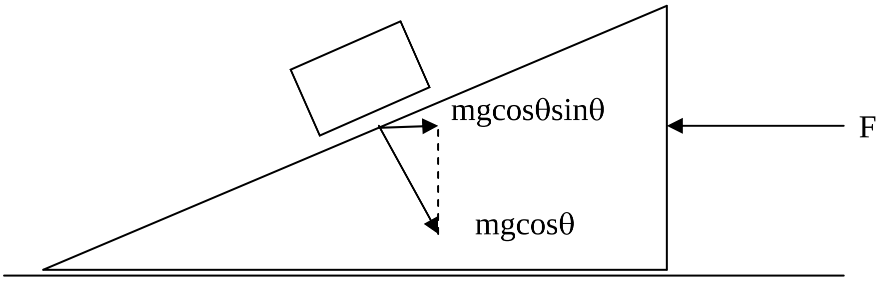
HKAL Physics MC Answers

Year: 1999

Question Number:2, 6, 7,10,14,17,19,26,28,29,33,34,35,36, 37,38,41,44

1999 MC(2)

The block exerts a normal force mgcosθ on the inclined surface. The horizontal component of "mgcosθ" is mgcosθsinθ. If the incline is stationary, there is no horizontal net force, so F = mgcosθsinθ = 24 N

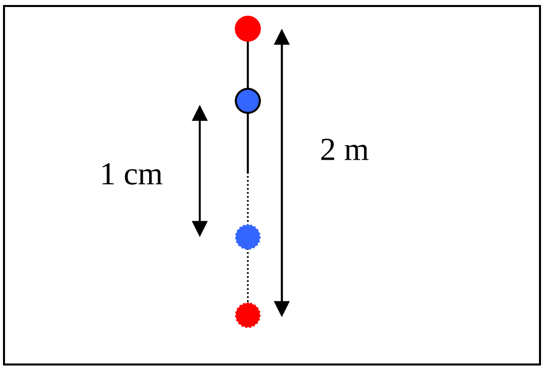


1999MC (6)

Total rotational energy = loss of gravitational PE

= mg(0.5 x 2) + 2mg(1 x 2)

=5 mg



1999MC (7)

Area of the graph of τ against t = change of angular momentum

(cf area of F-t graph = impulse =change of momentum)

Area = 20 x 10/2 = 100 kg m^2 s^{-1}

1999MC (10)

L is a convex lens, we know "Object at 2F, I is formed at 2F". So 2f = 4 cm, f = 2 cm

M is a convex mirror, we know" No matter where the object is placed, the image is formed behind the mirror and lies between the mirror and the focus".

So its focal length is more than 4 cm.

1999 MC(14)

Caution: The formula for Doppler effect $\frac{c \pm v_o}{c \mp v_s} f$ is for frequency only.

What are the basic causes of Doppler effect?

When a source is moving, an observer will see a shorter/longer wavelength.

When an observer is moving, he will see a wave of faster/slower speed.

Before the ambulance overtakes the car, the wavelength of sound received by an observer =

$\frac{c - u_2}{f}$ (It is the "apparent wavelength in forward direction", see Note P.227)

After the ambulance overtakes the car, the wavelength of sound received by an observer

= $\frac{c + u_2}{f}$ (It is the "apparent wavelength in backward direction")

So the ratio is $\frac{c - u_2}{c + u_2}$

u_1 is irrelevant because it only affects the speed of wave relative to the observer

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1999 MC(17)

(1) Incorrect. The three resistors are joined in parallel, so their p.d.'s must be the same.

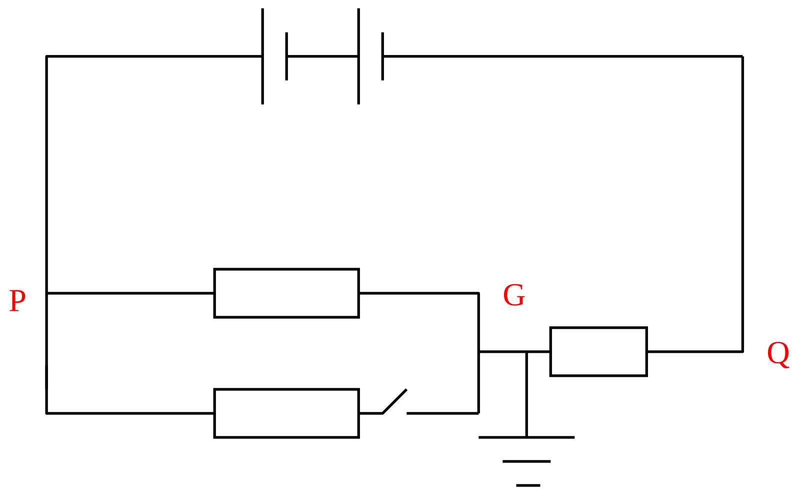
By definition, a p.d. of 1V between two points is defined when 1J of electrical energy is converted into other forms of energy when 1C of charge passes through these two points.

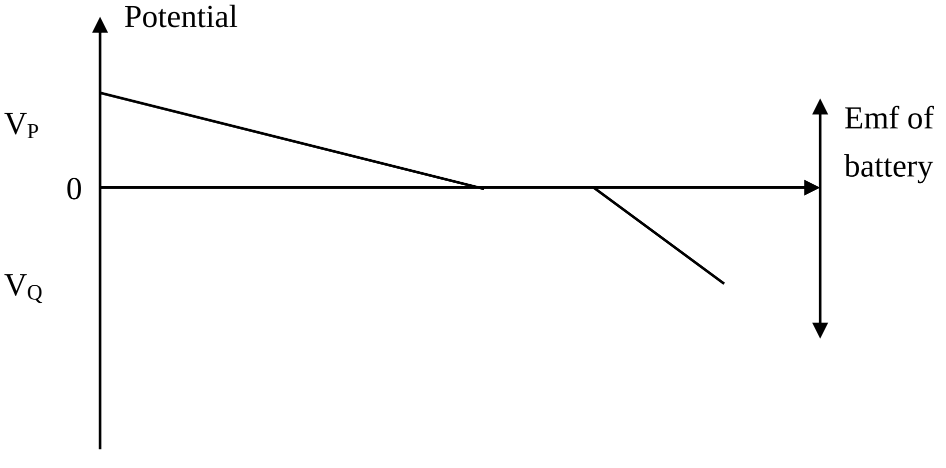
Same p.d. means same energy is dissipated when 1C passes through.

(2) Correct The resultant resistance is smaller than the smallest among those in parallel

(3) Correct When more resistors are connected in parallel, the equivalent resistance will be further reduced. Effectively, this has the same effect as an increase in the cross-sectional area of a conducting wire..

1999 MC(19)





When S is closed, the total current will increase, so p.d. across GQ is larger and the p.d. across PG is smaller.
Since G is grounded. , p.d. across GQ is increased, this means potential at Q is more negative (decrease).
P.d. across PG is decreased, so potential at P is closer to zero (decrease).

1999MC (26)

When the switch S goes to the left, it is connected to the source E. So its trace is a horizontal line higher than the GND.
When the switch goes to the right, it is connected to a wire (right side of the outer circuit) with zero resistance, so it records 0V. (The p.d’s. across R and C are opposite; their sum is always zero)

1999MC (28)

(1) Molecular KE = 3kT/2, so kT has the unit of energy (joule)

(2) Photon energy = hν (ν is freq)

(3) When an electron across a p.d V, the kinetic energy gained = eV

1999MC (29)

(1) The current decays suddenly, so a large induced emf (several V) across L.

(2) Such a large induced emf can light up a neon bulb.

(3) The emf is large, but the circuit is still incomplete, so no current flows.

A large induced emf, but induced current = 0 because the total resistance of the circuit is infinite.

When the switch is opened, bulb B dies out immediately.

1999 MC(33)

X: mean kinetic energy of hydrogen gas molecules at room temperature

Y: ionization energy of a hydrogen atom

Z: photon energy of a particular line in the visible emission spectrum of hydrogen.

At the first glance, Z < Y.

Compare X and Z

(I) Use formulae

At room tempt, mean KE of ideal gas = 3kT/2

$= 3 \times 1.38 \times 10^{-23}/2 = 2.1 \times 10^{-23}$ J $= 1.3 \times 10^{-4}$ eV

Ionization energy of hydrogen = 13.6 eV

The first excitation energy ~ 10 eV

Photon energy = energy released in de-excitation ~ values not much less than 13.6 eV

(II) Use argument

We have never heard that a bottle of hydrogen gas at room temperature could emit visible light. Hydrogen molecules collide elastically in a gas, their KE transfer among them. If the molecules had enough KE to cause an excitation, they would. Not observing that just implies the KE is not adequate. X < Z.

Largest possible excitation = ionization Z < Y

1999MC (34)

Gamma rays originate from nucleus. Atomic excitations cannot emit gamma rays.

1999MC (35)

(1) Incorrect. At C, the two magnetic fields are exactly opposite, so they cancel each other. The resultant field is zero (the right-hand grip law).

(2) Correct The directions of the magnetic fields at these two points are both horizontal.

(3) Correct Magnetic field is proportional to current

1999MC(36)

Induced emf $\varepsilon = -\frac{d(N\Phi)}{dt}$

Induced current I = ε/R = $-\frac{1}{R}\frac{d(N\Phi)}{dt}$

Total (net) charge circulating around the coil is the integration of I over time t.

Charge Q is therefore proportional to $-\frac{N}{R}(\Phi_f - \Phi_i)$ .... (*)

(*) is independent of time t.

(*) is also independent of N, because the resistance R is entirely due to the coil , so R ∝ N. The ratio N/R is always a constant, which is independent of N !

[This question is deleted because it has two answers]

1999MC (37)

A. 400V=P(5V) P = 80 kPa

B. Yes, the molecules are in random motion.

C. PV = nRT. The number of moles are different in X and Y, so PV is not the same.

D. Density is the same

E. Same temperature, same rms speed.

1999MC (38)

(1) By definition, ideal gas obeys Boyle's law under any circumstances.
(A real gas only obeys Boyle's law under high temperature and low pressure)

(2) Molecules of ideal gas is assumed to be points

(3) Intermolecular forces are neglected (intermolecular energy is therefore zero)
[Kinetic energy includes translational, rotational and vibrational]

1999MC (41)

The figure in the first row shows at the same time X and Y complete two and three cycles respectively (count the number of contacts along one vertical line and one horizontal line).

$f_1: f_2 = 2 : 3$

The figure in the second row shows at the same time X and Y complete one and two cycles respectively.

$f_2: f_3 = 1 : 2$

Therefore, $f_1 : f_3 = 2: 6 = 1 : 3$,

Only the figure shown in D has the ratio 1: 3.

1999MC (44)

Density of water = 1000 kg m^{-3}

Human can just float on water, so density is about 1000 kg m^{-3}

Weight of human is about 50- 70 kg.

Volume is about 60/1000 ~ 0.06 ~ 0.1 m^3
