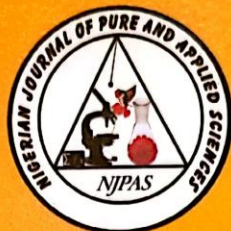


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EMPIRICAL DETERMINATION OF TIME WINDOW FOR GRAVITATIONAL ACCELERATION DETERMINATION

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ABSTRACT

Variations in the acceleration due to gravity, from place to place on the earth surface are caused by parameters such as inequality of earth's radius from pole to equator, temperature variation, density variation in the subsurface rocks and many others. Hence, this work examined practically temperature effect in order to determine the appropriate period when acceleration due to gravity could be determined with least adverse effect of the diurnal temperature instability. Experiments were carried out in the laboratory. First, diurnal temperature variation with time was monitored with a digital thermometer for two days from which three suitable experimental periods were determined as 2:30 am, 2:45 pm and 8:30 am, indicating the coldest, hottest and moderate temperature periods. Free oscillation simple pendulum method was used to determine acceleration due to gravity (g) at the periods identified above for a period of 3 weeks. The values obtained were compared with $9.78031225 \text{ ms}^{-2}$, standard absolute gravity value obtained at School of Aviation Technology, Zaria; the value which was tied to the International Gravity standardization Net, (IGSN71) through Primary Gravity Network for Nigeria (PGNN85). An average of $9.74651200 \text{ ms}^{-2}$ was obtained at 8:53 am (coldest period), 0.3% deviated from the standard. $9.72281780 \text{ ms}^{-2}$ was obtained at 2:45 pm, a deviation of about 0.5%, and the largest deviation of 0.70% occurred at 2:30 am. It was concluded that a consistent and reliable acceleration due to gravity could be determined around 9:00 am to 2:40 pm. However, measurements around 2:30 am could suffer spurious variations.

Key words: Absolute-gravity, time-window, laboratory, Pendulum, experimental-gravity,

INTRODUCTION

Two solid bodies at a distance apart either attract or repel each other, depending on the magnitude of their separation. During attraction the lighter one tends to move towards the heavy one. The resulting motion brings about a change in velocity, which is acceleration (Nettleton 1971). The solid earth, as a massive body, thus, has an attraction on a smaller object at a distance on its surface. Now, the time rate resulting from a change of velocity caused by the earth attraction on such object called acceleration due to gravity g is an important parameter in the fields of Physics like Geophysics.

The value of acceleration due to gravity g varies from place to place on earth and scientists advanced reasons for this observation. One of these is variation in the earth's radius from equator to the pole caused by its 24-hour rotation about its vertical axis which resulted in the bulginess at the equator and slight flattening at the pole (Williams, 1970, 1973). Another reason is that g varies with location change, which is due to non-uniformity of the subsurface geological rock structures and types (i.e. lithological variation). One other cause is diurnal temperature variation (Osemeikhian, and Asolkhia, 1994; Okeke, 2001), which formed the basis of this work.

This work was aimed at practically assessing the trend of effect of diurnal temperature variation on the acceleration due to gravity g as compared with the standard (absolute) value of g determined at a location in College of Aviation Technology Zaria by Osazuwa (1985).

The three suitable hottest, coldest and temperate periods used for data collections were practically determined for two days. Free oscillation simple pendulum method was then used to obtain g at each three selected periods in a day for three weeks for the data collection. All these were done in a Physics Laboratory located at latitude $11^{\circ} 5' 19''$ N, longitude $7^{\circ} 43' 35''$ E.

Simple pendulum set-up was used to obtain the acceleration due to gravity g at a location. Using the relationship in equation 1, g values were calculated for each experiment.

$$g = \frac{4\pi^2 L}{T^2} \quad (1)$$

The period T was got for 20 oscillations in each case and the length L of the pendulum was measured and kept constant throughout the experiment.

MATERIALS AND METHODS

Instrumentation

Below is the comprehensive list of the instruments used for the work.

Table 1: Instrument list

Instrument	Purpose
Navigator (i.e. G.P.S)	Location determination
Digital read-out thermometer	Data time window determination
2 cm diameter lead bulb	g data collection
Metre rule	g Data Collection
Digital read out stop watch	g Data Collection

Determination of Diurnal Time Window

Using the watch and thermometer, appropriate data acquisition time windows were obtained. The time windows are the time intervals when the practical works were conducted; i.e. the hottest, coldest and moderate temperature time of the day. Atmospheric temperature was taken hourly, for 48 hours consecutively (i.e., 2 days), at the laboratory where the experiment was to be accomplished. Two linear graphs of temperature against time for the two days were obtained as shown in fig.1 and the result was summarized in table 2.

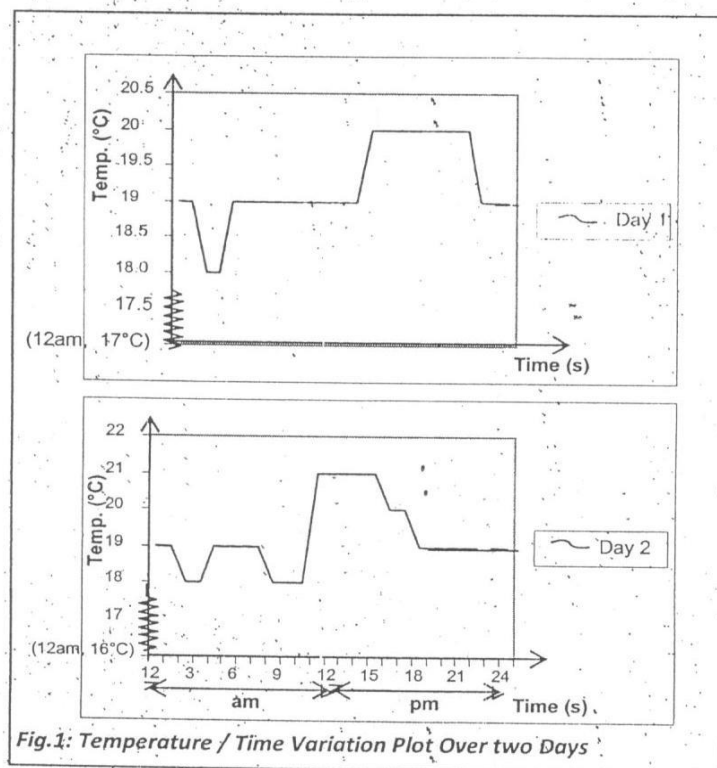


Table 2: Experimental time window

Day	Range	Temp. (°C)	Time Range	Mean Time
1.	Highest	20	2:00 - 9:00 pm	4:20 pm
	Lowest	18	2:00 - 3:00 am	2:30 pm
	Moderate	19	2:30 - 4:30 am	9:30 am
2.	Highest	21	11:00 - 3:00 am	1:00 pm
	Lowest	18	2:00 - 3:00 am	2:30 am
	Moderate	19	2:30am - 1:00 pm	8:15 am

It was hence determined that:

- average time for highest temperature reading = 2:45 pm
- average time for lowest temperature reading = 2:30 am
- average time for moderate temperature reading = 8:53 am

The above periods were used for data collection throughout the period of the experimentation. Henceforth, gravity values for coldest period were denoted with g_c , hottest values with g_h and moderate values were denoted with g_m .

Gravity Data Acquisition

The gravity g data were acquired by conducting simple pendulum experiments at each time window obtained above. Thus, three values of g were gotten trice daily viz: at 2:45 pm., 2:30am and 8:53 am for diurnal highest, lowest and moderate temperatures respectively. This was done for twenty - one days.

RESULTS AND DISCUSSION

The values of g obtained using the period T derived experimentally from all the time windows for 21 days using equation 1 were tabulated in table 3.

Table 3: Experimental Gravity data

DATE	FIRST DATA		SECOND DATA		THIRD DATA	
	TIME		TIME		TIME	
	2:30 AM		8:53 AM		2:45 PM	
	Mean Gravity g_c (ms^{-2})	Tem p ($^{\circ}C$)	Mean Gravity g_m (ms^{-2})	Tem p ($^{\circ}C$)	Mean Gravity g_h (ms^{-2})	Tem p ($^{\circ}C$)
04/08/04	9.5724005	20	9.6555975	20	9.7391998	20
05/08/04	9.7872640	19	9.7666216	20	9.7357802	20
06/08/04	9.7433057	19	9.7480992	20	9.6819887	20
08/08/04	9.7707449	20	9.8135052	20	9.7597553	20
09/08/04	9.7105310	20	9.7378318	20	9.7153004	20

10/08/ 04	9.7050847	20	9.7535818	20	9.7016830	20
12/08/ 04	9.7187092	19	9.7570108	20	9.7364640	19
13/08/ 04	9.6630303	19	9.7686829	20	9.7501547	20
14/08/ 04	9.6340238	19	9.7686829	20	9.7501547	20
15/08/ 04	9.6664116	19	9.7241670	20	9.7344129	20
16/08/ 04	9.6989630	20	9.7893319	20	9.7139373	20
17/08/ 04	9.7207553	19	9.7893319	20	9.6528969	20
18/08/ 04	9.7003229	19	9.7207553	20	9.7412524	20
19/08/ 04	9.7893319	19	9.7446749	19	9.7207553	20
20/08/ 04	9.7309958	19	9.7494694	19	9.7153004	20
21/08/ 04	9.7460444	19	9.7486992	19	9.7207553	20
22/08/ 04	9.7296295	19	9.7228040	19	9.7597553	17
23/08/ 04	9.7330458	19	9.7125746	20	9.7118933	20
24/08/ 04	9.7378318	19	9.7412524	20	9.7241670	20
25/08/ 04	9.7734952	19	9.7604416	19	9.7091690	20
26/08/ 04	9.7357802	19	9.7289464	20	9.7050847	20

The gravity values from the data processed for the 3 data periods were summarised in the Table 4.

Table 4: g range for data periods

g type	Period	Lowest g (m/s ²) & Date	Highest g (m/s ²) & Date
g _c	2:30 am	9.57240050 / 04-01-'12	9.78933190 / 19-01-'12
g _m	8:53 am	9.65559750 / 04-01-'12	9.81350520 / 08-01-'12
g _h	2:45 pm	9.65289690 / 17-01-'12	9.7575530 / 22-01-'12

This indicated the highest value of g around 8:53 am and the lowest value occurred at about 2:30 am., which is the coldest period of the day as at the period of this work

Now, the mean $g_c = 9.71449550 \text{ m/s}^2$, mean $g_h = 9.72281780 \text{ m/s}^2$ and the mean $g_m = 9.74651200 \text{ m/s}^2$. Comparing these values with one of the absolute values (9.78031225) gotten at school of Aviation, Zaria by Osazuwa (1985), which was set as the standard, the second data time i.e. 8:45 am with value 9.74651200 m/s^2 , is the most suitable time to get the closest value. The next suitable time is the third data time i.e. 2:45 p.m. with value 9.72281780 m/s^2 .

CONCLUSION

Variation in g at various diurnal temperatures obtained here was a proof of the temperature effect on the accuracy of experimental g as speculated by Telford, Geldart and Sheriff (2004) Period around 8.53 am appeared the best to obtained most accurate g experimentally. This is so because the temperature has minimum adverse influence on the experimental values in this work.

Actually, measurement of temporal variations in gravity has rather been sporadic to date. However, it is a fact that density has relationship with temperature and bulk volume. Now, temperature increase leads to expansion, which means volume increase. Volume increase causes density reduction, Keith (1990). But, density played a prominent role in the gravity value at every location on the earth surface. Therefore, it is no surprise, as shown in this work, that temperature variation showed an impact on the gravity variation.

REFERENCES

- Keith, G. (1990). *Advanced Physics*. 2nd Ed. G. Britain. Cambridge University Press.
- Nettleton, L.L. (1971). *Elementary Gravity and Magnetism For Geologists and Seismologists*. Society of Exploration Geophysicists. Tulsa, Oklahoma. Pp 102.
- Okeke, P.N. (2001). The Role of Space Science and Technology in National Development Conference Paper Presented at National Physics Summit Organised by National Mathematics Centre, Abuja, Nigeria. 12p.
- Osazuwa, I.B. (1985): The establishment of primary Gravity Network for Nigeria Ph.D. Thesis. Physics Department, Ahmadu Bello University, Zaria Nigeria.
- Osemeikhian, J.E.A. and Asokhia, M.B. (1994). *Applied Geophysics*. SAMTOS Services LTD Lagos. Pp 79-90.
- Telford, W. M. Geldart, L. P. and Sheriff, R. E. (2004): 2nd Ed., *Applied Geophysics*. Cambridge University Press, Cambridge, New York.
- William, B. (1970): *Encyclopaedia Britannica*. Chicago. Encyclopaedia Britannica Inc. Vol. 10.
- William, B. (1973): *The new Encyclopaedia Britannica Macropaedia*. Chicago William Benton Publisher, 1943 - 1973. Vol. 8.