UNIVERSITY OF SWAZILAND

MAIN EXAMINATION PAPER

PROGRAMMES:

BSc. ABE 1, BSc. Agric. Econ and AgBMgt 1, BSc. Ag.Ed 1, BSc. Agron 1, BSc. An. Sc 1, BSc. An. Sc 1 (Dairy Option), BSc. COS 1, BSc. COSE 1, BSc. FSNT 1, BSc. Hort 1, BSc. TADM 1

COURSE CODE: ABE 101

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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QUESTION 1

a. Lucile has R1.05 credit on her pre-paid electricity meter. Electricity cost 65.0c/kW-hr. She gets home, cooks supper before dark using a 2000.0W stove for 50.0 minutes, then studies, using a 100.0 W light bulb. How long will she be able to study? Show calculations to support your answer.
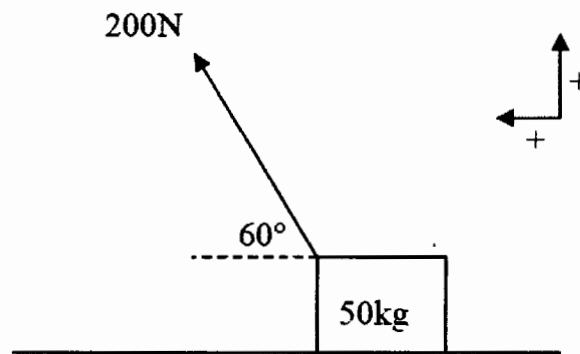
[15 marks]

b. A box is being dragged along a rough concrete floor, as shown in the diagram. The mass of the box is 50.0 kg and the force exerted by the rope is 200.0 N, while the force of friction is 25.0 N. Take "up" and "left" to be positive as shown in the diagram alongside. Determine:

i.   the normal force acting on the box, and   **[5 marks]**

ii.   the acceleration of the box   **[5 marks]**

c. In fluid mechanics, the Reynolds number is a dimensionless number involving fluid velocity v, density ρ, viscosity μ, and a characteristic length r. Find this dimensionless product of the variables; given the table of dimensions below (Fill in the missing values first).
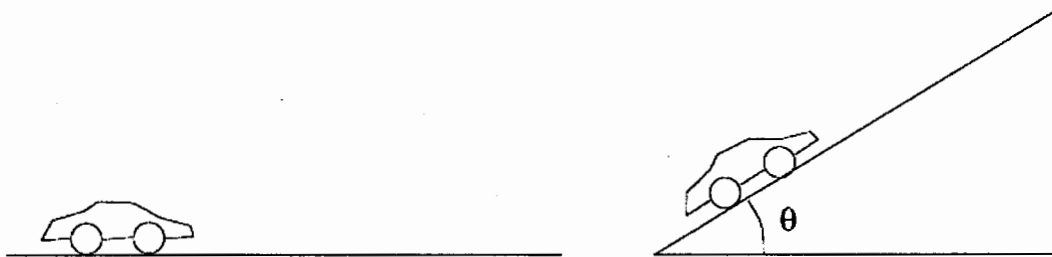
Variable	v	ρ	μ	r
Dimension			$ML^{-1}T^{-1}$	

[15 marks]

QUESTION 2

a. Oil of specific gravity 0.75 is flowing through a 150.0 *mm* (diameter) pipe under a pressure of 103.0 *kPa*. If the total energy relative to a datum plane, z, is 2.4 *m* below the centre of the pipe is 17.9 *m*, determine the flow rate (volumetric) of the oil.   **[10 marks]**

b. A small car's engine can deliver 90 *kW* of power. The car's mass is 1000 *kg*.

(i) Assume the total resistive force is proportional to the velocity: $F_{friction} = av$. The drag coefficient a is a = 100 *Ns/m*. How fast can the car move on a level road? Express the speed in the units of *m/s*.   **[10 marks]**

(ii) How fast can the car travel up a slope if we ignore all friction? The angle of the slope is θ (sin (θ) = 3/5 and cos (θ) = 4/5). Express the speed in the units of *m/s*.   **[10 marks]**

QUESTION 3

a. A block of wood floats in water with 50.0 *mm* projecting above the water surface. When placed in glycerin of specific gravity 1.35, the block projects 76.0 *mm* above the surface of that liquid. Determine the specific gravity of the wood.   **[15 marks]**

b. A transformer with N_p =100 turns, N_s = 1000 turns receives 240 *V* A.C. What is the voltage discharged and what type of transformer is this? If the numbers of windings are reversed, what will be the voltage discharged and what type of a transformer will it be?
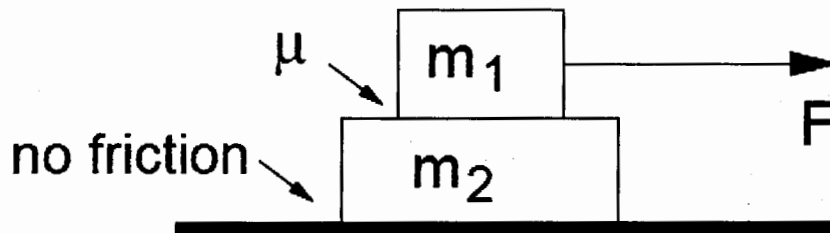
[10 marks]

c. State three (3) uses of dimensional analysis in physics.   **[5 marks]**

QUESTION 4

a. Two blocks of mass m_1 and m_2 are put on a frictionless level surface as shown in the figure below. The static coefficient of friction between the two blocks is μ. A force F acts on the top block m_1.

i. When the force F is small, the two blocks move together. Draw the free-body diagrams of the block m_1 and the block m_2.   **[5 marks]**

ii. Find the acceleration of the two blocks for small F.   **[10 marks]**

iii. Find the magnitude of the force F above which the block m_1 starts to slide relative to the block m_2.   **[10 marks]**

b. Explain the characteristics of 'Resistance' and how it differs between a Series circuit and a Parallel circuit.   **[5 marks]**