required is 3 N.

1993MC(7)

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

At x = A/2, v = u.

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

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

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

1993MC (11)

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

(A) k is NOT a dimensionless constant. Its unit should be as 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.

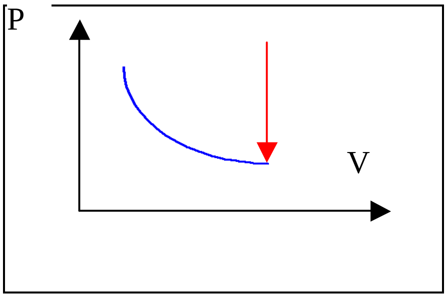
The manometer measure the kinetic pressure $\frac{1}{2} r \; v^2$

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

$\frac{1}{2} rv^2 = rgh$, so $v^2 = 2gh$ (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 ⟶ 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)

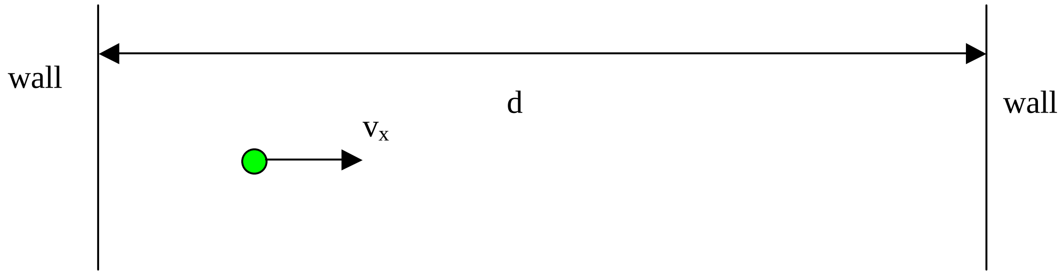
(1) Correct PV = nRT, same P, V and T, so same n

(2) $P = \frac{1}{3} \rho \overline{c^2}$ where density ρ = 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 2 d.

1993MC (26)

Using $f' = \frac{c}{c+v} f$, *we get* $l' = \frac{c}{f'} = \frac{c+v}{f} = (1+\frac{v}{c})l$

Apparent wavelength $\lambda' = \lambda(1 + \frac{v}{c}) = 656.3(1+\frac{200000}{3\times10^8}) = 656.7$ nm

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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 m. Separation between two consecutive positions of soft sound (nodes) = half of wavelength

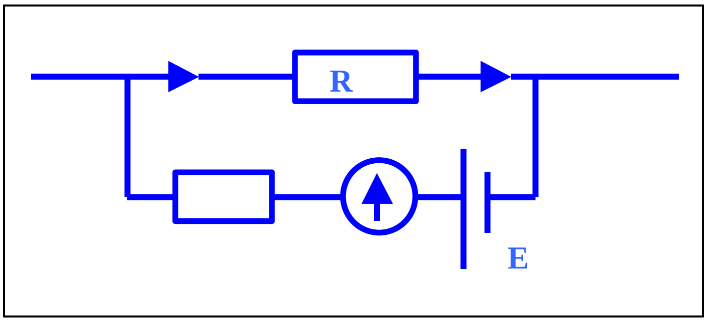
(3) Correct. Wavelength will be shortened when the frequency is increased.

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)



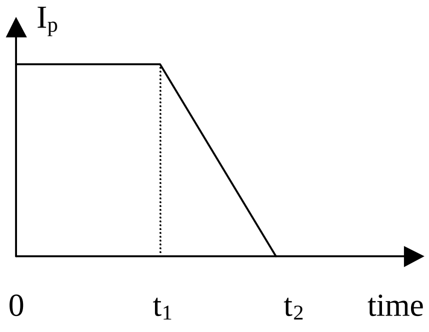
P.d. across the right 6Ω resistor = $(\frac{12}{6+6+3})6 = 4.8$ V

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: $e = -\frac{d(N\Phi)}{dt}$



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.