BEGINNING OF TERM II EXAMINATIONS 2018

PHYSICS P510/1

INSTRUCTIONS:

- Attempt not more than one question from each section.
- Each section question begins on a new page
- All questions carry equal marks.

Time allowed: 1 hour 30 minutes

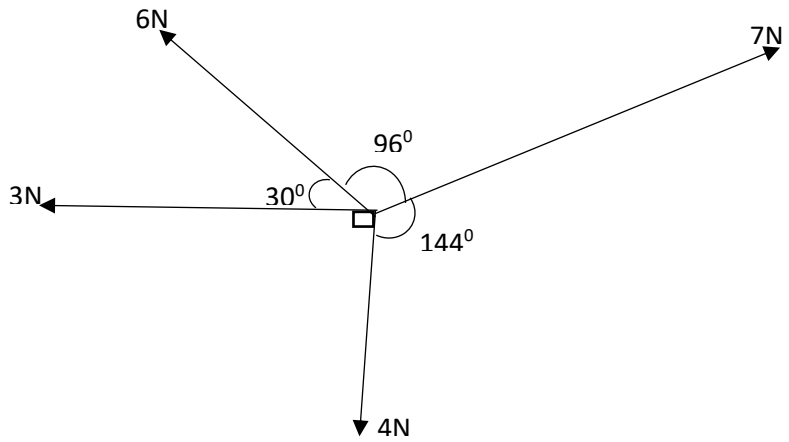
Where necessary assume the following;

- *Electronic charge, (e)* $= 1.6 \times 10^{-19} C$
- *Acceleration due to gravity, (g)* $= 9.81\ ms^{-2}$
- *Electron mass, (m_e)* $= 9.11 \times 10^{-31} kg$
- *Mass of the earth, (M_E)* $= 6.0 \times 10^{24} kg$
- *Plank's constant, (h)* $= 6.63 \times 10^{-34}\ Js$
- *Stefan's constant, (σ)* $= 5.7 \times 10^{-8}\ Wm^{-2} K^{-4}$
- *Radius of earth (R_e)* $= 6.4 \times 10^{6} m$
- *Radius of the sun (R_s)* $= 7.0 \times 10^{8}\ m$
- *Speed of light in a vacuum (c)* $= 3.0 \times 10^{8} m/s$
- *Specific latent of fusion of ice (L_f)* $= 3.36 \times 10^{5} Jkg^{-1}$
- *Specific heat capacity of water (C)* $= 4200 Jkg^{-1} K^{-1}$
- *Universal Gravitation constant, (G)* $= 6.67 \times 10 - ^{11}\ Nm^2\ kg^{-2}$
- *Avogadro's number (N_A)* $= 6.02 \times 10^{23}\ mol^{-1}$
- *Density of water (ρ)* $= 10^{3} kgm^{-3}$
- *Surface tension of water ( )* $= 7.2 \times 10^{-2}\ Nm^{-1}$
- *Charge to mass ratio (e/m)* $= 1.8 \times 10^{11}\ Ckg^{-1}$
- *Density of copper* $= 8.93 \times 10^{3}\ kgm^{-3}$
- *Specific heat capacity of copper* $= 3.70 \times 10^{2}\ Jkg^{-1} K^{-1}$

SECTION A

1. a) Distinguish between fundamental and derived physical quantities giving two examples of each. (4 marks)
   b) What is meant by the terms dimensions of a physical quantity and dimension index. (2 marks)
   c) Derive the dimensions of the following:
      i) Pressure (3 marks)
      ii) Specific heat capacity (3 marks)
      iii) Moment of a force (3 marks)
      iv) tensile stress (2 marks)
   d) The mass of the largest stone that can be moved by a flowing river is given by $m = \frac{KPV^6}{g^5}$ where V is the velocity of water, P is it's density, g is the acceleration due to gravity and K is a dimensionless constant. Prove that the equation is dimensionally consistent.

2. a) Define scalar and vector quantities. (2 marks)
   b) Identify the following quantities as vectors or scalars. Momentum, Pressure, temperature, Work, acceleration, electric intensity, electric potential charge. (4 marks)
   c) i) What is meant by resultant vector? (1 mark)
      ii) The figure below shows four forces acting on a particle B of mass 5 kg initially at rest. Find the velocity at a point of 20 m from its initial position. (7 marks)



d) i) Define the terms uniform velocity and acceleration. (2 marks)

ii) Give two examples of uniformly accelerated motion. (2 marks)

iii) How does the term instantaneous velocity differs from the term average velocity. (2 marks)

SECTION B

4.a) i) State the desirable properties a material must have to be used as a thermometric substance. (02 marks)

ii) Thermometers based on different thermometric properties have cases when they agree and when they may not. Explain why and when this can happen. (03 marks)

b) i) Describe how a simple constant volume gas thermometer can be used to establish a Celsius scale of temperature. (04 marks)

ii) State any reasons why one may use or not use a constant volume gas thermometer (03 marks)

iii) When the gas bulb of a constant volume gas thermometer was immersed in crushed ice, the difference in mercury level indicated 5 cm. The same bulb was placed above steam from boiling water and the difference in mercury levels was 15 cm. If the unknown temperature calculated was 80 ^{0}C, what was the difference in the mercury levels at this unknown temperature. (04 marks)

c) i) Which thermometric property do pyrometers use? (01 mark)

ii) Name the two types of pyrometers that measures temperature (02 marks)
iii) When would one opt for pyronometers during measurement of temperature. (01 mark)

SECTION C

5.a) Define the following terms as applied to radioactivity

i) Nuclear number (1 mark)

ii) Decay constant (1 mark)

iii) Half life (1 mark)

b) Show that the relationship between half life, $t_{\frac{1}{2}}$ and the decay constant, λ is

$t_{\frac{1}{2}} = \frac{0.693}{\lambda}$ (3 marks)

c) A radioactive material initially has an activity of 3.5 x 10^3 per second. If the nuclide has a half life of 30 days. Calculate,

(i) the initial number of atoms present. (2 marks)

(ii) the activity after 20 days (4 marks)

d) Describe the structure and mode of action of a cloud chamber. (5 marks)

e) Explain how carbon dating can be used in determining the age of a plant remain. (3 marks)

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