UACE

P510/1

14th JUNE 2021

2 hour

LEADERSHIP ACADEMY OF SOUTH SUDAN

BEGINNING OF TERM THREE EXAMINATIONS

S 5 PHYSICS PAPER ONE

TIME: 2 HOURS

INSTRUCTIONS TO CANDIDATES:

- *Answer four questions choosing two from each of the sections A and B. Any additional question(s) answered will not be marked.*
- *Non-programmable scientific calculators may be used.*
- *Assume where necessary;*
  - *Acceleration due to gravity g ;* $= 9.81ms^{-2}$
  - *Electron charge, e* $= 1.6 \times 10^{-19}\ C$
  - *Electron mass* $= 9.11 \times 10^{-31}\ kg$
  - *Mass of the earth* $= 5.97 \times 10^{24}\ kg$
  - *Plank's constant, h* $= 6.6 \times 10^{-34} Js^{-1}$
  - *Stephan's-Boltzmann's Constant σ* $= 5.67 \times 10^{-8} Wm^{-2}K^{-4}$
  - *Radius of the earth* $= 6.4 \times 10^{6} m$
  - *Radius of the sun* $= 7.0 \times 10^{8} m$
  - *Radius of the earth's orbit about the sun* $= 1.5 \times 10^{11} m$
  - *Speed of light in a vacuum, C* $= 3.0 \times 10^{8} ms^{-1}$
  - *Thermal conductivity of the copper* $= 390 Wm^{-1}K^{-1}$
  - *Thermal conductivity of the iron* $= 75 Wm^{-1}K^{-1}$
  - *Specific heat capacity of water* $= 4200 Jkg^{-1}K^{-1}$
  - *Universal gravitational constant, G* $= 6.67 \times 10^{-11}\ Nm^2Kg^{-2}$
  - *Avogadro's number, N_A* $= 6.02 \times 10^{23} mol^{-1}$
  - *Density of water* $= 1.0 \times 10^{3} Kgm^{-3}$
  - *Gas constant, R* $= 8.31 Jmol^{-1}K^{-1}$
  - *Charge to mass ratio, e/m* $= 1.8 \times 10^{11}\ Ckg^{-1}$
  - *The constant* $\frac{1}{4\pi\varepsilon_0}$ $= 9.0 \times 10^{9} F^{-1}m$
  - *Specific heat capacity of copper* $= 400 Jkg^{-1}K^{-1}$
  - *Specific latent heat of fusion of ice* $= 3.3 \times 10^{5} Jkg^{-1}$

SECTION A

Question one

a) (i) Define linear momentum of a body. (01 mark)

(ii) Use Newton`s laws of motion to show that when two bodies collide, their total momentum is conserved. (04 marks)

b) Explain why a long jumper should normally land on sand. (03 marks)

c) Differentiate between conservative force and non-conservative force and give one example of each. (04 marks)

d) Define power. (01 mark)

e) A pump discharges water through a nozzle of diameter $4.5cm$ with a speed of $62ms^{-1}$ into a tank 16m above intake.

(i) Calculate the work done per second by the pump in raising the water if the pump is ideal. (04 marks)

(ii) Find the power wasted if the efficiency of the pump is 75%. (03 marks)

Question two

a) (i) Define centripetal acceleration. (01 mark)

(ii) Explain a cyclist bend inward while going around a curved path. (03 marks)

b) Show that Newton`s law of gravitation is consistent with Kepler`s third law of planetary motion. (04 marks)

c) Describe a laboratory experiment of determining the universal gravitation constant G. (06 marks)

d) A satellite of mass 100kg is launched in a circular orbit at a height of $3.59 \times 10^7 m$ above earth`s surface.

(i) Find the mechanical energy of the satellite. (04 marks)

(ii) Explain what would happen if the mechanical energy of the satellite was decreased. (03 marks)

Question three

a) What is meant by a physical quantity? (01 mark)

b) Use dimensional analysis to check the validity of the expression of energy U stored in the wire given $\text{U} = -\frac{\text{EA}e^2}{2l}$ where E is Young`s modulus, A is cross section area, e is the extension and l is the length of the wire. (04 marks)

c) State the principle of moments. (01 mark)

d) Explain why a long spanner is preferred to a short one in undoing a tight bolt.

e) (3Mrks)

f) A uniform ladder of length $10m$ and weight $400N$, leans against a smooth wall and its foot rests on a rough ground. The ladder makes an angle of 60^0 with the

horizontal. If the ladder just slips when a person of weight $800N$ climbs $6m$ up the ladder, calculate the;

(i) Reactions of the wall and the ground. (04 marks)

(ii) Distance another person of weight $600N$ can climb so that the same reactions are exerted in e (i) above. (03 marks)

g) Describe an experiment to measure the coefficient of kinetic friction. (04 marks)

SECTION B (HEAT)

Question four

a) (i) Define a thermometric property and give two examples. (02 marks)

(ii) Describe with the aid of a diagram, how a constant volume gas thermometer may be used to measure temperature. (06 marks)

b) (i) Define the triple point of water. (01 mark)

(ii) Describe how you would measure the temperature of a body on thermodynamic scale using thermocouple. (03 marks)

c) Explain the extent to which thermometer based on different properties but calibrate using the same fixed points are likely to agree when used to measure a temperature;

(i) Near one of the fixed points. (02 marks)

(ii) Midway between the two fixed points. (02 marks)

d) The thermometer is constructed with a liquid which expands according to this equation. $V_\theta = V_o(1 + \alpha\theta + b\theta^2)$ if V_0 = volume at 0^0C and $\frac{a}{b}$ = 100. Θ is the temperature of Hg in glass thermometers. What would be the reading on this thermometer when the mercury is glass reads 80^0C. (04 marks)

Question five

a) (i) State Newton's law of cooling. (01 marks)

(ii) Use Newton's law of cooling to show that $\frac{d\theta}{dt} = -(\theta - \theta_R)\frac{d\theta}{dt}$, Where is the rate of fall of temperature and θ_R is the temperature of the surrounding. (03 marks)

b) Describe an experiment to verify Newton's law of cooling. (07 marks)

c) Describe with the aid a diagram an experiment to determine specific latent heat of vaporization of steam using the method of mixtures. (07 marks)

d) A 600W electric heater is used to raise the temperature of a certain mass of water in a thermos flask from room temperature to 80. The same temperature rise is obtained when steams from a boiler is passed into an equal mass of water at room temperature in the same time. If 16g of water 34 were being evaporated every minute in the boiler, find the specific latent heat of vaporization of steam, assumption no heat loses. (04 marks)

Question six

a) (i) State two differences between saturated and unsaturated vapors. (02 marks)
(ii) Sketch graphs of pressure against temperature for an ideal gas and for saturated water vapor originally at. (03 marks)

b) The specific heat capacity of oxygen at constant volume is 719 and its density at standard temperature and pressure is 1.49 . Calculate the specific heat capacity of oxygen at a constant pressure. (05 marks)

c) (i) With the aid of a labeled diagram, describe an experiment to determine saturated vapor pressure of water. (06 marks)
(ii) State how the experimental setup in (c) (i) may be modified to determine a saturated vapor pressure above atmospheric pressure. (01 mark)

d) (i) Define an ideal gas. (01 mark)
(ii) State and explain the conditions under which real gases behave as ideal gas. (04 marks)