

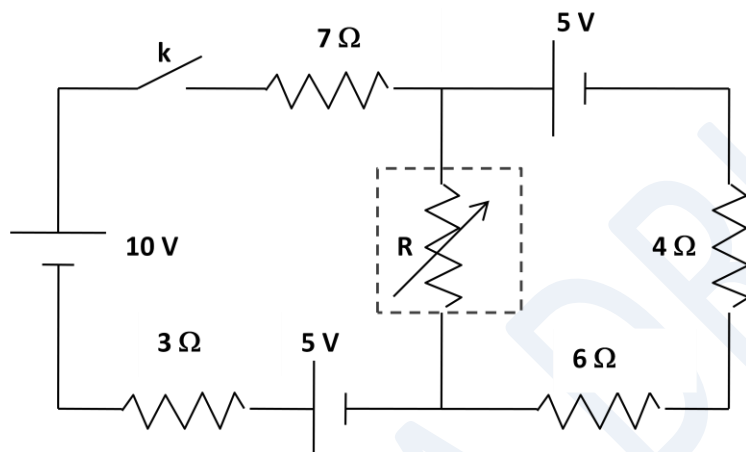
DAILY TEST SERIES FOR IIT-JEE 2009 FROM VIDYA DRISHTI

27.03.2009

Physics

Paragraph for comprehension 1 to 3

In the circuit shown the resistance R is kept in a chamber whose temperature is 20°C which remains constant. The initial temperature and resistance of R is 50°C and $15\ \Omega$ respectively. The rate of change of resistance with temperature is $\frac{1}{2}\ \Omega/^\circ\text{C}$ and the rate of decrease of temperature of T is $(\ln 3)/100$ times the temperature difference from the surrounding. Assume the resistance R loses heat only in accordance with Newton's law of cooling. Key K is closed at the time $t = 0$. Answer the following questions:



- Value of R for which power dissipation in it will be maximum is
 - $5\ \Omega$
 - $10\ \Omega$
 - $50\ \Omega$
 - $100\ \Omega$
- Temperature of R when power dissipation will be maximum is
 - 10°C
 - 20°C
 - 30°C
 - 50°C
- Time after which the power dissipation will be maximum is
 - 10 sec
 - 20 sec
 - 50 sec
 - 100 sec

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Mathematics

Paragraph for comprehension 4 to 6

Two curves $y = f(x)$ and $y = g(x)$ are such that the tangents drawn to them at points with the same abscissa, meet on y -axis and the normals at these points meet on x -axis. Let $f(1) = 2$, $g(1) = 1$ and $h(x) = 2f(x) - x$. Tangent is drawn at point P on the curve $y = h(x)$ to meet the co-ordinate axis at A and B . locus of circumference of triangle OAB , where O is origin, is a curve C_2 . Answer the following questions:

4. $h(x)$ represents
 - (a) parabola
 - (b) ellipse
 - (c) hyperbola
 - (d) none of these

5. Equation of curve C_2 is
 - (a) $xy = 3$
 - (b) $y^2 = 6x$
 - (c) $\frac{x^2}{2} + y^2 = 1$
 - (d) $x^2 - y^2 = 1$

6. area bounded by C_2 , $x = 1$, $x = 3$ and $y = 3$ is equal to
 - (a) $6 - 2 \ln 3$
 - (b) $6 \ln 3$
 - (c) $6 + 2 \ln 3$
 - (d) $6 - 3 \ln 3$

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Chemistry

Paragraph for comprehension 7 to 9

The reaction between bromic acid and hydriodic acid is monitored by titrating one of the products against standard $\text{Na}_2\text{S}_2\text{O}_3$ solution. The following data was recorded at 300 K with both reactants taken in equal concentrations:

Time (seconds)	300	600	900	1200	∞
Conc. Of products (mol dm^{-3})	2.1×10^{-3}	4.2×10^{-3}	5.9×10^{-3}	7.6×10^{-3}	0.05

The rate of reaction increases four times between 28°C and 46°C . Answer the following questions:

- Which reactant species is getting reduced during the reaction?
 - Bromic acid
 - Hydriodic acid
 - Both (a) and (b)
 - None of these
- Order of reaction is
 - 1
 - 1.5
 - 2
 - 1
- Activation energy of the reaction is
 - 23 kJ/mol
 - 102.1 kJ/mol
 - 87.3 kJ/mol
 - 61.5 kJ/mol

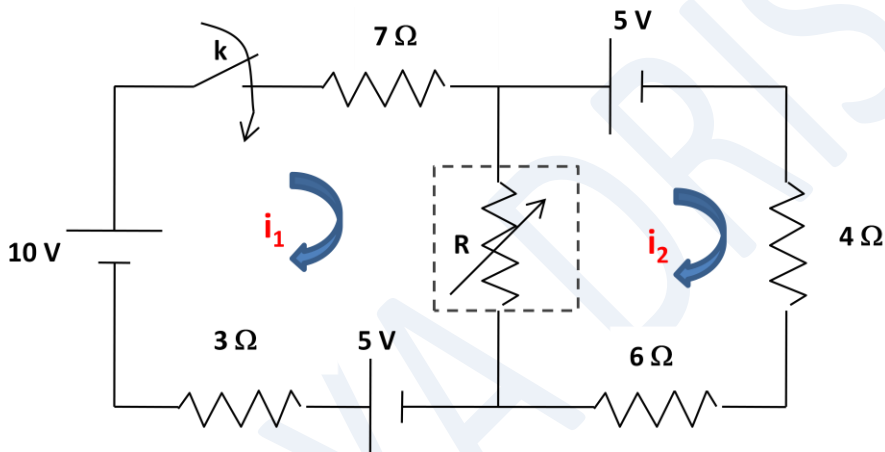
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SOLUTIONS:

1. (a)
2. (c)
3. (d)
4. (c)
5. (a)
6. (d)
7. (a)
8. (b)
9. (d)

Physics



1. Let i_1 and i_2 be the currents in two loops respectively.

Using loop law:

For loop 1:

$$10 - 10i_1 - R(i_1 - i_2) + 5 = 0 \quad \dots(1)$$

For loop 2:

$$(10 + R)i_2 - Ri_1 = -5 \quad \dots(2)$$

Solving we get,

$$i_1 = \frac{15 + 2R}{10 + 2R}$$

$$i_2 = \frac{5 + 2R}{10 + 2R}$$

Power dissipated in R,

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$$P = (i_1 - i_2)^2 R$$

$$\Rightarrow P = \frac{25R}{(5+R)^2} \quad \dots(A)$$

For maximum power dissipation

$$\frac{dP}{dR} = 0$$

$$\Rightarrow R = 5\Omega \quad (\text{Differentiating eqn. (A) wrt R and equating to zero})$$

2. We have,

$$R = R_0 - \left(\frac{dR}{d\theta} \right) \Delta\theta$$

$$\Rightarrow 5 = 15 - \left(\frac{1}{2} \right) \Delta\theta$$

$$\Rightarrow \Delta\theta = 20^\circ C$$

Therefore, temperature at that instant = $30^\circ C$.

3. According to Newton's law

$$\frac{d\theta}{dt} = -k(\theta - 20)$$

$$\Rightarrow \int_{50}^{30} \frac{d\theta}{(\theta - 20)} = -k \int_0^t dt$$

$$\Rightarrow t = 100s$$

Mathematics

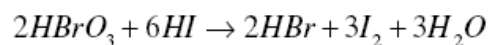
Try to solve yourself ☺

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Chemistry

7.



HBrO_3 gets reduced,

8.

$$K = \frac{1}{a} \frac{x}{a-x}$$

$$K_{300} = 2.92 \times 10^{-3} \quad K_{600} = 3.057 \times 10^{-3} \quad K_{1200} = 2.99 \times 10^{-3}$$

Hence, order $n = 2$

9.

$$\log 4 = \frac{E \times 18}{2.303 \times 8.314 \times 301 \times 3.19} = 61.5 \text{ kJ/mol}$$