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

DO NOT OPEN THIS PAPER UNTIL PERMISION HAS BEEN GRANTED BY THE CHIEF INVIGILATOR

QUESTION 1

a. A certain airplane has a cruising speed of 200 km/hr relative to the ground when there is no wind. The pilot points the airplane at 40° N of W and flies for three hours.

i. How far north and how far west of his original location is he after the three hours?

[6 marks]

ii. If a 50 km/hr wind blows at 30° N of E during the trip, what would be the plane's resultant velocity? **[6 marks]**

iii. Answer part (i) using the resultant velocity at (ii). **[8 marks]**

Note: Use diagrams to support your work, but solve the problem using vector components.

b. The volume flow-rate for a fluid moving along a pipe can be measured with a venturi constriction. A student in an ABE 101 exam has derived the following expression for the flow-rate, Q, is given by the equation

$$Q = \frac{A_2}{\rho}\sqrt{\frac{2\Delta p}{(1-(A_2/A_1)^2)}}$$

Where;

A_1 and A_2 are the pipe areas at the wide part of the pipe and the constriction Respectively,

ρ = Mass density and,

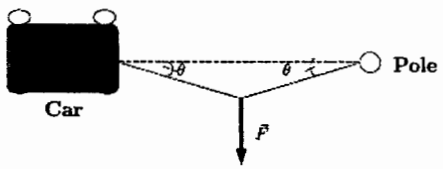
p = is the pressure drop between the wide part of the tube and the constriction.

Is this equation dimensionally consistent? Show all your arguments to support your answer. **[10 marks]**

c. State the principle of conservation of energy and explain how this principle is applied when a ball is thrown vertically upwards. **[10 marks]**

QUESTION 2

a. Your car is stuck in a mud hole. You are alone but have a long, strong rope. Having studied physics you tie the rope tautly to a telephone pole and pull on it sideways as in the figure below.



(i) Find the forces exerted by the rope on the car when and you are pulling with a force of 400 N and the car does not budge. **[5 marks]**

(ii) How strong must the rope be if it takes a force F of 600 N to move the car when . **[10 marks]**

b. State the Bernoulli's equation and the Pascal's principle as used in fluid mechanics. **[5 marks]**

c. Explain why an inflated life jacket makes someone to float in water even if that person does not know how to swim. **[5 marks]**

d. State two (2) uses of dimensional analysis in physics. **[5 marks]**

QUESTION 3

a. A wooden cube with a specific gravity of 0.90 and side length 0.120 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 of the cube projects above the surface? **[5 marks]**

b. The velocity-time graph represents the movement of a car that was initially travelling towards the East.

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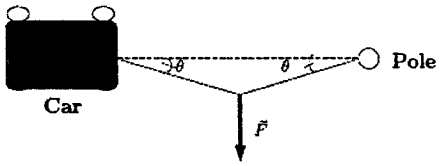

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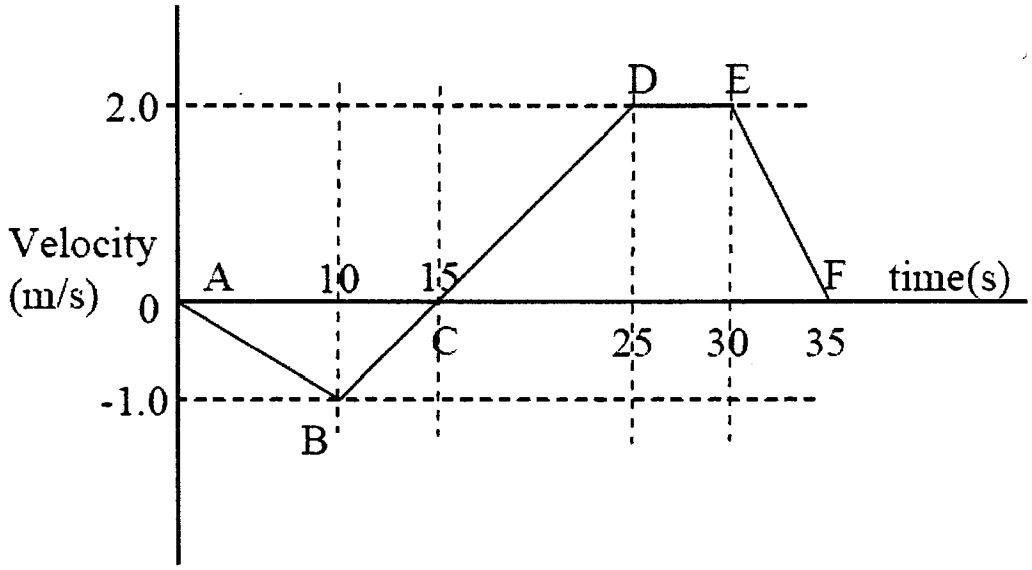

(i) At which stage(s) did the car have a constant velocity? **[2 Marks]**

(ii) Use the graph to calculate the acceleration from *E* to *F*. **[3 Marks]**

(iii) Use the graph to determine the displacement of the car between A and C. **[3 Marks]**

(iv) Describe the motion of the car from B to C. **[2 Marks]**

QUESTION 4

a. After a refueling stop a race car accelerates at $6m/s^2$, and after 4 seconds re-enters the raceway. At that instant, another race car traveling at a constant speed of 70 m/s overtakes and passes the re-fueled car. If the re-fueled car maintains its acceleration, how much time is required for it to catch the other car? **[10 marks]**

b. Outline the characteristics of 'Electric Resistance' and discuss how it differs between a Series circuit and a Parallel circuit. **[10 marks]**

c. An electric kettle is rated '2 *kW*, 240 *V*' and when filled with cold water takes 5 minutes to boil. Calculate;

(i) The resistance of the element when the kettle is in use. **[4 marks]**

(ii) The average weekly (7 days) cost of using the kettle, assuming that it is filled six times each day with cold water which is then boiled, and 1 *kWh* costs 51 cents. **[6 marks]**