

Year:1995

Question Number:1,4,15,19,21,23,25,27,31,38,39,42

1995MC (1)

When given a slight push, the toy car moves down with constant velocity, so

$$mg\sin\theta = \text{friction.} \dots \dots (1)$$

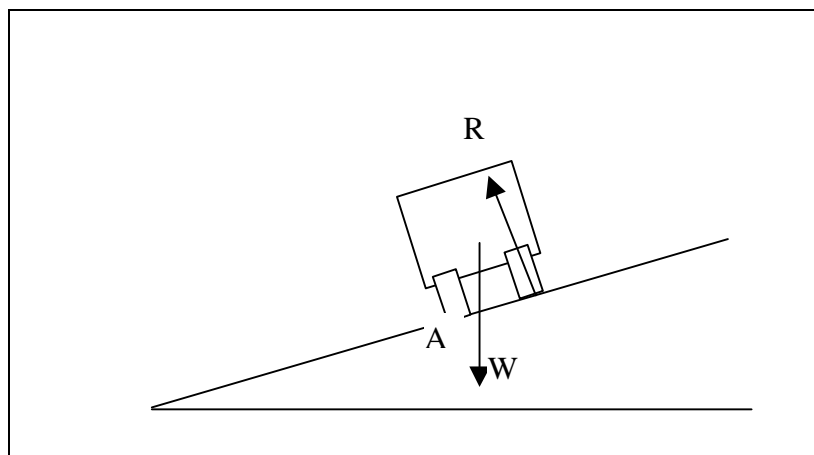
To pull the car up the inclined plane, it is required to balance two forces, $mg\sin\theta$ and friction, since both are acting down along the inclined plane.

Because of (1)

$$\text{Force} = mg \sin\theta + \text{friction} = 2 mg\sin\theta$$

1995MC (4)

(a) **The car is safe, it will not overturn.**



W: weight of the car

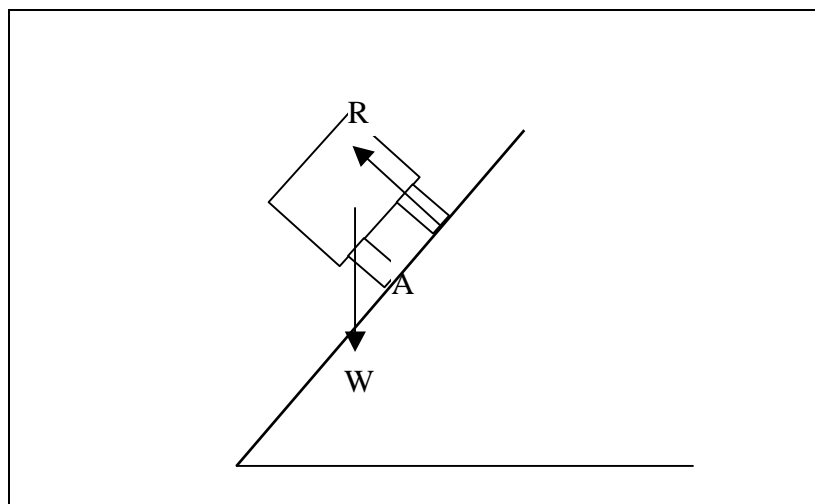
R: normal reaction force at the upper wheel

Take moment about A (the bottom of the lower wheel),

clockwise moment produced by W = anticlockwise moment produced by R

Equilibrium is achieved.

(b) **The car will overturn**

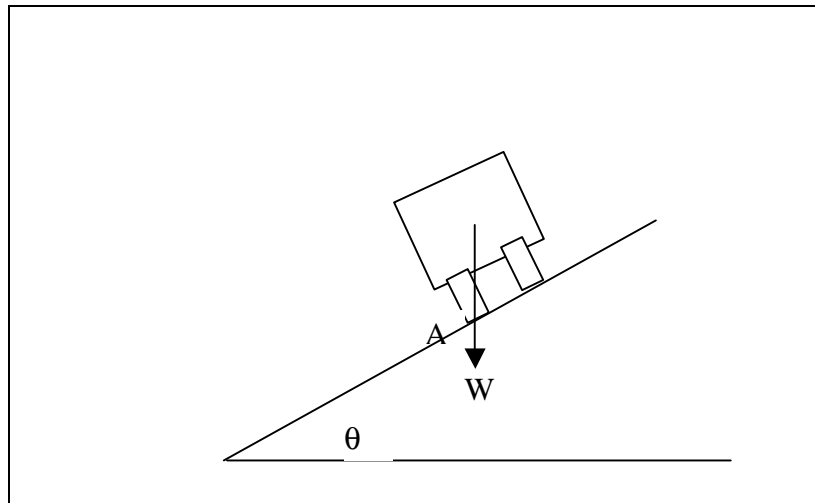


Even R is present, equilibrium cannot be achieved.

About A , both the moment produced by W and R are anticlockwise.

(when the upper wheel loses contact with the ground, R disappears)

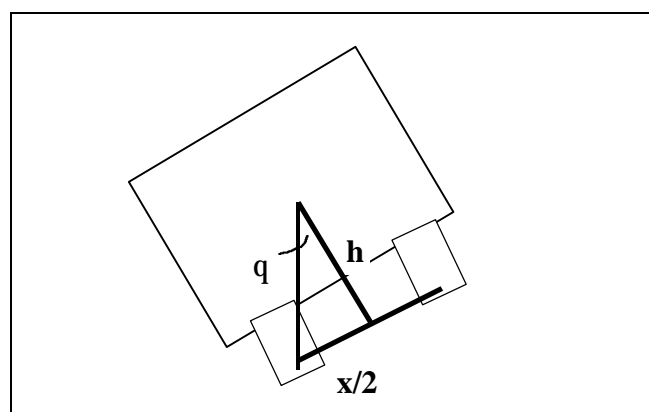
(c) **Marginal case**



The CM (center of mass) of the car locates just above the lower wheel. The upper wheel does not press against the ground, so $R = 0$.

Then there is no turning moment about A . Equilibrium is marginally achieved

| | | |
|-----------------------------|---|---------------|
| CM lies on the right of A | → | not overturn |
| CM lies on the left of A | → | overturn |
| CM just above A | → | marginal case |



From the above figure, $\tan \theta = \frac{x}{2h}$

1995MC (15)

Green light is NOT reflected

$$2nd = (m + 1/2)\lambda$$

$$2(1.25)d = (m + 1/2)550 \text{ nm}$$

| m | d |
|---|----------|
| 0 | 110 nm |
| 1 | 330 nm ← |
| 2 | 550 nm |

1995MC(19)

The db will be increased by 3 when the intensity is doubled.

At a point of constructive interference, the intensity will be four times higher than that of a single wave.

The intensity is 4 times lower, so the db will be decreased by 6 db.

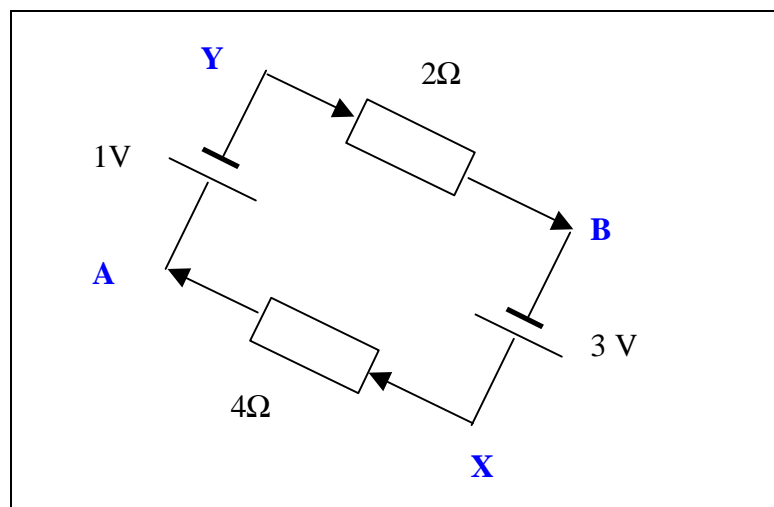
1995MC(21)

r.m.s. speed = 341 ms^{-1} Temperature $T = 298 \text{ K}$

$$\text{By } \frac{3}{2}RT = \frac{1}{2}M_m C^2, \text{ where } M_m \text{ is the molar mass.}$$

M_m is found to be 63.9 g

1995MC(23)



Net emf of the circuit = $3 - 1 = 2 \text{ V}$
 Current = $2/6 = 1/3 \text{ A}$ (dir: XAYBX)

We walk from X to Y via A

X to A: potential drop = $4(1/3) = 4/3 \text{ V}$
 A to Y: potential drop = 1 V
 Net p.d. = $4/3 + 1 = 2.33 \text{ V}$

Alternatively, we walk from X to Y via B

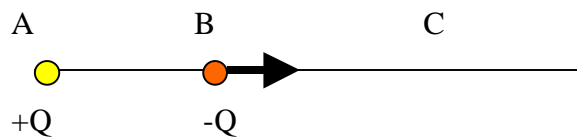
X to B: potential drop = 3 V
B to Y: potential rise = $2(1/3)$
 Net p.d. $3 - 2/3 = 2.33 \text{ V}$



1995MC (25)

Initial p.d. across capacitor $V_0 = \text{maximum current (i.e, the current at } t = 0) \times R$
 $= 100 \times 50 = 5000 \text{ A}$

Initial charge stored in cap = $CV_0 = 5 \times 10^{-3} \text{ C}$

1995MC(27).



- (1) Correct. To move the negative charge from B to C, a positive work is done on the system, i.e. the system gains potential energy.
- (2) Correct. Before the move, the two E-fields at C 
 After the move, they become 
- (3) Incorrect. After the move, the potential at C will be more negative because the negative charge is brought nearer

1995MC(31)

By symmetry, p.d. across $L_1 = 6 \text{ V}$

$P = V^2/R$. R is unchanged, so $P \propto V^2$

When $V = 12 \text{ V}$, $P = 8 \text{ W}$. When $V = 6 \text{ V}$, $P = 8/4 = 2 \text{ W}$

- (1) EM wave (visible or X-ray) is emitted during a transition from a higher energy level to a lower one.
- (2) length = speed of light \times time = $3 \times 10^8 \times 10^{-9} = 0.3$ m
- (3) $hf = E_f - E_i$
-

1995MC (39)

$$\mathbf{e} = \frac{N_2(AB)}{t}$$

- (i) We are not interested in the direction of ϵ , so we drop the '-' sign.
- (ii) The current decreases uniformly, so $dI/dt \Rightarrow I/t$
- (iii) B is produced by the inside solenoid, $B = \mu_0 n_1 I$
- (iv) What is A ?

Inside A_2 , only the part A_1 has an B-field passing through

AB should be divided into $A_1(\mu_0 n_1 I) + (A_2 - A_1)0 = A_1 \mu_0 n_1 I$

**Inside a long solenoid $B = \mu_0 n_1 I$;
outside a long solenoid, B is approximately zero**

In view of all these considerations, $\epsilon = N_2 (A_1 \mu_0 n_1 I)/t$

1995MC (42)

- 1.5 cycles on screen. It corresponds to $1.5 \times \frac{1}{7.5} = 0.02s$

The screen has four divisions, so one division corresponds to $0.02/4 = 0.005$ s

So the time base is 5 ms per division.
