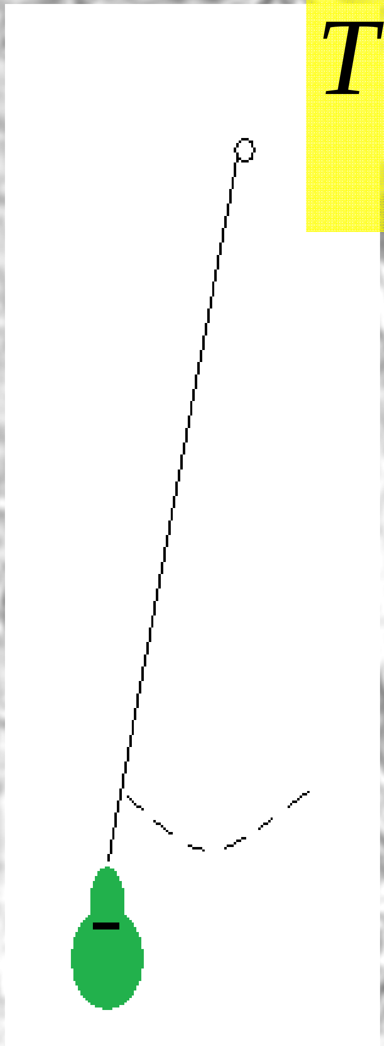
Discussione dati del 25/02/2015 :

$$T = 2\pi\sqrt{\frac{l+l'}{g}} \equiv T^2 = \frac{4\pi^2}{g}l + \frac{4\pi^2}{g}l'$$



Considerando $y=T^2$ **e** $x=l$, si vuole utilizzare la relazione lineare del tipo $y=Bx+A$ per fornire la misura di g da $B=4\pi^2/g$.

l lunghezza del cordino fino al segno sul corpo, *t* tempo impiegato per tre oscillazioni

l [cm]												media	dev st. c
124.5	*t* [s]	7.03	6.67	6.80	6.83	6.77	7.36	6.56	6.51	6.60	6.52	6.765	0.265215
124.3													
97.5	*t* [s]	5.91	6.01	5.97	6.01	5.97	5.59	5.84	6.13	5.93	5.93	5.929	0.141457
97.3													
68.8	*t* [s]	5.07	4.96	5.07	5.04	5.12	5.06	5.15	4.97	5.03	5.10	5.057	0.060378
68.8													
38.2	*t* [s]	3.09	3.78	3.63	3.53	3.86	3.67	3.76	3.85	3.70	3.85	3.672	0.230834
38.5													

l [cm]	$\Delta_l/2$ [cm]	ε_l [cm]	δl [cm] lineare	$\delta l/l$	$\delta l/l$ %	t [s]	σ_t [s]	ε_t [s]	δt [s] lineare	$\delta t/t$	$\delta t/t$ %
124.4	0.10	0.05	0.15	0.0012	0.1	6.77	0.27	0.005	0.28	0.041359	4.1
97.4	0.10	0.05	0.15	0.0015	0.2	5.93	0.14	0.005	0.15	0.025295	2.5
68.8	0.00	0.05	0.05	0.0007	0.1	5.06	0.06	0.005	0.07	0.013834	1.4
38.35	0.15	0.05	0.20	0.0052	0.5	3.67	0.23	0.005	0.24	0.065395	6.5

$T = t/3$

T	δT	$\delta T/T$	$\delta T/T$
[s]	[s]		%
	lineare		
2.26	0.09	0.041298	4.1
1.98	0.05	0.025253	2.5
1.69	0.023	0.013831	1.4
1.22	0.08	0.065413	6.5

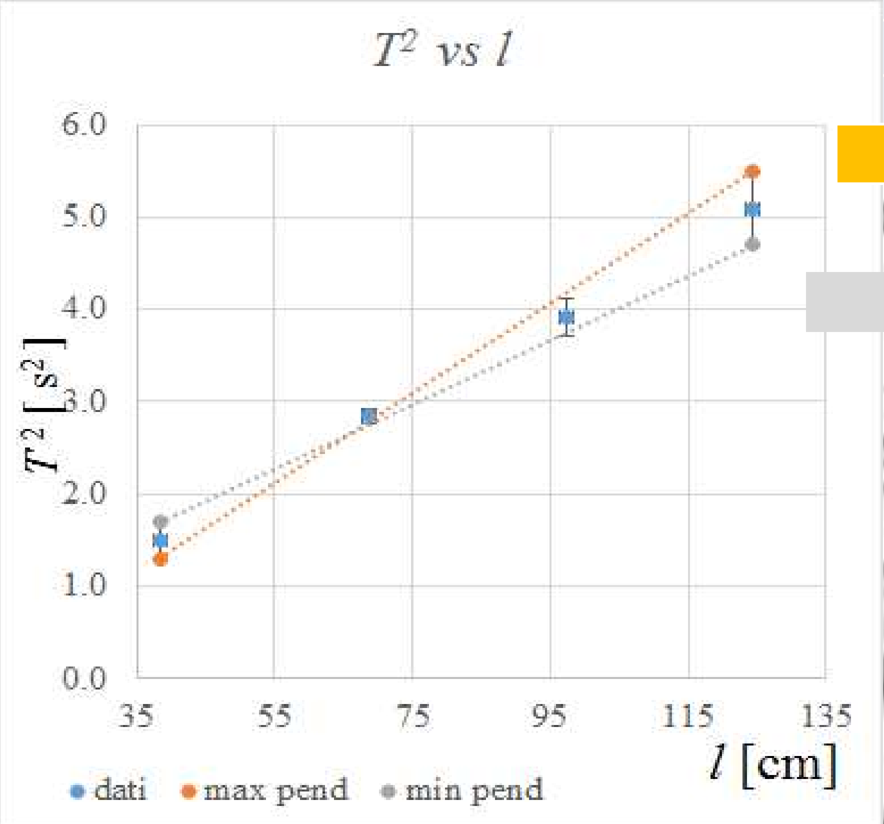
$$T^2 = \frac{4\pi^2}{g} l + \frac{4\pi^2}{g} l'$$

T^2	$\delta(T^2)$	T^2	$\delta(T^2)/T^2$	$\delta(T^2)/T^2$
[s^2]	[s^2]	[s^2]		%
	lineare	arrot		
5.1076000	0.4	5.1	0.078315	7.8
3.9204000	0.20	3.92	0.051015	5.1
2.8459690	0.08	2.85	0.02811	2.8
1.4957290	0.20	1.50	0.133714	13.4

$$\delta(T^2) = 2T\delta T$$

Approccio grossolano vedi Ciullo G. *Introduzione al laboratorio di Fisica* pg. 91

	x		*y*	δy		
	l		T^2	$d(T^2)$		
	[cm]		[s^2]	[s^2]	Max pend.	min pend.
				lineare	$y_{4+}\delta y_4$	y_4-δy_4
4	124.4		5.1	0.4	5.5	4.7
3	97.4		3.92	0.20		
2	68.8		2.85	0.08		
1	38.35		1.50	0.20	1.30	1.70
					y_1-δy_1	y_1+δy_1



B_{max} =	$\Delta y/\Delta x$=	4.20/86.05=	4.88E-02	$s^2\ cm^{-1}$
B_{min}=	$\Delta y/\Delta x$=	3.00/86.05=	3.49E-02	$s^2\ cm^{-1}$

B_{ms} =	B_{vc} =	0.04185 =	0.0419	$s^2\ cm^{-1}$
δB =	$\Delta_B/2$=	0.00695=	0.007	$s^2\ cm^{-1}$

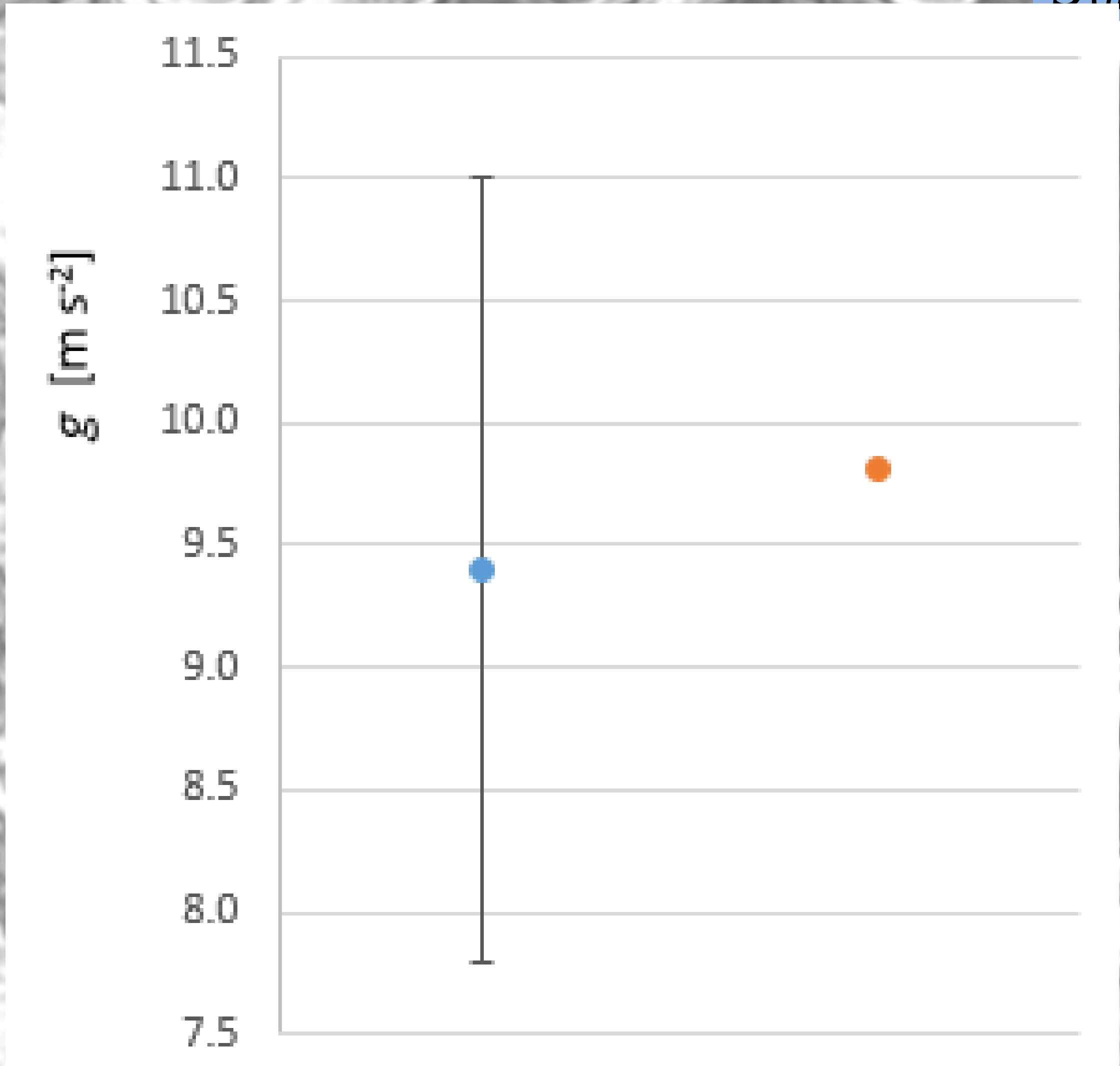
g=	$4\pi^2/B$ =	942.2056707=	940	$cm\ s^{-2}$
δg=	$\Delta B/B\ g$=	157.4090619=	160	$cm\ s^{-2}$

g_{mis} = 940 ± 160 cm s^{-2}

g_{mis} = 9.4 ± 1.6 m s^{-2}

Precisione della misura 17 %

g_{att} = 9.807 m s^{-2}



Approccio rigoroso (solo per conoscenza non richiesta): MMQ pesati

Si ottiene per i coefficienti A e B, utilizzando i pesi p_i:

$$\sum p_i y_i - A\sum p_i - B\sum p_i x_i = 0\,,$$
$$\sum p_i x_i y_i - A\sum p_i x_i - B\sum p_i x_i^2 = 0\,.$$

Se si risolve il sistema delle due equazioni per le due incognite A e B si ottiene:

$$\Delta_{pes} = \sum p \sum px^2 - \left(\sum px\right)^2\,,$$

$$A_{pes} = \frac{\sum px^2 \sum py - \sum px \sum pxy}{\Delta_{pes}}\,,\quad B_{pes} = \frac{\sum p \sum pxy - \sum px \sum py}{\Delta_{pes}}\,,$$

$$\sigma_{A_{pes}} = \sqrt{\frac{\sum px^2}{\Delta_{pes}}}\,,\qquad \sigma_{B_{pes}} = \sqrt{\frac{\sum p}{\Delta_{pes}}}\,.$$

Se applichiamo il metodo dei minimi quadrati pesati (MMQp)

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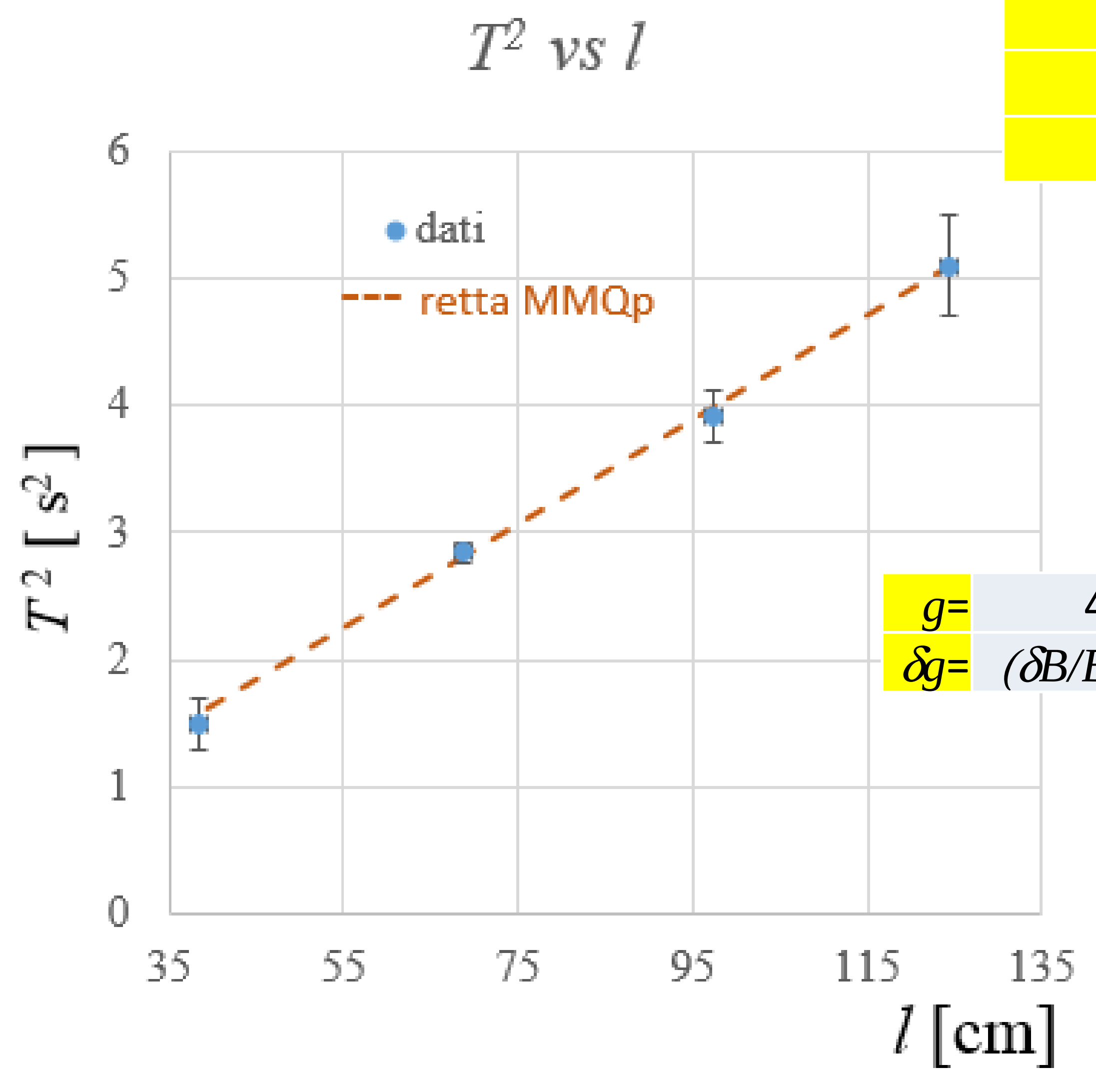
Solo per conoscenza MMQ pesati



B_{ms} =	0.04101851	0.041	s^2 cm^{-1}
δB=	0.00399926	0.004	s^2 cm^{-1}

g=	$4\pi^2/B$=	962.8882343=	960	s^2 cm^{-1}
δg=	$(\delta B/B)\ g_{ms}$=	93.94031554=	90	s^2 cm^{-1}

g_{mis} = 960 ± 90 cm s^{-2}

g_{mis} = 9.6 ± 0.9 m s^{-2}

Precisione della misura 9 %

g_{att} = 9.807 m s^{-2}