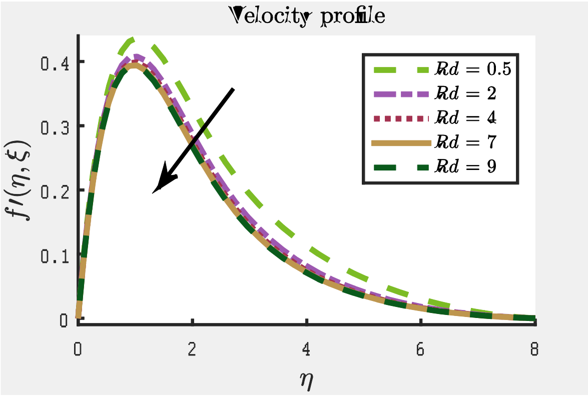
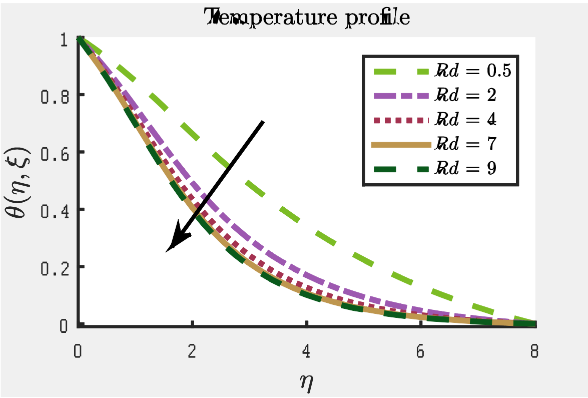
< $\eta \leq 8$. In Figures 5b and 5c, it is seen that an increase in ξ increases both the temperature and concentration profile.

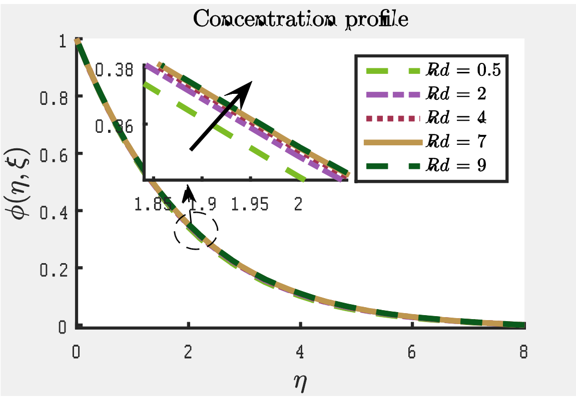
Figures 6a to 6c display the effect of increasing radiation on the flow profiles.



(a) Effect of $f'(\eta, \xi)$



(b) Effect of $\theta(\eta, \xi)$



(c) Effect of $\phi(\eta, \xi)$

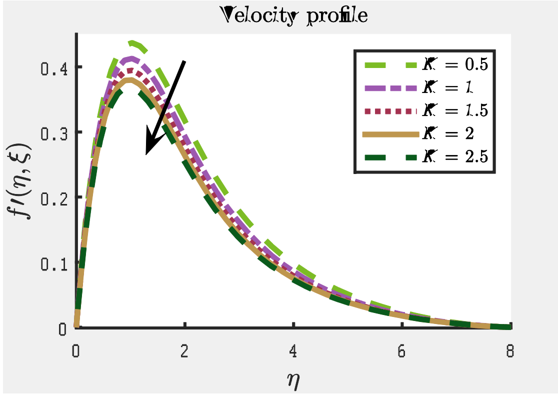
Figure 6. Effect of radiation *Rd*

As shown in Figures 6a and 6b, an increase in radiation decreases the velocity and the temperature profiles, however, Figure 6c shows an increase in concentration when *Rd* is increased. When radiation is present, the thermal boundary layer was always found to thicken, which may be explained by the fact that radiation provides an additional means to diffuse energy.

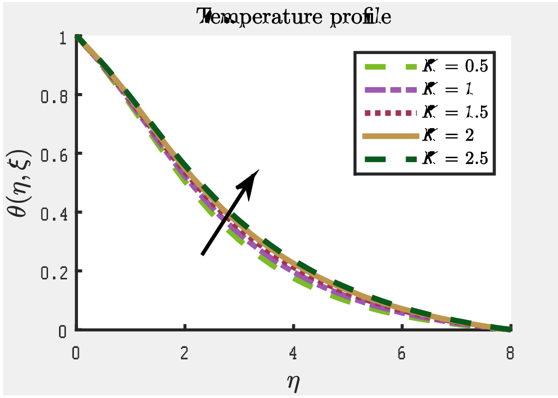
In Figures 7a to 7c, the effect of increasing chemical reaction on the flow profiles are displayed.

Figure 7: Effect of chemical reaction *K* From Figures 7a and 7c, it is observed that as chemical reaction increases, velocity and concentration decreases while temperature increases as displayed in Figure 7b.

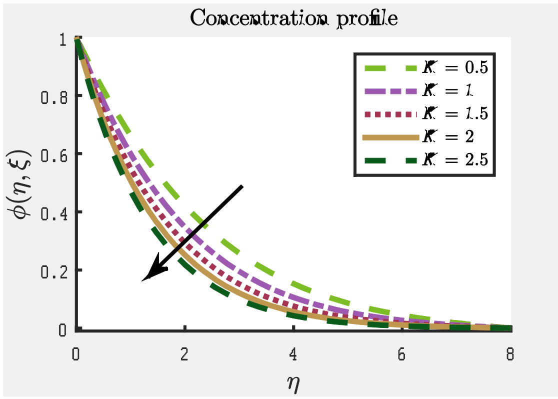
Figures 8a to 8c display the effect of heat source on the profiles.



(a) Effect of $f'(\eta, \xi)$



(b) Effect of $\theta(\eta, \xi)$

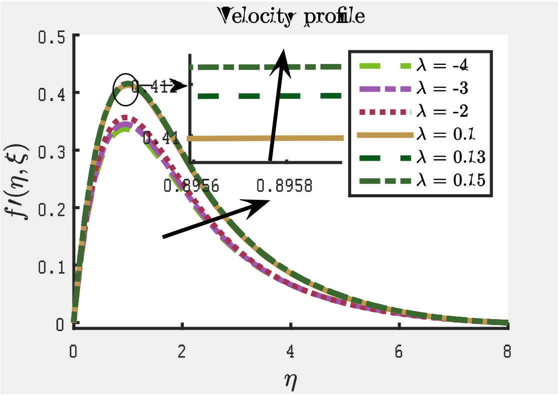


(c) Effect of $\phi(\eta, \xi)$

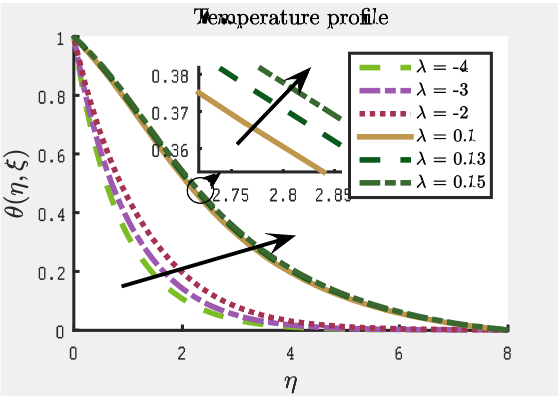
Figure 7. Effect of chemical reaction K

From Figures 8a and 8b, it is observed that as the amount of heat let into the medium increases, the fluid heats up thereby increasing the temperature of the medium and increasing the movement of the fluid. Expectedly, this reaction causes some of the fluid to vaporize thereby decreasing the concentration of the fluid in the medium as shown in Figure 8c. Physically, the higher values of v in the equations $Gr = \frac{g^*\beta_T(T_w - T_\infty)a^3}{\upsilon^2}$, and $K = \frac{\boldsymbol{k_1 a^2}}{\upsilon \mathbf{G_r^{1/2}}}$ make fall in the chemical molecular diffusivity. An increase in the chemical reaction parameter will suppress species concentration. On the other hand, the energy is absorbed by decreasing the values of heat sink parameter resulting in the temperature to drop near the boundary layer.

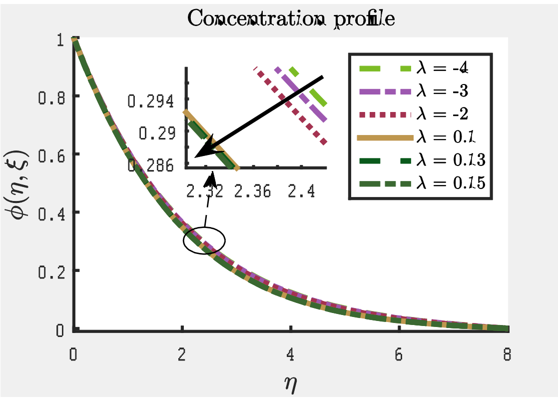
Figures 9a to 9c display the effect of the permeability parameter δ on the various fluid flow profiles.



(a) Effect of $f'(\eta,\xi)$

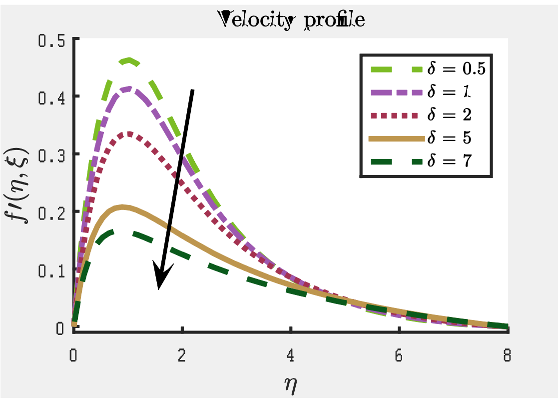


(b) Effect of $f'(\eta,\xi)$

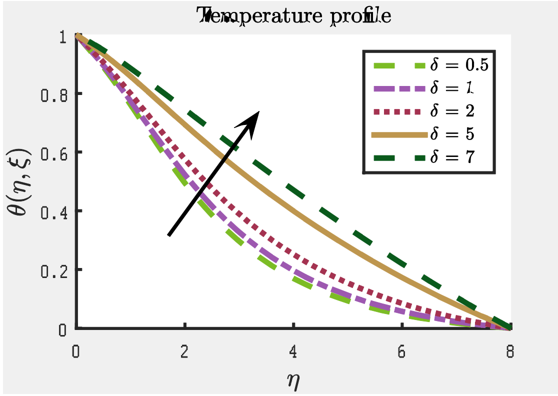


(c) Effect of $f'(\eta,\xi)$

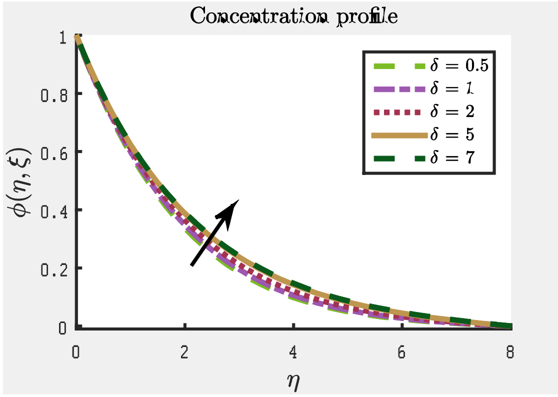
Figure 8. Effect of heat source λ



(a) Effect of $f'(\eta,\xi)$



(b) Effect of $f'(\eta,\xi)$



(c) Effect of $f'(\eta,\xi)$

Figure 9. Effect of permeability δ

As shown in Figure 9a, an increase in the permeability of the wall of the porous medium significantly decreases the velocity of the fluid. However, as displayed in Figures 9b and 9c, an increase in δ increases the temperature and concentration of the fluid in the porous medium.

5. CONCLUSION

This paper presents the simultaneous effect of the MHD free convection flow on a sphere through porous medium considering ohmic dissipation, chemical reaction, heat generation, and absorption. The effect of tangential coordinate, radiation, chemical reaction, heat source/sink and permeability on the velocity, temperature and concentration flow profiles have been investigated. The results were obtained using the multi-domain spectral quasilinearization method. The key findings of the study include;

- Increasing the amount of heat coming into the porous medium increased the movement and temperature of fluid particles while decreasing concentration due to increased evaporation. The reverse is the case when heat is expelled from the medium.
- An increase in the chemical reaction and permeability of the medium leads to a decrease in the velocity of the fluid while increasing temperature of the medium.
- An increase in radiation and permeability increases concentration of the incompressible fluid Contributions of chemical reaction, thermal radiation heat source/sink and permeability parameter on the

motion of the fluid are significant and they cannot be ignored.

Contribution of chemical reaction, thermal reaction heat sources/sink and permeability parameter on the motion of the fluid flow are significant and they cannot be ignored.

In this study, we assumed the magnetic field strength to be low so that the Hall and ion-slip effects are neglected. The relationship between the fluxes and the driving potentials are also not considered. The future work will include these and other similar parameter influence on the flow.

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NOMENCLATURE

u, v	Velocity components
T	Temerature
C	Concentration
CP	specific heat, J. kg^{-1}. K^{-1}
g^*	gravitational acceleration, $m.s^{-2}$
A	Radius of a sphere
x, y	coorinates axes
r	radial distance
U,V	diamensionless coordinates
Pr	Prandtl number
M	Magnatic parameter

Greek symbols

α	thermal diffusivity, m^2. s^{-1}

β_T	thermal expansion coefficient, K^{-1}
β	Casson parameter
ϕ	solid volume fraction
Θ	dimensionless temperature
μ	dynamic viscosity, kg. $m^{-1}.s^{-1}$
ρ	fluid density
β_C	coefficient of expansion with concentration
σ_0	Stephan-Boltzmann constant

Subscripts

K*	mean absorption parameter
Gr_x	local Grashof number
T_∞	Ambient temperature
Q_0	Heat generation/absorption parameter
B_0	strength of the magnetic field
T_w	surface temperature