Građevinski fakultet
Fizika
Preddiplomski studij

Rezultati pismenog ispita
23.02.2017.

Ime	Prezime	Bodovi
Matija	Baf	Nije pristupio
Dominik	Blažević	0
Mario	Bošnjaković	85
Doris	Brkić	80
Josip	Buzuk	80
Lara	Ćosić	80
Filip	Dogančić	75
Luka	Elez	80
Dominik	Franjić	30
Ana	Granić	80
Neven	Grbeša	75
Dorotea	Ibrahimpašić	60
Margareta	Jakšić	88
Dominik	Klanjšček	90
Tihana Marija	Kopić	10
Maja	Krijan	80
Elizabeta	Kvesić	90
Ružica	Lasić	70
Irena	Leovac	15
Boris	Major	80
Luka	Mandura	10
Dominik	Marelja	60
Filip	Mihić	80
Fran	Milat	80
Antonio	Mirosavljević	62
Helena	Mišković	70
Antonio	Nekić	90
Paula	Pavlović	75
Renato	Petković	70
Tino	Petrošanec	50
Matko	Popović	80
Matea	Prgić	80
Ema	Pušić	80
Filip	Smojver	50
Veronika	Stjepanović	80
Renata	Struhak	80
Tomislav	Šarčević	100
Josip	Tadić	Nije pristupio

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Dominik	Taušan	55
Tomislav	Tomšić	80
Josipa	Vranjić	90
Luka	Vrljić	Nije pristupio
Mihael	Vučić	50
Ivfica	Vučković	80
Antonio	Vujić	Nije pristupio
Ivan	Vuković	60
Kristijan	Wolfl	80
Anamarija	Zlovolić	35

Napomena: za prolaz je potrebno imati 50%.

Usmeni dio ispita će se održati u petak, 24.02.2017. u 12:00 na Odjelu za fiziku.

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Ime i prezime: ________________________________

Br. bodova: __________________

23.02.2017.

1. Astronaut na Zemlji ima težinu 540,0 N. Koliku će težinu imati na planetu čiji je polumjer dvostruko veći od Zemljinog, a masa trostruko veća od Zemljine? (405 N)

30. ***REASONING*** The weight of a person on the earth is the gravitational force F_{earth} that it exerts on the person. The magnitude of this force is given by Equation 4.3 as

$$F_{\text{earth}} = G\frac{m_{\text{earth}}m_{\text{person}}}{r_{\text{earth}}^2}$$

where r_{earth} is the distance from the center of the earth to the person. In a similar fashion, the weight of the person on another planet is

$$F_{\text{planet}} = G\frac{m_{\text{planet}}m_{\text{person}}}{r_{\text{planet}}^2}$$

We will use these two expressions to obtain the weight of the traveler on the planet.

SOLUTION Dividing F_{planet} by F_{earth} we have

$$\frac{F_{\text{planet}}}{F_{\text{earth}}} = \frac{G\dfrac{m_{\text{planet}}m_{\text{person}}}{r_{\text{planet}}^2}}{G\dfrac{m_{\text{earth}}m_{\text{person}}}{r_{\text{earth}}^2}} = \left(\frac{m_{\text{planet}}}{m_{\text{earth}}}\right)\left(\frac{r_{\text{earth}}}{r_{\text{planet}}}\right)^2$$

or

$$F_{\text{planet}} = F_{\text{earth}}\left(\frac{m_{\text{planet}}}{m_{\text{earth}}}\right)\left(\frac{r_{\text{earth}}}{r_{\text{planet}}}\right)^2$$

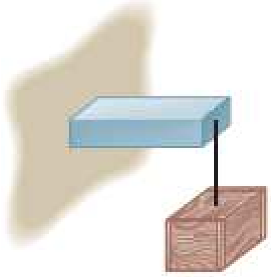
Since we are given that $\frac{m_{\text{planet}}}{m_{\text{earth}}} = 3$ and $\frac{r_{\text{earth}}}{r_{\text{planet}}} = \frac{1}{2}$, the weight of the space traveler on the planet is

$$F_{\text{planet}} = (540.0\text{ N})(3)\left(\frac{1}{2}\right)^2 = \boxed{405.0\text{ N}}$$

2. Na slici je prikazan drveni sanduk mase 160 kg koji je obješen na čeličnu šipku ($E = 8{,}1 \cdot 10^{10}$ N/m^2). Duljina šipke je 0,10 m, a poprečni presjek 3,2 cm^2. Ako zanemarimo masu šipke, odredite:

a. Tlak na šipku (4,9 MPa)

b. Vertikalnu deformaciju Δy desnog kraja šipke (6,0 µm)



57. ***REASONING*** The shear stress is equal to the magnitude of the shearing force exerted on the bar divided by the cross sectional area of the bar. The vertical deflection ΔY of the right end of the bar is given by Equation 10.18 [$F = S(\Delta Y / L_0)A$].

SOLUTION

a. The stress is

$$\frac{F}{A} = \frac{mg}{A} = \frac{(160\text{ kg})(9.80\text{ m/s}^2)}{3.2\times 10^{-4}\text{ m}^2} = \boxed{4.9\times 10^6\text{ N/m}^2}$$

b. Taking the value for the shear modulus S of steel from Table 10.2, we find that the vertical deflection ΔY of the right end of the bar is

$$\Delta Y = \left(\frac{F}{A}\right)\frac{L_0}{S} = (4.9\times 10^6\text{ N/m}^2)\,\frac{0.10\text{ m}}{8.1\times 10^{10}\text{ N/m}^2} = \boxed{6.0\times 10^{-6}\text{ m}}$$

3. Protok krvi u aorti koja opskrbljuje mozak iznosi $3{,}6 \cdot 10^{-6}$ m^3/s.

   a. Ako je polumjer aorte 5,2 mm, odredite srednju brzinu krvi u aorti. (4,2 cm/s)

   b. Odredite brzinu krvi u suženju aorte, ako je polumjer aorte u tom djelu 3 puta manji (pretpostavimo da je protok krvi ostao isti) (38,0 cm/s)

56. ***REASONING***

a. According to Equation 11.10, the volume flow rate Q is equal to the product of the cross-sectional area A of the artery and the speed v of the blood, $Q = Av$. Since Q and A are known, we can determine v.

b. Since the volume flow rate Q_2 through the constriction is the same as the volume flow rate Q_1 in the normal part of the artery, $Q_2 = Q_1$. We can use this relation to find the blood speed in the constricted region.

SOLUTION

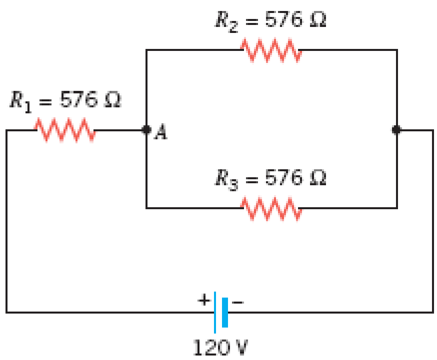
a. Since the artery is assumed to have a circular cross-section, its cross-sectional area is $A_1 = \pi r_1^2$, where r_1 is the radius. Thus, the speed of the blood is

$$v_1 = \frac{Q_1}{A_1} = \frac{Q_1}{\pi r_1^2} = \frac{3.6\times10^{-6}\,\mathrm{m^3/s}}{\pi\left(5.2\times10^{-3}\,\mathrm{m}\right)^2} = \boxed{4.2\times10^{-2}\,\mathrm{m/s}} \qquad (11.10)$$

b. The volume flow rate is the same in the normal and constricted parts of the artery, so $Q_2 = Q_1$. Since $Q_2 = A_2 v_2$, the blood speed is $v_2 = Q_2/A_2 = Q_1/A_2$. We are given that the radius of the constricted part of the artery is one-third that of the normal artery, so $r_2 = \frac{1}{3} r_1$. Thus, the speed of the blood at the constriction is

$$v_2 = \frac{Q_1}{A_2} = \frac{Q_1}{\pi r_2^2} = \frac{Q_1}{\pi\left(\frac{1}{3}r_1\right)^2} = \frac{3.6\times10^{-6}\,\mathrm{m^3/s}}{\pi\left[\frac{1}{3}\left(5.2\times10^{-3}\,\mathrm{m}\right)\right]^2} = \boxed{0.38\,\mathrm{m/s}}$$

4. Odredite snagu svakog otpornika prikazanog na shemi. Otpor svakog otpornika iznosi 576 Ω, dok je napon izvora 120 V. (11,1 W; 2,78 W, 2,78 W)



70. ***REASONING*** The power P dissipated in each resistance R is given by Equation 20.6b as $P = I^2 R$, where I is the current. This means that we need to determine the current in each resistor in order to calculate the power. The current in R_1 is the same as the current in the equivalent resistance for the circuit. Since R_2 and R_3 are in parallel and equal, the current in R_1 splits into two equal parts at the junction A in the circuit.

SOLUTION To determine the equivalent resistance of the circuit, we note that the parallel combination of R_2 and R_3 is in series with R_1. The equivalent resistance of the parallel combination can be obtained from Equation 20.17 as follows:

1042 ELECTRIC CIRCUITS

$$\frac{1}{R_p} = \frac{1}{576\ \Omega} + \frac{1}{576\ \Omega} \quad \text{or} \quad R_p = 288\ \Omega$$

This 288-Ω resistance is in series with R_1, so that the equivalent resistance of the circuit is given by Equation 20.16 as

$$R_{eq} = 576\ \Omega + 288\ \Omega = 864\ \Omega$$

To find the current from the battery we use Ohm's law:

$$I = \frac{V}{R_{eq}} = \frac{120.0\ \text{V}}{864\ \Omega} = 0.139\ \text{A}$$

Since this is the current in R_1, Equation 20.6b gives the power dissipated in R_1 as

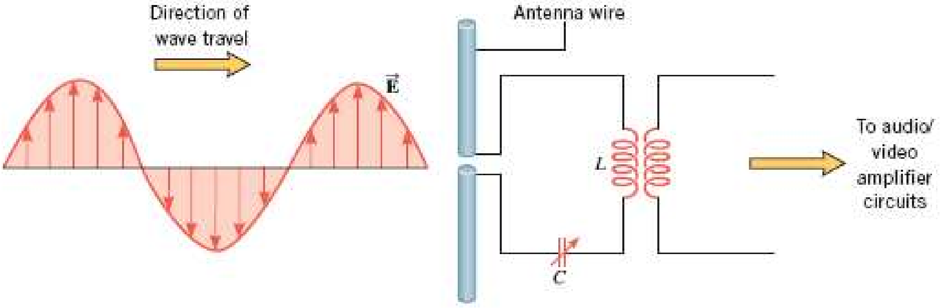
$$P_1 = I_1^2 R_1 = (0.139\ \text{A})^2 (576\ \Omega) = \boxed{11.1\ \text{W}}$$

R_2 and R_3 are in parallel and equal, so that the current in R_1 splits into two equal parts at the junction A. As a result, there is a current of $\frac{1}{2}(0.139\ \text{A})$ in R_2 and in R_3. Again using Equation 20.6b, we find that the power dissipated in each of these two resistors is

$$P_2 = I_2^2 R_2 = \left[\tfrac{1}{2}(0.139\ \text{A})\right]^2 (576\ \Omega) = \boxed{2.78\ \text{W}}$$

$$P_3 = I_3^2 R_3 = \left[\tfrac{1}{2}(0.139\ \text{A})\right]^2 (576\ \Omega) = \boxed{2.78\ \text{W}}$$

5. FM radio postaje koriste radio valove u rasponu frekvencija od 88,0 MHz do 108 MHz. Ako pretpostavimo da je induktivitet zavojnice na slici $6{,}00 \cdot 10^{-7}$ H, odredite raspon kapaciteta kondenzatora antene kako bi mogla „pokupiti“ radiovalove svih FM stanica. (3,62 – 5,45 pF)



4. ***REASONING*** In order to pick up radio waves, the circuit must have a resonant frequency f_0 that matches the frequency of the radio waves. The resonant frequency depends upon the capacitance C and inductance L of the circuit via $f_0 = \frac{1}{2\pi\sqrt{LC}}$ (Equation 23.10). In order to pick up the entire range of FM waves, the circuit must be able to attain the lowest ($f_{\text{low}} = 88$ MHz) and highest ($f_{\text{high}} = 108$ MHz) necessary resonant frequency. We will use Equation 23.10 to determine the corresponding minimum and maximum capacitance values.

SOLUTION Squaring both sides of $f_0 = \frac{1}{2\pi\sqrt{LC}}$ (Equation 23.10) and solving for C, we obtain

$$(f_0)^2 = \frac{1}{(2\pi)^2 LC} \qquad \text{or} \qquad C = \frac{1}{(2\pi f_0)^2 L} \tag{1}$$

As we see from Equation (1), the greater the frequency, the smaller the value of the capacitance. So the highest frequency $f_{\text{high}} = 108$ MHz corresponds to the minimum value of the capacitance C_{min}. From Equation (1), we obtain

$$C_{\text{min}} = \frac{1}{(2\pi f_{\text{high}})^2 L} = \frac{1}{(2\pi)^2 (108\times10^6\ \text{Hz})^2 (6.00\times10^{-7}\ \text{H})} = 3.62\times10^{-12}\ \text{F}$$

On the other end of the FM frequency range, matching the lowest frequency of $f_{\text{low}} = 88.0$ MHz requires a maximum capacitance value C_{max} of

$$C_{\text{max}} = \frac{1}{(2\pi f_{\text{low}})^2 L} = \frac{1}{(2\pi)^2 (88.0\times10^6\ \text{Hz})^2 (6.00\times10^{-7}\ \text{H})} = 5.45\times10^{-12}\ \text{F}$$

Therefore, the capacitance values should range from $\boxed{3.62\times10^{-12}\ \text{F to } 5.45\times10^{-12}\ \text{F}}$.