I Mekanik, Repetitionsuppgifter i fysik
Inledande diagnostiskt prov

1. a) $\Delta t = 11 - 4 = 7\ s$
$\Delta v = 2,2 - 0,2 = 2,0\ m/s$

$a = \frac{\Delta v}{\Delta t} = \frac{2,0}{7} = \underline{\underline{0,3}}\ m/s^2$ R

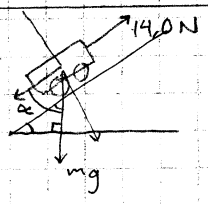
b) 1 ruta $= 0,2 \cdot 1 = 0,2\ m$
Rutor under kurvan: $2 \cdot 10 + 26 = 46$
$s = 46 \cdot 0,2\ m = \underline{\underline{9,2\ m}}$ R

2. $s = \frac{gt^2}{2}$

$\frac{2s}{g} = t^2$

$t = \sqrt{\frac{2s}{g}} = \sqrt{\frac{2 \cdot 0,80\ m}{9,82\ m/s^2}} = 0,404\ s$

$s = vt = 5,0\ m/s \cdot 0,404\ s = \underline{\underline{2,02\ m}}$ R

3. 

$mg \cdot \cos\alpha = 14,0\ N \Rightarrow m = \frac{14,0\ N}{g \cdot \cos\alpha} = \frac{14,0\ N}{9,82\ N/kg \cdot \cos 65,7°} = \underline{\underline{3,46\ kg}}$ R

$\alpha = 180° - 90° - 24,3° = 65,7°$

4. $F_s = mg + \frac{mv^2}{r} = m\left(g + \frac{v^2}{r}\right) = 0,1\ kg \cdot \left(9,82\ N/kg + \frac{(1,4\ m/s)^2}{1,20\ m}\right) = \underline{\underline{1,14\ N}}$ R

5. $\frac{mv^2}{2} = mgh$

$h = \frac{v^2}{2g} = \frac{(2,4\ m/s)^2}{2 \cdot 9,82\ m/s^2} = \underline{\underline{0,29\ m}}$ R

6. $80\ W \cdot 0,80 \cdot t = 5,6\ kg \cdot g \cdot 2,5\ m$

$t = \frac{5,6\ kg \cdot 9,82\ N/kg \cdot 2,5\ m}{80\ W \cdot 0,80} = \underline{\underline{2,15\ s}}$ R

7. Före: $m_1 v_{10}$

Efter: $m_1 v_{11} + m_2 v_{21}$

Före = Efter $\Rightarrow v_{10} = \frac{m_1 v_{11} + m_2 v_{21}}{m_1} = \frac{400\ kg \cdot 2\ m/s + 300\ kg \cdot 4\ m/s}{400\ kg} =$

$= \underline{\underline{5\ m/s}}$ R

1 Mekanik, Repetitionskurs i fysik
Inledande diagnostiskt prov

8. $s = A\sin(\omega t)$

a) $A = 0{,}14\ \text{mm}$

$v = \dot{s} = A\omega\cos(\omega t)$

$v_{max} = A\omega = 0{,}22\ \text{m/s}$

$$\omega = \frac{v_{max}}{A} = \frac{0{,}22\ \text{m/s}}{0{,}14\cdot 10^{-3}\ \text{m}} = 1{,}5714\cdot 10^{3}\ \text{rad/s}$$

$a = \dot{v} = -A\omega^2\sin(\omega t)$

$a_{max} = A\omega^2 = 0{,}14\cdot 10^{-3}\,\text{m}\cdot(1{,}5714\cdot 10^{3}\ \text{s}^{-1})^2 = \underline{346\ \text{m/s}^2}$ R

b) $\frac{2\pi}{T} = \omega \iff T = \frac{2\pi}{\omega} = \frac{2\pi}{1{,}5714\cdot 10^{3}} = \underline{4{,}00\ \text{ms}}$ R

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9. $mgr_1 = Fr_2$

$$F = \frac{mgr_1}{r_2} = \frac{2{,}0\ \text{kg}\cdot 9{,}82\ \text{N/kg}\cdot 0{,}35\ \text{m}}{1{,}0\ \text{m}} = 6{,}874\ \text{N} \approx \underline{6{,}9\ \text{N}}$$ R

1.1 $v_a = 70\ \text{km/h}$

$v_b = 80\ \text{km/h}$

$v_b\cdot t - v_a\cdot t = s = 24\ \text{m}$

$(v_b - v_a)\,t = s$

$$t = \frac{s}{v_b - v_a} = \frac{24\ \text{m}}{10\ \text{km/h}} = \frac{24}{10^4}\cdot 3600\ \text{s} = \underline{8{,}64\ \text{s}}$$ R

1.2

a) $0{,}62\ \text{m} - 0{,}05\ \text{m} = \underline{0{,}57\ \text{m}}$ R

b) $\frac{-0{,}625\ \text{m}}{0{,}625\ \text{s}} = \underline{-1{,}0\ \text{m/s}}$ R

c) $\underline{0{,}8\ \text{s}}$ R

1.3 $$v = \frac{s}{t} = \frac{(5{,}2+12{,}0)\ \text{km}}{(15+24)\ \text{min}} = \frac{17{,}2\ \text{km}}{39\ \text{min}} = \frac{17{,}2\cdot 10^{3}\ \text{m}}{39\cdot 60\ \text{s}} = \underline{7{,}35\ \text{m/s}}$$ R

1.4 $v = v_0 + at = 1{,}22\ \text{m/s} + 3{,}36\ \text{m/s}^2\cdot 2{,}00\ \text{s} = \underline{7{,}94\ \text{m/s}}$ R

1.5 $s = 1{,}50\ \text{m}$

$t = 1{,}22\ \text{s}$

$v_0 = 0\ \text{m/s}$ ⟶

$s = 0{,}5(v+v_0)\,t = 0{,}5\,vt$

$v = \frac{2s}{t}$

$v = v_0 + at$

$\frac{2s}{t} = at$

$a = \frac{2s}{t^2}$

$v_1^2 = v_0^2 + 2as_1$, $s_1 = \frac{s}{2}$

$v_1^2 = 2\cdot\frac{2s}{t^2}\cdot\frac{s}{2} = 2\frac{s^2}{t^2}$

$$v_1 = \sqrt{2}\cdot\frac{s}{t} = \sqrt{2}\cdot\frac{1{,}50\ \text{m}}{1{,}22\ \text{s}} = \underline{1{,}74\ \text{m/s}}$$ R

1.6

$s = 6{,}74\ \text{m}$
$v_0 = 50\ \text{km/h}$
$v = 0\ \text{m/s}$

$v^2 = v_0^2 + 2as$
$-2as = v_0^2$

$$a = \frac{v_0^2}{-2s} = \frac{(50\cdot 10^3/3600)^2}{-2\cdot 6{,}74}\ \text{m/s}^2 = \underline{-14{,}3\ \text{m/s}^2}$$ R (fel i facit?)

1.7

a) $\underline{2{,}6\ \text{m/s}}$ R

b) $\underline{0\text{s} \to 3\text{s}\ \&\ 8 \to 13\text{s}}$ R

c) $12\ \text{m} + 1{,}5\ \text{m} = \underline{13{,}5\ \text{m}}$ R

1.8

$d_1 = \max(x) - \min(x) = 1{,}043 - 0{,}241 = 0{,}802\ \text{m}$
$d_2 = \max(y) - \min(y) = 0{,}852 - 0{,}056 = 0{,}796\ \text{m}$

$d = \max(d_i) = 0{,}802\ \text{m}$

$$r = \frac{0{,}802\text{m}}{2} = \underline{0{,}401\ \text{m}}$$ R

b) $T_1 = 1{,}00 - 0{,}00 = 1{,}00\text{s}$ (x min − min)
$T_2 = 2\cdot(0{,}74 - 0{,}24) = 1{,}00\text{s}$ (y max − min)

$$v = \frac{\pi d}{T} = \frac{\pi\cdot 0{,}802\text{m}}{1{,}00\ \text{s}} = \underline{2{,}52\ \text{m/s}}$$ R

c) $$a = \frac{v^2}{r} = \frac{(2{,}52\ \text{m/s})^2}{0{,}401\ \text{m}} = \underline{15{,}8\ \text{m/s}^2}$$ R

1.9

a) $$v = \frac{2\pi r}{T} = \frac{2\pi\cdot 1{,}5\cdot 10^{11}\text{m}}{365{,}25\cdot 24\cdot 3600\ \text{s}} = \underline{29{,}9\ \text{km/s}}$$ R

b) $$a = \frac{v^2}{r} = \frac{(29{,}9\cdot 10^3\ \text{m/s})^2}{1{,}5\cdot 10^{11}\text{m}} = \underline{6{,}0\ \text{mm/s}^2}$$ R

1.10

$x = v\cdot t$

a) $$v = \frac{x}{t} = \frac{12{,}0\text{m}}{10\cdot 0{,}2\text{s}} = 6{,}0\ \text{m/s}$$ R

b) $y = s = v\cdot t - 0{,}5\,a\,t^2 = -0{,}5\,a\,t^2$
($v = 0$, vid y_{max})

$$a = \frac{-2y_{max}}{t^2} = \frac{-2\cdot 6{,}8\text{m}}{(6\cdot 0{,}2\text{s})^2} = -9{,}44\ \text{m/s}^2$$ R (9,8 enligt facit)

1.11

$v_y^2 = v_{y0}^2 + 2\cdot a\cdot s$

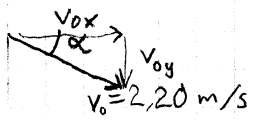
a) Högsta punkt: $0 = v_0^2 + 2\cdot g\cdot s$

$$v_{y0} = \sqrt{-2\cdot g\cdot s} = \sqrt{2\cdot 9{,}82\cdot 17{,}0} = 18{,}3\ \text{m/s}$$

$$v = \sqrt{v_{x0}^2 + v_{y0}^2} = \sqrt{15^2 + 18{,}27^2} = \underline{23{,}6\ \text{m/s}}$$ R

b) $\alpha = \tan^{-1}(v_{..}/v) = \tan^{-1}(18{,}27\ /\ 15) = 50.6°$ R

1.12 $\alpha = \sin^{-1}((1{,}31 - 0{,}83)/1{,}80) = 15{,}47°$



$v_{oy} = -v_0 \cdot \sin\alpha = -2{,}20 \cdot \sin 15{,}47° = -0{,}5868$ m/s

$v_{ox} = v_0 \cdot \cos\alpha = +2.20 \cdot \cos 15{,}47° = 2{,}120$ m/s

$s = v_0 \cdot t + 0{,}5 \cdot a \cdot t^2$, $v_0 = v_{oy}$, $a = -g$

$-0{,}83 = -0{,}5868\,t - 0{,}5 \cdot 9{,}82 \cdot t^2$

$0{,}5 \cdot 9{,}82\,t^2 + 0{,}5868\,t - 0{,}83 = 0$

$x^2 + px + q = 0$

$x = -\frac{p}{2} \pm \sqrt{\frac{p^2}{4} - q}$

$t^2 + \frac{0{,}5868}{0{,}5 \cdot 9{,}82}\,t - \frac{0{,}83}{0{,}5 \cdot 9{,}82} = 0$

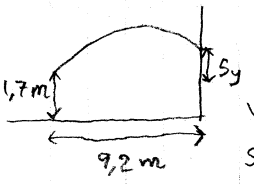
$t^2 + 0{,}1195\,t - 0{,}1690 = 0$

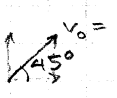
$t_1 = -\frac{0{,}1195}{2} + \sqrt{\frac{0{,}1195^2}{4} + 0{,}1690} = 0{,}3557$ s

$t_2 < 0$, orimlig lösning

$s_x = v_{ox} \cdot t = 2{,}120$ m/s $\cdot\ 0{,}3557$ s $= 0{,}754$ m $\approx \underline{0{,}75\text{ m}}$ R

1.13





$v_{oy} = v_{ox} = v_0 \cos 45° = 8{,}49$ m/s

$s_x = v_{ox} \cdot t \Leftrightarrow t = s_x / v_{ox} = 9{,}2\text{ m}/(12{,}0\text{ m/s} \cdot \cos 45°) = 1{,}084$ s

$s_y = \underbrace{v_{oy} \cdot t}_{=s_x} + 0{,}5 \cdot \underbrace{a}_{=-g} \cdot t^2 = 9{,}2 - 0{,}5 \cdot 9{,}82 \cdot 1{,}084^2 = 3{,}43$ m

$1{,}7 + 3{,}4 = \underline{5{,}1\text{ m}}$ R

1.14 $s = s_0 + v_0 t + 0{,}5\,a\,t^2 = 5{,}3 - 0{,}5 \cdot 9{,}82 \cdot t^2 = 0$

a)

$t = \sqrt{5{,}3/(0{,}5 \cdot 9{,}82)} = 1{,}039$ s $\approx \underline{1{,}04\text{ s}}$ R

b) $\bar{v} = 5{,}3\text{ m}/1{,}039\text{ s} = \underline{5{,}1\text{ m/s}}$ R

1.15 se 1.14

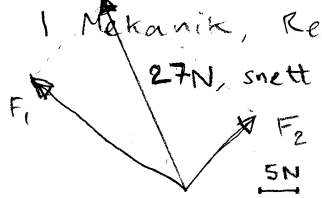
a) $t = \sqrt{s_0/(0{,}5 \cdot g)} = \sqrt{78/(0{,}5 \cdot 9{,}82)} = 3{,}99$ s $\approx \underline{4{,}0\text{ s}}$ R

b) $s_x = v_{ox} \cdot t = 30 \cdot 3{,}99 = 119{,}7$ m $\approx \underline{120\text{ m}}$ R

c) $v_y = -g \cdot t = -9{,}82 \cdot 3{,}99 = -39{,}18$ m/s

$\alpha = \tan^{-1}\frac{|v_y|}{v_x} = \tan^{-1}\left(\frac{39{,}18}{30}\right) = \underline{52{,}6°}$ R (facit 52,5°)

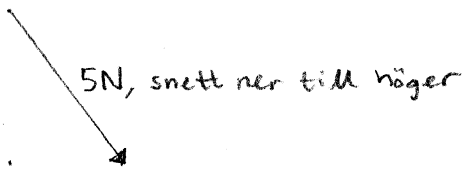
1.16



1.17 Min: $9{,}0\text{N} - 6{,}0\text{N} = 3{,}0\text{N}$
Max: $9{,}0\text{N} + 6{,}0\text{N} = 15{,}0\text{N}$

$6{,}0\text{N} - 10{,}0\text{N} - 14{,}0\text{N}$

1.18 $F_x = 6+7-2-8 = 3\text{N}$
$F_y = 3+4-2-5-4 = -4\text{N}$



1.19 $F_x = -8\text{N}$, 8N i x-led
$F_y = 4\text{N}$, 4N i y-led

1.20
a) $F_F = \mu \cdot F_N = \mu \cdot mg = 0{,}32\text{N}$

$$\mu = \frac{0{,}32\text{N}}{0{,}12 \cdot 9.82\text{N}} = 0{,}2716 \approx \underline{0{,}27}$$

b) $F_F = \mu \cdot mg = 0{,}2716 \cdot (0{,}12+0{,}30) \cdot 9{,}82\text{N} = \underline{1{,}12\text{N}}$

1.21
a) $F_N = 1{,}0 \cdot 9{,}82\text{N} - 3{,}5\text{N} = \underline{6{,}32\text{N}}$ R

b) $F_F = \mu F_N = \mu \cdot mg = 3{,}5\text{N}$

$$\mu = \frac{3{,}5\text{N}}{mg} = \frac{3{,}5}{1.0 \cdot 9{,}82} = 0{,}356 \approx \underline{0{,}36}$$ R

1.22 $F_F = \mu F_N = \mu mg = k \cdot \Delta l$

$$\mu = \frac{k \cdot \Delta l}{mg} = \frac{12{,}45 \cdot (45{,}5 - 26{,}0) \cdot 10^{-2}}{1{,}12 \cdot 9{,}82} = \underline{0{,}22}$$ R

1.23 $F_a = m \cdot a$
$F_g = m \cdot g$
$F^g = mg + ma = m(g+a) = 75 \cdot (9{,}82 + 4{,}5) = \underline{1074\text{N}}$ R

1.24 $s = v_0 t + \frac{1}{2} a t^2 = 2{,}22\text{m}$ (1)
a) $t = 0{,}87\text{s} \Rightarrow v = 0\ \text{m/s}$
$s = vt - \frac{1}{2} a t^2 = -\frac{1}{2} a t^2 = 2{,}22\text{m}$

$-\frac{1}{2} a \cdot 0{,}87^2 = 2{,}22$

$a = -2 \cdot \frac{2{,}22}{0{,}87^2} = -5{,}87\ \text{m/s}^2$

(1) $\Rightarrow$ $v_0 t = s - \frac{1}{2} a t^2$

exakta värdet ↓

$$v_0 = \frac{s - \frac{1}{2} a t^2}{t} = \frac{2{,}22 + \frac{1}{2} \cdot 5{,}87 \cdot 0{,}87^2}{0{,}87} = \underline{5{,}10\text{m/s}}$$

b) $F = m \cdot a = 1.00 \cdot (-5{,}87) = -5.87\text{N}$ dvs 5.87N motsatt hastighetens

1.25

$v = v_0 + at$

$v - v_0 = at$

$a = \frac{v - v_0}{t} = \frac{20\ km/h - 40\ km/h}{7,5\ s} = -\frac{20 \cdot 10^3\ m/3600\ s}{7,5\ s} = -740,74 \cdot 10^{-3}\ m/s^2$

$F = ma = 1200\ kg \cdot (-740,74 \cdot 10^{-3}\ m/s^2) = -888,9\ N$

$a = \frac{F}{m}$

$t = \frac{v - v_0}{a} = \frac{-m v_0}{F} = \frac{(1200+1800)\ kg \cdot 30\ km/h}{888,9\ N} =$

($v = 0\ km/h$)

$= \frac{3000\ kg \cdot 30 \cdot 10^3/3600\ s}{888,9\ N} = \underline{\underline{28,1\ s}}$ R

1.26

$F = C \cdot \frac{m_1 \cdot m_2}{r^2} = 6,67 \cdot 10^{-11} \cdot \frac{6,37 \cdot 10^{23} \cdot 210}{(343 \cdot 10^4)^2} = \underline{\underline{758\ N}}$ R

1.27 a) $F = k \cdot \frac{q_1 \cdot q_2}{r^2} = 8,99 \cdot 10^9 \cdot \frac{(160,22 \cdot 10^{-21})^2}{(5,3 \cdot 10^{-13})^2} = 822\ \mu N \approx 0,82\ mN$

b) $F_c = \frac{m_e v^2}{r} \Rightarrow v^2 = \frac{F_c r}{m_e} \Rightarrow v = \sqrt{\frac{F_c r}{m_e}} = \sqrt{\frac{822 \cdot 10^{-6} \cdot 5,3 \cdot 10^{-13}}{911 \cdot 10^{-33}}} =$

$= \underline{\underline{22\ Mm/s}}$ R (fel i facit)

1.28 $c = 2\pi r$, $f = 83\ varv/min \Rightarrow T = \frac{1}{f} = \frac{1}{83/60\ s} = \frac{60}{83}\ s = 0,7229\ s$

$F_c = \frac{mv^2}{r} = \frac{m(2\pi r/T)^2}{r} = \frac{m\,4\pi^2 r^2}{rT} = \frac{4\pi^2 mr}{T} < F_F$

$4\pi^2 mr < F_F T$

$r < \frac{F_F T}{4\pi^2 m} = \frac{120 \cdot 10^{-3} \cdot 0,7229}{4\pi^2 \cdot 55 \cdot 10^{-3}} = 40,0\ mm \approx 4,0\ cm$

Svar: Innanför radien $\underline{\underline{4,0\ cm}}$ R? (fel i facit?)

1.29

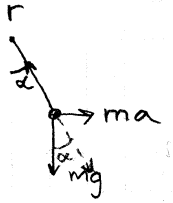
$F_c = \frac{mv^2}{r}$

$F_g = mg$

$F = mg + \frac{mv^2}{r} = m\left(g + \frac{v^2}{r}\right) = 0,20 \cdot \left(9,82 + \frac{1,53^2}{1,2}\right) = \underline{\underline{2,35\ N}}$ R

1.30

$F_c = \frac{mv^2}{r} = ma \Rightarrow a = \frac{v^2}{r}$

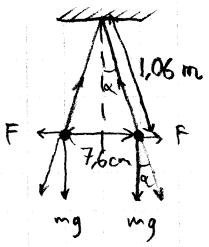


$\tan\alpha = \frac{ma}{mg} = \frac{a}{g} = \frac{v^2}{gr} = \frac{(120\ km/h)^2}{9,82\ m/s^2 \cdot 350\ m} =$

$= \frac{(120 \cdot 1000\ m/(3600\ s))^2}{9,82\ m/s^2 \cdot 350\ m} = 0,3233$

$\alpha = \tan^{-1} 0,3233 = 17,9°$

1.31



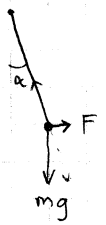
$\cos\alpha = \frac{7,6/2}{106}$

$\tan\alpha = \frac{F}{mg}$

$F = mg\tan\alpha = mg\tan\left(\cos^{-1}\left(\frac{7,6}{2\cdot 106}\right)\right) =$

$= 0,28\cdot 10^{-3}\cdot 9,82\cdot \tan\cos^{-1}\left(\frac{7,6}{2\cdot 106}\right) = \underline{\underline{77\ mN}}$ (fel i facit?)

1.32



$\tan 6° = \frac{F}{mg}$

$F = mg\tan 6° = 25\cdot 10^{-6}\cdot 9,82\cdot \tan 6° = \underline{\underline{26\ \mu N}}$ R

1.33

a) $mgh = \frac{mv^2}{2}$

$2gh = v^2$

$v = \sqrt{2gh} = \sqrt{2\cdot 9,82\cdot 1,8} = \underline{\underline{5,9\ m/s}}$ R

b Efter 3:e studsen: $mgh(1-0,22)^3 = mgh_2$

$h_2 = 0,78^3\cdot h = 0,78^3\cdot 1,8 = \underline{\underline{0,85\ m}}$ R

1.34

$\frac{mv^2}{2} = Fs$ (m i kg)

$F = \frac{mv^2}{2s} = \frac{0,162\cdot 5,8^2}{2\cdot 17,6} = \underline{\underline{0,15\ N}}$ R

1.35

$W_0 = \frac{mv_0^2}{2}$

$\frac{2W_0}{m} = v_0^2$

$v_0 = \sqrt{\frac{2W_0}{m}}$

$v = \frac{v_0}{2} = \frac{1}{2}\sqrt{\frac{2W_0}{m}} = \sqrt{\frac{2W_0}{4m}} = \sqrt{\frac{W_0}{2m}}$

$W = \frac{mv^2}{2} = \frac{m\cdot \frac{W_0}{2m}}{2} = \frac{W_0}{4} = \frac{27,8\ kJ}{4} = \underline{\underline{6,95\ kJ}}$ R

1.36 a) $F_g = mg = 0,060\cdot 9,82 = 0,5892\ N \approx \underline{\underline{0,59\ N}}$ R

b) $h = 26 - 12 = 14\ cm = 0,14\ m$

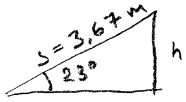
$mgh = \frac{mv^2}{2}$

$v = \sqrt{2gh} = \sqrt{2\cdot 9,82\cdot 0,14} = \underline{\underline{1,66\ m/s}}$ R

$F = F_c + F_g = \frac{mv^2}{r} + F_g = m\left(\frac{2gh}{r} + g\right) = mg\left(\frac{2h}{r} + 1\right) = 0,5892\left(\frac{2\cdot 0,14}{0,9} + 1\right)$

$= \underline{\underline{0,77\ N}}$ R

1.37



$\sin v = \frac{h}{s}$

$h = s \cdot \sin v = 3,67 \cdot \sin 23°$

$W_F = F_F \cdot s = 1,40\,N \cdot 3,67\,m$

$W_p = mgh = 3,5 \cdot 9,82 \cdot 3,67 \cdot \sin 23°$

$W = W_F + W_p = 1,40N \cdot 3,67 + 3,5 \cdot 9,82 \cdot 3,67 \cdot \sin 23° = \underline{54,4\ J}$ R

1.38 $\frac{mv^2}{2} = Fs$

$F = \frac{mv^2}{2s} = \frac{8,0 \cdot 10^{-3} \cdot 400^2}{2 \cdot 0,16} = \underline{4,0\ kN}$ R

1.39 $v_x = 15,2\ m/s$

$\frac{mv_y^2}{2} = mgh$

$v_y = \sqrt{2gh}$

$v = \sqrt{v_x^2 + v_y^2} = \sqrt{15,2^2 + 2 \cdot 9,82 \cdot 19,5} = \underline{24,8\ m/s}$ R

1.40 $\frac{mv^2}{2} = mgh + \frac{mv_0^2}{2}$

$v = \sqrt{2gh + v_0^2} = \sqrt{2 \cdot 9,82 \cdot 6,00 + 8,44^2} = \underline{13,75\ m/s}$ R

1.41 $\frac{(m_1 + m_2)v^2}{2} + m_1 gh = m_2 gh$

$\frac{(m_1 + m_2)v^2}{2} = m_2 gh - m_1 gh = (m_2 - m_1)gh$

$v = \sqrt{\frac{2(m_2 - m_1)gh}{m_2 + m_1}} = \underline{5,72\ m/s}$ R

1.42 $v_1 = 30\ km/h = 30 \cdot 10^3 / 3600\ m/s$
$v_2 = 50\ km/h = 50 \cdot 10^3 / 3600\ m/s$

$W = \frac{mv_2^2}{2} - \frac{mv_1^2}{2} = \frac{m}{2}(v_2^2 - v_1^2) = \frac{1400}{2}\left((50^2 - 30^2) \cdot (10^3/3600)^2\right)$

$= \underline{86,4\ kJ}$ R

1.43 $\Delta W = W_i - W_f$

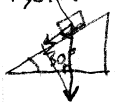
$\Delta W = F \cdot s$

$F = \Delta W / s = \left(\frac{mv_0^2}{2} - \frac{mv^2}{2}\right)/s = \frac{m}{2s}(v_0^2 - v^2)$

$= \frac{20 \cdot 10^{-3}}{2 \cdot 0,1}\left(185^2 - 95^2\right) = \underline{2,52\ kN}$ R

1.44

$v = at$



$\cos 60° = \frac{F}{mg}$

$F = mg\cos 60°$

$a = \frac{F}{m} = g\cdot\cos 60°$

$\frac{mv^2}{2} = mgh$

$v = \sqrt{2gh}$

$t = \frac{v}{a} = \frac{\sqrt{2gh}}{g\cdot\cos 60°} = \frac{\sqrt{2h}}{\sqrt{g}\cdot\cos 60°} = \frac{\sqrt{2\cdot 0{,}90}}{\sqrt{9{,}82}\cdot\cos 60°} = \underline{\underline{0{,}86\ s}}$ R

1.45

$W = P\eta t = mgh$

$t = \frac{mgh}{P\eta} = \frac{4{,}6\cdot 9{,}82\cdot 6{,}5}{60\cdot 0{,}85} = \underline{\underline{5{,}76 s}}$ R

1.46

$v = 90\ km/h = \frac{90\cdot 10^3}{3600}\ m/s$

$W = \frac{mv^2}{2} = \frac{1280}{2}\cdot\left(\frac{90\cdot 10^3}{3600}\right)^2 = 400\ kJ$

$W_0 = P_0\cdot t = 60\cdot 10^3\cdot 20{,}0 = 1{,}2\ MJ$

$\eta = \frac{W}{W_0} = \frac{400}{1200} = 33{,}3\ \%$

Går till spillvärme: $1-\eta = \underline{\underline{66{,}7\ \%}}$ R

1.47

$W = Fs$

$W = P\cdot t$

$F\cdot s = P\cdot t$

$F\cdot\frac{s}{t} = P$

$F\cdot v = P$

$F = \frac{P}{v} = \frac{25\cdot 10^3\ W}{50\ m/s} = \underline{\underline{500 N}}$ R

1.48

$P_0 = \frac{W}{t} = \frac{mgh}{t} = \frac{m}{t}\cdot gh = 42\cdot 10^3\cdot 9{,}82\cdot 65 = 26{,}8\ MW$

$\frac{V}{t} = 42\ m^3/s$

$\frac{m}{t} = \rho\cdot\frac{V}{t} = 1000\cdot 42\ m^3/s = 42\cdot 10^3\ m^3/s$

$P = \eta P_0 = 0{,}80\cdot 26{,}8 = \underline{\underline{21{,}4\ MW}}$ R

1.49 a)

$+\rightarrow$

$P_1 = m_a v_{a1} + m_b v_{b1}$

$P_2 = m_a v_{a2} + m_b v_{b2}$

$P_1 = P_2 \Rightarrow m_a v_{a1} + m_b v_{b1} = m_a v_{a2} + m_b v_{b2}$

$v_{a2} = \frac{m_a v_{a1} + m_b v_{b1} - m_b v_{b2}}{m_a} = v_{a1} + \frac{m_b(v_{b1} - v_{b2})}{m_a} =$

$= 2{,}17 + \frac{0{,}145(-1{,}94 - 1{,}03)}{0{,}247} = \underline{\underline{0{,}43\ m/s}}$ (samma håll)

(saknas i facit)

1.49 b) Värme: $\Delta W = W_1 - W_2 = \frac{m_a v_{a1}^2}{2} + \frac{m_b v_{b1}^2}{2} - \frac{m_a v_{a2}^2}{2} - \frac{m_b v_{b2}^2}{2}$

$= \frac{1}{2}\left(m_a(v_{a1}^2 - v_{a2}^2) + m_b(v_{b1}^2 - v_{b2}^2)\right)$

$= \frac{1}{2}\left(0{,}247(2{,}17^2 - 0{,}426^2) + 0{,}145(1{,}94^2 - 1{,}03^2)\right)$

$= \underline{0{,}755\ \text{J}}$ R

1.50 $\frac{m_b v_b^2}{2} = (m_b + m_k) g h$

$v_b = \sqrt{\frac{2(m_b + m_k) g h}{m_b}} = \sqrt{\frac{2(8{,}70 \cdot 10^{-3} + 1{,}250) \cdot 9{,}82 \cdot 0{,}023}{8{,}70 \cdot 10^{-3}}} = \underline{8{,}08\ \text{m/s}}$

(fel i facit?)

1.51 $v = \frac{0{,}96 - 0{,}77}{(180 - 160) \cdot 10^{-3}} = 9{,}5\ \text{m/s}$

$v = \frac{0{,}77 - 0{,}59}{0{,}02} = 9{,}0\ \text{m/s}$

$v = \frac{0{,}59 - 0{,}41}{0{,}02} = 9{,}0\ \text{m/s}$

$v = \frac{0{,}41 - 0{,}22}{0{,}02} = 9{,}5\ \text{m/s}$

$v = \frac{0{,}22 - 0{,}04}{0{,}02} = 9{,}0\ \text{m/s}$

$\bar{v} = \frac{9{,}5 + 9{,}0 + 9{,}0 + 9{,}5 + 9{,}0}{5} = 9{,}2\ \text{m/s}$

$F \cdot \Delta t = p - p_0$, $p = m\bar{v}$, $p_0 = 0$

$F = \frac{p}{\Delta t} = \frac{m\bar{v}}{\Delta t} = \frac{0{,}45 \cdot 9{,}2}{0{,}07} = \underline{59\ \text{N}}$ K

1.52 $p_1 = p_2 \Rightarrow m_a v_{a1} = m_a v_{a2} + m_b v_{b2}$

a) $v_{a1} = \frac{m_a v_{a2} + m_b v_{b2}}{m_a} = v_{a2} + \frac{m_b v_{b2}}{m_a} = 2 + \frac{350 \cdot 4}{450} = \underline{5{,}1\ \text{m/s}}$ R

b) Värme: $\Delta W = W_1 - W_2 = \frac{m_a v_{a1}^2}{2} - \frac{m_a v_{a2}^2}{2} - \frac{m_b v_{b2}^2}{2} =$

$= \frac{1}{2}\left(m_a(v_{a1}^2 - v_{a2}^2) - m_b v_{b2}^2\right) = \frac{1}{2}\left(450(5{,}111^2 - 2^2) - 350 \cdot 4^2\right) =$

$= \underline{2{,}18\ \text{kJ}}$ R

1.53 $\frac{mv^2}{2} = W \Rightarrow v = \sqrt{\frac{2W}{m}}$

$p = mv = m \cdot \sqrt{\frac{2W}{m}} = \sqrt{2Wm} = \sqrt{2 \cdot 32{,}0 \cdot 0{,}450} = 5{,}37\ \text{kg m/s}$

$\approx \underline{5{,}4\ \text{kg} \cdot \text{m/s}}$ R

1.54 $F\Delta t = p - p_0$, $p_0 = 0$, $p = mv$

$F = \frac{p}{\Delta t} = \frac{mv}{\Delta t} = \frac{0{,}120 \cdot 45}{0{,}02} = \underline{270\ \text{N}}$ R

1.55

$10 \cdot T = 13{,}4\ s$

$T = 1{,}34\ s$

$\omega = 2\pi f = \frac{2\pi}{T}$

$\omega = \sqrt{\frac{k}{m}}$

$\sqrt{\frac{k}{m}} = \frac{2\pi}{T}$

$\frac{k}{m} = \frac{4\pi^2}{T^2}$

$k = \frac{4\pi^2 m}{T^2}$

$F = -k \cdot x$

$F = mg$

F ↑+

$-k \cdot x = mg$

$-\frac{4\pi^2 \cancel{m}}{T^2} \cdot x = \cancel{m} g$

$x = -\frac{gT^2}{4\pi^2} = -\frac{9{,}82 \cdot 1{,}34^2}{4\pi^2} = -0{,}447\ m$

$l = l_0 - x = 20\ cm - (-44{,}7) = 64{,}7\ cm \approx \underline{0{,}65\ m}$ (fel i facit)

1.56

a) $A = \frac{11\ cm}{2} = 5{,}5\ cm = 0{,}055\ m$

$\omega = 2\pi f = 2\pi \cdot \frac{20}{27{,}8}\ rad/s = 4{,}520\ rad/s$

$v_{max} = A \cdot \omega = 0{,}055 \cdot 4{,}520\ m/s = \underline{0{,}249\ m/s}$ R

b) $\omega = \sqrt{\frac{k}{m}}$

$\omega^2 = \frac{k}{m}$

$k = m\omega^2$

$m_2 = m + 0{,}050\ kg$

$20\,T_2 = 20 \cdot 2\pi\sqrt{\frac{m_2}{k}} = 20 \cdot 2\pi\sqrt{\frac{m_2}{m\omega^2}} = 20 \cdot 2\pi\sqrt{\frac{0{,}1 + 0{,}05}{0{,}1 \cdot 4{,}520^2}} = \underline{34{,}0\ s}$ R

1.57

$A = 0{,}34\ mm$, $a_{max} = 65{,}2\ m/s^2$

a) $a_{max} = A \cdot \omega^2$

$\omega^2 = \frac{a_{max}}{A}$

$\omega = \sqrt{\frac{a_{max}}{A}}$

$v_{max} = A \cdot \omega = \sqrt{A \cdot a_{max}} = \sqrt{0{,}34 \cdot 10^{-3} \cdot 65{,}2} = \underline{0{,}149\ m/s}$ R

b) $T = \frac{1}{f} = \frac{2\pi}{\omega} = 2\pi \cdot \sqrt{\frac{A}{a_{max}}} = \underline{14{,}3\ ms}$ R

1.58

$\omega = 227\ rad/s$

a) $\omega = 2\pi f$

$f = \omega / 2\pi = 227/2\pi\ s^{-1} = \underline{36{,}1\ Hz}$ (fel i facit)

b) $A = 4{,}51 \cdot 10^{-4}\ m$

$2A = 2 \cdot 4{,}51 \cdot 10^{-4}\ m = \underline{902\ \mu m} = 9{,}02 \cdot 10^{-4}\ m$ (fel i facit)

c) $v_{max} = A \cdot \omega = 4{,}51 \cdot 10^{-4} \cdot 227\ m/s = \underline{0{,}102\ m/s}$ (fel i facit)

1.59 E

1.60

$a_{max} = A\omega^2 = A(2\pi f)^2 = A \cdot 4\pi^2 f^2$

$f = \sqrt{\frac{a_{max}}{4\pi^2 \cdot A}} = \sqrt{\frac{80}{4\pi^2 \cdot 0{,}025}} = 9{,}0\ Hz$

1.61

a) $\omega = 2{,}62 \cdot 10^3\ s^{-1}$

$\omega = 2\pi f = \frac{2\pi}{T}$

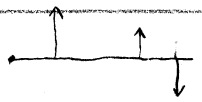
$T = \frac{2\pi}{\omega} = \frac{2\pi}{2{,}62 \cdot 10^3}\ s = \underline{2{,}40\ ms}$ R

b) $v_{max} = A \cdot \omega = 1{,}24 \cdot 10^{-6} \cdot 2{,}62 \cdot 10^3\ m/s = \underline{3{,}25\ mm/s}$ R

c) $a_{max} = A \cdot \omega^2$

$F_{max} = m \cdot a_{max} = m \cdot A\omega^2 = 4{,}5 \cdot 10^{-7} \cdot 1{,}24 \cdot 10^{-6} \cdot (2{,}62 \cdot 10^3)^2 = \underline{3{,}83\ \mu N}$ R

1.62



$F_1 r_1 + F_2 r_2 + F_3 r_3 + F_4 r_4 = 0$

$-5{,}00 \cdot 0{,}22 + 4{,}00 \cdot 0{,}18 + 7{,}00 \cdot 0{,}06 + 4{,}00 \cdot r_4 = 0$

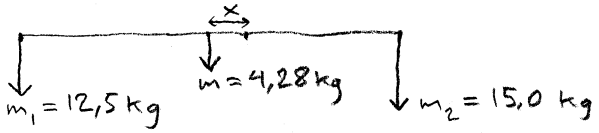
$4{,}00 \cdot r_4 = -0{,}04$

$r_4 = \frac{-0{,}04}{4{,}00} = -0{,}01\ m$

D.v.s. Hävarm (m) Riktning

0,01 medurs

1.63



$2L = 1\ m$

$m_2 g(L - x) = mgx + m_1 g(L + x)$

$m_2 L - m_2 x = mx + m_1 L + m_1 x$

$m_2 L - m_1 L = mx + m_1 x + m_2 x = (m + m_1 + m_2)x$

$x = \frac{(m_2 - m_1)L}{m + m_1 + m_2} = \frac{(15{,}0 - 12{,}5) \cdot 1}{4{,}28 + 12{,}5 + 15{,}0} = 0{,}0787\ m = 7{,}9\ cm$ från mitten mot 15,0 kg-vikten.

D.v.s 42,1 cm från 15 kg-vikten (fel i facit)

1.64

$mgx = F \cdot L$

$F = \frac{mgx}{L} = \frac{0{,}20 \cdot 9{,}82 \cdot 0{,}05}{0{,}12} = \underline{0{,}82\ N}$ R

1.65 $m_p g x = mg \cdot 0{,}5$

$x = \frac{0{,}5m}{m_p} = \frac{0{,}5 \cdot 30{,}0}{75{,}0} = \underline{0{,}2\ m}$ R

I Mekanik, Repetitionskurs i fysik
Slutdiagnos

1.

a) $\frac{1}{2}mv_0^2 + Fs = \frac{1}{2}mv^2$

$F = ma$

$\frac{1}{2}mv_0^2 + mas = \frac{1}{2}mv^2$

$as = \frac{1}{2}(v^2 - v_0^2)$

$a = \frac{1}{2s}(v^2 - v_0^2) = \frac{1}{2 \cdot 0{,}68}(1{,}88^2 - 0{,}16^2) = \underline{\underline{2{,}58 \text{ m/s}^2}}$ R

b) $x = v_0 t + \frac{1}{2}at^2$

$\frac{1}{2}at^2 + v_0 t = x$

$at^2 + 2v_0 t = 2x$

$t^2 + \frac{2v_0}{a}t = \frac{2x}{a}$

$t^2 + 2 \cdot \frac{v_0}{a} \cdot t + \left(\frac{v_0}{a}\right)^2 - \left(\frac{v_0}{a}\right)^2 = \frac{2x}{a}$

$\left(t + \frac{v_0}{a}\right)^2 = \frac{2x}{a} + \left(\frac{v_0}{a}\right)^2$

$t + \frac{v_0}{a} = \pm\sqrt{\frac{2x}{a} + \left(\frac{v_0}{a}\right)^2}$

$t = -\frac{v_0}{a} \pm \sqrt{\frac{2x}{a} + \left(\frac{v_0}{a}\right)^2} = -\frac{0{,}16}{2{,}58} + \underset{t>0}{\sqrt{\frac{2 \cdot 0{,}34}{2{,}58} + \left(\frac{0{,}16}{2{,}58}\right)^2}}$

$= \underline{\underline{0{,}46 \text{ s}}}$ R

2.

$x = v_{ox} t$

$y = v_{oy} t - \frac{1}{2}gt^2$

$0 = v_{oy} t - \frac{1}{2}gt^2$

$-\frac{1}{2}gt + v_{oy} = 0$

$v_{oy} = \frac{1}{2}gt$

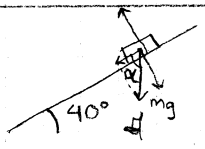
$t_2 = t/2 = 5{,}40/2 = 2{,}70 \text{ s}$

$y_{max} = \frac{1}{2}gt \cdot t_2 - \frac{1}{2}gt_2^2$

$= \frac{1}{2}gt_2\underbrace{(t - t_2)}_{t - \frac{t}{2} = \frac{t}{2}} = \frac{1}{2} \cdot 9{,}82 \cdot 2{,}70^2 = \underline{\underline{35{,}8 \text{ m}}}$ R

3.

$F_F = \mu F_N$



$\alpha = 180° - 90° - 40° = 50°$

$F_N = mg\sin\alpha$

$F_g = mg\cos\alpha$

$F = F_g - F_F = mg\cos\alpha - \mu mg\sin\alpha \Rightarrow a = g(\cos\alpha - \mu\sin\alpha)$

$\frac{mv_0^2}{2} + Fs = \frac{mv^2}{2} \Rightarrow a = \frac{v^2}{2s} \Rightarrow g\cos\alpha - g\mu\sin\alpha = \frac{v^2}{2s}$

$\underbrace{\frac{mv_0^2}{2}}_{=0}$

$g\mu\sin\alpha = g\cos\alpha - \frac{v^2}{2s}$

$\mu = \frac{g\cos\alpha - \frac{v^2}{2s}}{g\sin\alpha} = \frac{\cos\alpha - \frac{v^2}{2sg}}{\sin\alpha} = \frac{\cos 50° - \frac{4{,}45^2}{2 \cdot 2{,}0 \cdot 9{,}82}}{\sin 50°} = \underline{\underline{0{,}18}}$ R

4.

a) $\frac{mv^2}{2} = mgh$

$v = \sqrt{2gh} = \sqrt{2 \cdot 9{,}82 \cdot 0{,}17} = 1{,}83 \text{ m/s}$ R

b) $F = m\left(\frac{v^2}{r} + g\right) = 0{,}060 \cdot \left(\frac{(1{,}83)^2}{0{,}850} + 9{,}82\right) = 0{,}82 \text{ N}$ R

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5. a) $J = F \cdot \Delta t = 1372 \cdot 0{,}012 = 16{,}5 \text{ kg} \cdot \text{m/s} = \underline{16{,}5 \text{ Ns}}$ R

b) $J = p - p_0 = mv$ ($p_0 = 0$)

$v = \frac{J}{m} = \frac{16{,}5}{0{,}45} = \underline{36{,}6 \text{ m/s}}$ R

---

6. a) $A = 2{,}3 \cdot 10^{-4} \text{ m}$

$2A = 2 \cdot 2{,}3 \cdot 10^{-4} \text{ m} = 0{,}46 \cdot 10^{-3} \text{ m} = \underline{0{,}46 \text{ mm}}$ R

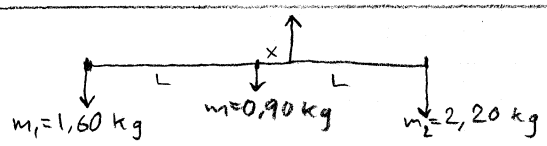
b) $\omega = \frac{2\pi}{T}$

$T = \frac{2\pi}{\omega} = \frac{2\pi}{83{,}6} = 75{,}2 \text{ ms}$ R

c) $a_{max} = A \cdot \omega^2$

$F_{max} = m a_{max} = m \cdot A \cdot \omega^2 = 5{,}0 \cdot 10^{-5} \cdot 2{,}3 \cdot 10^{-4} \cdot 83{,}6^2 = 80{,}4 \text{ μN}$ R

7.



$m_1 g(L+x) + mgx = m_2 g(L-x)$

$m_1 L + m_1 x + mx = m_2 L - m_2 x$

$(m_1 + m_2 + m)x = (m_2 - m_1)L$

$x = \frac{(m_2 - m_1)L}{m_1 + m_2 + m}$

$L + x = \frac{(m_1 + m_2 + m + m_2 - m_1)L}{m_1 + m_2 + m} = \frac{(2m_2 + m)L}{m_1 + m_2 + m} = \frac{(2 \cdot 2{,}20 + 0{,}90) \cdot 1{,}50/2}{1{,}60 + 2{,}20 + 0{,}90} =$

$= 0{,}846 \text{ m} \approx \underline{0{,}85 \text{ m}}$ R

2 Tryck, gaslagarna och värmelära, Repetitionskurs i fysik
Inledande diagnostiskt prov

1. $m = 0{,}185\ \text{kg} + 0{,}2\ \text{l} \cdot 1\ \text{kg/l} = 0{,}385\ \text{kg}$

$A = \pi \cdot r^2 = \pi \cdot (2{,}40 \cdot 10^{-2}\ \text{m})^2$

$p = \frac{F}{A} = \frac{mg}{\pi r^2} = \frac{0{,}385\ \text{kg} \cdot 9{,}82\ \text{N/kg}}{\pi (2{,}40 \cdot 10^{-2}\ \text{m})^2} = \underline{\underline{2{,}09\ \text{kPa}}}$ R

2. $p_l \cdot A + \rho_{Hg} \cdot A \cdot h \cdot g = p_b \cdot A$

$p_b = 103{,}2 \cdot 10^3\ \text{Pa} + 13{,}546\ \text{g/cm}^3 \cdot 11{,}3\ \text{cm} \cdot 9{,}82\ \text{N/kg} = \underline{\underline{118{,}2\ \text{kPa}}}$ R

3. NTP: 0 °C, 101,3 kPa

$pV = nRT$

$p_1 V_1 = p_2 V_2$

$p_2 = \frac{p_1 V_1}{V_2} = \frac{101{,}3\ \text{kPa} \cdot 20\ \text{ml}}{17\ \text{ml}} = \underline{\underline{119{,}2\ \text{kPa}}}$ R

4. $pV = nRT$

$\frac{V_1}{T_1} = \frac{V_2}{T_2} \iff V_2 = \frac{V_1 T_2}{T_1} = \frac{2{,}8\ \text{l} \cdot 323{,}15\ \text{K}}{293{,}15\ \text{K}} = \underline{\underline{3{,}1\ \text{l}}}$

$T_1 = 20 + 273{,}15 = 293{,}15\ \text{K}$
$T_2 = 50 + 273{,}15 = 323{,}15\ \text{K}$

5a. $\Delta T = 1083\ ^\circ\text{C} - 20\ ^\circ\text{C} = 1063\ \text{K}$

$W = 0{,}38\ \text{kJ/(kg·K)} \cdot 1063\ \text{K} \cdot 2{,}4\ \text{kg} = \underline{\underline{969\ \text{kJ}}}$ (Fel i facit?)

5b. $W = 205\ \text{kJ/kg} \cdot 2{,}4\ \text{kg} = \underline{\underline{492\ \text{kJ}}}$ R

6. värm is: $W = c \cdot m \cdot \Delta t = 2{,}2\ \text{kJ/(kg·K)} \cdot 0{,}045\ \text{kg} \cdot 18\ \text{K} = 1{,}782\ \text{kJ}$

smält is: $W = L_s \cdot m = 334\ \text{kJ/kg} \cdot 0{,}045\ \text{kg} = 15{,}03\ \text{kJ}$

värm vatten: $W = c \cdot m \cdot (t - 0\,^\circ\text{C}) = 4{,}19\ \text{kJ/(kg·K)} \cdot 0{,}045\ \text{kg} \cdot t$

kyl etanol: $W = c \cdot m \cdot (24\ ^\circ\text{C} - t) = 2{,}43\ \text{kJ/(kg·K)} \cdot 0{,}5\ \text{kg} \cdot (24\ ^\circ\text{C} - t)$

$2{,}43\ \frac{\text{kJ}}{\text{kg·K}} \cdot 0{,}5\ \text{kg} \cdot (24^\circ - t) = 4{,}19\ \text{kJ/(kg·K)} \cdot 0{,}045\ \text{kg} \cdot t + 15{,}03\ \text{kJ} + 1{,}782\ \text{kJ}$

$4{,}19\ \frac{\text{kJ}}{\text{kg·K}} \cdot 0{,}045\ \text{kg} \cdot t + 2{,}43\ \frac{\text{kJ}}{\text{kg·K}} \cdot 0{,}5\ \text{kg} \cdot t = 2{,}43\ \frac{\text{kJ}}{\text{kg·K}} \cdot 0{,}5\ \text{kg} \cdot 24^\circ - 15{,}03\ \text{kJ} - 1{,}782\ \text{kJ}$

$1{,}40355 \cdot t = 12{,}348$

$t = \frac{12{,}348}{1{,}40355}\ ^\circ\text{C} = \underline{\underline{8{,}8\ ^\circ\text{C}}}$ R

2 Tryck, gaslagarna och värmelära, Repetitionsuppgifter i fysik

2.1 $P = \frac{mg}{A} = \frac{34 \cdot 9{,}82}{0{,}3 \cdot 0{,}4} = \underline{2782 \text{ Pa}} \approx 2{,}8 \text{ kPa}$ R

2.2
$P_1 = P_0 + h_1 \rho_1 g$
$P_2 = P_0 + h_2 \rho_2 g$

$P_2 = P_1 \Rightarrow h_2 \rho_2 = h_1 \rho_1 \Leftrightarrow \rho_2 = \frac{h_1 \rho_1}{h_2} = \frac{0{,}175 \cdot 1000}{0{,}14} = \underline{1250 \text{ kg/m}^3}$ R

2.3
$P_1 = P_0 + h_1 \rho_1 g$

$P_2 = P_1 \Rightarrow P_2 = P_0 + h_1 \rho_1 g \Rightarrow P_2 - P_0 = \Delta P = h_1 \rho_1 g = 0{,}184 \cdot 1000 \cdot 9{,}82 =$
$= \underline{1{,}81 \text{ kPa}}$ R

2.4 $P_1 V_1 = P_2 V_2$

$V_2 = \frac{P_1 V_1}{P_2} = \frac{(P_0 + h\rho g) V_1}{P_0} = \left(1 + \frac{h\rho g}{P_0}\right) V_1 = \left(1 + \frac{2{,}4 \cdot 1000 \cdot 9{,}82}{101{,}3 \cdot 10^3}\right) \cdot 0{,}04 \text{ ml} =$
$= \underline{0{,}049 \text{ ml}}$ R

$P_2 = P_0$
$P_1 = P_0 + h\rho g$

2.5
$\frac{V_1}{T_1} = \frac{V_2}{T_2}$

$V_2 = \frac{V_1 T_2}{T_1} = \frac{4{,}20 \text{ l} \cdot (273{,}15 + -18) \text{K}}{(273{,}15 + 21) \text{K}} = \underline{3{,}64 \text{ liter}}$ R

2.6
$\frac{P \cdot V}{T} = R \cdot n$

NTF: $n = \frac{PV}{RT} = \frac{101{,}3 \cdot 10^3 \cdot 1}{8{,}315 \cdot 273{,}15} = 44{,}601 \text{ mol}$

Molmassa: $M = \frac{1{,}29 \text{ kg}}{44{,}601 \text{ mol}} = 28{,}92 \text{ g/mol}$ ($\rho_{luft} = 1{,}29 \text{ kg/m}^3$ vid NTP)

Bildäck: $m = M \cdot n = \frac{M P_1 V_1}{R T_1} = \frac{28{,}92 \cdot 10^{-3} \cdot (101{,}3 \cdot 10^3 + 2{,}5 \cdot 10^5) \cdot 0{,}018}{8{,}315 \cdot (273{,}15 + 25)} = \underline{74 \text{ g}}$ R

2.7
$P_1 V_1 = P_2 V_2$

$P_1 A h_1 = (P_1 + \frac{mg}{A}) A h_2$

$h_2 = \frac{P_1 h_1}{P_1 + \frac{mg}{A}} = \frac{h_1}{1 + \frac{mg}{P_1 A}} = \frac{0{,}25}{1 + \frac{5 \cdot 9{,}82}{101{,}3 \cdot 10^3 \cdot 4 \cdot 10^{-3}}} = \underline{0{,}223 \text{ m}}$ R

2.8 $W = c \cdot m \cdot \Delta T = 0{,}39 \cdot 10^3 \cdot 0{,}454 \cdot (400 - 20) = \underline{67{,}3 \text{ kJ}}$ R

2.9 $W = c_1 \cdot m_1 \cdot \Delta T + c_2 \cdot m_2 \cdot \Delta T = (c_1 \cdot m_1 + c_2 \cdot m_2) \cdot \Delta T =$
$= (0{,}90 \cdot 10^3 \cdot 0{,}65 + 4{,}19 \cdot 10^3 \cdot 0{,}8) \cdot (94 - 20) = 291 \text{ kJ} \approx \underline{0{,}29 \text{ MJ}}$ (fel i facit)

2.10

$$\eta = \frac{W_n}{W_t} = \frac{c \cdot m \cdot \Delta T}{P \cdot t} = \frac{4{,}19 \cdot 10^3 \cdot 0{,}4 \cdot (100-18)}{750 \cdot 4{,}5 \cdot 60} = 0{,}68 = \underline{68\%}$$ R

2.11

$W = U \cdot I \cdot t$

$W = c \cdot m \cdot \Delta T$

$c \cdot m \cdot \Delta T = U \cdot I \cdot t$

$$c = \frac{U \cdot I \cdot t}{m \cdot \Delta T} = \frac{25 \cdot 2{,}0 \cdot 7 \cdot 60}{5{,}0 \cdot 10} = \underline{420\ \text{J/(kg·K)}}$$ R

2.12

$$c = \frac{n \cdot \cancel{m} \cdot g \cdot h}{\cancel{m} \cdot \Delta T} = \frac{50 \cdot 9{,}82 \cdot 1{,}50}{22{,}2-17{,}0} = \underline{142\ \text{J/(kg·K)}}$$ R

2.13

$W = c \cdot m \cdot \Delta T + m \cdot L_s = m \cdot (c \cdot \Delta T + L_s) = 1 \cdot (0{,}90 \cdot 10^3 \cdot (660-20) + 395 \cdot 10^3) =$

$= 971 \cdot \text{kJ} = \underline{0{,}97\ \text{MJ}}$ R

2.14

$W_i = m_i L_s + c_{H_2O} \cdot m_i \cdot \Delta T_i$

$W_e = c_e \cdot m_e \cdot \Delta T_e$

$W_i = W_e \Rightarrow m_i L_s + c_{H_2O} \cdot m_i (T - T_i) = c_e \cdot m_e \cdot (T_e - T)$

$m_i L_s + c_{H_2O} \cdot m_i \cdot T - c_{H_2O} \cdot m_i \cdot T_i = c_e \cdot m_e \cdot T_e - c_e \cdot m_e \cdot T$

$c_{H_2O} \cdot m_i \cdot T + c_e \cdot m_e \cdot T = c_e \cdot m_e \cdot T_e + c_{H_2O} \cdot m_i \cdot T_i - m_i L_s$

$$T = \frac{c_e \cdot m_e \cdot T_e + c_{H_2O} \cdot m_i \cdot T_i - m_i L_s}{c_e \cdot m_e + c_{H_2O} \cdot m_i} = \frac{c_e \cdot m_e \cdot T_e + m_i (c_{H_2O} \cdot T_i - L_s)}{c_e \cdot m_e + c_{H_2O} \cdot m_i} =$$

$$= \frac{2{,}43 \cdot 10^3 \cdot 0{,}3 \cdot 37 + 0{,}06 (4{,}19 \cdot 10^3 \cdot 0 - 334 \cdot 10^3)}{2{,}43 \cdot 10^3 \cdot 0{,}3 + 4{,}19 \cdot 10^3 \cdot 0{,}06} = \underline{7{,}1\ ^\circ\text{C}}$$ R

2.15

$W = c \cdot m \cdot \Delta T + m L_s = m (c \cdot \Delta T + L_s) = 2 \cdot 0{,}022^3 \cdot 10^3 \cdot (2{,}2 \cdot 10^3 \cdot (0 - -18) + 334 \cdot 10^3) =$

$= \underline{8{,}0\ \text{kJ}}$ (fel i facit?)

2.16

$W = P \cdot t$

$$t = \frac{W}{P} = \frac{m \cdot L_{\text{Å}}}{P} = \frac{2{,}0 \cdot 2260 \cdot \cancel{10^3}}{1{,}5 \cdot \cancel{10^3}} = 3{,}01\ \text{ks} = \underline{50{,}2\ \text{min}}$$ R

2.17

$W_i = m_i L_s + c \cdot m_i \cdot \Delta T_i$

$W_{H_2O} = c \cdot m_{H_2O} \cdot \Delta T_{H_2O}$

$W_i = W_{H_2O} \Rightarrow m_i L_s + c \cdot m_i \cdot \Delta T_i = c \cdot m_{H_2O} \cdot \Delta T_{H_2O}$

$m_i L_s + c \cdot m_i \cdot (T - T_i) = c \cdot m_{H_2O} \cdot (T_{H_2O} - T)$

$m_i L_s + c \cdot m_i \cdot T - c \cdot m_i \cdot T_i = c \cdot m_{H_2O} \cdot T_{H_2O} - c \cdot m_{H_2O} \cdot T$

$c \cdot m_i \cdot T + c \cdot m_{H_2O} \cdot T = c \cdot m_{H_2O} \cdot T_{H_2O} + c \cdot m_i \cdot T_i - m_i \cdot L_s$

$$T = \frac{c (m_{H_2O} \cdot T_{H_2O} + m_i \cdot T_i) - m_i \cdot L_s}{c \cdot m_i + c \cdot m_{H_2O}} =$$

$$= \frac{4{,}19 \cdot 10^3 (0{,}2 \cdot 53 + 0{,}05 \cdot 0) - 0{,}05 \cdot 334 \cdot 10^3}{4{,}19 \cdot 10^3 \cdot (0{,}2 + 0{,}05)} = \underline{26{,}5\ ^\circ\text{C}}$$

2 Tryck, gaslagarna och värmelära, Repetitionskurs Fysik

Slutdiagnos

1, a) $P = \frac{F}{A} = \frac{mg}{\pi r^2} = \frac{1,80 \cdot 9,82}{\pi \cdot 0,142^2} = \underline{279 \text{ Pa}}$ R

b) $W = c \cdot m \cdot \Delta T = 0,45 \cdot 10^3 \cdot 1,80 \cdot (100 - 20) = \underline{64,8 \text{ kJ}}$ R

2, a) $P_1 = h_1 \rho_1 g = 0,03 \cdot 1000 \cdot 9,82 = 294,6 \text{ Pa} = \underline{0,29 \text{ kPa}}$ R

b) $P_2 = P_1 + h_2 \rho_2 g = 294,6 \text{ Pa} + 0,03 \cdot 1600 \cdot 9,82 = 766,0 \text{ Pa} = \underline{0,77 \text{ kPa}}$ R

3, a) $\frac{P_1 \cdot V_1}{T_1} = \frac{P_2 \cdot V_2}{T_2}$

$V_2 = \frac{P_1 \cdot V_1 \cdot T_2}{P_2 \cdot T_1} = \frac{300 \cdot 10^3 \cdot 0,9 \cdot 273,15}{103,2 \cdot 10^3 \cdot (273,15 + 25)} = 2,40 \text{ m}^3$ (lika fel i facit)

b) $m = \rho V_2 = 1,29 \cdot 2,397 = \underline{3,1 \text{ kg}}$ (lika fel i facit)

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4. $c_{Cu} \cdot m_{Cu} \cdot (T_{100} - T) = c_{H_2O} \cdot m_{H_2O} \cdot (T - T_{20})$

$c_{Cu} \cdot m_{Cu} \cdot T_{100} - c_{Cu} \cdot m_{Cu} \cdot T = c_{H_2O} \cdot m_{H_2O} \cdot T - c_{H_2O} \cdot m_{H_2O} \cdot T_{20}$

$c_{Cu} \cdot m_{Cu} \cdot T_{100} + c_{H_2O} \cdot m_{H_2O} \cdot T_{20} = c_{Cu} \cdot m_{Cu} \cdot T + c_{H_2O} \cdot m_{H_2O} \cdot T$

$T = \frac{c_{Cu} \cdot m_{Cu} \cdot T_{100} + c_{H_2O} \cdot m_{H_2O} \cdot T_{20}}{c_{Cu} \cdot m_{Cu} + c_{H_2O} \cdot m_{H_2O}} = \frac{0,39 \cdot 10^3 \cdot 0,3 \cdot 100 + 4,19 \cdot 10^3 \cdot 0,06 \cdot 20}{0,39 \cdot 10^3 \cdot 0,3 + 4,19 \cdot 10^3 \cdot 0,06} =$

$= \underline{45,4^\circ C}$ R

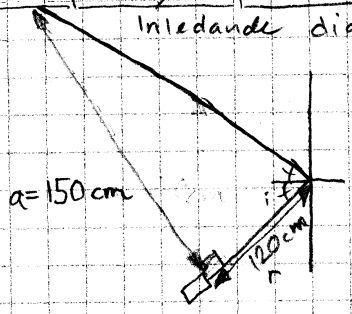
---

5. $t = \frac{W}{P} = \frac{L_A \cdot m}{P} = \frac{2260 \cdot 10^3 \cdot 0,5}{2 \cdot 10^3} = 565 \text{ s} = \underline{9,4 \text{ min}}$ R

3 Optik, Repetitionskurs i fysik

Inledande diagnostiskt prov

1.



$$\frac{a}{r} = \tan(2i)$$

$$i = \frac{1}{2}\tan^{-1}\left(\frac{150}{120}\right) = \underline{\underline{25{,}7^\circ}}$$ R

2. B R

3.

$\alpha_1 = 90^\circ - 55^\circ = 35^\circ$
$\alpha_2 = 90^\circ - 72^\circ = 18^\circ$

Snells lag: $n_1 \sin\alpha_1 = n_2 \sin\alpha_2$, $n_1 = 1$

$$n_2 = \frac{\sin\alpha_1}{\sin\alpha_2} = \frac{\sin 35^\circ}{\sin 18^\circ} = \underline{\underline{1{,}86}}$$ R

4.

Brytningslagen $n_1 \sin\alpha_1 = n_2 \sin\alpha_2$

$\alpha_1 = 90^\circ - \theta$
$n_1 = 1{,}60$
$n_2 = 1{,}0$
$\alpha_2 = 90^\circ$

$n_1 \sin\alpha_1 = 1$
$\alpha_1 = \sin^{-1}(1/n_1)$
$90^\circ - \theta = \sin^{-1}(1/n_1)$
$\theta = 90^\circ - \sin^{-1}(1/1{,}60) = 51{,}3^\circ$

Svar: $\underline{\underline{0^\circ \leq \theta \leq 51{,}3^\circ}}$ R

5. Gauss linsformel

$$\frac{1}{a} + \frac{1}{b} = \frac{1}{f}$$

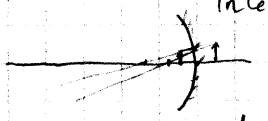
$a = 40$ cm
$b = 60$ cm

a) $f = \left(\frac{1}{40\text{cm}} + \frac{1}{60\text{cm}}\right)^{-1} = \underline{\underline{24\text{ cm}}}$ R

b) $G = \frac{h'}{h} = \frac{b}{a} = \frac{60}{40} = \frac{3}{2} = \underline{\underline{1{,}5}}$ ggr R

c) 60 cm från lampan (40 cm från väggen) R

6.



Newtons formel

$s_o \cdot s_b = f^2$

$s_o = 12{,}0\,\text{cm} - 8{,}0\,\text{cm} = 4{,}0\,\text{cm}$

$f = 12{,}0\,\text{cm}$

$s_b = f^2 / s_o = (12{,}0\,\text{cm})^2 / 4{,}0\,\text{cm} = 36\,\text{cm}$

a) 36 cm från fokus (bakom spegeln), 36 cm - 12 cm = 24 cm bakom spegeln R

b) virtuell R

c) större R

7.

b, c, d, e R

8. $a = 2{,}0\,\text{m}$

$\frac{1}{a} + \frac{1}{b} = \frac{1}{f}$

$\frac{1}{b} = \frac{1}{f} - \frac{1}{a}$

$b = \left(\frac{1}{f} - \frac{1}{a}\right)^{-1} = \left(\frac{1}{30{,}0\,\text{mm}} - \frac{1}{2{,}0\,\text{m}}\right)^{-1} = \underline{30{,}5\,\text{mm}}$ R

$a = \infty\,\text{m}$

$b = \left(\frac{1}{30{,}0\,\text{mm}} - 0\right)^{-1} = \underline{\underline{30{,}0\,\text{mm}}}$ R

9. $b = 3{,}0\,\text{m}$

$h' = 216\,\text{cm}$

$h = 36\,\text{mm}$

$G = \frac{h'}{h} = \frac{b}{a}$

$a = b \cdot \frac{h}{h'}$

$f = \left(\frac{1}{a} + \frac{1}{b}\right)^{-1} = \left(\frac{1}{b} \cdot \frac{h'}{h} + \frac{1}{b}\right)^{-1} = \left(\frac{1}{b}\left(\frac{h'}{h} + 1\right)\right)^{-1} = b\left(\frac{h'}{h} + 1\right)^{-1}$

$= 3{,}0 \cdot \left(\frac{216\,\text{cm}}{36\,\text{mm}} + 1\right)^{-1} = \underline{\underline{49{,}2\,\text{mm}}} = 4{,}92\,\text{cm}$ R

3 Optik, Repetitionskurs i fysik

3.1

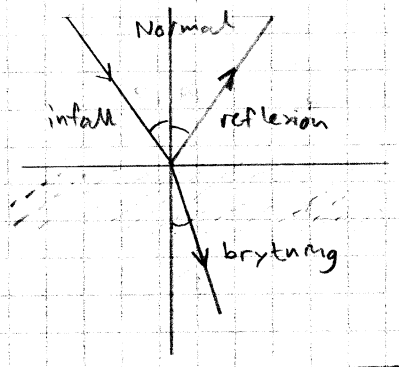
Mätt med gradskiva

$\alpha_1 = 50°$ $\alpha_2 = 30°$

$n_1 \cdot \sin\alpha_1 = n_2 \sin\alpha_2$, $n_1 = 1$

$$n_2 = \frac{\sin\alpha_1}{\sin\alpha_2} = \frac{\sin 50°}{\sin 30°} = \underline{\underline{1,53}}$$

3.2



3.3 B, G, H

3.4

$n_1 \cdot \sin\alpha_1 = n_2 \sin\alpha_2$

$$\sin\alpha_2 = \frac{n_1}{n_2}\sin\alpha_1 = \frac{1,5}{1,333}\sin 31°$$

$$\alpha_2 = \sin^{-1}\left(\frac{1.5}{1.333}\sin 31°\right) = \underline{\underline{35,4°}}$$

Total reflexion $\alpha_2 = 90°$

$n_1 \sin\alpha_1 = n_2$

$\sin\alpha_1 = n_2/n_1$

$\alpha_1 = \sin^{-1}(n_2/n_1) = \sin^{-1}(1.333/1,5) = \underline{\underline{62,7°}}$

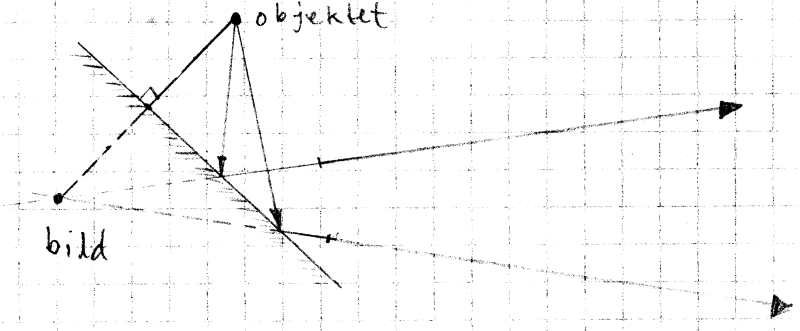
3.5

$$\tan\alpha_2 = \frac{9,6/2}{18} = \frac{9,6}{36}$$

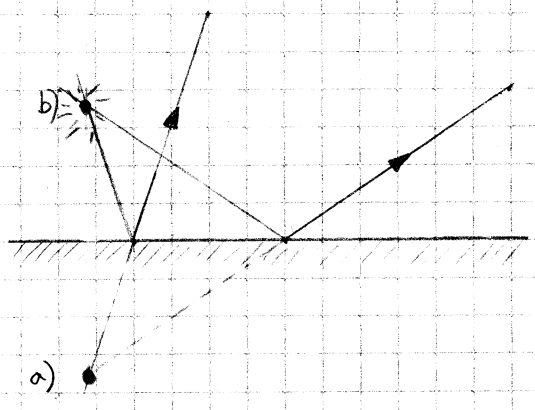
$n_1 \cdot \sin\alpha_1 = n_2 \cdot \sin\alpha_2$, $n_1 = 1$

$$n_2 = \frac{\sin\alpha_1}{\sin\alpha_2} = \frac{\sin 24°}{\sin\tan^{-1}(9,6/36)} = \underline{\underline{1,58}}$$

3.6



3.7



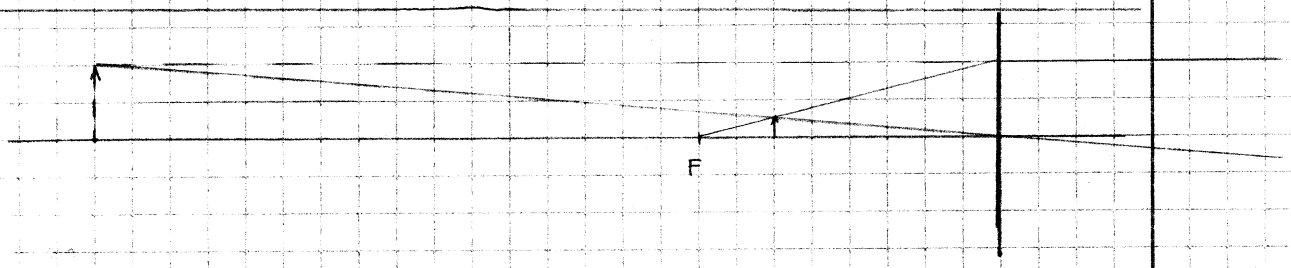
3.8

$$\frac{1}{a} + \frac{1}{b} = \frac{1}{f}$$

$$\frac{1}{b} = \frac{1}{f} - \frac{1}{a}$$

$$b = \left(\frac{1}{f} - \frac{1}{a}\right)^{-1} = \left((12\,\text{cm})^{-1} - (16\,\text{cm})^{-1}\right)^{-1} = \underline{48\,\text{cm}}$$

3.9 a)



b)

$$\frac{1}{a} + \frac{1}{b} = \frac{1}{f}$$

$$b = (f^{-1} - a^{-1})^{-1} = \left((16\,\text{cm})^{-1} - (12\,\text{cm})^{-1}\right)^{-1} = -48$$

$$-\frac{b}{a} = \frac{h_b}{h_a}$$

$$\frac{48}{12} = \frac{h_b}{1\,\text{cm}}$$

$$h_b = 4\,\text{cm}$$

$$a = (f^{-1} - b^{-1})^{-1} = (f^{-1} - (4a)^{-1})^{-1} = \frac{1}{\frac{1}{f} - \frac{1}{4a}}$$

$$-\frac{b}{a} = -\frac{4\,\text{cm}}{1\,\text{cm}}$$

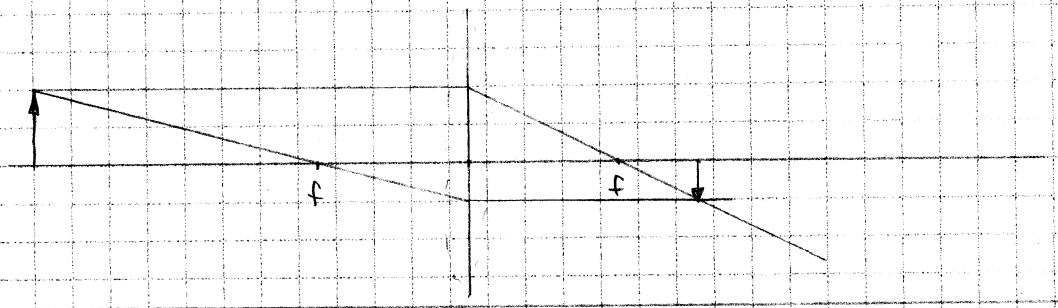
$$b = 4a$$

$$\frac{1}{f} - \frac{1}{4a} = \frac{1}{a}$$

$$\frac{1}{f} = \frac{1}{a} + \frac{1}{4a} = \frac{1}{a}\left(1 + \frac{1}{4}\right) = \frac{5}{4a}$$

$$a = \frac{5}{4} f = \frac{5}{4} \cdot 16\,\text{cm} = \underline{20\,\text{cm}}$$ (annorlunda än facit)

3.10



3.11 virtuell, rättvänd, mindre

3.12 $a = 30\,\text{cm}$ $\quad h_a = 4\,\text{cm}$ $\quad \frac{1}{a}+\frac{1}{b}=\frac{1}{f} \Leftrightarrow b = (f^{-1}-a^{-1})^{-1}$

$f = 10\,\text{cm}$ $\quad -\frac{b}{a} = \frac{h_b}{h_a} \Leftrightarrow h_b = -\frac{b h_a}{a} = -\frac{(f^{-1}-a^{-1})^{-1} h_a}{a} = \underline{\underline{-2\,\text{cm}}}$

3.13

$$-\frac{b}{a} = \frac{h_b}{h_a}$$

$$-\frac{30\,\text{cm}}{a} = \frac{-5\,\text{cm}}{10\,\text{cm}}$$

$$a = -b\cdot\frac{h_a}{h_b} = -30\,\text{cm}\cdot\frac{10\,\text{cm}}{-5\,\text{cm}} = 60\,\text{cm}$$

$$\frac{1}{a}+\frac{1}{b}=\frac{1}{f}$$

$$f = (a^{-1}+b^{-1})^{-1}\,\text{cm} = (60^{-1}+30^{-1})^{-1}\,\text{cm} = \underline{\underline{20\,\text{cm}}}$$ (enl. facit 10 cm.)

3.14

$$-\frac{b}{a} = \frac{h_b}{h_a} = m = -2 \Rightarrow b = 2a$$

↑ konvex lins, reell bild

$a + b = 48\,\text{cm} \Rightarrow a + 2a = 48\,\text{cm}$

$3a = 48\,\text{cm}$

$a = 16\,\text{cm}$

$b = 2a = 32\,\text{cm}$

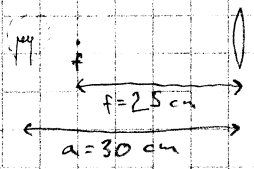
$$\frac{1}{a}+\frac{1}{b}=\frac{1}{f}$$

$$f = (a^{-1}+b^{-1})^{-1} = ((16\,\text{cm})^{-1}+(32\,\text{cm})^{-1})^{-1} = 10{,}7\,\text{cm}$$

Svar: Konvex lins, $f = +10{,}7$ cm, 32 cm från skärmen.

3.15

a)



$$\frac{1}{a}+\frac{1}{b}=\frac{1}{f}$$

$$\frac{1}{b} = \frac{1}{f}-\frac{1}{a}$$

$$b = (f^{-1}-a^{-1})^{-1} = \underline{\underline{150\,\text{cm}}}$$

b)

$$-\frac{b}{a} = m$$

$$m = -\frac{150}{30} = \underline{\underline{-5}} \quad (\times 5)$$

3.16 $f = 8\,cm$
$a = 12\,cm$
$h_a = 2\,cm$

$\frac{1}{a} + \frac{1}{b} = \frac{1}{f} \Leftrightarrow b = (f^{-1} - a^{-1})^{-1} = (8^{-1} - 12^{-1})^{-1}\,cm = 24\,cm$

$-\frac{b}{a} = \frac{h_b}{h_a} \Leftrightarrow h_b = -\frac{b h_a}{a} = -\frac{24 \cdot 2}{12}\,cm = -4\,cm$

Svar: Bilden är reell, 4 cm (dubbelt så stor), upp och ner, befinner sig 24 cm framför spegeln. R

3.17 E R

3.18 $f = 200\,mm$
$h_a = 6\,mm$
$h_b = -60\,mm$

$-\frac{b}{a} = \frac{-60}{6} = -10$

$b = 10a$

$\frac{1}{a} + \frac{1}{b} = \frac{1}{f} \Rightarrow \frac{1}{a} + \frac{1}{10a} = \frac{1}{a}\left(1 + \frac{1}{10}\right) = \frac{11}{10a} = \frac{1}{f}$

$a = \frac{11f}{10} = \frac{11 \cdot 200\,mm}{10} = 220\,mm$

$b = 10a = \underline{2200\,mm} = 2{,}2\,m$ R

3.19
a) $a = 45\,mm \quad b = \infty$

$\frac{1}{a} + \frac{1}{b} = \frac{1}{f}$

$f = \underline{45\,mm}$ R

b) $\frac{1}{a} = \frac{1}{f} - \frac{1}{b}$

$a = ((45\,mm)^{-1} - (500\,mm)^{-1})^{-1} = \underline{49{,}5\,mm}$ R

3.20 $a = 1{,}0\,m + 5{,}0\,cm = 105{,}0\,cm$

$\frac{1}{a} + \frac{1}{b} = \frac{1}{f}$

$b = (f^{-1} - a^{-1})^{-1} = ((5{,}0\,cm)^{-1} - (105{,}0\,cm)^{-1})^{-1} = 5{,}25\,cm$

Svar: $b - f = 5{,}25\,cm - 5{,}0\,cm = 0{,}25\,cm = \underline{2{,}5\,mm}$ R

3.21 $f = 5{,}0\,cm$

$\frac{1}{a} + \frac{1}{b} = \frac{1}{f}$

$b = \infty$
$a = 5{,}0\,cm$
$b = 1{,}0\,m$

$a = (f^{-1} - b^{-1})^{-1} = ((5{,}0\,cm)^{-1} - (100\,cm)^{-1})^{-1} = 5{,}26\,cm$

$\Delta = 5{,}26\,cm - 5{,}0\,cm = \underline{0{,}26\,cm}$ R

3.22 $f = 10\,cm$

$b = 6{,}0\,m$

$$\frac{1}{a} + \frac{1}{b} = \frac{1}{f}$$

$$a = (f^{-1} - b^{-1})^{-1} = ((10\,cm)^{-1} - (600\,cm)^{-1})^{-1} = 10{,}17\,cm$$

$$m = -\frac{b}{a} = -\frac{600\,cm}{10{,}17\,cm} = 59$$

Svar: a) $\underline{\times 59}$ R

b) $\underline{10{,}2\,cm}$ R

3.23

a) $$-\frac{b}{a} = \frac{h_b}{h_a} = \frac{-684}{36}$$

$$a + b = 2000\,mm$$

$$a + \frac{684}{36} \cdot a = a\left(1 + \frac{684}{36}\right) = a \cdot \frac{720}{36} = 20a = 2000\,mm \Leftrightarrow a = \underline{100\,mm} = 10\,cm$$ R

b) $$b = 2000\,mm - a = 2000\,mm - 100\,mm = 1900\,mm$$

$$f = (a^{-1} + b^{-1})^{-1} = (100^{-1} + 1900^{-1})^{-1}\,mm = \underline{95\,mm} = 9{,}5\,cm$$ R

3,24 $$-\frac{b}{a} = \frac{h_b}{h_a} = \frac{-2{,}2\,m}{2{,}5\,cm}$$

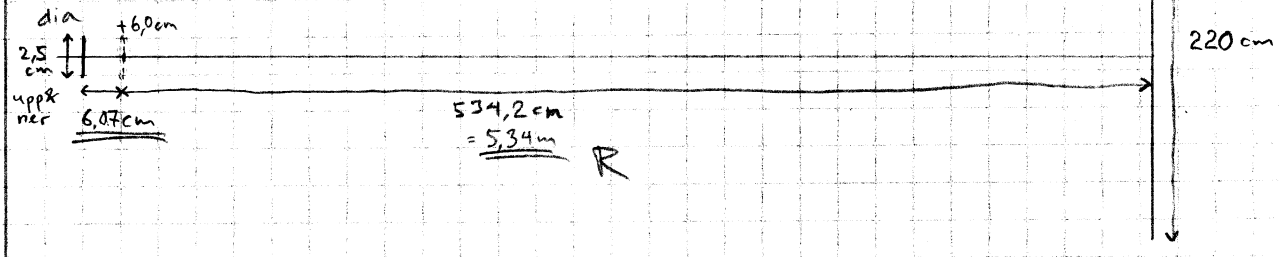
$$b = \frac{220}{2{,}5} - a$$

$$\frac{1}{a} + \frac{1}{b} = \frac{1}{f}$$

$$\frac{1}{a} + \frac{2{,}5}{220\,a} = \frac{1}{a}\left(1 + \frac{2{,}5}{220}\right) = \frac{222{,}5}{220\,a} = \frac{1}{f}$$

$$a = \frac{222{,}5}{220} f = \frac{222{,}5}{220} \cdot 6{,}0\,cm = 6{,}07\,cm$$

$$b = \frac{220}{2{,}5} \cdot 6{,}07 = 534{,}2\,cm$$



R

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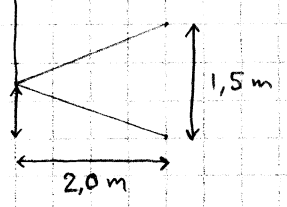
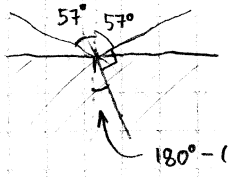
1. Slutdiagnos



Svar: $\frac{1{,}5\,m}{2} = \underline{0{,}75\,m}$ R

2.



$180° - (90° + 57°) = 33°$

$n_1 \sin\alpha_1 = n_2 \sin\alpha_2$

$n_1 = 1,\ \alpha_1 = 57°,\ \alpha_2 = 33°$

$$n_2 = \frac{\sin\alpha_1}{\sin\alpha_2} = \frac{\sin 57°}{\sin 33°} = \underline{1{,}54}$$ R

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3. $n_1 \sin\alpha_1 = n_2 \sin\alpha_2$

Totalreflexion $\Rightarrow \alpha_2 = 90°$

$$\sin\alpha_1 = \frac{n_2}{n_1}$$

$$\alpha_1 = \sin^{-1}\left(\frac{n_2}{n_1}\right) = \sin^{-1}\left(\frac{1{,}33}{1{,}56}\right) = \underline{58{,}5°}$$ R

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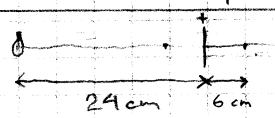
4. a)



$$\frac{1}{a} + \frac{1}{b} = \frac{1}{f}$$

$$b = (f^{-1} - a^{-1})^{-1} = (6^{-1} - 24^{-1})^{-1}\ \text{cm} = 8\ \text{cm}$$

Från linsen: $24\ \text{cm} + 8\ \text{cm} = \underline{32\ \text{cm}}$ R (fel; facit)

b) $$-\frac{b}{a} = \frac{h_b}{h_a} = m$$

$h_a = 18\ \text{mm}$

$$h_b = -\frac{b h_a}{a} = -\frac{8 \cdot 18\ \text{mm}}{24} = \underline{-6\ \text{mm}}$$ R

c) $m = -1 \Rightarrow a = b \Rightarrow$

$$\frac{2}{a} = \frac{1}{f}$$

$a = 2f = 2 \cdot 6.0\ \text{cm} = 12{,}0\ \text{cm}$

$b = 12\ \text{cm}$

Avst. låga till skärm: $a + b = \underline{24\ \text{cm}}$ R

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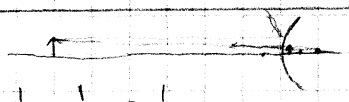
5. a)



$$\frac{1}{a} + \frac{1}{b} = \frac{1}{f}$$

$$b = (f^{-1} - a^{-1})^{-1} = ((-30)^{-1} - 180^{-1})^{-1} = \underline{-25{,}7\ \text{cm}}$$

b) $$m = -\frac{b}{a} = \frac{25{,}7}{180} = 142{,}7 \cdot 10^{-3} = \underline{0{,}14}$$

c) virtuell

d) rättvänd

6.

$$-\frac{b}{a} = \frac{h_b}{h_a}$$

b)

$$a = -\frac{b\,h_a}{h_b} = \frac{2{,}50\,\text{m} \cdot 1}{26} = \underline{\underline{96{,}2\,\text{mm}}} \approx 9{,}6\,\text{cm}$$ R

a)

$$f = (a^{-1} + b^{-1})^{-1} = (96{,}2^{-1} + 2500^{-1})^{-1} = \underline{\underline{92{,}6\,\text{mm}}} \approx 9{,}3\,\text{cm}$$ R

7.

$$-\frac{b}{a} = \frac{h_b}{h_a} \Rightarrow a = -\frac{b\,h_a}{h_b}$$

$$\frac{1}{a} + \frac{1}{b} = \frac{1}{f} \Rightarrow -\frac{h_b}{b\,h_a} + \frac{1}{b} = \frac{1}{f}$$

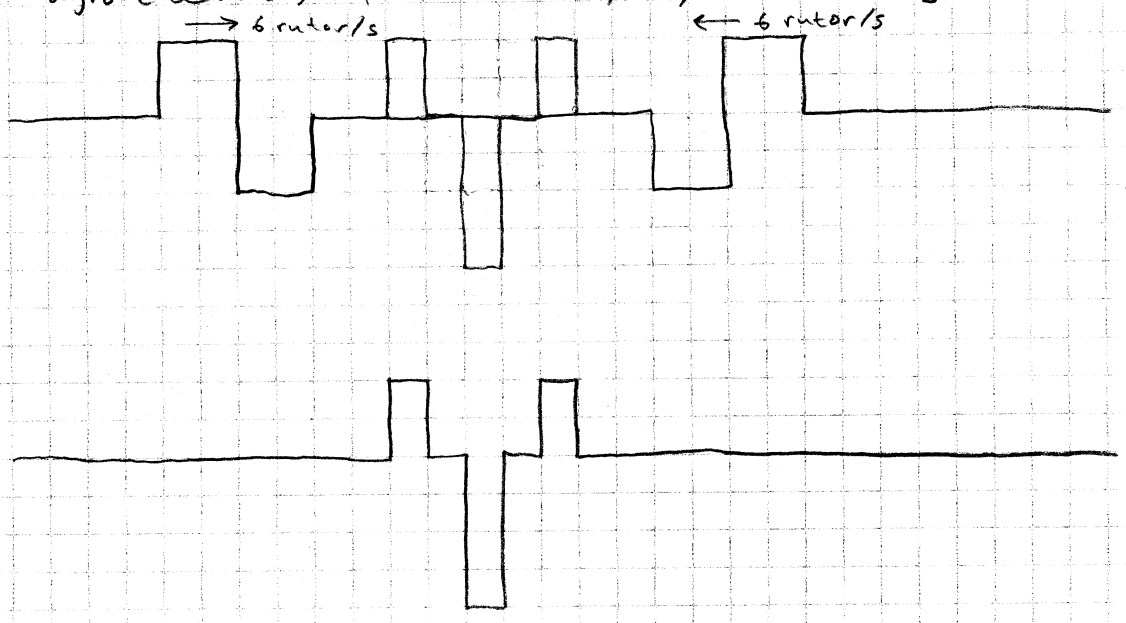
$$\frac{1}{b}\left(1 - \frac{h_b}{h_a}\right) = \frac{1}{f}$$

$$\frac{1}{b} = \frac{1}{f\left(1 - \frac{h_b}{h_a}\right)}$$

$$b = f\left(1 - \frac{h_b}{h_a}\right) = 32\,\text{mm} \cdot \left(1 - \frac{-3{,}4\,\text{m}}{35 \cdot 10^{+3}\,\text{m}}\right) = \underline{\underline{3{,}14\,\text{m}}}$$ R

4 Vågrörelselära, Repetitionskurs i fysik, Inledande diagnostiskt prov

1.



2.

a) $\lambda f = v$

$f = v/\lambda = \frac{340\ m/s}{0,78\ m} = \underline{435,9\ Hz} \approx 436\ Hz$

b) $\lambda = \frac{v}{f} = \frac{1500\ m/s}{435,9\ s^{-1}} = \underline{3,44\ m}$

3.

a) $2A = 2,8\ mm$

$A = \underline{1,4\ mm}$

b)

$\frac{T}{2} = 0,45\ s$

$T = 0,90\ s$

$\omega = \frac{2\pi}{T} = \frac{2\pi}{0,90\ s} = \underline{6,98\ rad/s}$

4.

a) $2\lambda = 2,60\ m$

$\lambda = 1,30\ m$

$c = \lambda \cdot f = 1,30\ m \cdot 25,3\ Hz = \underline{32,89\ m/s} \approx 32,9\ m/s$

b) $\lambda = \frac{2,60\ m}{7} \cdot 2 = 0,7429\ m$

$f = \frac{v}{\lambda} = \frac{32,89\ m/s}{0,7429\ m} = \underline{44,3\ Hz}$

5.

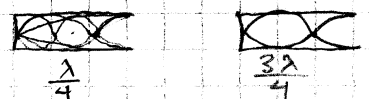
$\frac{\lambda}{2} = 2,0\ m$

$\lambda = 4,0\ m$

$v = \lambda \cdot f = 4,0\ m \cdot 900\ Hz = \underline{3600\ m/s} = 3,6\ km/s$

6.

a)

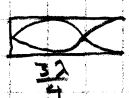


$\lambda = \frac{v}{f} = \frac{340\ m/s}{51,2\ Hz} = 6,64\ m$

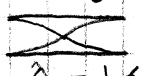
$\frac{\lambda}{4} = \underline{1,66\ m}$

b) $\frac{3\lambda}{4} = 1,66\ m$

$\lambda = \frac{4}{3} \cdot 1,66\ m = \underline{2,21\ m}$



c)



$\frac{\lambda}{2} = 1,66\ m$

$\lambda = 2 \cdot 1,66\ m = 3,32\ m$

$f = v/\lambda = 340\ m/s / 3,32\ m = 102,4\ Hz$

7.

$BQ - AQ = \lambda$

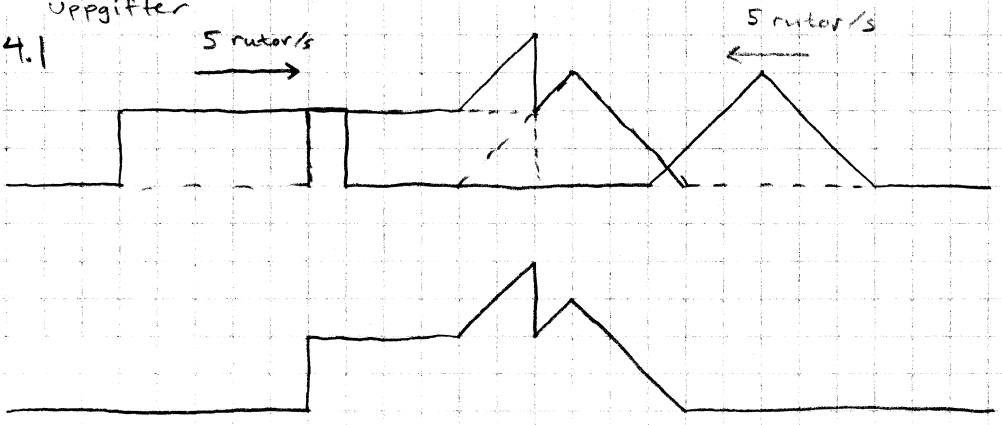
$BQ = \sqrt{1{,}40^2 + (2{,}4/2 + 0{,}68)^2}$

$AQ = \sqrt{1{,}40^2 + (2{,}4/2 - 0{,}68)^2}$

$\lambda = BQ - AQ = 0{,}851\ m = \underline{\underline{85{,}1\ cm}}$

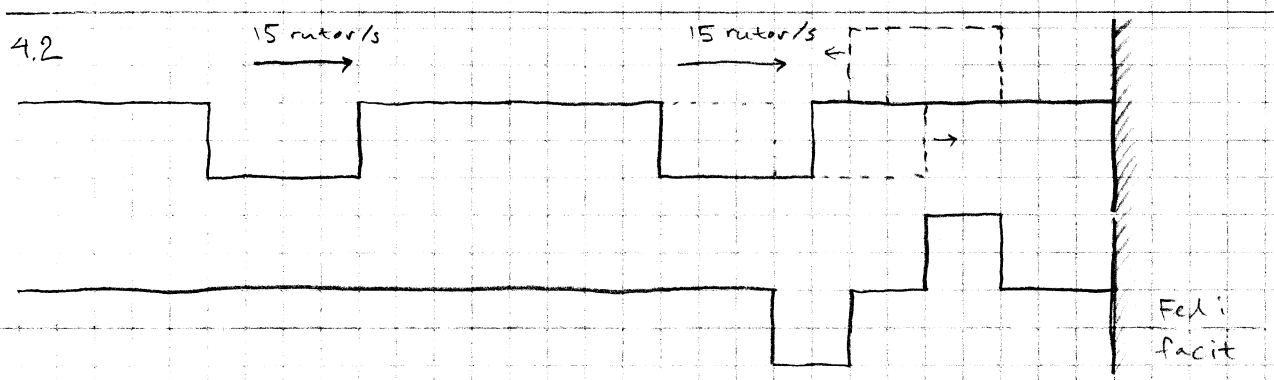
Uppgifter

4.1



Fel i facit

4.2



Fel i facit

4.3

a) $2 \cdot 0{,}235\ m = \underline{\underline{0{,}47\ m}}$ R

b) 

$6{,}16 \cdot t = \pi$

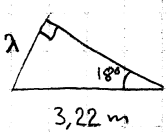
$t = \pi / 6{,}16 = \underline{\underline{0{,}510\ s}}$ R

4.4 $\lambda = 6{,}0\ m / 5$

$v = \frac{6{,}0\ m}{3{,}7\ s}$

$v = \lambda \cdot f$ $\quad f = \frac{v}{\lambda} = \frac{6{,}0\ m/3{,}7\ s}{6{,}0\ m/5} = \frac{5}{3{,}7\ s} = \underline{\underline{1{,}35\ Hz}}$ Fel i facit

4.5



$\frac{\lambda}{3{,}22\ m} = \sin 18°$

$\lambda = 3{,}22\ m \cdot \sin 18° = 0{,}995\ m$

$v = \lambda f$

$f = \frac{v}{\lambda} = \frac{340\ m/s}{0{,}995\ m} = \underline{\underline{342\ Hz}}$ R

4.6 $\lambda = \frac{v}{f} = \frac{340\ m/s}{56\ kHz}$

$s = v \cdot t = 340\ m/s \cdot 40{,}0\ ms$

Antal: $\frac{s}{\lambda} = \frac{v \cdot t}{v/f} = f \cdot t = 56\ kHz \cdot 40{,}0\ ms = \underline{\underline{2240}}$ st

4.7

$y = y_0 \sin 2\pi f t = 1{,}6 \sin(2\pi \cdot 40 \cdot t) = 0{,}8$

$\sin(2\pi \cdot 40 \cdot t) = \frac{0{,}8}{1{,}6} = \frac{1}{2}$

$2\pi \cdot 40 \cdot t = \sin^{-1}\left(\frac{1}{2}\right) = \frac{\pi}{6}$

$t = \frac{1}{6} \cdot \frac{1}{2 \cdot 40} = \frac{1}{480}\ s = \underline{2{,}08\ ms} \approx 2{,}1\ ms$ R

4,8

$s = v \cdot t$

a) $t = \frac{s}{v} = \frac{2 \cdot 20{,}0\ m}{1500\ m/s} = \underline{26{,}7\ ms}$ R

b) $v = \lambda f$

$\lambda = \frac{v}{f} = \frac{1500\ m/s}{240\ kHz} = \underline{6{,}25\ mm}$ R

4.9

$\lambda = \frac{2}{5} \cdot 2{,}20\ m$

$v = \lambda \cdot f = \frac{2}{5} \cdot 2{,}20\ m \cdot 27\ s^{-1} = \underline{23{,}8\ m/s}$ R

4.10

a) $\lambda = \frac{2}{5} \cdot 3{,}50\ m$

$v = \lambda f = \frac{2}{5} \cdot 3{,}50\ m \cdot 42{,}6\ Hz = \underline{59{,}6\ m/s} \approx 60\ m/s$ R

b) $\lambda = \frac{2}{7} \cdot 3{,}50\ m$

$f = \frac{v}{\lambda} = \frac{\frac{2}{5} \cdot 3{,}50\ m \cdot 42{,}6\ Hz}{\frac{2}{7} \cdot 3{,}50\ m} = \frac{7}{5} \cdot 42{,}6\ Hz = 59{,}64 Hz$

$\Delta f = (59{,}64 - 42{,}6)\ Hz = \underline{\pm 17{,}0\ Hz}$

U_{pp} till ca 60 Hz R

4.11

$\lambda = \frac{2}{6} \cdot 2{,}4\ m$

$v = \lambda f = \frac{2}{6} \cdot 2{,}4\ m \cdot 24\ Hz = \underline{19{,}2\ m/s}$ R

4.12

a) $\frac{\lambda}{2} = L$

$\lambda = 2L$

$v = \lambda f = 2Lf = 2 \cdot 0{,}65\ m \cdot 440\ Hz = \underline{572\ m/s}$ R

b) $f = \frac{v}{\lambda} = \frac{v}{4L} = \frac{1144\ m/s}{4 \cdot (0{,}65 - 0{,}164)\ m} = \underline{588\ Hz}$ R

c) 3:e övertonen $4 \cdot 440\ Hz = 1760\ Hz$ R

$f_3 = 4 \cdot f_0 = 4 \cdot 588{,}48\ Hz = 2354\ Hz$ R

4.13

a) $f_0 = v/(4 \cdot L) = 340\ m/s\ /(4 \cdot 1{,}500\ m) = \underline{56{,}67\ s^{-1}}$ R

b) $\lambda_0 = \frac{v}{f_0} = \frac{340\ m/s}{440\ Hz} = 0{,}7727\ m$; $\frac{1{,}500\ m}{\lambda_0/4} = 7{,}76$; 7. uddas $\frac{\lambda_0}{4} = \underline{1{,}352\ m}$ R

4.14

$L_1 = v/(4 \cdot f_{01})$

$f_{02} = v/(2 \cdot L_2) = v/(2 \cdot v/(4 \cdot f_{01})) = \frac{4 \cdot f_{01}}{2} = 2 f_{01} = 2 \cdot 200\ Hz$

$= \underline{400\ Hz}$ R

4.15

a) $f_{o2} = 2 f_{o1}$

$f_{o1} = \frac{1}{2} f_{o2} = \frac{1}{2} \cdot 620\ Hz = \underline{\underline{310\ Hz}}$ R

b) $f_{11} = 3 \cdot f_{o1} = 930\ Hz$

$f_{21} = 5 \cdot f_{o1} = 5 \cdot 310\ Hz = \underline{\underline{1550\ Hz}}$ R

c) $f_{o2} = \frac{v}{2L}$

$L = \frac{v}{2 f_{o2}} = \frac{340\ m/s}{2 \cdot 620\ s^{-1}} = 0{,}274\ m$

CO_2: $f_{o2} = \frac{260\ m/s}{2 \cdot 0{,}274\ m} = 474\ Hz$

$f_{o1} = \frac{1}{2} \cdot 474 = \underline{\underline{237\ Hz}}$ R

$f_{21} = 5 \cdot f_{o1} = 5 \cdot 237 = \underline{\underline{1185\ Hz}}$ R

4.16 $PA = 5{,}8\ cm$ $QA = 5{,}95\ cm$
$PB = 8{,}95\ cm$ $QB = 7{,}3\ cm$

$PB - PA = 3{,}15\ cm = (n + 0{,}5)\lambda$
$QB - QA = 1{,}35\ cm = (m + 0{,}5)\lambda$

$n\lambda + 0{,}5\lambda = 3{,}15$

$n = \frac{3{,}15 - 0{,}5\lambda}{\lambda}$ $\quad m = \frac{1{,}35 - 0{,}5\lambda}{\lambda}$

$n - m = 2$

$\frac{3{,}15 - 0{,}5\lambda}{\lambda} - \frac{1{,}35 - 0{,}5\lambda}{\lambda} = 2$

$3{,}15 - 0{,}5\lambda - 1{,}35 + 0{,}5\lambda = 2\lambda$
$3{,}15 - 1{,}35 = 2\lambda$
$\lambda = (3{,}15 - 1{,}35)/2 = \underline{\underline{0{,}9\ cm}}$ R

$m = \frac{1{,}35 - 0{,}5\lambda}{\lambda} = \frac{1{,}35}{\lambda} - 0{,}5 = 1$

d.v.s ordningstalet = 2 R

4.17 $PA = \sqrt{272^2 + (58{,}0/2 - 18{,}3)^2} = 272{,}21\ cm$
$PB = \sqrt{272^2 + (58{,}0/2 + 18{,}3)^2} = 276{,}08\ cm$

$PB - PA = 0{,}5\lambda$
$\lambda = 2 \cdot (PB - PA) = \underline{\underline{7{,}74\ cm}}$ R

4.18

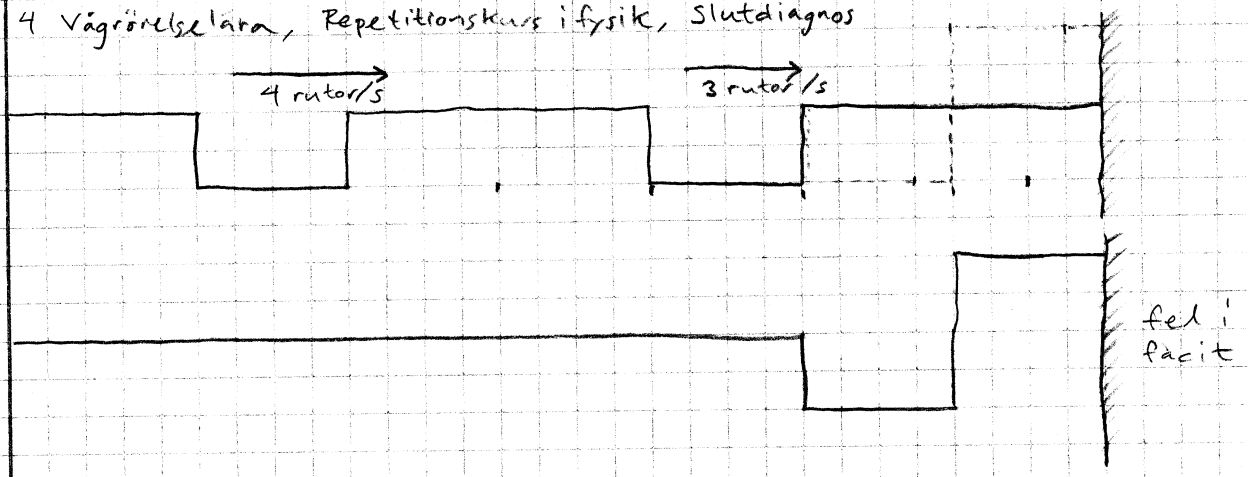
$\Delta x = 5\ dm - 1{,}5\ dm = 3{,}5\ dm = 0{,}35\ m$
$T = 3{,}5\ div = 3{,}5 \cdot 200\ \mu s = 700\ \mu s = 700 \cdot 10^{-6}\ s$

$\Delta x = n\lambda + \frac{\lambda}{2} = \lambda(n + \frac{1}{2})$

$\lambda = \Delta x / (n + \frac{1}{2})$

$v = \lambda \cdot f = \lambda / T = \Delta x / (T \cdot (n + \frac{1}{2})) = \underline{\underline{333\ m/s}}$ R (n = 1)

1.



2.

a) $v = \lambda f = 0{,}80\,\text{m} \cdot \frac{28}{60\,\text{s}} = \underline{0{,}37\ \text{m/s}}$ R

b) $\frac{1}{2} = \sin\left(2\pi \cdot \frac{28}{60} \cdot t\right)$ (Egentligen är vattenvågor ej sinusformade)

$2\pi \cdot \frac{28}{60} \cdot t = \frac{\pi}{6}$

$t = \frac{5}{8}\,\text{s} = \underline{0{,}18\ \text{s}}$ R

3.

a) $\frac{\lambda}{2} = 2{,}5\,\text{m} \Leftrightarrow \lambda = 5{,}0\,\text{m}$

$f = 5{,}0\ \text{Hz}$

$v = \lambda \cdot f = 5{,}0\,\text{m} \cdot 5{,}0\ \text{Hz} = 25\ \text{m/s}$

$v = \sqrt{\frac{F}{\mu}} \Leftrightarrow v^2 = \frac{F}{\mu}$

$F = \mu v^2 = \frac{28{,}5 \cdot 10^{-3}\,\text{kg}}{2{,}5\,\text{m}} \cdot (25\ \text{m/s})^2 = \underline{7{,}1\ \text{N}}$ R

b) $\lambda_1 = \frac{\lambda}{2}$

$f_1 = \frac{v}{\lambda_1} = \frac{v}{\lambda/2} = 2 \cdot \frac{v}{\lambda} = 2 \cdot f = 2 \cdot 5{,}0\ \text{Hz} = \underline{10{,}0\ \text{Hz}}$ R

c)

$\lambda = 2 \cdot \frac{2{,}5\,\text{m}}{5} = 1\,\text{m}$

$v = \lambda \cdot f = 1\,\text{m} \cdot 20\ \text{Hz} = 20\ \text{m/s}$

$F = \mu v^2 = \frac{28{,}5 \cdot 10^{-3}\,\text{kg}}{2{,}5\,\text{m}} \cdot (20\ \text{m/s})^2 = \underline{4{,}6\ \text{N}}$ R

4.

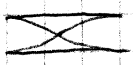
$\frac{\lambda}{2} = 1{,}50\,\text{m} \Leftrightarrow \lambda = 2 \cdot 1{,}50\,\text{m} = 3{,}0\,\text{m}$

$f = \frac{v}{\lambda} = \frac{5100\ \text{m/s}}{3{,}0\,\text{m}} = \underline{1700\ \text{Hz}}$ R

5.

$v = \lambda f$

a) $\lambda = \frac{v}{f} = \frac{340\ \text{m/s}}{750\ \text{Hz}} = 0{,}453\,\text{m}$

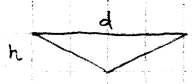


$L = \frac{\lambda}{2} = \frac{0{,}453\,\text{m}}{2} = \underline{0{,}227\,\text{m} = 22{,}7\,\text{cm}}$ R

$\frac{1}{2}\lambda + \frac{1}{4}\lambda = \frac{3}{4}\lambda = L$

$\lambda_1 = \frac{4}{3}L = \underline{0{,}302\,\text{m}} = 30{,}2\,\text{cm}$ R

6.



$$2\sqrt{h^2+\left(\frac{d}{2}\right)^2} - d = n\lambda + \frac{1}{2}\lambda = \lambda\left(n+\frac{1}{2}\right)$$

$$2\sqrt{60^2+\left(\frac{92}{2}\right)^2} - 92 = 4\sqrt{1429} - 92 = 59{,}21 = \lambda\left(n+1+\frac{1}{2}\right)$$

$$2\sqrt{60^2+\left(\frac{130}{2}\right)^2} - 130 = 10\sqrt{313} - 130 = 46{,}92 = \lambda\left(n+\frac{1}{2}\right)$$

$\lambda\left(n+1+\frac{1}{2}\right) - \lambda\left(n+\frac{1}{2}\right) = \cancel{\lambda n} + \lambda + \cancel{\frac{1}{2}\lambda} - \cancel{\lambda n} - \cancel{\frac{1}{2}\lambda} = \lambda = 59{,}21 - 46{,}92 =$

$= 12{,}29 = \underline{\underline{12{,}3\ \text{cm}}}$ (fel i facit)

Repetitionskurs i fysik 5. Kretslära, inledande diagnostiskt prov

1a $R = 8\,\Omega + 16\,\Omega = 24\,\Omega$

$U = R \cdot I$

$I = \frac{U}{R} = \frac{12\,V}{24\,\Omega} = \underline{0.5\,A}$ R

b $U = R \cdot I = 8\,\Omega \cdot 0.5\,A = \underline{4\,V}$ R

2 $U = R \cdot I_1 = 220\,\Omega \cdot 0{,}52\,mV = 114.4\,mV$

$I_2 = \frac{U}{R} = \frac{114.4 \cdot 10^{-3}\,V}{330\,\Omega} = 0.3467\,mA$

$I_{tot} = I_1 + I_2 = 0.52\,mA + 0.3467\,mA = \underline{0.867\,mA}$ R

3. $\frac{1}{R} = \frac{1}{120} + \frac{1}{220} + \frac{1}{150} = 0.019545$

$R = \underline{51.1\,\Omega}$ R

4. $R = \rho \cdot \frac{l}{A}$

$l = \frac{R \cdot A}{\rho} = \frac{2{,}6\,\Omega \cdot \pi (0{,}25 \cdot 10^{-3})^2\,m^2}{0.017 \cdot 10^{-6}\,\Omega m} = \underline{30\,m}$ R

5. $P = U \cdot I$

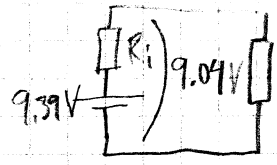
$I = I_1 + I_2 = \frac{P_1}{U} + \frac{P_2}{U} = \frac{2.5W}{6.0V} + \frac{4.5\,W}{6.0\,V} = \frac{2.5W + 4.5W}{6.0\,V} = \underline{1.2\,A}$ R

6. $\frac{1}{R} = \frac{2}{67.2\,\Omega} \Leftrightarrow R = 33.6\,\Omega$

$I = \frac{U}{R} = \frac{230\,V}{33{,}6\,\Omega} = 6.845\,A$

$P = U \cdot I = 230 \cdot 6.845\,W = \underline{1.57\,kW}$ R

7.

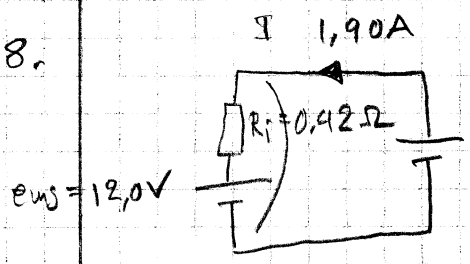


$R = 1.82\,\Omega$ $U_i = 9.39 - 9.04 = 0.35\,V$

$I = \frac{U}{R} = \frac{9.04\,V}{1.82\,\Omega} = 4.97\,A$

$R_i = \frac{U_i}{I} = \frac{0.35\,V}{4.97\,A} = \underline{0.0705\,\Omega}$ R

8.



$U = ems + R_i \cdot I = 12{,}0 + 0{,}42 \cdot 1{,}90 = \underline{12{,}8\ V}$ R

9. $R_A = 3 \cdot 8\,\Omega = 24\,\Omega$

$R_B = 2 \cdot 8\,\Omega = 16\,\Omega$

$\frac{1}{R} = \frac{1}{R_A} + \frac{1}{R_B} = \frac{1}{24} + \frac{1}{16}$

$R = 9{,}6\,\Omega$

$I_A = \frac{U}{R_A} = \frac{24}{24} = 1\ A$

$I_B = \frac{U}{R_B} = \frac{24}{16} = \frac{3}{2} = 1{,}5\ A$

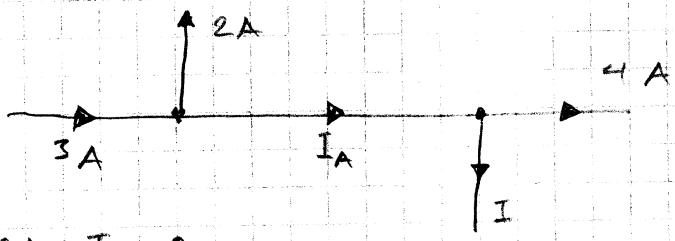
$U_B = 8 \cdot 1 - 8 \cdot 1{,}5 = 8(\underbrace{1 - 1.5}_{-0.5}) = \underline{-4\ V}$ R

10. $I = \frac{U}{R} = \frac{17{,}5}{50} = 0{,}35\ A$

$ems = I \cdot (R_{50} + R_{30}) = 0{,}35(50 + 30) = \underline{28\ V}$ R

Repetitionskurs i fysik, kretsteori

5.1



$3A - 2A - I_A = 0$

$I_A = 3A - 2A = 1A$

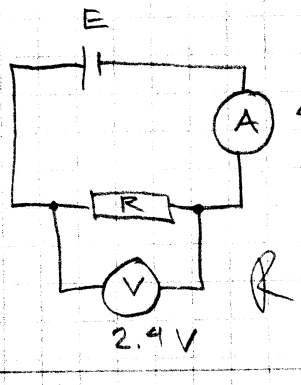
$I_A + 4A - I = 0$

$1A - 4A = I$

$\underline{I = -3A}$

5.2

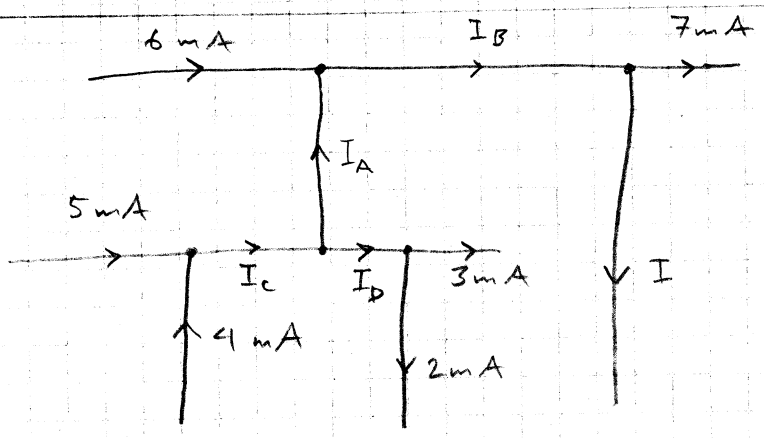
a)



40 mA

b) $R = \frac{U}{I} = \frac{2.4\,V}{0.040\,A} = \underline{60\,\Omega}$

5.3



$-I + I_B - 7\,mA = 0 \Rightarrow \underline{I = 10mA - 7\,mA = 3\,mA}$

$6\,mA + I_A - I_B = 0 \Rightarrow I_B = 6 + 4 = 10\,mA$

$5\,mA + 4\,mA - I_C = 0 \Rightarrow I_C = 9\,mA$

$I_C - I_A - I_D = 0 \Rightarrow I_A = I_C - I_D = 9 - 5 = 4\,mA$

$I_D - 2_mA - 3mA = 0 \Rightarrow I_D = 5\,mA$

5.4 a) $R_{tot} = 16.0 + 8.0 = 24.0\ \Omega$

$U_{AB} = R_{16} I = R_{16} \cdot \frac{E}{R_{tot}} = 16 \cdot \frac{12}{24} = \frac{16 \cdot 12}{24} = \underline{\underline{8\ V}}$ R

$I = \frac{E}{R_{tot}}$

b) $R_{tot} = (R_{16}^{-1} + R_4^{-1})^{-1} + R_8 = (16^{-1} + 4^{-1})^{-1} + 8 = \frac{56}{5}\ \Omega$

$I = \frac{E}{R_{tot}} = \frac{12}{(56/5)} = \frac{15}{14}\ A$

$U_{AB} = E - U_8 = E - R_8 \cdot I = 12 - 8 \cdot \frac{15}{14} = \frac{24}{7} = \underline{\underline{3.43 V}}$ R

5.5 $\underline{\underline{2.6\ mA}}$ R

5.6 $R_{tot} = ((3+2)^{-1} + 4^{-1})^{-1} = \frac{20}{9}\ \Omega$

$\underline{\underline{I}} = \frac{E}{R_{tot}} = \frac{12}{(20/9)} = \frac{27}{5} = \underline{\underline{5.4\ A}}$ R

5.7 $R_{tot} = ((12 \cdot 2)^{-1} + 12^{-1})^{-1} = 8$

$I = \frac{12}{8} = \underline{\underline{1.5\ A}}$ R

5.8 $R_{tot} = R_{220} + (R_{180}^{-1} + R_{120}^{-1})^{-1} = 292\ \Omega$

$I = \frac{E}{R_{tot}} = \frac{22}{292} = \frac{11}{146}\ A$

$U_{220} = R_{220} \cdot I = 220 \cdot \frac{11}{146} = \frac{1210}{73}\ V$

$U_{180} = E - U_{220} = 22 - \frac{1210}{73} = \frac{396}{73}\ V$

$\underline{\underline{I_{180}}} = \frac{U_{180}}{R_{180}} = \frac{396/73}{180} = \frac{11}{365} = 0.0301 = \underline{\underline{30,1\ mA}}$ R

5.9 Öppen S: $R_{tot} = R + R = 2R$

$I = \frac{E}{R_{tot}} = \frac{E}{2R}$; $U_A = R \cdot I = \frac{R \cdot E}{2R} = \frac{E}{2} = U_C$

$P_A = P_C = \frac{E}{2} \cdot \frac{E}{2R} = \frac{E^2}{4R} = 0.25 \cdot \frac{E^2}{R}$

$P_B = 0$

Svar: C R

A lyser svagare och C lika starkare

Sluten S: $R_{tot} = (R^{-1} + R^{-1})^{-1} + R = \frac{3R}{2}$

$I = \frac{E}{R_{tot}} = \frac{E}{(3R/2)} = \frac{2E}{3R}$; $U_C = R \cdot I = R \cdot \frac{2E}{3R} = \frac{2E}{3}$; $P_C = U_C \cdot I = \frac{2E}{3} \cdot \frac{2E}{3R} = \frac{4E^2}{9R} \approx 0.44 \cdot \frac{E^2}{R}$ lika, lika

$U_A = U_B = E - U_C = \frac{3E}{3} - \frac{2E}{3} = \frac{E}{3}$

$I_A = \frac{U_A}{R} = \frac{E/3}{R} = \frac{E}{3R} = I_B$; $P_A = P_B = U_A \cdot I_A = \frac{E}{3} \cdot \frac{E}{3R} = \frac{E^2}{9R} \approx 0.11 \cdot \frac{E^2}{R}$

5.10 $U_{330} = R_{330} \cdot I_{330} = 330 \cdot 0.012 = 3.96\ V$

$I_{p560} = \frac{U_{330}}{R_{560}} = \frac{3.96}{560} = 7.071\ mA$

$I = I_{330} + I_{560} = 12\ mA + 7.071\ mA = 19.071\ mA$

$R_{tot} = R_{560} + (R_{330}^{-1} + R_{560}^{-1})^{-1} = 560 + (330^{-1} + 560^{-1})^{-1} =$

$= \frac{68320}{89}\ \Omega$; $U_{s560} = R \cdot I = 560 \cdot 0.019071 = 10.68\ V$

$\underline{\underline{E = R_{tot} \cdot I = \frac{68320}{89} \cdot 0.019071 = 14.6\ V}}$ R

5.11 $R = R_{100} + ((R_{180} + R_{100})^{-1} + R_{150}^{-1})^{-1} + R_{120} =$

$= 100 + ((180 + 100)^{-1} + 150^{-1})^{-1} + 120 = \frac{13660}{43}\ \Omega =$

$= 318\ \Omega$ R

5.12 $U = R \cdot I \Leftrightarrow R = \frac{U}{I}$

a) $R = \frac{\rho}{A} \cdot L = 0.117375 \cdot L'_{cm} \div 0.318558 = 11.7375\ L$ (se TI-89)

$\dim[R] = \Omega$

$\dim[L'_{cm}] = cm$

b) $L = L_{cm}/100 \Leftrightarrow L_{cm} = 100\ L$

$\frac{\rho}{A} = 11.7375\ \frac{\Omega}{m} \Leftrightarrow \rho = 11.7375 \cdot \pi (0.2\,10^{-3})^2 = \underline{1.475 \cdot 10^{-6}\ \Omega \cdot m} \approx 1.48\ \Omega \cdot mm^2/m$

$A = \pi r^2 = \pi \cdot (0.2 \cdot 10^{-3})^2\ m^2$ R

5.13 $R = \frac{\rho \cdot L}{A}$

$L = \frac{RA}{\rho_{Cu}} = \frac{4.4\ \Omega \cdot \pi (0.19 \cdot 10^{-3})^2\ m^2}{1,72 \cdot 10^{-2} \cdot 10^{-6}\ \Omega \cdot m} = 29.012\ m \approx 30\ m$ R

5.14 $R = \frac{\rho \cdot L_1}{A_1}$

$\rho = \frac{R A_1}{L_1}$

$V = L_1 \cdot A_1$, $L_2 = 60\ cm$

$L_2 \cdot A_2 = V \Rightarrow A_2 = \frac{V}{L_2} = \frac{L_1 A_1}{L_2}$

$R = \frac{\rho L_2}{A_2} = \frac{R A_1}{L_1} \cdot \frac{L_2}{\left(\frac{L_1 A_1}{L_2}\right)} = \frac{R A_1}{L_1} \cdot \frac{L_2^2}{L_1 A_1} = \frac{R L_2^2}{L_1^2} = \frac{4.32 \cdot (0.60)^2}{(0.12)^2} = \underline{\underline{108\ \Omega}}$ R

5.15 $W = P \cdot t = U \cdot I \cdot t = 400 \cdot 10^3 \cdot 2000 \cdot 50 \cdot 10^{-6} = \underline{40\ kJ}$ R

5.16 $R = \frac{\rho L}{A} \Leftrightarrow L = \frac{RA}{\rho} = \frac{PA}{I^2 \rho} = \frac{5.0 \cdot \pi (0.2 \cdot 10^{-3})^2}{1{,}0^2 \cdot 110 \cdot 10^{-2} \cdot 10^{-6}} = \underline{571\ mm}$ R

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

$P = U \cdot I \Leftrightarrow U = \frac{P}{I}$

$U = R \cdot I \Leftrightarrow R = \frac{U}{I} = \frac{(P/I)}{I} = \frac{P}{I} \cdot \frac{1}{I} = \frac{P}{I^2}$

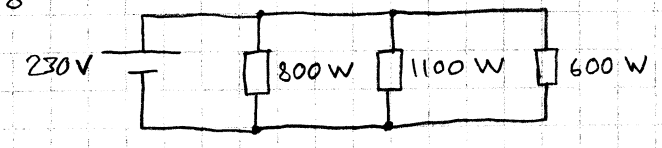
5.17a) $P = U \cdot I \Leftrightarrow I = \frac{P}{U} = \frac{0{,}5\ W}{2.5\ V} = \underline{200\ mA}$ R

b) $U = R \cdot I \Leftrightarrow R = \frac{U}{I} = \frac{U}{(P/U)} = U \cdot \frac{U}{P} = \frac{U^2}{P} = \frac{2.5^2}{0.5} = \underline{12{,}5\ \Omega}$ R

c) $U_R = 4.5 - 2.5 = 2.0\ V$

$R_R = \frac{U_R}{I} = \frac{2.0\ V}{200\ mA} = \underline{10\ \Omega}$ R

5.18



$P = U \cdot I \Leftrightarrow I = \frac{P}{U}$

$\sum I = \frac{800\ W}{U} + \frac{1100\ W}{U} + \frac{600\ W}{U} = \frac{800 + 1100 + 600}{U} = \frac{2500}{230} = 10.9\ A$

d 16 A R

5.19

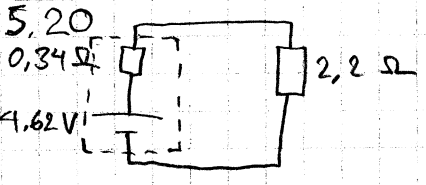
a)

$U_L = \frac{230\ V}{14} = \underline{16{,}4\ V}$ R

b) $I_{tot} = 14 \cdot \frac{P_L}{U_L} = 14 \cdot \frac{16}{(230/14)} = \frac{14^2 \cdot 16}{230} = 13.6\ A$ R

c) 16 W R

5.20

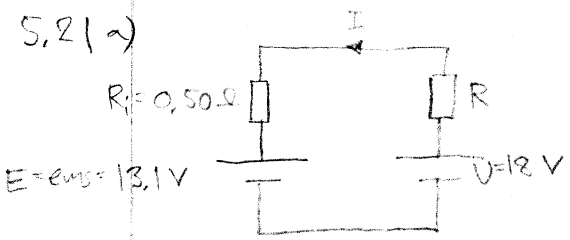


$R_{tot} = 0{,}34 + 2.2 = 2{,}54\ \Omega$

$I = \frac{U}{R_{tot}} = \frac{4.62}{2.54}\ A$

$U_R = R \cdot I = 2.2 \cdot \frac{4.62}{2.54} = \underline{4.00\ V}$ R

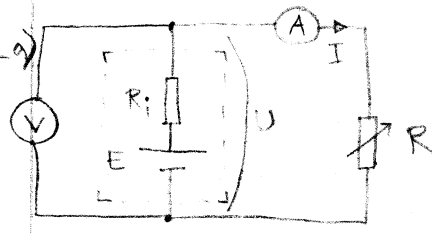
5.21 a)



$$U - R \cdot I - R_i \cdot I - E = 0$$
$$U - R_i \cdot I - E = R \cdot I$$
$$R = \frac{U-E}{I} - R_i = \frac{18-13.1}{2.0} - 0{,}50 = \underline{1.95\ \Omega}$$

b) $U_p = E + R_i \cdot I = 13{,}1 + 0.50 \cdot 2.0 = \underline{14.1\ V}$

5.22 a)



b) $U - RI = 0 \iff U = RI$

$$E - R_i I - RI = 0$$
$$U = -R_i I + E$$
$$-R_i = -0.68 \Rightarrow R_i = \underline{0.62\ \Omega}$$
$$E = 4{,}459\ V = \underline{4.46\ V}$$

5.23

$$E - R_i I - RI = 0$$
$$E - R_i \cdot 2{,}46 - 5{,}0 \cdot 2.46 = 0$$
$$E - R_i \cdot 1.61 - 8{,}0 \cdot 1.61 = 0 \Rightarrow E = R_i \cdot 1{,}61 + 12.88$$
$$R_i \cdot 1.61 + 12.88 - R_i \cdot 2.46 - 12.3 = 0$$
$$12.88 - 12.3 = R_i (2.46 - 1.61)$$
$$R_i = \frac{12.88 - 12.3}{2{,}46 - 1.61} = 0{,}682\ \Omega \approx \underline{0.68\ \Omega}$$

$$E = 0.68235 \cdot 1.61 + 12.88 = 13.98\ V \approx \underline{14.0\ V}$$

5.24 $U_3 = \frac{12}{3} = 4\,V$

$U_2 = \frac{12}{2} = 6\,V$

$V_P = -U_2 + U_3 = -6 + 4 = \underline{\underline{-2\,V}}$

5.25

a) $\underline{\underline{+20\,V}}$

b) $20 - 30 = \underline{\underline{-10\,V}}$

5.26 $\underline{\underline{-16\,V}}$

5.27

$U_4 = \frac{4}{20+4} \cdot 12 = \frac{4}{24} \cdot 12 = \frac{1}{6} \cdot 12^2 = 2\,V$

$U_{70} = \frac{70}{50+70} \cdot 12 = \frac{70}{120} \cdot 12 = \frac{7}{12} \cdot 12 = 7\,V$

$V_P = -U_4 + U_{70} = -2 + 7 = \underline{\underline{+5\,V}}$

Slutdiagnos

1. a) 25 mA R

b) $U = R \cdot I = (48+12) \cdot 0.025 = \underline{\underline{1.5\,V}}$ R

2. a) $I = I_1 + I_2 \Leftrightarrow I_2 = I - I_1 = 56 - 25 = \underline{\underline{31\,mA}}$ R

b) $R_1 = \frac{U}{I_1} = \frac{12}{0.025} = \underline{\underline{480\,\Omega}}$ R

$R_2 = \frac{U}{I_2} = \frac{12}{0.031} = \underline{\underline{387\,\Omega}}$ R

3.

a) $R_5 = \frac{7{,}20}{5} = 1.44\,\Omega$

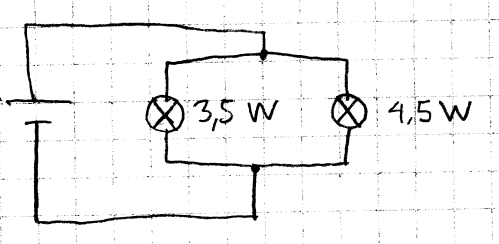
$R = (5R_5^{-1})^{-1} = \underline{\underline{0{,}288\,\Omega}} = 0{,}29\,\Omega$ R

b) $R = \frac{\rho L}{A} \Leftrightarrow \rho = \frac{RA}{L} = \frac{7.20 \cdot \pi (0.20 \cdot 10^{-3})^2}{2.0} = 4.52 \cdot 10^{-7}\,\Omega m$

$= 4.52 \cdot 10^{-1}\,\Omega \cdot mm^2/m$

$= \underline{\underline{45.2 \cdot 10^{-2}\,\Omega \cdot mm^2/m}}$ R

4.



$P = U \cdot I$

$I = \frac{P}{U}$

$I = \frac{P_{3,5}}{U} + \frac{P_{4,5}}{U} = \frac{P_{3,5} + P_{4,5}}{U} = \frac{3.5 + 4.5}{6.0} =$

$= \underline{\underline{1{,}33\,A}}$ R

5. $P = U \cdot I$

$I = \frac{P}{U}$

$I = \frac{420+250}{230} = \frac{67}{23}\ A$

$\#datorer = \frac{10\ A}{67/23\ A} = 3.4 \approx \underline{3}$ st R

6. $E = 6.28\ V$

$E - R_i I - RI = 0\ V \Rightarrow 6.06 - 1.82\,I = 0$

$R = 1.82\ \Omega$ $\quad 1.82\,I = 6.06$

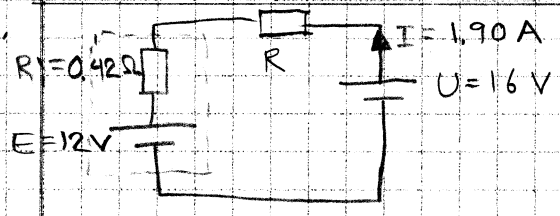
$E - R_i I = 6.06\ V$ $\quad I = \frac{6.06}{1.82}$

$6.28 - R_i \cdot \frac{6.06}{1.82} = 6.06$

$R_i \cdot \frac{6.06}{1.82} = 6.28 - 6.06$

$R_i = \frac{1.82}{6.06}(6.28-6.06) = \underline{66\ m\Omega}$ R

7.



$U - RI - R_i I - E = 0$

$RI = U - E - R_i I$

$R = \frac{U-E}{I} - R_i = \frac{16-12}{1.90} - 0.42 = \underline{1,69\ \Omega} \approx 1,7\ \Omega$ R

8. $U_{50} = \frac{50}{30+50} \cdot 64 = 40\ V$

$V_A = \underline{+40\ V}$ R

9. $U_2 = \frac{U}{2}$

$U_3 = \frac{U}{3}$

$U_3 - U_2 = -6$

$\frac{U}{3} - \frac{U}{2} = -6$

$U(\frac{1}{3} - \frac{1}{2}) = -6$

$U = \underline{36\ V}$ R

Repetitionskurs i fysik, Statisk elektricitet, elektriska fält och kondensatorn

1. a) $E = \frac{F}{Q}$

$F = EQ = 2.70\ \text{kV/m} \cdot 3.8\ \text{nC} = \underline{10.26\ \mu\text{N}} = \underline{10.3\ \mu\text{N}}$ R

b) $E = \frac{U}{d}$

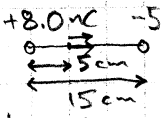
$U = E \cdot d = 2.70\ \text{kV/m} \cdot 6.0\ \text{cm} = \underline{162\ \text{V}}$ R

c) $W = F \cdot d$ $\quad d = 6.0 - 1.0 = 5.0\ \text{cm}$

$F = EQ$

$V = \frac{W}{Q} = \frac{F \cdot d}{Q} = \frac{EQd}{Q} = Ed = 2.70\ \text{kV/m} \cdot 5.0\ \text{cm} = \underline{135\ \text{V}}$ R

2.



$E = \frac{1}{4\pi\varepsilon} \frac{Q}{r^2}$

$E = \frac{1}{4\pi\varepsilon_0} \cdot \frac{8.0\ \text{nC}}{(5\ \text{cm})^2} + \frac{1}{4\pi\varepsilon_0} \cdot \frac{-5.0\ \text{nC}}{(10\ \text{cm})^2} = \frac{1}{4\pi\varepsilon_0}\left(\frac{8\ \text{nC}}{(5\ \text{cm})^2} + \frac{5.0\ \text{nC}}{(10\ \text{cm})^2}\right)$

$= \underline{33.3\ \text{kV/m}}$ ✓

3. $E = \frac{F}{Q} \Rightarrow F = EQ$

$F = ma$

$a = \frac{F}{m} = \frac{EQ}{m} = \frac{E \cdot e}{m_e} = \frac{1.8\ \text{kV/m} \cdot e}{m_e} = 317 \cdot 10^{12}\ \text{m/s}^2$ R

4. a) $W = \frac{mv^2}{2} = \frac{m_e (2.6\ \text{Mm/s})^2}{2}$

$U = \frac{W}{Q} = \frac{m_e (2.6\ \text{Mm/s})^2}{2 \cdot e} = \underline{19\ \text{V}}$ R

b) $W = U \cdot Q = 19\ \text{eV}$ R

5. $E = \frac{U}{d} \Rightarrow d = \frac{U}{E} = \frac{W/Q}{E} = \frac{W}{EQ} = \frac{200\ \text{eV}}{40\ \text{kV/m} \cdot e} = \underline{5\ \text{mm}}$ R

$U = \frac{W}{Q}$

6. $Q = CU = 2.2\,\mu F \cdot 30\,V$
$= \underline{66\,\mu C}$ R

7. $C = ((3 \cdot 22\,\mu F)^{-1} + (22\,\mu F)^{-1} + (2 \cdot 22\,\mu F)^{-1})^{-1} =$
$= \underline{12\,\mu F}$ R

8. $E - \frac{Q}{C} - RI = 0$

a) $Q = 0$

$E - RI = 0$

$E = RI$

$I = \frac{E}{R} = \frac{20\,V}{47\,k\Omega} = 426\,\mu A = \underline{0{,}43\,mA}$ R

b) $I = 0{,}15\,mA$

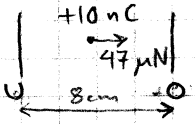
$E - \frac{Q}{C} - RI = 0$

$\frac{Q}{C} = E - RI$

$Q = C(E - RI) = 680\,nF \cdot (20\,V - 47\,k\Omega \cdot 0{,}15\,mA) =$
$= \underline{8{,}81\,\mu C}$ R

c) $\underline{0\,A}$ R

6.1



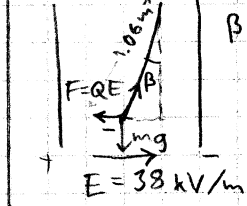
$F = QE \Rightarrow E = \frac{F}{Q}$.

$E = \frac{U}{d} \Rightarrow$

$U = Ed = \frac{Fd}{Q} = \frac{47\,\mu N \cdot 8\,cm}{10\,nC}$

$= \underline{376\,V}$ R

6.2



$\beta = 2{,}9°$

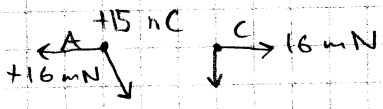
$\tan\beta = \frac{QE}{mg}$

$Q = \frac{mg\tan\beta}{E} = \frac{0{,}28\,g \cdot 9{,}82\,m/s^2 \tan 2{,}9°}{38\,kV/m}$

$= 3{,}7\,nC$

$N_e = \frac{Q}{e} = \underline{23 \cdot 10^9\,st}$ R

6.3 a)



$$F_{AC} = \frac{k Q_A Q_C}{r_{AC}^2}$$

$$Q_C = \frac{F_{AC} r_{AC}^2}{k Q_A} = \frac{16\,\text{mN} \cdot (3\,\text{dm})^2}{k \cdot 15\,\text{nC}}$$

$$F_{BC} = \frac{k Q_B Q_C}{r_{BC}^2} = \frac{k Q_B}{r_{BC}^2} \cdot \frac{F_{AC} r_{AC}^2}{k Q_A}$$

$$= \frac{Q_B}{Q_A} \cdot \frac{(3\,\text{dm})^2}{(6\,\text{dm})^2} \cdot F_{AC}$$

$$= \frac{-15\,\text{nC}}{+15\,\text{nC}} \cdot \frac{3^2}{6^2} \cdot 16\,\text{mN}$$

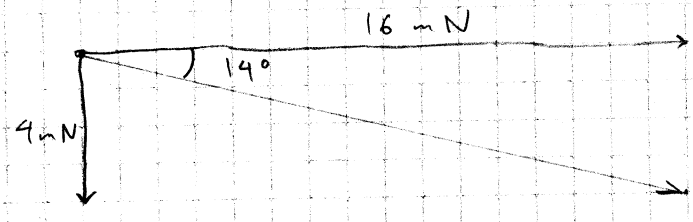
$$= -\frac{9}{36} \cdot 16\,\text{mN} = -4\,\text{mN}$$

Svar: 4 mN, neråt (på c) R

b) beror på skalan om 1 ruta = 0,5 cm

$$Q_C = \frac{16\,\text{mN} \cdot (1{,}5\,\text{cm})^2}{k \cdot 15\,\text{nC}} = +27\,\text{nC}$$ R

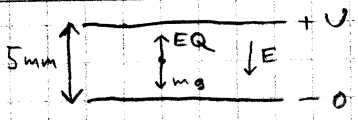
c)



Snett neråt höger med -14° rel. horisontalen. R

6.4 $E = \frac{U}{d} = \frac{52\,\text{V}}{3{,}0\,\text{cm}} = 1{,}7\,\text{kV/m}$ R

6.5



$m = 5{,}3 \cdot 10^{-15}\,\text{kg}$
$Q = -4e$

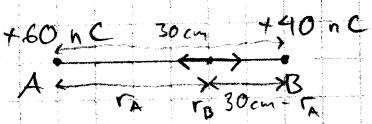
$$E = \frac{U}{d}$$

$$F = EQ = mg$$

$$\frac{UQ}{d} = mg$$

$$U = \frac{mgd}{Q} = \frac{5{,}3 \cdot 10^{-15}\,\text{kg} \cdot 9{,}82\,\text{m/s}^2 \cdot 5\,\text{mm}}{4e} = 406\,\text{V}$$ R

6.6



$$\frac{kQ_A}{r_A^2} = \frac{kQ_B}{(30\,\text{cm} - r_A)^2} \Rightarrow$$

$$r_A = \frac{30\sqrt{Q_A}(\sqrt{Q_A} - \sqrt{Q_B})}{Q_A - Q_B}\,\text{cm} = 16{,}5\,\text{cm} = 0{,}165\,\text{m}$$ R

$$r_A \neq \frac{30\sqrt{Q_A}(\sqrt{Q_A} + \sqrt{Q_B})}{Q_A - Q_B}\,\text{cm} = 163\,\text{cm}$$

ty ej nom

6:2 Rörelse av partiklar i ett elektriskt fält

6.7

$$\frac{1}{2} m_e v^2 = Ue$$

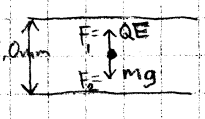
$$v = \sqrt{\frac{2Ue}{m_e}} = \sqrt{\frac{2 \cdot 120\,V \cdot e}{m_e}} = \underline{6.50 \cdot 10^6\ m/s = 6.5\ Mm/s}$$ R

6.8

$$\frac{1}{2} m_e v^2 = e E s$$

$$s = \frac{\frac{1}{2} m_e v^2}{eE} = \frac{m_e (1{,}32 \cdot 10^6\ m/s)^2}{2e \cdot 2{,}38\ kV/m} = 2.08\ mm = \underline{2.1\ mm}$$ R

6.9



$$E = \frac{U}{s}$$

$$F = F_1 - F_2$$

$$a = \frac{F}{m} = \frac{QE - mg}{m} = \frac{3eE}{m} - g = \frac{3eU}{ms} - g = \frac{3e \cdot 400\,V}{6{,}3 \cdot 10^{-15}\,kg \cdot 5.0 \cdot 10^{-3}\,m} - g$$

$$= 6.10\ m/s^2 - 9.80665\ m/s^2 = -3.70\ m/s^2$$

Svar: 3,7 m/s² nedåt R

6.10

$$\frac{m_e v^2}{2} = e E s_1, \text{ där } E = \frac{U}{s}$$

$$v = \sqrt{\frac{2eEs_1}{m_e}} = \sqrt{\frac{2eUs_1}{m_e s}} = \sqrt{\frac{2e \cdot 110\,V \cdot 4\,mm}{m_e \cdot 6\,mm}} = \underline{5.1 \cdot 10^6\ m/s}$$
$$= \underline{5.1\ Mm/s}$$ R

6:3 Kondensatorn

6.11

$$Q = C \cdot U$$

$C = 5{,}03\ nC/V = \underline{5.03\ nF}$ (enl 1 in.rcg.) R (men ej errors)

6.12

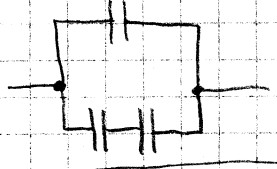
$$C = 10 + (10^{-1} + 10^{-1})^{-1} = \underline{15\ \mu F}$$ R

$(2 \cdot 10^{-1})^{-1}$
$\frac{1}{2} \cdot 10$

6.13

$$C_1 = (120^{-1} + 120^{-1})^{-1} = 60\ \mu F$$

$$C = 120 + C_1 = 180\ \mu F$$



6.14 $(C_L^{-1} + C_H^{-1})^{-1} = C_{tot} = 225\ nF$

$C_L = C_{Up} + C_{Lo} = \frac{1}{2}C + C = \frac{3}{2}C$

$C_{Up} = (C^{-1} + C^{-1})^{-1} \qquad C_{Lo} = C$

$C_H = C + C = 2C$

$C_{Up} = (2C^{-1})^{-1} = \frac{C}{2}$

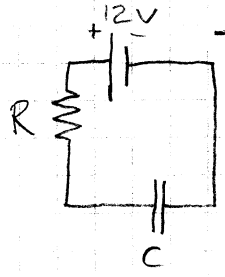
$C_{tot} = ((\frac{3}{2}C)^{-1} + (2C)^{-1})^{-1} = (\frac{2}{3}C^{-1} + \frac{1}{2}C^{-1})^{-1} = (\frac{7}{6}C^{-1})^{-1}$

$= \frac{6}{7}C = 225\ nF$

$\Leftrightarrow \quad C = \frac{7}{6} \cdot 225\ nF = \underline{262.5\ nF} \approx 263\ nF$ R

6.15 $Q = CU = 47\ nF \cdot 4.5\ V = \underline{212\ nC}$ R

6.16 6:4 RC-kretsen



A, C, B, D. R

6.17 a) $E = R \cdot i_0 \Leftrightarrow i_0 = \frac{U}{R} = \frac{50.0\ V}{33\ k\Omega} = \underline{1.52\ mA}$ R

b) $C = \frac{q}{u_c} \Leftrightarrow u_c = \frac{q}{C}$

$u_R + u_c = i \cdot R + \frac{q}{C} = 0$

$-33\ k\Omega \cdot 1{,}2\ mA + \frac{q}{3{,}9\ \mu F} = 0$

$q = 3{,}9\ \mu F \cdot 33\ k\Omega \cdot 1{,}2\ mA$

$= \underline{154\ \mu C.}$ R

6.18 $E = u_R + u_c$

$E = R \cdot i + \frac{q}{C}$

$u_R = R \cdot i$

$7.63\ V = R \cdot 0{,}41\ mA$

$R = \frac{7{,}63\ V}{0{,}41\ mA} = 18{,}61\ k\Omega$

$12\ V = 7.63\ V + \frac{q}{12\ \mu F}$

$q = 12\ V \cdot 12\ \mu F - 7.63\ V \cdot 12\ \mu F$

$= (12 - 7.63)\ V \cdot 12\ \mu F = 52.44\ \mu C$

a) $\underline{q = 52\ \mu C}$ R

b) $\underline{R = 18{,}6\ k\Omega}$ R

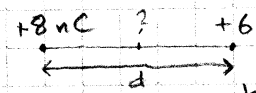
6 Statisk elektricitet, elektriska fält och kondensatorn

Slutdiagnos

1. a) $E = \frac{U}{d} = \frac{800\,V}{4.0\,cm} = \underline{20\,kN/C} = \underline{20\,kV/m}$ R

b) $F = E \cdot Q = 20\,kN/C \cdot 1.2\,pC = \underline{24\,nN}$ R

2. a)



$E = E_8 - E_6 = \frac{kQ_8}{r_8^2} - \frac{kQ_6}{r_6^2} = \frac{k}{r^2}(Q_8 - Q_6) = \underline{29\,kN/C} = 29\,kV/m$ R

$r_8 = r_6 = r$

b) $E_8 - E_6 = 0$

$\frac{kQ_8}{r_8^2} = \frac{kQ_6}{(d-r_8)^2}$

solve $\left(\frac{q_8}{r^2} = \frac{p_6}{(d-r)^2}, r\right)$

$r = \frac{d(\sqrt{p_6} - \sqrt{q_8}) \cdot \sqrt{q_8}}{p_6 - q_8}$ eller $r = \frac{-d(\sqrt{p_6} + \sqrt{q_8}) \cdot \sqrt{q_8}}{p_6 - q_8}$

$= 26.79\,mm = \underline{2,7\,cm}$ R

$= 373,2\,mm = 37,3\,cm$

Förkastas p.g.a. orimlighet: E-fältet kan aldrig vara 0 bortom två positiva laddningar.

3.

$F = m \cdot a$

$F = \frac{kQe}{r^2} = ma$

$a = -\frac{kQe}{mr^2} = \frac{-k \cdot 40\,nC \cdot e}{m \cdot (75\,mm)^2} = -11.2 \cdot 10^{15}\,m/s^2$

$= \underline{-11.2\,Pm/s^2}$ R (d.v.s. mot punktladdningen)

4a) $W_1 = \frac{mv^2}{2} = \frac{m(2.5\,Mm/s)^2}{2} = 2.85 \cdot 10^{-18}\,J = \underline{17,8\,eV}$ R

b) $U = \frac{W}{Q}$ $W_2 = \frac{mv^2}{2} = \frac{m(1.0\,Mm/s)^2}{2} = 2,84\,eV$

$U = \frac{W}{Q} = \frac{W_1 - W_2}{e} = \frac{17,8\,eV - 2,84\,eV}{e} = 14,96\,V = \underline{15,0\,V}$ R

c) $\underline{2,84\,V}$ R

5. $C = \frac{Q}{U}$

$U = \frac{Q}{C} = \frac{67\,\mu C}{1,2\,mF} = \underline{56\,mV}$ R

6. $C_{tot} = ((3C)^{-1} + C^{-1} + (2C)^{-1})^{-1}$

$= \left(\frac{1}{3}C^{-1} + C^{-1} + \frac{1}{2}C^{-1}\right)^{-1} = \left(\frac{11}{6}C^{-1}\right)^{-1} = \frac{6}{11}C = 8,0\,\mu F$

$C = \frac{11}{6} \cdot 8,0\,\mu F = \frac{44}{3}\,\mu F = \underline{14,7\,\mu F}$ R

7.

a) $E - Ri_0 = 0$

$E = Ri_0$

$i_0 = \frac{E}{R} = \frac{20\,V}{1{,}2\,M\Omega} = 16{,}7\,\mu A$ R

b) $C = \frac{Q}{U}$

$\frac{q}{C} - Ri = 0$

$q = CRi = 56\,nF \cdot 1{,}2\,M\Omega \cdot 10\,\mu A = \underline{672\,nC}$ R

c) $i_\infty = 0\,A$ R

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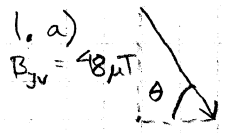
7 Magnetism och induktion
Inledande diagnostiskt prov

1. a)



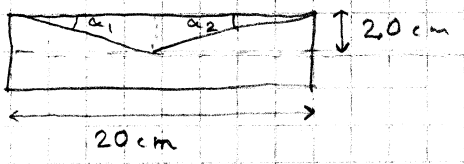
$\tan\theta = \frac{B_{JV}}{B_{JH}}$

$B_{JH} = \frac{B_{JV}}{\tan\theta} = \frac{48\,\mu T}{\tan 56°} = \underline{32{,}4\,\mu T}$ R

b) $\Theta = B_{JV} \cdot A = 48\,\mu T \cdot 2{,}0 \cdot 1{,}2\,m^2 = 115\,\mu Wb$ R

2.

$B = \frac{\mu I N}{2l}(\cos\alpha_1 + \cos\alpha_2)$



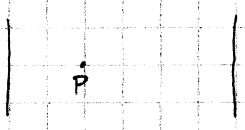
$\tan\alpha = \frac{2}{20} = \frac{1}{10} = 0{,}1$

$\alpha = \tan^{-1} 0{,}1$

$I = \frac{2lB}{\mu N \cdot 2\cos(\tan^{-1}0{,}1)} = \frac{2 \cdot 20\,cm \cdot 65\,\mu T}{\mu_0 \cdot 500 \cdot 2\cos(\tan^{-1}0{,}1)} = \underline{20{,}8\,mA}$ R

3.

a) $B = \frac{\mu}{4\pi}\frac{2I}{a}$



$I = \frac{4\pi a B}{2\mu} = \frac{4\pi \cdot 2{,}0\,cm \cdot 22\,\mu T}{2\mu_0} = \underline{2{,}2\,A}$ R

b) $I = \frac{4\pi \cdot 4.0\,cm \cdot 22\,\mu T}{2\mu_0} = \underline{4{,}4\,A}$ (i samma riktning) R

c) $\underline{44\,\mu T}$ R

---

4. $F = IlB = 20\,A \cdot 1\,m \cdot 65\,\mu T = \underline{1{,}3\,mN}$ R

(forts) 7 Magnetism och induktion
Inledande diagnostiskt prov

5. a) $F = QvB$

$a = \frac{v^2}{r}$

$F = ma$

$\frac{mv^2}{r} = QvB$

$r = \frac{mv^2}{QvB} = \frac{mv}{QB} = \frac{m_e \cdot 1{,}94 \cdot 10^7 \text{ m/s}}{q_e \cdot 26 \text{ mT}} = \underline{\underline{4{,}24 \text{ mm}}}$ R

b) $r = \frac{mv}{QB} \Rightarrow v = \frac{rQB}{m}$

$W_k = \frac{1}{2}mv^2 = \frac{1}{2}m\left(\frac{rQB}{m}\right)^2 = \frac{1}{2}m\frac{r^2Q^2B^2}{m^2} = \frac{1}{2}\frac{r^2Q^2B^2}{m}$

$\frac{\frac{1}{2}\frac{(\frac{1}{2}r)^2Q^2B^2}{m}}{\frac{1}{2}\frac{r^2Q^2B^2}{m}} = \frac{\frac{1}{4}r^2}{r^2} = \frac{1}{4} = \underline{\underline{25\,\%}}$ R

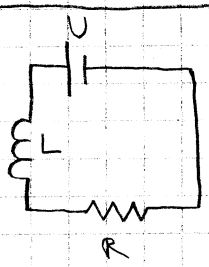
6. $e = Bvl = 65\,\mu\text{T} \cdot 20 \text{ km/h} \cdot 60 \text{ cm} = \underline{\underline{216\,\mu\text{V}}} = 0{,}22 \text{ mV}$ R

7. $\Phi = BA$

$e = N\frac{d\Phi}{dt} = NA\frac{dB}{dt}$

$\frac{dB}{dt} = \frac{e}{NA} = \frac{5{,}0 \text{ mV}}{2000 \cdot \pi \cdot (2{,}0 \text{ cm})^2} = \underline{\underline{2{,}0 \frac{\text{mT}}{\text{s}}}}$ R

8.

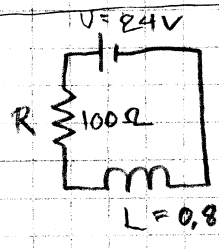


$U = L\frac{di}{dt} + Ri$

$L\frac{di}{dt} = U - Ri = 6 \text{ V}$

$L = \frac{6 \text{ V}}{\frac{di}{dt}} = \frac{6 \text{ V}}{32{,}5 \text{ A/s}} = \underline{\underline{184 \text{ mH}}} = 0{,}19 \text{ H}$ R

9.



$U = Ri + L\frac{di}{dt}$

a) 0 A R

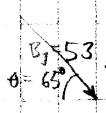
b) $i = \frac{U}{R} = \frac{24 \text{ V}}{100 \Omega} = \underline{\underline{240 \text{ mA}}}$ P

c) $i = 120 \text{ mA}$

$\frac{di}{dt} = \frac{U - Ri}{L} = \frac{24 \text{ V} - 100 \Omega \cdot 0{,}12 \text{ A}}{0.80 \text{ H}} = \underline{\underline{15 \text{ A/s}}}$ R

7 Magnetism och induktion

7.1



$$\frac{B_{JV}}{B_J} = \sin\theta$$

$$B_{JV} = B_J \sin\theta = 53\ \mu T \sin 65°$$

$$\Phi = B_{JV} \cdot A = 53\ \mu T \sin 65° \cdot 0{,}68\ m^2 = \underline{33\ \mu Wb}$$ R

7.2

$$B_{JV} = B_J \sin\theta = 66\ \mu T \cdot \sin 45°$$

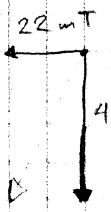
$$\Phi = B_{JV} \cdot l \cdot b = 66\ \mu T \cdot \sin 45° \cdot 50\ m \cdot 84\ m = \underline{196\ mWb}$$ R

7.3

a) Syd

b) Väster

7.4



$$B = \sqrt{22^2 + 44^2} = 49{,}2\ mT$$

Svar: e R

7.5

$$B = \frac{\mu_0 \cdot N \cdot I}{2r} + B_{JV}$$

$N = 4$

$r = 9{,}0\ cm$

$B_{JV} = \underline{46{,}1\ \mu T}$ R

$$\frac{\mu_0 N}{2r} = 26{,}3\ \mu T/A$$

$$\mu_0 = \frac{26{,}3 \cdot 2r}{N} = \frac{26{,}3\ \mu T/A \cdot 2 \cdot 9{,}0\ cm}{4} = \underline{1{,}18 \cdot 10^{-6}\ Vs/(Am)}$$ V

7.6

$$B = \frac{\mu_0 \cdot N \cdot I}{L}$$

$$N = \frac{B \cdot L}{\mu_0 \cdot I} = \frac{12\ mT \cdot 20\ cm}{\mu_0 \cdot 3{,}0\ A} = \underline{637\ varv}$$ R

7.7

$$B = \pm\frac{\mu_0 N I}{2r} + B_{JV}$$

$$B_{JV} = B \mp \frac{\mu_0 N I}{2r} = \pm 113{,}4\ \mu T \mp \underbrace{\frac{\mu_0 \cdot 9 \cdot 4{,}2A}{2 \cdot 140\ cm}}_{169{,}6\ \mu T} = \begin{matrix} -56{,}2 \\ 283{,}0 \\ -283{,}0 \end{matrix}$$

$\underline{56{,}2\ \mu T}$ R

7.8

$$B = \frac{\mu_0 I}{2\pi \cdot d}$$

$$\mp B_1 \pm B_2 = 200\,\mu T$$

$$\mp \frac{\mu_0 6{,}5\,A}{2\pi \cdot 1{,}0\,cm} \pm \frac{\mu_0 I}{2\pi \cdot 1{,}0\,cm} = 200\,\mu T$$

$$I = \pm\left(\frac{200\,\mu T \cdot 2\pi \cdot 1{,}0\,cm}{\mu_0} \pm 6{,}5\,A\right) = \begin{matrix} \pm 16{,}5\,A \\ \pm 3{,}5\,A \end{matrix}$$ R

7.9

$$B = \frac{\mu_0 \cdot 12{,}0\,A}{2\pi \cdot d} = 40\,\mu T$$

$$d = \frac{\mu_0 \cdot 12{,}0\,A}{2\pi \cdot 40\,\mu T} = 60\,mm \text{ (2 rutor).}$$

1 ruta = 30 mm = 3 cm.

a) $$B_A = -\frac{\mu_0 12{,}0\,A}{2\pi \cdot 3\,cm} = +80\,\mu T$$ R

b) $$B_B = \frac{-\mu_0 12{,}0\,A}{2\pi \cdot 3\,cm} = +80\,\mu T$$

$$B = B_A + B_B = -160\,\mu T$$ R

7.10

a) $$B = \frac{\mu_0 I}{2\pi \cdot d}$$

$$B_{tot} = 2B = \frac{\mu_0 I}{\pi d}$$

$$I = \frac{B_{tot}\pi d}{\mu_0} = \frac{0{,}14\,mT \cdot \pi \cdot 6\,cm}{\mu_0} = 21\,A$$ R

b) $$F = B \cdot I \cdot L =$$

$$= \frac{\mu_0 I \cdot I \cdot L}{2\pi \cdot d} = \frac{\mu_0 \cdot 21\,A}{2\pi \cdot 12\,cm} \cdot 21A \cdot 1m = 735\,\mu N$$ R

7.11

a) $$BQv = \frac{mv^2}{r} \Leftrightarrow B = \frac{m_e v}{ef} = 627\,\mu T$$ R

$v = 2{,}9\ Mm/s$
$Q = e$
$r = 2{,}63\,cm$
$m = m_e$

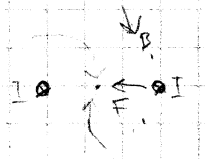
b) $$Ee = \frac{m_e v^2}{r} \Leftrightarrow E = \frac{m_e v^2}{er} = 1{,}81\ kN/C = 1{,}8\ kV/m$$ R

$$\frac{V}{m} \rightarrow \frac{N}{C} \qquad U = \frac{W}{Q}$$

$$\frac{V}{m} = \frac{J/C}{m} = \frac{Nm/C}{m} = \frac{N}{C}$$

7.12

a) $B = \frac{\mu_0 I}{2\pi d}$



$F = BIL \Leftrightarrow B = \frac{F}{IL}$

$\frac{\mu_0 I}{2\pi d} = \frac{F}{IL}$

$I^2 = \frac{2\pi d F}{\mu_0 L}$

$I = \sqrt{\frac{2\pi d F}{\mu_0 L}} = \sqrt{\frac{2\pi \cdot 4{,}0\,\text{cm} \cdot 5{,}82\,\mu\text{N}}{\mu_0 \cdot 1\,\text{m}}} = \underline{\underline{1{,}08\,\text{A}}}$ R

b) OI eller

$B = 2\frac{\mu_0}{2\pi d/2}\sqrt{\frac{2\pi d F}{\mu_0 L}} = 2\sqrt{\frac{\mu_0^2}{\pi^2 d^2}\frac{2\pi d F}{\mu_0 L}} = 2\sqrt{\frac{2\mu_0 F}{\pi d L}}$

$= 2\sqrt{\frac{2\mu_0 \cdot 5{,}82\,\mu\text{N}}{\pi \cdot 4{,}0\,\text{cm} \cdot 1\,\text{m}}} = \underline{\underline{21{,}6\,\mu\text{T}}}$ R

7.13

a) $BQv = \frac{mv^2}{r}$

$m = \frac{BQr}{v} = \frac{0{,}60\,\text{T} \cdot e \cdot 7{,}12\,\text{cm}}{1{,}93 \cdot 10^5\,\text{m/s}} = 35{,}5 \cdot 10^{-27}\,\text{kg} = \underline{\underline{21{,}4\,\text{u}}}$ R

b) $BQv = EQ$

$E = Bv = 0{,}60\,\text{T} \cdot 1{,}93 \cdot 10^5\,\text{m/s} = \underline{\underline{116\,\text{kV/m}}}$ R

7.14

$d_b = 13{,}8$ l.e.
$d_a = 7{,}4$ l.e.

$r_b = \frac{d_b}{2}$
$r_a = \frac{d_a}{2}$

$BQv = \frac{mv^2}{r}$

$v = \frac{BQr}{m}$

$W = \frac{mv^2}{2} = \frac{m}{2}\left(\frac{BQr}{m}\right)^2 = \frac{B^2Q^2r^2}{2m}$

Förlorad rörelseenergi:

$1 - \frac{W_a}{W_b} = 1 - \frac{\frac{B^2Q^2r_a^2}{2m}}{\frac{B^2Q^2r_b^2}{2m}} = 1 - \frac{r_a^2}{r_b^2} = 1 - \frac{d_a^2}{d_b^2} = 0{,}712 = \underline{\underline{71\%}}$ R

7.15

$W = \frac{mv^2}{2} \Leftrightarrow v^2 = \frac{2W}{m} \Rightarrow v = \sqrt{\frac{2W}{m}}$

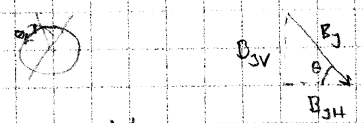
$F = BQv = 25\,\text{mT} \cdot e \cdot \sqrt{\frac{2 \cdot 9{,}6 \cdot 10^{-17}\,\text{J}}{m_e}} = \underline{\underline{58{,}2\,\text{fN}}}$ R

7.16 $U = N \cdot \frac{\Delta\Phi}{\Delta t} = 750 \cdot \frac{0{,}5 - 0{,}2}{18 - 2}\ \frac{\text{mWb}}{\text{ms}} = \underline{14{,}1\ \text{V}}$ R

7.17 Q R

7.18 $U = N \cdot \frac{\Delta\Phi}{\Delta t} = 200 \cdot \frac{(250 - 0)\ \mu\text{V}}{(0{,}5 - 0{,}1)\ \text{ms}} = \underline{125\ \text{V}}$ R

7.19



$B_{3V} = B_J \sin\theta$

$U = N \cdot \frac{\Delta\Phi}{\Delta t} = 1 \cdot \frac{B_{3V} \cdot \Delta A}{\Delta t} = \frac{B_{3V} l \Delta s}{\Delta t} = B_{3V} l v = B_J \sin\theta \cdot l \cdot v = \underline{2{,}9\ \text{mV}}$ R

7.20 $U = N \cdot \frac{\Delta\Phi}{\Delta t} = 1200 \cdot \frac{(300 - 50)\ \mu\text{Wb}}{12\ \text{ms}} = \underline{25\ \text{V}}$ R

7.21

$U = R \cdot I = 2{,}1\ \Omega \cdot 850\ \mu\text{A} = 1{,}785\ \text{mV}$

$U = N \cdot \frac{\Delta\Phi}{\Delta t} = 1 \cdot \frac{B \Delta A}{\Delta t} = \frac{B l \Delta s}{\Delta t} = B l v$

$v = \frac{U}{Bl} = \frac{1{,}785\ \text{mV}}{22{,}5\ \text{mT} \cdot 18\ \text{cm}} = 441\ \text{mm/s} = \underline{0{,}441\ \text{m/s}}$ R

7.22 $E = L \cdot \frac{dI}{dt} = 60\ \text{mH} \cdot 3{,}8\ \text{A/s} = \underline{228\ \text{mV}} = \underline{0{,}23\ \text{V}}$ R

7.23 $E = iR + L\frac{di}{dt} = \left(1{,}6\text{A} - \frac{1{,}6\text{A}}{0{,}40\text{s}} \cdot 0{,}10\text{s}\right) \cdot 1{,}2\ \Omega + 45\ \text{mH} \cdot \frac{-1{,}6\text{A}}{0{,}40\text{s}}$

$= \underline{1{,}26\ \text{V}}$ R

7.24

a) $E = iR + L\frac{di}{dt}$

vid $t = 0$ är $i = 0$

$E = L\frac{di}{dt}$

$\frac{di}{dt} = \frac{E}{L} = \frac{36\ \text{V}}{1{,}5\ \text{mH}} = \underline{24\ \text{kA/s}}$ R

b) $E = iR + L\frac{di}{dt}$

$\frac{di}{dt} = \frac{E - iR}{L} = \frac{36\ \text{V} - 20\ \text{mA} \cdot 560\ \Omega}{1{,}5\ \text{mH}} = \underline{16{,}5\ \text{kA/s}}$ R

c) $E = iR$

$i = \frac{E}{R} = \frac{36\ \text{V}}{560\ \Omega} = \underline{64{,}3\ \text{mA}}$ R

Efter ~~lång~~ oändlig tid R

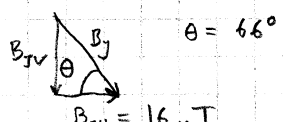
7.25

$$E = L \cdot \frac{di}{dt}$$

$$L = \frac{E}{di/dt} = \frac{3{,}4\,V}{0{,}5\,mA/30\,ms} = \underline{204\,mH} = \underline{0{,}20\,H}$$ R

Slutdiagnos

1. a)



$\theta = 66°$

$$\frac{B_{JH}}{B_J} = \cos\theta$$

$$B_J = \frac{B_{JH}}{\cos\theta} = \frac{16\,\mu T}{\cos 66°} = \underline{39\,\mu T}$$ R

b) $\Phi = B \cdot A = 16\,\mu T \cdot 2{,}0\,m \cdot 3{,}0\,m = \underline{96\,\mu Wb}$ R

2.

$$B_{tot} = B_J + B$$

$$B = B_{tot} - B_J = 115\,\mu T - 72\,\mu T = 43\,\mu T$$

$$B = \frac{\mu_0}{2} \cdot \frac{NI}{r}$$

$$I = \frac{2rB}{\mu_0 N} = \frac{2 \cdot 15{,}0\,cm \cdot 43\,\mu T}{\mu_0 \cdot 12} = \underline{855\,mA}$$ R

3. a)

$$B = \frac{\mu_0 I}{2\pi \cdot d}$$

$$B_{tot} = B - B = \underline{0\,T}$$ R

b) $$B_{tot} = 2B = \frac{\mu_0 I}{\pi \cdot d} = \frac{\mu_0 \cdot 14{,}0\,A}{\pi \cdot 1{,}0\,cm} = \underline{560\,\mu T}$$ R

c) $$F = BIL = \frac{\mu_0 \cdot 14{,}0\,A}{2\pi \cdot 2{,}0\,cm} \cdot 14{,}0\,A \cdot 1{,}0\,m = \underline{1{,}96\,mN}$$ R

4. a)

$$F = \frac{mv^2}{r} = QvB$$

$$\frac{mv}{r} = QB$$

$$v = \frac{rQB}{m} = \frac{2{,}83\,cm \cdot e \cdot 0{,}26\,mT}{m_e} = \underline{1{,}29\,Mm/s}$$ R

b) a: falskt p.g.a. $\frac{dp}{dt} = 0$ Korrekta: b R

b: $r_b = \frac{mv}{QB}$

$r_a = \frac{mv}{QB/2} = \frac{2mv}{QB} = 2r_b$

sant

c: falskt

d: falskt

e: falskt

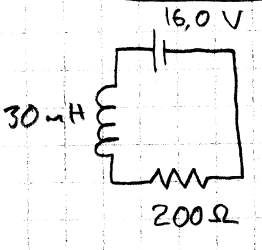
5. $U = -\frac{d\Phi}{dt} = -\frac{B\,dA}{dt} = -\frac{B l\,ds}{dt} = -Blv$

$v = -\frac{U}{Bl} = \frac{25\,\mu V}{68\,\mu T \cdot 0{,}90\,m} = \underline{\underline{408\ mm/s}} = 0{,}41\ m/s$ R

6. $U = N\frac{\Delta\Phi}{\Delta t} = N \cdot A \cdot \frac{\Delta B}{\Delta t} = N \cdot \pi r^2 \cdot \frac{\Delta B}{\Delta t} = 600 \cdot \pi \cdot (1{,}5\,cm)^2 \cdot 0{,}85\ T/s =$

$= \underline{\underline{360\,mV}}$ R

7.



$E = iR + L \cdot \frac{\Delta i}{\Delta t}$

a) 0 A R

b) $E = i \cdot R \Leftrightarrow i = \frac{E}{R} = \frac{16{,}0\,V}{200\,\Omega} = \underline{\underline{80\,mA}}$ R

c) $E = iR + L \cdot \frac{\Delta i}{\Delta t}$

$\frac{\Delta i}{\Delta t} = \frac{E - iR}{L} = \frac{16{,}0\,V - 6{,}0\,V}{30\,mH} = \underline{\underline{333\,A/s}}$ R