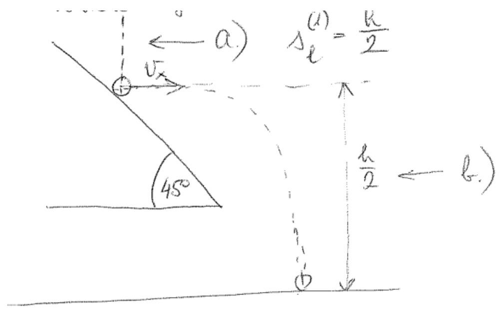
Összesen: 15 pont

1.

h= 30 m, α= 45°

When left-side ball collides with the slope:



a) in case of the first half of the movement ➡ free fall: ➡ $v_0 = 0$

$$S_l^{(1)} = \frac{g}{2} t_e(1)^2 \longrightarrow t_e^{(1)} = \sqrt{\frac{2s_e^{(1)}}{g}} = \sqrt{\frac{2*\frac{h}{2}}{g}} = \sqrt{\frac{h}{g}}$$ (3pont)

b) projectile motion in horizontal direction ➡ in vertical direction it is a free fall : (3 pont)

$$s_e^{(2)} = \frac{g}{2} t_e^{(2)2} \Rightarrow t_e^{(2)} = \sqrt{\frac{2s_e^{(2)}}{g}} = \sqrt{\frac{2*\frac{h}{2}}{g}} = \sqrt{\frac{h}{g}}$$ (3pont)

So $t_{left} = t_e^{(1)} + t_e^{(2)} = \sqrt{\frac{h}{g}} + \sqrt{\frac{h}{g}} = 2 * \sqrt{\frac{h}{g}} = 2 * \sqrt{\frac{30m}{10\frac{m}{s^2}}} = 2 * \sqrt{3}\, s =$

$t_{left} = 3{,}4641 s \approx 3{,}46$ s (2 pont)

then right- hand ball falls in free fall:

$$s_r = \frac{g}{2} t_r^2 \Rightarrow \quad h = \frac{g}{2} t_r^2 \Rightarrow \quad t_r = \sqrt{\frac{2h}{g}} = \sqrt{\frac{2*30m}{10\frac{m}{s^2}}}$$ (3 pont)

$t_r = \sqrt{6}$ s = 2,44949s≈ 2,45 s (1 pont)

Answer:

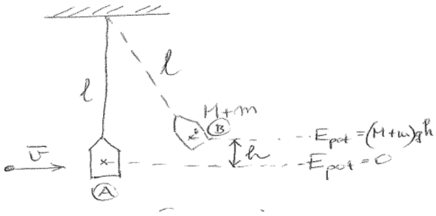
a) <u>$t_{left} = 3{,}46$ s</u>
<u>$t_{right} = 2{,}45$ s</u>

b) The <u>right-hand ball</u> reaches the ground level earlier

Összesen: 15 pont

2.

M = 3 kg



m= 5g = 0,005 kg
g = $10\frac{m}{s^2}$

h = 5 cm = 0,05 m
l= 1 m

---

v= ?

Conversation of momentum theorem: (I = m*v)

Before collision : $m*v + 0$ (1p)
After collision: $(M+m)*u$ (1p)

$mv + 0 = (M+m)\,u$
$u = \frac{m*v}{M+m}$ (1) (3p)

(5 pont)

Conversation of energy (mechanical energy) theorem:

At the beginning of joint motion : A : $\frac{1}{2}(M+m)u^2 + 0$ ⟵ (1p)
At the end of joint motion: B: $0 + (M+m)g*h$ ⟵ (1p)

$\frac{1}{2}\cancel{(M+m)}\,u^2 = \cancel{(M+m)}g*h$
$u^2 = 2gh$
$u = \sqrt{2gh}$ (2) (3p)

(5 pont)

Here: (1) = (2). So:

$\frac{m*v}{M+m} = \sqrt{2gh}$ / * (M+m) (≠0)

$m*v = \sqrt{2gh}$ * (M+m) / : m(≠0)

$v = \frac{M+m}{m} * \sqrt{2gh}$ (3 pont)

$v = \frac{(3+0{,}005)\cancel{kg}}{0{,}005\cancel{kg}} * \sqrt{2*10\frac{m}{s^2}*0{,}05m} = \frac{3{,}005}{0{,}005} * \sqrt{2*10*0{,}05}\,\frac{m}{s} =$

$V = 601 * \sqrt{1} = 601\,\frac{m}{s}$ (2 pont)

The speed of the flying bullet was $\underline{v = 601\,\frac{m}{s}}$

Összesen 12 pont

3.

Összesen: 12 pont

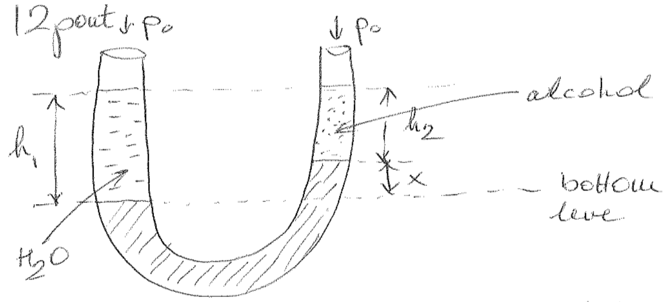
$\rho_{Hg} = 13600\ \frac{kg}{m^3}$

$\rho_{H_2O} = 1000\ \frac{kg}{m^3}$

$\rho_{alc} = 700\ \frac{kg}{m^3}$

$g = 10\ \frac{m}{s^2}$

$h_2 = 25 cm = 0{,}25 m$



$\rho_{H_2O} > \rho_{alc} \Rightarrow$ water is at the left side, alcohol is on the right-side stem. (2 pont)

Hydrostatic pressure are the same at both sides at bottom level:

Left side hydrostatic pressure: $P_{H_2O} + P_o$ (2 pont)

Right side hydrostatic pressure: $P_{alc} + P_{Hg} + P_o$ (2 pont)

equilibrium

2 pont

$P_{H_2O} + \cancel{P_o} = P_{alc} + P_{Hg} + \cancel{P_o}$ $(p = \delta g h)$

$\delta_{H_2O} * g * h_1 = \delta_{alc} * g * h_2 + \delta_{Hg} * g * x$ /:g

$\delta_{H_2O} * h_1 = \delta_{alc} * h_2 + \delta_{Hg} * x$

$\delta_{H_2O} * h_1 - \delta_{alc} * h_2 = \delta_{Hg} * x$ $/ : \delta_{Hg}$ $(\neq 0)$

$$\left(\frac{\delta_{H_2O} * h_1 - \delta_{alc} * h_2}{\delta_{Hg}} = x = \frac{1000\frac{kg}{m^3} * (h_2 + x) - \delta_{alc} * h_2}{\delta_{Hg}}\right]$$

$\delta_{H_2O} * (h_2 + x) - \delta_{alc} * h_2 = \delta_{Hg} * x$

$\delta_{H_2O} * h_2 + \delta_{H_2O} * x - \delta_{alc} * h_2 = \delta_{Hg} * x$

$\delta_{H_2O} * h_2 - \delta_{alc} * h_2 = \delta_{Hg} * x - \delta_{H_2O} * x = (\delta_{Hg} - \delta_{H_2O}) * x$

$$X = \frac{\delta_{H_2O} * h_2 - \delta_{alc} * h_2}{\delta_{Hg} * \delta_{H_2O}} = \frac{\left[1000\frac{kg}{m^3} - 700\frac{kg}{m^3}\right] * 0{,}25 m}{13600\frac{kg}{m^3} - 1000\frac{kg}{m^3}}$$

(2 pont)

$$\frac{300\cancel{\frac{kg}{m^3}} * 0{,}25\ m}{12600\cancel{\frac{kg}{m^3}}} = \frac{3 * 0{,}25\ m}{126} = 0{,}005952\ m$$

X= 0,005952 m = 0,5952 cm≈ 0,60 cm≈<u>6 mm</u>

(2 pont)

Összesen: 6 pont

4.

m = 2 kg

$C_{Al} = 900\frac{J}{Kg*K}$

t = 5 min = 5*60s =300s

T_1 = 273K+20 = 293K

T_2 = 273K+70 = 343K

⇒ $\triangle$T = 50 °C or K

(2 pont)

a) $P_{net} = \frac{E}{t} = \frac{C_{al}*m*\Delta T}{t} = \frac{900\frac{J}{kg*K}*2\,kg*50\,K}{300\,s}$

$P_{net} = \frac{9*2*50}{3}$ J/s = 3*2*50 J/s = 6*50 J/s = P = 300 W (1 pont)

b) λ = ?

$\lambda = \frac{P_{net}}{P} = \frac{300W}{500W} = \frac{3}{5}\,W/W = \frac{6}{10} = 0{,}6$ ⇒ 60%

(1 pont)

Or

vagy (2 pont)

$\lambda = \frac{W_{net}}{W_{sum}} = \frac{P_{net}*t}{P_{sum}*t} = \frac{P_{net}}{P_{sum}} = \frac{P_{net}}{P}$

The efficiency is 60%

Összesen: 12 pont

5.

U_o= 10 V
$R_{in=}$ 0,5 Ω
$R_{ont=}$ 2 Ω

C= 0,5 μF = 5*10^{-7} F

a) Sum of the resistances:

$R = R_{in} + R_{out} = 0{,}5\ \Omega + 2\Omega = 2{,}5\ \Omega$ (2 pont)

Current flow sin the main arm:

$I = \frac{U_o}{R} = \frac{10V}{2{,}5\Omega} = 4\ A$ (2 pont)

Electric voltage fells ont he outer resistance:

$U = I * R_{out} = 4A*2\Omega = 8\ V$ (2 pont)

This U = 8 V, fells between the condenser plates as well, due to parallel switch of Ront and C.

Answer for a. : U= 8V } (3 pont)

b) Charge of the condenser is:

$Q = C*U = 5*10^{-7}F * 8V = 4*10^{-6}C = 4\mu C$

(3 pont)

Part II.

a) $13600\ \frac{kg}{m^3} \neq 1360\ \frac{kg}{dm^3}$ $1\ m^3 = 1000\ dm^3$

b) $13600\ \frac{kg}{m^3} = 13{,}6\ \frac{g}{cm^3}$

c) $2{,}7\ \frac{g}{cm^3} = 2700\ \frac{kg}{m^3} \neq 27\ \frac{kg}{m^3}$

d) $1\ \frac{g}{cm^3} \neq 1000\ \frac{kg}{dm^3}$ $\left(1\ \frac{g}{cm^3} = 1000\ \frac{kg}{m^3}\right)$

Correct is: B.

2. $m = 2\ kg$
$\Delta T = 40°C = 40\ K$
$C_{alc} = 2{,}4 \frac{kJ}{kg * °C}$

$\Delta E = C_{alc} * m * \Delta T = 2{,}4 \frac{kJ}{kg * K} * 2\ kg * 40\ K = \underline{192\ kJ}$
°C °C

Correct is : A.

3. It stays in equilibrium Correct is: C.

4. L= 0,5m $E_{kin} = E_{pot}$
m $\frac{1}{2} m v^2 = m g L$
g

$v^2 = 2gL$
$v = \sqrt{2gL} = \sqrt{2 * (10) * 0{,}5m} = \sqrt{(10) m} =$
g g

$= \sqrt{g * m} = \sqrt{1 * m * g}$

Correct is: B.

5. Alpha particle is positively charged particle. Nuclens of Gold atom is also positively charged. „A” and „B”. drawings are correct.

Correct is: F.

a) 6. A. yes $\not{o} = 90\,° = \frac{\pi}{2}$ (rad)

$a = -A\omega^2 \sin(\omega t + (-\frac{\pi}{2}))$

B. no

C. no

D. yes $\not{o} = \pi = 180°$ $a = -A\ \omega^2 \sin(\omega t + \pi)$

Drawings A. and B. can describe harmonic oscillators.

Correct answer is : D.

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7. $\delta_{wood} < \delta_{metal}$ → $G_{wood} > G_{metal}$ → wooden sphere moves downward!

$F_{buo} = V_{object} * \delta_{fluid} * g$ is buoyancy force

Correct answer is : A.

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8. Correct answer is : C.

Saud waves cannot propagate ont he Moon , because the Moon does not have athmosphere.

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9. $p = \delta_{fluid} * g * h$ if diameter is increasing, then h is decreasing.

Correct answer is : D.

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10. G= m*g does not change!

Correct answer is : A.

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11. Correct is: B.

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12. Correct is: C.

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13. Correct is: D. $R = \delta * \frac{l}{A}$ $\frac{10m}{1\,mm^2} = \frac{20m}{2\,mm^2}$

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14. Correct is: C.

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15. Correct is: B.

Part II. - Simple choice test

1.) Good solution is: b. (2 pont)

2.) Good solution is: a. (3 pont)

3.) Good solution is: c. (2 pont)

4.) Good solution is: b. (3 pont)

5.) Good solution is: f. (3 pont)

6.) Good solution is: d. (3 pont)

7.) Good solution is: a. (3 pont)

8.) Good solution is: c. (2 pont)

9.) Good solution is: d. (3 pont)

10.) Good solution is: a. (3 pont)

11.) Good solution is: b. (2 pont)

12.) Good solution is: c. (3 pont)

13.) Good solution is: d. (3 pont)

14.) Good solution is: c. (3 pont)

15.) Good solution is: b. (2 pont)

Összesen: 40 pont