Slip effects on Magnetohydrodynamic (MHD) flow of Williamson Nanofluid over an Exponentially Shrinking Sheet


Department of Mathematics, and Statistics, QUEST, Nawabshah, Pakistan

Received 10th March 2019 and Revised 12th August 2019

Abstract: In present study the impacts of velocity, thermal and concentration slip boundary conditions of the Williamson nanofluid on the Magnetohydrodynamic (MHD) flow, heat and the mass transfer over a shrinking surface are considered. The magnetohydrodynamic flow is considered in absence of thermal and Joule heating. Using of appropriate similarity transformations, the partial differential equations of the boundary layer have been converted into the ordinary differential equations. To get the required solutions, an efficient Runge-Kutta 4th order technique with shooting method has been utilized in maple programming. In order to check the method precision, we compare our results with published literature and observed to be in excellent agreement. Numerically Gotten solutions have been displayed in form of tables and graphs for a numerous values of flow pertinent parameters, such as, Hartmann number, Schmidt number, thermophoresis and Brownian motion parameter. Furthermore, many other parameters like of non-Newtonian Williamson parameter with slip boundary condition, Prandtl number, Schmidt number and suction parameter have been examined graphically. At long last, the result of the problem is composed as a conclusion in light of the tables and plotted graphs.

Keywords: Slip Boundary Conditions; Williamson Nanofluid; Shooting Technique; Shrinking

1. INTRODUCTION

No slip condition can be explained in fluid dynamics as when velocity of flowing fluid becomes zero related to concerned solid wall/surface. Be that as it may, to understand the flow characteristics is a good thinking to study the conditions of slip in real situation. Basically, Navier Stokes developed on basis of the no slip condition. (Lund, et al., 2019) examined the MHD flow of Casson nanofluid with slip conditions. It is observed that the velocity slip and critical shear rate are increasing the velocity profile. (Mukhopadhyay, 2013) considered the MHD viscous fluid flow on the exponential stretching sheet by using the slip boundary condition. From her study it is concluded that the increment of the velocity slip reduces the velocity of the fluid. (Lund, et al., 2019) considered the slip effect on non-Newtonian nanofluid find dual solutions for the different ranges of suction parameter.

There are various models present in the literature that explores the shear thinning influence such as, Carreus model, Ellis model and Cross model, power law model, but very few researchers have considered Williamson fluid model that describes the shrinking phenomena. Williamson fluid model is one of the non-Newtonian fluids that describes flow of the shear thinning liquids. This model was developed by Williamson (Lund, et al., 2019). Recently, flow of Williamson fluid with different conditions was investigated by few authors (Williamson, 1929). (Lund, et al., 2019) (Hayat, et al., 2016). (Alarifi, et al., 2019) (Rehman, et al., 2017). The thermal properties specially the thermal conductivity of operational fluid might be controlled in case of the nanosized particles (1-100nm) are suspended into the common fluid which are named as nanofluids. Some example of the common base fluids are engine oil, glycol, water etc. whereas the nanosized particles are made up of the gold, silver, copper, nanotubes, copper oxide, etc. The thermal properties of the operational fluid are changed because of the variation of the thermal properties of the nano-sized particles as well as common base fluid. These interesting properties make the nanofluids the useful functioning fluid for the many industrial and engineering applications. Some of the applications are food industry, Geothermal processes, electronic technology, miniature technology, nuclear reactors and thermal reservoirs. Considering to the scope of this paper, there has been given a summarized literature concerned to the flow and the heat transfer of the nanofluids on the shrinking surfaces.

There has been observed in the literature the Williamson nanofluid slip flow due to the shrinking sheets have not been entertained properly up to now. Therefore, prime aim of this study is to find numerical solutions of two-dimensional magnetohydrodynamic Williamson nanofluid flow over the shrinking surface...
that subjected to the three slip conditions: that are the velocity, temperature, and the solutal. To apply the numerical method named as shooting method at first the ordinary differential equations are obtained from the concerned governing partial differential equation by applying proper similarity transformations. Shooting method with shootslib function in maple software were used by many researches such as (Kecebas, and Yuirusoy, 2006) (Hafidzuddin, et al., 2014) (Raza, et al., 2016). The main purpose is to find the behavior of different non-dimensional physical parameters such as slip, magnetic parameter, Williamson parameter, Brownian motion, the thermophoresis parameter, Prandtl number and suction parameter on the temperature, velocity, and the concentration profile. These effects are demonstrated by graphically. The effects on the coefficient of skin friction and the local Nusselt number are represented by graphs. The obtained results are compared with concerned results given in the previous literature to check the accuracy of applied method.

2. METHODOLOGY

We consider the incompressible two-dimensional steady state Williamson nanofluid flow on the stretching and shrinking surface. The velocity of the shrinking plate is $-U_w e^{x/l}$ along the $x$-axis. The fluid velocity, the temperature and the concentration of the nanoparticle nearby the surface are supposed to be $u_w$, $T_w = T_w$, $C_w = C_w$ and $C_u = C_u$, respectively, which are as shown in (Fig. 1). The basic governing equations of the mass conservation, the momentum, energy and the concentration in the form of the Cartesian coordinates form will be written,

$$ \frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} = 0 $$

$$ u \frac{\partial u}{\partial x} + v \frac{\partial u}{\partial y} = \left( \theta + \sqrt{2} \nu \left( \frac{\partial u}{\partial y} \right)^2 \right) $$

$$ \frac{\partial T}{\partial x} + v \frac{\partial T}{\partial y} = \alpha \frac{\partial^2 T}{\partial y^2} + \tau \left( \frac{D_b}{T_w} \frac{\partial C}{\partial y} \right) $$

$$ \frac{\partial C}{\partial x} + v \frac{\partial C}{\partial y} = D_b \frac{\partial^2 C}{\partial y^2} + \frac{D_T}{T_w} \frac{\partial T}{\partial y} $$

The corresponding boundary conditions are given by (Bhattacharyya, et al.,2013).

$$ v = v_w, ~ u = -U_w e^{x/l} + N_s \theta \left( \frac{\partial u}{\partial y} + \sqrt{2} \Gamma \left( \frac{\partial u}{\partial y} \right)^2 \right), $$

$$ T = T_w(x) = T_w(x) + \frac{\partial T}{\partial y}, \quad C = C_w(x) $$

$$ = C_w(x) + k_r \frac{\partial C}{\partial y}, \quad at \ y = 0 $$

$$ u \to 0, \quad T \to T_w, \quad C \to C_w as \ y \to \infty $$

where $\rho$ is fluid density, $\sigma$ is electrical conductivity, $\theta$ denotes the kinematic viscosity, $B$ is the magnetic induction, thermal diffusivity is denoted by $\alpha$, $N_s = N_i e^{-x/2l}$, $K = K_0 e^{-x/2l}$ and $K^* = K_0 e^{-x/2l}$ is the velocity, the thermal and the concentration slips ($N_1$, $K_1$, $K^*_1$ is the initial value of the velocity, the thermal and the concentration slip factors). Where $D_B$ indicates Brownian diffusion coefficient, $D_T$ indicates the thermophoretic diffusion coefficient, and the $\tau = \frac{(\rho c)_p}{(\rho c)_f}$ denotes ratio of effective heat capacity of solid nanoparticles material to the effective heat capacity concerned base fluid.

The following similarity transformation are applied to get the similarity solutions

$$ \psi = \sqrt{2 \beta U_w e^{x/2l}(\eta)}; \quad \theta(\eta) = \frac{T - T_w \psi}{T_w - T_w}; \quad \phi $$

$$ = \frac{C_w - C_w \psi}{C_w - C_w}; \quad \eta $$

$$ = y \sqrt{\frac{U_w}{2\beta l}} e^{x/2l} $$

In components of velocity, the stream function $\psi$ will be written as

$$ u = \frac{\partial \psi}{\partial y}, v = -\frac{\partial \psi}{\partial x} $$

By applying above transformations, the equations (2)-(4) along with boundary conditions (5) take the following forms:

$$ (1 + \lambda f''')f''' - 2f^{''2} + Mf' = 0 $$

$$ \frac{1}{Pr} \theta'' + \frac{f \theta' + f' \theta + N_s \theta' + N_i (\theta')^2}{N_b \theta''} = 0 $$

Here, prime denotes derivatives due to the new independent variable $\eta$. The boundary conditions are taken as:

$$ f(0) = S; \quad f'(0) = -1 + \beta (f''(0) + \lambda (f''(0))^2); \quad \theta(0) = 1 + \delta_1 \theta'(0); \quad \psi(0) = 1 + \delta \phi'(0) $$

$$ f'(\eta) \to 0; \quad \theta(\eta) \to 0; \quad \phi(\eta) \to 0 as \eta \to \infty $$
Here, the differentiation with respect to $\eta$ is denoted by prime. However, $\beta = N_1 \sqrt{\frac{\partial u_w}{2l}}$, $\delta_r = K_1 \sqrt{\frac{u_w}{2l}}$, and $\delta_c = K_1 \sqrt{\frac{u_w}{2l}}$ are velocity, thermal and concentration slip parameters respectively, $\varepsilon = \frac{b}{u_w}$ is stretching and shrinking parameter (where $b < 0$ is Shrinking and $b > 0$ is Stretching sheet respectively), $\lambda = \Gamma \sqrt{\frac{\nu_b \exp(3\chi/1)}{\partial t}}$ is dimensionless Williamson fluid parameter, $M = \frac{2\pi \beta t^1}{\rho u_w}$ is Hartmann number, $Pr = \frac{\sigma}{\nu}$ is Prandtl number, $N_c = \frac{\tau_d (T_w - T_0)}{\nu T_0}$ is thermophoresis parameter, $N_b = \frac{\tau_d (C_w - C_0)}{\nu}$ is Brownian motion parameter and $S < 0$ is mass injection parameter and $S > 0$ is mass suction parameter.

The specified physical quantities of the interest are specially, the skin friction coefficient $C_f$, local Nusselt number $N_u$ as well as local Sherwood number $S_h$ that are described as:

$$C_f = \frac{\mu_0 \left( \frac{\partial u}{\partial y} + \frac{\nu}{2} \left( \frac{\partial u}{\partial y} \right)^2 \right)}{\rho U_w^2} ; \quad N_u = \frac{x}{(T_w - T_0) \left( \frac{\partial T}{\partial y} \right)_{y=0}} ; \quad S_h = \frac{x}{(C_w - C_0) \left( \frac{\partial C}{\partial y} \right)_{y=0}}$$

Using the non-dimensional variables, we obtain

$$\sqrt{2Re} e^{-3x/2l} C_f = \left( f''(0) + \frac{\lambda}{2} (f''(0))^2 \right) ; \quad \theta'(0)$$

$$\frac{2}{\sqrt{Re}} e^{-x/2l} N_u ; \quad \psi'(0)$$

$$\frac{2}{\sqrt{Re}} e^{-x/2l} S_h$$

3. **RESULTS AND DISCUSSION**

The effects of the various non-dimension physical parameters on velocity, temperature, concentration, skin friction, Nusselt number and the Sherwood number have been drawn in plots by applying Runge-Kutta 4th order method by the help of the shooting technique. To check the exactness of present results, comparison has been given in the (Table 1) to the corresponding values of the local Nusselt number. Obtained results indicates excellent agreement. From the table 1 it is concluded that applied method is the highly effective, well-matched and accurate to examine the solutions of equations 7-10. On the other hand, results of skin friction coefficient, rate of the heat transfer as well as concentration rate are presented in (Tables 2).

(Fig. 2-5) determine the velocity profile. The effect of the Williamson fluid parameter $\lambda$ and velocity slip parameter $\beta$ on the velocity profile is despite in figure 2 and 3 respectively. It shows that the increases value of Williamson parameter $\lambda$ reduces the momentum boundary layer thickness. It is due to fact, increasing Williamson parameter $\lambda$ the relaxing the time of fluid enhances producing viscosity of fluid to increase and hereafter the velocity decreases in fig. 2. In present study, changes in the temperature are not greatly affected as compare to velocity profile with (\lambda). It is observed in fig. 3, the slip rises the shrinking velocity of sheet reduced, and the fluid no longer remains same and so velocity and thickness of momentum boundary layer decreases. It seems that effect of magnetic and suction parameters on velocity profiles have same behavior as we already noticed in fig 4 and 5.

(Figs. 6-10) represents the temperature behavior of the nanofluid because of the variation in the applied physical parameters. The temperature profiles show the increase in Hartmann number, Prandtl number, and thermal slip decrease temperature and thickness of thermal boundary layer. On other hand, temperature is increased because of the increment in Brownian motion and the thermophoresis parameters.

The change in the nanofluid concentration because of the increase in the value of the emergent physical parameters is depicted in the (Figs. 11-14). The concentration profile tendency indicate that the concentration has the decreasing tendency because of the increase in solutal slip parameter increases in fig 11. Moreover, the behavior of the dual nature is observed of the concentration of the nanofluid because of the increase in the Prandtl number. It can be observed from the Fig. 13 that the concentration is decreasing when Brownian motion is increasing. More, the boundary layer thickness of the concentration is increasing because of the increase in thermophoresis in fig. 14.
(Figs. 15-17) are plotted to observe the effects of \( \beta, \lambda, M, \Pr, \delta_T, \delta_C, N_b, N_t \) on the skin friction coefficient, the Nusselt number and the Sherwood number for the Williamson fluid with existence of the nanoparticles. Fig 15 shows that skin friction reduces as Williamson parameter \( \lambda \) and the velocity slip parameter increase. On the other hand, heat transfer rate also decreases as thermal slip parameter \( \delta_T, \delta_C, N_b, N_t \) increase in Fig 16. However, individually heat transfer rate increases with increment in Prandtl number \( \Pr \). Fig. 17 demonstrates that the coefficient of the Sherwood number is increasing when thermal slip parameter \( \delta_T, \delta_C, N_b, N_t \) increase.

4. **CONCLUSION**

From the above investigation, following main remarks are concluded.

1. Skin friction reduces as Williamson parameter \( \lambda \) and the velocity slip parameter increase.
2. The behavior of the dual nature is observed of the concentration of the nanofluid because of the increase in the Prandtl number.
3. The temperature profiles show the increase in Hartmann number, Prandtl number, thermal slip and suction parameter decrease temperature and thickness of thermal boundary layer.
Fig. 6. $\theta(\eta)$ for increasing values of $M$.

Fig. 7. $\theta(\eta)$ for increasing values of $\delta_r$.

Fig. 8. $\theta(\eta)$ for increasing values of $Pr$.

Fig. 9. $\theta(\eta)$ for increasing values of $N_b$.

Fig. 10. $\theta(\eta)$ for increasing values of $N_t$.

Fig. 11. $\phi(\eta)$ for increasing values of $\delta_c$. 

Slip effects on Magnetohydrodynamic (MHD)...
Fig. 12. \( \Psi(\eta) \) for increasing values of \( Pr \).

\[
\begin{align*}
\lambda &= 0.3 \\
\delta &= 0.1 \\
M &= 0.5 \\
\beta &= 0.1 \\
Pr &= 1 \\
Sc &= 1 \\
Nt &= 0.2 \\
Nv &= 0.4 \\
S &= 3
\end{align*}
\]

Fig. 13. \( \Psi(\eta) \) for increasing values of \( Nb \).

\[
\begin{align*}
\lambda &= 0.3 \\
\delta &= 0.1 \\
M &= 0.5 \\
\beta &= 0.1 \\
Pr &= 1 \\
Sc &= 1 \\
\eta &= 0.1, 1, 3, 5
\end{align*}
\]

Fig. 14. \( \Psi(\eta) \) for increasing values of \( Nt \).

\[
\begin{align*}
\lambda &= 0.3 \\
\delta &= 0.1 \\
M &= 0.5 \\
\beta &= 0.1 \\
Pr &= 1 \\
Sc &= 1 \\
\eta &= 0.1, 1, 3, 5
\end{align*}
\]

Fig. 15. Behavior of skin friction for different values of Hartmann number \( M \), velocity slip \( \beta \) and Williamson fluid \( \lambda \) parameters.

Fig. 16. Behavior of Heat transfer for the different values of the Prandtl number \( Pr \), thermal slip \( \delta_T \) and solutalslip \( \delta_C \), and Brownian motion \( Nb \) and thermophoresis \( Nt \) parameters.

Fig. 17. Behavior of Concentration transfer for the different values of the Prandtl number \( Pr \), thermal slip \( \delta_T \) and solutalslip \( \delta_C \), and Brownian motion \( Nb \) and thermophoresis \( Nt \) parameters.
Table 1: The compression of values of heat transfer for various values of $M$, $Pr$.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>0.9548</td>
<td>0.9548</td>
<td>0.9547</td>
<td>0.95478</td>
<td>0.9548106</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>--</td>
<td>1.4715</td>
<td>1.4714</td>
<td>1.47151</td>
<td>1.4714540</td>
</tr>
<tr>
<td>3</td>
<td>1.8691</td>
<td>1.8691</td>
<td>1.8691</td>
<td>1.86909</td>
<td>1.8690687</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>2.5001</td>
<td>2.5001</td>
<td>2.5001</td>
<td>2.50012</td>
<td>2.5001279</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>3.6604</td>
<td>3.6604</td>
<td>3.6603</td>
<td>3.66039</td>
<td>3.6603693</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>--</td>
<td>--</td>
<td>0.8610</td>
<td>0.86113</td>
<td>0.8611092</td>
</tr>
<tr>
<td>2</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>1.3771168</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>1.7761661</td>
<td></td>
</tr>
</tbody>
</table>

Table 2: The values of $f''(0)$, $-\theta'(0)$ and $-\phi'(0)$ over Shrinking sheet for various values of $\lambda$, $\delta_r$, $\delta_c$, $Pr$, $M$, $N_b$, $N_t$, $Sc$ and $S$.

<table>
<thead>
<tr>
<th>$\lambda$</th>
<th>$\beta$</th>
<th>$\delta_r$</th>
<th>$\delta_c$</th>
<th>$Pr$</th>
<th>$M$</th>
<th>$N_b$</th>
<th>$N_t$</th>
<th>$Sc$</th>
<th>$S$</th>
<th>$f''(0)$</th>
<th>$-\theta'(0)$</th>
<th>$-\phi'(0)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.16152</td>
<td>1.77732</td>
<td>1.39451</td>
</tr>
<tr>
<td>0.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.64691</td>
<td>1.76875</td>
<td>1.38257</td>
</tr>
<tr>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.47195</td>
<td>1.76382</td>
<td>1.37568</td>
</tr>
<tr>
<td>1</td>
<td>0.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.21279</td>
<td>1.75359</td>
<td>1.36114</td>
</tr>
<tr>
<td>0.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.05009</td>
<td>1.80634</td>
<td>1.41644</td>
</tr>
<tr>
<td>0.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.92404</td>
<td>1.83661</td>
<td>1.44767</td>
</tr>
<tr>
<td>0.4</td>
<td>0.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.82636</td>
<td>1.85607</td>
<td>1.46754</td>
</tr>
<tr>
<td>0.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.82637</td>
<td>1.57548</td>
<td>1.58063</td>
</tr>
<tr>
<td>0.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.82637</td>
<td>1.36655</td>
<td>1.64681</td>
</tr>
<tr>
<td>0.4</td>
<td>0.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.82636</td>
<td>1.20550</td>
<td>1.72969</td>
</tr>
<tr>
<td>0.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.82637</td>
<td>1.22044</td>
<td>1.41134</td>
</tr>
<tr>
<td>0.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.82637</td>
<td>1.23068</td>
<td>1.19197</td>
</tr>
<tr>
<td>0.4</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.82636</td>
<td>1.23813</td>
<td>1.03163</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.82637</td>
<td>1.63869</td>
<td>0.93896</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.82637</td>
<td>2.05313</td>
<td>0.84513</td>
</tr>
<tr>
<td>6.2</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.82637</td>
<td>2.12468</td>
<td>0.82912</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.84223</td>
<td>2.12486</td>
<td>0.83291</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.86608</td>
<td>2.12516</td>
<td>0.83844</td>
</tr>
<tr>
<td>3</td>
<td>0.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.88376</td>
<td>2.12537</td>
<td>0.84241</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.88376</td>
<td>2.01310</td>
<td>1.15058</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.88376</td>
<td>-0.03928</td>
<td>1.33767</td>
</tr>
<tr>
<td>7</td>
<td>0.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.88376</td>
<td>-0.05269</td>
<td>1.33949</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.88376</td>
<td>-0.05481</td>
<td>1.34138</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.88376</td>
<td>-0.05605</td>
<td>1.34470</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.88376</td>
<td>-0.05681</td>
<td>1.34849</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.88376</td>
<td>-0.04515</td>
<td>1.59337</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.88376</td>
<td>-0.03949</td>
<td>1.75310</td>
</tr>
<tr>
<td>2.5</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.88376</td>
<td>-0.03535</td>
<td>1.86516</td>
</tr>
<tr>
<td>2.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.85873</td>
<td>-0.04135</td>
<td>1.76936</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.82982</td>
<td>-0.04645</td>
<td>1.63668</td>
</tr>
<tr>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.79645</td>
<td>-0.05468</td>
<td>1.43798</td>
</tr>
</tbody>
</table>
REFERENCES: