Ttask

(2) In geyser and hair drier Electric current .i.e) Electrical energy is converted into heat Energy.

(3) Given length of the wire $l = 4m$

Radius of the wire $r = 0.25$ mm

$= \frac{1}{4}$ mm

$= \frac{1}{4} \times 10^{-3}$ m

Resistance of the wire $R = 24\,\Omega$.

$\therefore$ Resistivity $\rho = R\frac{A}{l}$

$$= R\frac{\pi r^2}{l}$$

$$= \frac{\overset{6}{\cancel{24}} \times 3.14 \times [\frac{1}{4} \times 10^{-3}]^2}{\cancel{4}}$$

$$= 6 \times 3.14 \times \frac{1}{16} \times 10^{-6}$$

$$= \frac{18.84}{16} \times 10^{-6}$$

$$= 1.175 \times 10^{-6}\,\Omega\,m$$

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(4)

Given Resistance $R = 8\ \Omega$

Current $i = 3\ A$

Time $t = 4$ min

$= 4 \times 60$ sec

$= 240$ sec

$\therefore$ Heat Produced in the resistor $Q = i^2 R t$

$\Rightarrow Q = (3)^2 \times 8 \times (240)$

$= 9 \times 1920$

$= 17280\ J$

(5)

Given Resistance $R = 20\ \Omega$

voltage $V = 220\ V$

$\therefore$ Power consumed by the toaster

$$P = \frac{V^2}{R}$$

$$P = \frac{(220)^2}{20} = \frac{220 \times \overset{11}{\cancel{220}}}{\cancel{20}}$$

$P = 2420\ W$

(6)

Given current $i = 10\ A$; Resistance $= 20\ \Omega$

voltage $= ?$

Acc to ohm's law $V = iR = 10 \times 20$

$= 200\ V$

7

No of electrons $n = 10^6$

time $t = 1$ sec.

From $i = \frac{ne}{t}$

$= \frac{10^6 \times 1.6 \times 10^{-19}}{1}$

$= 1.6 \times 10^{-13}$ A

8

Given current $i = 1mA = 10^{-3}A$

From $i = \frac{ne}{t}$; where $e = 1.6 \times 10^{-19}C$

$= 16 \times 10^{-20}$ C.

$\Rightarrow 10^{-3} = \frac{n}{t} \times 16 \times 10^{-20}$

$\Rightarrow \frac{n}{t} = \frac{10^{-3}}{16 \times 10^{-20}} = \frac{1}{16} \times 10^{17}$

$= 0.0625 \times 10^{17}$

$= 6.25 \times 10^{15}$

9

Given voltage $V = 50$ V

Resistance $R = 10\ \Omega$.

Acc to ohm's law $V = iR$

$\Rightarrow 50 = i\ 10$

$\Rightarrow i = \frac{50}{10} = 5A$

(10)

Given current through the wire is doubled

i.e) $i' = 2i$ where i is initial current

Acc to joule's law $Q = i^2 R t$

when R = constant

$Q \propto i^2$

$\therefore$ As current is doubled i.e) $2i$

$Q' \propto (2i)^2$

$\Rightarrow Q' \propto 4i^2$

$\therefore$ Heat Produced is quadrapled

(15)

Given Resistance $R = 20\,\Omega$

Current $i = 2A$

Time $t = 5$ min

$= 5 \times 60$

$= 300$ sec.

Heat produced $Q = i^2 R t$

$= 2^2 \times 20 \times 300$

$= 4 \times 20 \times 300$

$= 24000J$

(16) Given Resistance $R = 50\,\Omega$; voltage $V = 220V$

$\therefore$ Power $= \frac{V^2}{R} = \frac{220 \times 22\cancel{0}}{5\cancel{0}} = \frac{4640}{5} = 928W$

(17)

Given

Radius of orbit $r = 5 \times 10^{-11} m$

speed $v = 8.2 \times 10^{6}$ m/s

Current $i = \frac{q}{t} = \frac{e}{\frac{2\pi r}{v}}$

$i = \frac{e v}{2\pi r}$

$i = \frac{1.6 \times 10^{-19} \times \overset{4.1}{\cancel{8.2}} \times 10^{6}}{\cancel{2} \times 3.14 \times 5 \times 10^{-11}}$

$i = \frac{1.6 \times 4.1}{3.14 \times 5} \times 10^{-2}$

$= 0.4178 \times 10^{-2}$

$= 0.42 \times 10^{-2} A$

$= 4.2 \times 10^{-3} A = 4.2 mA$

(18)

Given Resistance $R = 10 \Omega$.

current $i = 2A$

Time $t = 5$ min

$= 5 \times 60 = 300$ sec

$\therefore$ Heat Produced $Q = i^2 R t$

$= (2)^2 \times 10 \times 300$

$= 12000 J$

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L Task

Jee main level

(1)

No. of electrons $n = 7.5 \times 10^{15}$

Time $t = 10s.$

$\therefore$ Electric current $i = \frac{ne}{t}$

$$\Rightarrow i = \frac{7.5 \times 10^{15} \times 16 \times 10^{-20}}{10}$$

$$= 120 \times 10^{-6} A$$

$$= 120 \mu A$$

(2)

Given Current $i = 5A$

Resistance $R = 20 \Omega.$

$\therefore$ Power consumed $P = i^2 R$

$$= (5)^2 \times 20$$

$$= 25 \times 20$$

$$= 500W$$

(3)

Given Resistance $R = 5 \Omega$

Charge $q = 720 C$

$t = 1 min = 60 sec$

Acc to ohm's law $V = iR$

$$\Rightarrow V = \frac{q}{t} R = \frac{\cancel{720}^{12}}{\cancel{60}} \times 5$$

$$\Rightarrow V = 60 V.$$

(4)

Given Current $i = 1.5\,A$

time $t = 10\,min = 10 \times 60\,sec$

Heat $Q = 450\,J$

$\therefore$ Acc to Joule's law $Q = i^2 R t$

$\Rightarrow 450 = (1.5)^2 R (10 \times 60)$

$\Rightarrow 45 = 2.25 \times R \times 60$

$\Rightarrow R = \frac{45}{2.25 \times 60} = \frac{45}{135}$

$\Rightarrow R = \frac{1}{3}\,\Omega$

If time $= 10\,sec$

$\therefore Q = i^2 R t =$

$\Rightarrow 450 = (2.25) \times R \times 10$

$\Rightarrow 45 = 2.25 R \Rightarrow R = \frac{45}{2.25} = 20\,\Omega$

(5)

Given Resistance $R = 5\,\Omega$.

Power $P = 125\,W$

$\therefore P = i^2 R$

$\Rightarrow 125 = i^2 \times 5$

$\Rightarrow i^2 = \frac{125}{5} = 25$

$\Rightarrow i = \sqrt{25} = 5\,A$

(6)

Given Area of cross section $A = 3.4 \ mm^2$

$= 3.4 \times 10^{-9} m^2$

length $l = 400 m$

$\rho = 1.7 \times 10^{-8} \Omega m$

$\therefore$ we know that specific resistance (or) resistivity $\rho = R \frac{A}{l}$

$\rho \Rightarrow 1.7 \times 10^{-8} = R \times \frac{3.4 \times 10^{-9}}{40}$

$\Rightarrow R = \frac{\cancel{1.7} \times \cancel{40}^{20} \times 10^{-\cancel{9}8}}{{}_{2}\cancel{3.4} \times \cancel{10^{-9}}}$

$\Rightarrow R = 20 \times 10$

$= R = 200 \ \Omega$

(7)

Given specific resistance $\rho = 1.7 \times 10^{-7} \Omega m$

length $l = 10 m$

Area $A = 2 \times 10^{-6} m^2$

From resistivity $\rho = R \frac{A}{l}$

$\Rightarrow R = \rho \frac{l}{A} = \frac{1.7 \times 10^{-7} \times 10}{2 \times 10^{-6}}$

$\Rightarrow R = \frac{1.7}{2} = 0.85 \ \Omega$

(8)

voltage $V = 20\ V$

Resistance $R = 5\ \Omega$

Acc to ohm's law $V = iR$

$$\Rightarrow i = \frac{V}{R}$$

$$\Rightarrow i = \frac{20}{5} = 4A$$

(9)

Given Resistance $R = 25\ \Omega$

current $i = 2A$

Acc to ohm's law $V = iR$

$$\Rightarrow V = 2 \times 25$$

$$\Rightarrow V = 50\ V$$

(10)

Given Resistance $R = 15\ \Omega$

voltage $V = 30\ V$

Acc to ohm's law $V = iR$

$$\Rightarrow \overset{2}{\cancel{30}} = i\,(\cancel{15})$$

$$\Rightarrow i = 2A$$

(15)

No. of electrons $n = 6\times10^{16}$

charge of an electron $e = 16\times10^{-20}$ C

$\therefore$ Current $i = \frac{ne}{t}$

$\Rightarrow i = \frac{6\times10^{16}\times16\times10^{-20}}{1}$

$\Rightarrow i = 96\times10^{-4}$

$= 9.6\times10^{-3}$ A

(16)

Given Current $i = 3A$; time $= 120$ sec

Resistance $R = 10\,\Omega$

$\therefore$ Heat Produced $Q = i^2Rt$

$= (3)^2\times10\times120$

$= 9\times1200$

$= 10800$ J

(17)

Given Resistance $R = 25\,\Omega$

Current $i = 8$ A ; $t = 10$ min
$= 600$ sec

$\therefore$ Heat Produced $= i^2Rt = (8)^2\times25\times600$

$= 64\times25\times600$

$= 960000$ J

$= 960$ KJ

(18)

Resistance $R = 15\ \Omega$

Power $P = \cancel{900}\ \cancel{W}\ 540\,W$

$\therefore$ From $P = i^2 R$

$\Rightarrow 540 = i^2 \times 15$

$\Rightarrow i^2 = \dfrac{540}{15} = \dfrac{180}{5}$

$\Rightarrow i^2 = 36$

$\Rightarrow i = \sqrt{36} = 6A$

WS-1 8th integrated

T task (1)

(1)

Given Area $= 10\ cm^2$

$= 10 \times 10^{-4}\ m^2$

$= 10^{-3}\ m^2$

Mass $= 40\ kg.$

$\therefore$ Pressure $= \dfrac{F}{A} = \dfrac{mg}{A}$ Here the upper part of the body sustained by two thighs

$\therefore P = \dfrac{mg}{2A} = \dfrac{\overset{20}{\cancel{40}} \times 10}{\cancel{2} \times 10^{-3}}$

$P = 200 \times 10^3$

$= 2 \times 10^5\ N/m^2$

(2)

Given Area $A = 0.6\ m^2$

$= 6\times10^{-1}\ m^2$

Mass of the body = 80 kg.

$\therefore$ Pressure $= \frac{\text{Force}}{\text{Area}} = \frac{Mg}{A}$

$= \frac{80\times10}{6\times10^{-1}}$

$= \frac{40}{3}\times10\times10$

$= 13.33\times10^{2}$

$= 1.33\times10^{3}\ N/m^2$

(4)

Given Area = $80\ cm^2$

$= 80\times10^{-4}\ m^2$

$= 8\times10^{-3}\ m^2$

Mass = 80 kg.

$\therefore$ Pressure $= \frac{F}{2A}$ Here the body is supported by 2 feet

$P = \frac{mg}{2A}$

$= \frac{\cancel{80}^{10}\times10}{2\times\cancel{8}\times10^{-3}}$

$= \frac{1}{\cancel{2}}\times\cancel{100}^{50}\times10^{3}$

$= 50\times10^{3}$

$= 5\times10^{4}\ N/m^2$

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(4)

$P_{atm} = 10^5$ Pa

Area $= 40$ cm $\times 80$ cm

$= 3200$ cm^2

$= 3200 \times 10^{-4}$ m^2

Pressure $= \frac{F}{A} \Rightarrow$ Force $=$ Pressure $\times$ Area

$= 10^5 \times 3200 \times 10^{-4}$

$= 320 N \times 10^2$

$= 3.2 \times 10^4$ N

(5)

Given density $= 1.29$ kg/m^3

variation of Pressure with ~~hig~~ height is

$P = \rho g h$

$P = 1.05 \times 10^5$ N/m^2

$\Rightarrow 1.05 \times 10^5 = 1.29 \times 10 \times h$

$\Rightarrow h = \frac{1.05 \times 10^4}{1.29}$

$= 8013$ m.

(6)

Variation of Pressure with depth $P = \rho g h + P_a$

Given $P_a = 10^5$ N/m^2 ; $h = 10$ m ; $\rho_w = 10^3$ kg/m^3

$\therefore P = 10^3 \times 10 \times 10 + 10^5$

$= 10^5 + 10^5$

$= 2 \times 10^5 = 2$ atm

(10)

Given pressure at ground floor $P = 270 \text{ k Pa}$

$= 270 \times 10^3 \text{ Pa}$

Variation of Pressure with height is given by

$$P = \rho g h$$

$$\Rightarrow 270 \times \cancel{10^3} = \cancel{10^3} \times 10 \times h$$

$$\Rightarrow h = 27 \text{ m}.$$

If we take $g = 9.8 \text{ m/s}^2$ then we get $h = 27.55 \text{ m}$

Here $\rho \rightarrow$ density of water $= 10^3 \text{ kg/m}^3$

(16) (16), (17)

Given mass $= 4 \text{ kg}$

Area $= 2 \text{ m}^2$

weight $= Mg$

$= 4 \times 10 = 40 \text{N}.$

Pressure $= \frac{F}{A} = \frac{Mg}{A}$

$= \frac{40}{2}$

$= 20 \text{ N/m}^2$

LTask JEE Main level

1

Area of each thigh bone $= 20\ cm^2$

$= 20 \times 10^{-4}\ m^2$

Mass $= 50\ kg$

Here the upper part of the body is supported by 2 thighs

$\therefore$ Pressure $= \dfrac{\text{weight}}{2 \times \text{Area}}$

$= \dfrac{Mg}{2 \times A} =$

$= \dfrac{50 \times 10}{2 \times \cancel{20}^{2} \times 10^{-4}}$

$= \dfrac{50}{4} \times 10^{4} = 12.5 \times 10^{4}\ N/m^2$

2

Given Area of the body of the man $= 0.5\ m^2$

Mass $= 60\ kg$

$\therefore$ Pressure $= \dfrac{\text{weight}}{\text{Area}} = \dfrac{Mg}{A}$

$= \dfrac{60 \times 10}{0.5}$

$= 1200$

$= 12 \times 10^{2}\ N/m^2$

(3)

Given mass $= 90\ kg$

Area $A = 90\ cm^2 = 90 \times 10^{-4}\ m^2$

the upper part of the body was supported by 2 feet,

$\therefore$ Pressure $p = \dfrac{weight}{2 \times A} = \dfrac{Mg}{2A}$

$\Rightarrow p = \dfrac{90 \times 10}{2 \times \cancel{90} \times 10^{-4}}$

$\Rightarrow p = \dfrac{\cancel{10}^5}{\cancel{2}} \times 10^4$

$\Rightarrow p = 5 \times 10^4\ N/m^2$

~~(4)~~

(4)

Given Pressure $= 10^5\ Pa$

Area $= 10\,cm \times 20\,cm$

$= 200\ cm^2$

$= 200 \times 10^{-4}\ m^2$

We know that Pressure $= \dfrac{Force}{Area}$

$\Rightarrow$ Force $=$ Pressure $\times$ Area

$= 10^5 \times 200 \times 10^{-4}$

$= 2 \times 10^3\ N.$

$= 0{\cdot}2 \times 10^4\ N.$

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(5)

Given density $\rho = 1.29\ kg/m^3$; $g = 9.8\ m/s^2$

At sea level Pressure is = 1 atm

$= 10^5$ pascals (or) 1.013×10^5 Pa

$\therefore$ Pressure with height is given by

$$P = \rho g h$$

$$\Rightarrow 10^5 = 1.29 \times 9.8 \times h$$

$$\Rightarrow h = \frac{10^5}{1.29 \times 9.8} \simeq 8013\ m$$

(6)

depth = 5 m ; $\rho_w = 10^3\ kg/m^3$; $g = 10\ m/s^2$

Pressure at a depth = $P_a + \rho g h$

$$P = 10^5 + 10^3 \times 10 \times 5$$

$$= 10^5 + 10^4 \times 5$$

$$= 10^5 + 0.5 \times 10^5$$

$$\Rightarrow P = 1.5 \times 10^5 = 1.5\ atm$$

(10)

Pressure at ground floor $P = 100\ kPa$

$= 100 \times 10^3$ Pa

Variation of pressure with height $P = \rho g h$

$$\Rightarrow \overset{10}{\cancel{100}} \times \cancel{10^3} = \cancel{10^3} \times \cancel{10} \times h$$

$$\Rightarrow h = 10m.$$