PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 61

Total Marks : 27

Max. Time : 28 min.

Topics : Elasticity, Rotation, Heat, Newton's Law of Motion, Work, Power and Energy, Capacitance

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.2	(3 marks, 3 min.)	[6, 6]
Multiple choice objective ('–1' negative marking) Q.3 to Q.4	(4 marks, 4 min.)	[8, 8]
Subjective Questions ('–1' negative marking) Q.5	(4 marks, 5 min.)	[4, 5]
Comprehension ('–1' negative marking) Q.6 to Q.8	(3 marks, 3 min.)	[9, 9]

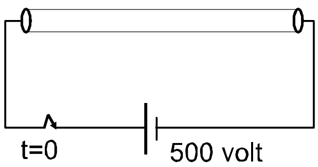
1. Two steel wires, where one has twice diameter and three times the length of the other, are stretched by the same force. The ratio of the elastic strain energy stored in them is

(A) 2 : 3 (B) 3 : 4 (C) 3 : 2 (D) 6 : 1

2. Two men of equal masses stand at opposite ends of the diameter of a turntable disc of a certain mass, moving with constant angular velocity. The two men make their way to the middle of the turntable at equal rates. In doing so

(A) kinetic energy of rotation has increased while angular momentum remains same.
(B) kinetic energy of rotation has decreased while angular momentum remains same.
(C) kinetic energy of rotation has decreased but angular momentum has increased.
(D) both, kinetic energy of rotation and angular momentum have decreased.

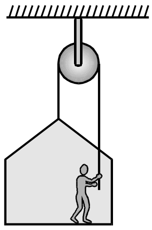
3. A straight nicrome wire is initially at room temperature 20ºC. It is connected to an ideal battery of 500 volt. Jusr after switching on, the current detected is 5 amp. Due to heating effect its temperature increases, and is also loosing heat to the environment according to newton's cooling law as $\frac{dQ_{loss}}{dt} = 45(T - 20°C)$J/sec. At steady state, the current detected is 4.5 amp.



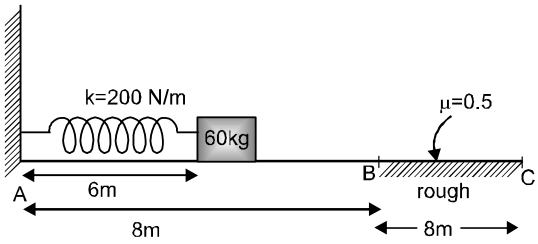
(A) staedy state temperature of the wire is 70 ºC
(B) steady state temperature of the wire is 75.5ºC
(C) temperature co–efficient of resistance of the wire is nearly 2.2×10^{-3} /ºC
(D) temperature co–efficient of resistance of the wire is nearly 1.57×10^{-3} /ºC

4. A painter is applying force himself to raise him and the box with an acceleration of 5 m/s^2 by a massless rope and pulley arrangement as shown in figure. Mass of painter is 100 kg and that of box is 50 kg. If g = 10 m/s^2, then:

(A) tension in the rope is 1125 N
(B) tension in the rope is 2250 N
(C) force of contact between the painter and the floor is 375 N
(D) none of these

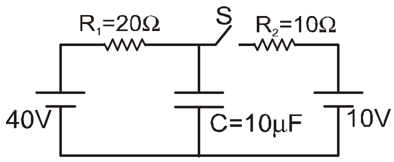


5. A block of mass 60 kg is released from rest when compression in the spring is 2m (natural length of spring is 8m). Surface AB is smooth while surface BC is rough. Block travels x distance before coming to complete rest. Value of x is : [g = 10 m/s^2]



COMPREHENSION

The circuit consists of two resistors (of resistance $R_1 = 20\ \Omega$ and $R_2 = 10\ \Omega$) , a capacitor (of capacitance C = 10μF) and two ideal cells. In the circuit shown the capacitor is in steady state and the switch S is open



6. The current through the resistor R_2 just after the switch S is closed is:

(A) 1 ampere (B) 2 ampere (C) 3 ampere (D) 4 ampere

7. The charge on capacitor in steady state with switch S closed.

(A) 100μC (B) 200μC (C) 300μC (D) 400μC

8. The circuit is in steady state with switch S closed. Now the switch S is opened. Just after the switch S is opened, the current through resistance R_1 is

(A) 1ampere (B) 2 ampere (C) 3 ampere (D) 4 ampere

Answers Key

1. (B) **2.** (A) **3.** (A) (C) **4.** (A) (C)

5. x = 3 m **6.** (C) **7.** (B) **8.** (A)

Hints & Solutions

2. $I_1\omega_1 = I_2\omega_2$

Since, men move towards middle of turn table I_2 decreases hence ω_2 increases.

$$\therefore \quad \Delta K = \frac{1}{2}I_1\omega_1^2 - \frac{1}{2}I_2\omega_2^2$$

$$= \frac{1}{2}I_1\omega_1^2\left[1 - \frac{I_2}{I_1}\cdot\frac{\omega_2^2}{\omega_1^2}\right] \qquad \left\{\frac{\omega_2}{\omega_1} > 1\right\}$$

$$= \frac{1}{2}I_1\omega_1^2\left[1 - \frac{\omega_2}{\omega_1}\right] < 0$$

So kinetic energy increases.

3. **(A,B)** For steady state

$$\left(\frac{dQ}{dt}\right)_{in} = \left(\frac{dQ}{dt}\right)_{out}$$

$(V)\,(i_{55}) = 45(T - 20)$

$(500)\,(4.5) = 45(T - 20)$

$T_{55} = 70^\circ C.$

(C,D) Resistance at 20ºC is $R = \frac{V}{i} = \frac{500}{5}$

$R_{20} = 100\ \Omega$

Resistance at 70ºC is $R = \frac{V}{i} = \frac{500}{4.5} \simeq 111\ \Omega$

$R_f = R_0(1 + \alpha\Delta T)$

$111 = 100(1 + \alpha(50))$

$$\alpha = \frac{0.11}{50} \simeq 2.2 \times 10^{-3}\ /^\circ C.$$

4. For painter ;

$R + T - mg = ma$

$R + T = m(g + a)$ ....(1)

For the system ;

$2T - (m + M)g = (m + M)a$

$2T = (m + M)\,(g + a)$ ....(2)

where ; $m = 100$ kg

$M = 50$ kg

$a = 5\ m/sec^2$

$$\therefore \quad T = \frac{150 \times 15}{2} = 1125\ N$$

and ; $R = 375$ N

5. By $W_{net} = \Delta K.E = 0$

$$\Rightarrow \quad \frac{1}{2}k(x_0^2 - x^2) = \mu mgx$$

$$\Rightarrow \quad \frac{1}{2} \times 200(2^2 - x^2) = \frac{1}{2} \times 60 \times 10x$$

$$\Rightarrow \quad x = 1m$$

Also at this moment $f_{max} > kx$

So, block will not move so total distance travelled = 2 + 1 = 3m.

6. In steady state, before the switch S is closed, potential difference across capacitor is 40 volts. Just after switch S is closed, charge and hence potential difference across the capacitor does not change appreciably. So, the potential difference across R_2 is 40–10 = 30 volt. The curent through R_2 is 3 ampere.

7. The current through resistors when the capacitor is in steady state with switch S closed.

$I = \dfrac{40 - 10}{R_1 + R_2} = 1amp$. Therefore potential difference across R_2 is 10 × 1 = 10 volts. Hence the potential difference across the capacitor is 10 + I R_2= 20 volts. So, the charge on capacitor q = CV = 200μC.

8. At the given instant, p.d across capacitor is 20 Volts. Hence the current through R_1 at the required instant of time is $I = \dfrac{40 - 20}{R_1} = 1amp$