UNIVERSITY OF SWAZILAND
FINAL EXAMINATION PAPER

PROGRAMME: ALL YEAR 1 PROGRAMMES (AGRICULTURE & CONSUMER SCIENCES)

COURSE CODE: ABE102

TITLE OF PAPER: PHYSICS

TIME ALLOWED: TWO (2) HOURS

SPECIAL MATERIAL REQUIRED: NONE

INSTRUCTIONS: ANSWER QUESTION ONE AND ANY TWO OTHER QUESTIONS.

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SECTION 1: COMPULSORY

Question 1

a. In fluid mechanics, the Reynolds number is dimensionless, involving fluid velocity, density, viscosity, and characteristic length.

    i. Given that the dimensions of viscosity are $ML^{-1}T^{-1}$, determine the dimensions of velocity and density. **[5 marks]**

    ii. Determine this dimensionless product of the variables (Reynolds number) **[10 marks]**

b. An electric kettle is rated 1250 W, 255 v. what is the resistance of the heating element when in use? If electricity is charged at E1.20 per kWh and the kettle is used for 30 minutes each day, what are the electricity costs per week? **[15 marks]**

c. Show how you would measure the density of a solid in a laboratory using the displacement method. **[10 marks]**

SECTION 2: ANSWER ANY TWO (2) QUESTIONS

Question 2

a. A wooden cube with a specific gravity of 0.9 and side length of 0.12 m is placed into a bucket of water and floats upright with its sides in a horizontal or vertical orientation.

    i. What is the mass of the cube? **[5 marks]**

    ii. What is the buoyancy force acting on the cube? **[5 marks]**

    iii. How much cube projects above the surface? **[5 marks]**

b. A canoe goes across a 698 m wide river at 3 m/s. Given that the water in the river flows at 2 m/s, what is the resultant velocity of the boat? **[5 marks]**

c. Justify that power, P from an engine that drives a tractor pulling a load at force, F and moving at velocity, v is given by the equation $P = Fv$. **[10 marks]**

Question 3

a. A bulldozer exerts a drawbar pull (force) of 20 kN when pulling a 5 m wide scrapper over a level road. If the forward speed is 8 km/h, calculate,

    i. the drawbar power developed and **[7.5 marks]**

ii.   the energy consumption in order to cover 2000 m   **[7.5 marks]**

b.   Calculate the pressure on a fluid in a cylindrical syringe when a nurse applies a force of 40 N to the syringe's piston of a 1 cm radius.   **[10 marks]**

c.   What are the practical uses of dimensional analysis?   **[5 marks]**

Question 4

a.   State the Ohm's and Kirchoff's laws in relation to the science of electricity.

           [5 marks]

b.   Show that the specific weight of a fluid is equal to the product of its density and acceleration due to gravity.   **[5 marks]**

c.   Two resistors having resistance of 1.7 and 4.7 Ω are connected in series with a battery of an electromotive force (e.m.f) of 12 V and negligible internal resistance. Determine,

   i.   the potential difference across each of the resistors   **[5 marks]**

   ii.   What is meant by the expression *e.m.f* of 12 V?   **[5 marks]**

d. Water for a shower is heated as it flows past an electric element. What is the flow rate of the water when the heater supplies 7 kW and warms the water from 15 °C to 45 °C? (Assume 1 litre of water has a mass of 1 kg and that the specific heat capacity is 4200 $Jkg^{-1}K^{-1}$).   **[10 marks]**