PRESIDENT'S OFFICE

REGIONAL ADMINISTRATION AND LOCAL GOVERNMENT

GEITA ADVENTIST SECONDARY SCHOOL

FORM FIVE HOLLIDAY PACKAGE 4TH MAY 2020

PHYSICS

INSTRUCTIONS:

- Attempt all questions
- All work done must be shown clearly

Errors and dimension

1. (a) Mention two applications and two limitations of dimensional analysis.
   (b) The frequency f of a note produced by a fact wire stretched between two support depends on the distance between the supports, the mass per unit length of the wire, and the tension T. Use dimension analysis to find how f is related to , and T.
2. (a) The period T of oscillation of a body is said to be 1.5I 0.002S while its amplitude A is 0.3I 0.005m and the radius of gyration K is 0.28I 0.005m. If the acceleration due to gravity 9 was found to be related to T A and K by the equation.
   =, find the:-
   (i) Numerical value of g in four decimal places
   (ii) Percentage error in g

Projectile motion

3. (a) (i) Define the term trajectory
   ( ) Briefly explain why horizontal component of the initial velocity of a projectile always remained constant.

   (b) (i) List down two limitations of projective motion
   (ii) A body projected from the ground at the angle of 60° is required to pass just above the two vertical walls each of height 7m. If the velocity of projection is 100m/s, calculate the distance between the two walls.
4. (a) (i) Mention two characteristics of projectile motion

(ii) If the range of the projectile is 120m and its time of flight is 4 seconds, determine the angle of projection and its initial velocity of projection assuming that the acceleration due to g rarity, $g = 10m/s^2$

(b) (i) Mention two examples of projectile motion
(ii) Find the velocity and angle of projection of a particle which passes in a horizontal direction just over the top of a wall which is 12m high and 32m away.

Newton's laws of motion

5. (a) (i) State the principles on which the rocket propulsion is based
(ii) A jet engine on a test bed takes in 40kg of air per second at a velocity of 100m/s and burns 0.80kg of fuel per second. After compression and heating the exhaust gases are ejected at 600m/s relative to the air craft. Calculate the thrust of the engine.

(b) (i) Define the term coefficient of restitution
(ii) Explain why the astronaut appears to be weightless when travelling in the space vehicle.
(iii) A jet of water emerges from a horse pipe of cross section area $5.0x10^{-3}m^2$ with a velocity of 3.om/s and strikes a wall at right angle. Assuming the water to be brought to rest by the wall and does not rebound, calculate the force on the wall.

6. (a) Define the following terms
( ) Momentum
(i) Impulse of a force

(b) (i) State the principle of conservation of linear momentum.

(ii) Give two examples of the principles stated above.

(c) A cannon of mass 1300kg fires a 72kg ball in a horizontal direction with a muzzle speed of 55m/s. If the cannon is mounted so that it can recoil / freely calculate the:-

(i) Recoil velocity of the cannon relative to the earth
(ii) Horizontal velocity of the ball relative to the earth.

Circular motion

7. (a) Define the following terms:-
( ) Radial acceleration
(i) Centripetal acceleration
(ii) Banked road

(b) A insect is released from rest at the top of the smooth bowling ball such that it slides over the ball. Prove that it will loose its fooling with the ball at an angle of about 48° with the vertical.

8. (a) What is the origin of centripetal force for:-
   ( ) A satellite orbiting around the earth
   (i) An election in the hydrogen atom

   (b) A small mass of 0.15kg is suspended from a fixed point by a thread of a fixed length. The mass is given a push so that it moves along a circular path of radius 1.82m in a horizontal place at a steady speed, taking 18.0 seconds to make 10 complete revolutions. Calculate:-

   (i) The speed of the small mass
   (ii) The centripetal acceleration
   (iii) The tension in the thread

Gravitational motion

9. (a) (i) What do you understand by the term escape velocity?
   (ii) Calculate the escape velocity from the moon's surface given that a man on the moon has $^1/_6$ his weight on earth. The mean radius the moon is 1.75×10^6m.

   (b) (i) Define the universal gravitational constant
   (ii) How is gravitational potential related to gravitational field strength?

10. (a) (i) Write down an expression for the acceleration due to gravity (g) of a body of mass (m) which is at a distance (r) from the centre of the earth.
    ( ) If the earth were made of lead of relative density of 11.3, what would be the value of acceleration due to gravity on the surface of the earth?

    (b) (i) Why the value of acceleration due to gravity (g) changes due to the change in latitude? Give two reasons.
    (ii) A rocket is fired from the earth towards the sun. at what point on its path is the gravitational force on the rocket zero?

Simple Harmonic motion (SHM)

11. (a) (i) State where the magnitude of acceleration is greatest in a simple harmonic motion.
    (b) A vertical spring fixed at one end has a mass of 0.2kg and is attacked at the other end.

    Determine the:-
    (i) Extension of the spring
    (ii) Energy stored in the spring

12. (a) The displacement of a particle from the equilibrium position moving with single harmonic motion is given by $x = 0.05 \sin 6t$, where t is time in seconds measured from an instant when $x = 0$. Calculate the:-
    ( ) Amplitude of the oscillation
    (i) Period of oscillation
    (ii) Maximum acceleration of the particle

(b) (i) Give two similarities between SHM and circular motion.

(ii) On the same set of axes, sketch how energy exchange (K.E to P.E) takes place in an oscillator placed in a damping medium.

Rotational Dynamics

13. (a) (i) State the parallel and perpendicular axes theorems

( ) Show that the K.E of rotation of a rigid body about an axis with a constant angular velocity W is given by K.E = ½ $1W^2$, where I is the moment of inertia of the rigid body about the given axis.

(b) (i) Define moment of inertial of a body

(ii) Briefly explain why there is no unique value of for the moment of inertial of a given body.

(iii) A horizontal disc rotating freely about a vertical axis makes 45 revolutions per minutes. A small piece of putty of mass 2.0 x 10^{-2}kg falls elliptically onto the disc and sticks to it at a distance of 5 x 10^{-2}m from the axis. If the number of revolutions per minutes is there by reduced to 36r p.m, calculate the moment of inertial of the disc.

14. (a) Explain briefly why a

( ) High diver can turn more somersaults before striking the water.

(i) Dancer on skates can spin fats by folding her arms?

(b) A heavy flywheel of moment of inertia 0.4kgm2 is mounted on a horizontal axle of radius 0.01m. If a force of 60N is applied tangentially to the axle.

(i) Calculate the angular velocity of the fly wheel after 5 seconds from rest.

(ii) List down two assumptions taken to arrive at your answer above.

Properties of matter

15. (a) (i) Explain in terms of surface energy, what is meant by the surface tension, Ɣ of a liquid.

(ii) What energy is required to form a soap bubble of radius 1.0mm if the surface tension of the soap solution is 2.5 x 10^{-4} N/m

(b) A circular ring of thin wire 3cm in radius is suspended with its plane horizontal by a thread passing through the 10cm mark of a metre rule pirated at its centre and is balanced by 8g weight suspended at the 80cm mark. When the ring is just brought in contact with the surface of a liquid, the 8g weight has to be moved to the 90cm mark to just detach the ring from the liquid. Find the surface tension of the liquid (assume zero angle of contact).

16. (a) Define the following terms

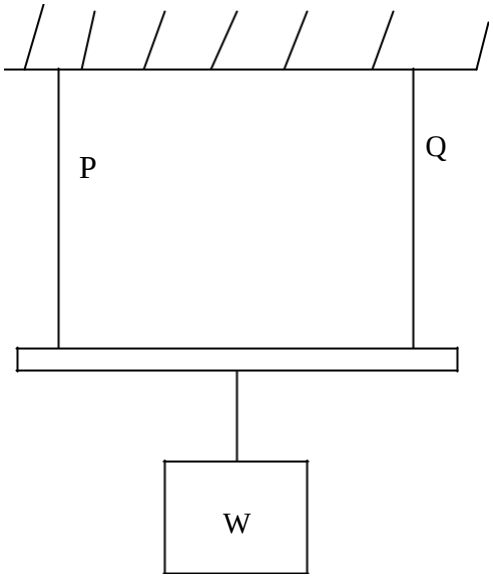
( ) Free surface energy

(ii) Capillary action

(iii) Angle of contact

(b) What is strain energy?

A piece of rod 1.05m long whose weight is negligible is suspended at its ends by wires Q and P of equal length as show a below.



The cross sectional area of P is 1mm2 and that of Q is 2mm^2, at what point along the bar should the weight be suspended in order to produce.

(i) Equal stress of P and Q
(ii) Equal strain of P and Q

(Given that young's modules of P = 2.4 x 10^{11} N/m2 and that of Q = 1.6 x 10^{11} N/m^2)

17. (a) (i) Define an ideal gas

( ) State the four (4) assumption necessary for an ideal gas that are used to develop the expression P = ½ ℓ C^2

(b) (i) How is pressure explained in terms of the kinetic theory?

(ii) Without a detailed mathematical analysis argue Re steps to follow in deriving the relation. P=½ℓC^2

(c) Define the temperature of an ideal gas as a consequence of the kinetic theory.

A certain diatomic gas is contained in a vessel whose inner surface is small absorber which remains any atoms or molecules of gas which strike it. Show that if doubling the absolute temperature causes one half of the molecules to dissociate into atoms then the rate at which the absorber is gaining mass increases by a factor $1 + \frac{1}{\sqrt{2}}$.

Fluid mechanics

1. (a) Write the continuity and Bernoulli's equations as applied to fluid dynamics

(b) (i) Under what conditions is the Bernoulli's equation applicable?
(ii) Discuss two (2) applications of the Bernoulli's equation
(iii) Develop an equation to determine the velocity of a fluid in a venturimeter pipe.

(c) The static pressure in a horizontal pipeline is 4.3×10^4Pa, the total pressure is 4.7×10^4Pa and the area of cross section is $20cm^2$. The fluid may be considered to be incompressible and non-viscous and has a density of $1000kg/m^3$. Calculate the flow velocity and the volume flow rate in the pipeline.

18. (a) (i) State Newton's law of viscosity and hence deduce the dimension of the coefficient of viscosity.
( ) In an experiment to determine the coefficient of viscosity of motor oil, the following measurements are made:-

- Mass of glass sphere = 1.2×10^{-4}kg
- Diameter of sphere = 4.0×10^{-3}m
- Terminal velocity of sphere = 5.4×10^{-4}m/s
- Density of oil = $860kg/m^3$

Calculate the coefficient of viscosity of the oil

(b) (i) Briefly explain the carburetor of a car as applied to Bernoulli's theorem.

(ii) Why hotter liquid flow faster than cold ones.

(iii) Why a flag flutter when strong minds are blowing on a certain day.

Heat

19. (a) Give a common example of a adiabatic process
(ii) What happens to the internal energy of a gas during adiabatic expansion?

(b) A mass of an ideal gas of volume $400cm^3$ at 288k expands adiabatically. If its temperature falls to 273k.
(i) Find the new volume of the gas
(ii) Calculate the final volume of the gas if it is then compressed isothermally until the pressure returns to its original value.

20. (a) (i) What is meant by thermal radiation?
( ) Briefly explain why forced convection is necessary for excess temperature less than 20k?

(b) (i) Why is the energy of thermal radiation less than that of visible light?
(ii) A body with a surface area of $5.0cm^2$ and a temperature of 727°C radiates 300 joules of energy in one minutes calculate its emissivity.

(c) (i) State Newton's law of cooling

(ii) A body cooks from 70°C to 40°C in 5 minutes. If the temperature of the surroundings is 10°C. Calculate the time it takes to cool from 50°C to 20°C.

21. (a) (i) What is meant by a thermometric property?
( ) Mention three qualities that make a particular property suitable for use in a practical thermometer.

(b) Study the values in table below which represent the observations of a particular room temperature obtained by using two types of thermometers and then answer the questions that follow:

Table

Temperature in °C	Resistance measured by resistance thermometer (Ω)	Pressure recorded by constant volume gas thermometer (NM^{-2})
Steam point 100°C	75.00	1.10×10^{7}
Ice point O°C	63.00	8.00×10^{6}
Unknown room temperature	64.992	8.51×10^{6}

(i) Calculate the value of unknown room temperature on the scales of resistance thermometer and constant volume gas thermometer.
(ii) Why do the answers in b (i) above differ slightly?

Waves and mechanical vibrations

22. (a) (i) Describe the formation of Newton's rings. How would you measure the wavelength of yellow light by use of Newton's rings?
(ii) What would happen to the central sport when air rests between the lens and the plates of the apparatus for Newton's rings?

(b) (i) What is meant by Doppler effect?
(ii) Mention two (2) common applications of the Doppler shift.

(c) Ultra sound of frequency 5×10^{5}Hz is incident at an angle of 30° to the blood vessel of a patient and a Doppler shift of 4.5 kHz is observed. If the blood vessel has a diameter 10^{-3}m and the velocity of ultrasound is 1.5×10^{3}m/s. Calculate the:-

(i) Blood flow velocity
(ii) Volume rate of blood flow

23. (a) (i) What is interference? Explain the term path difference with reference to the interference of two wave-train,

(ii) What is it not possible to see interference when the light beams from head lamps of a car over lap?

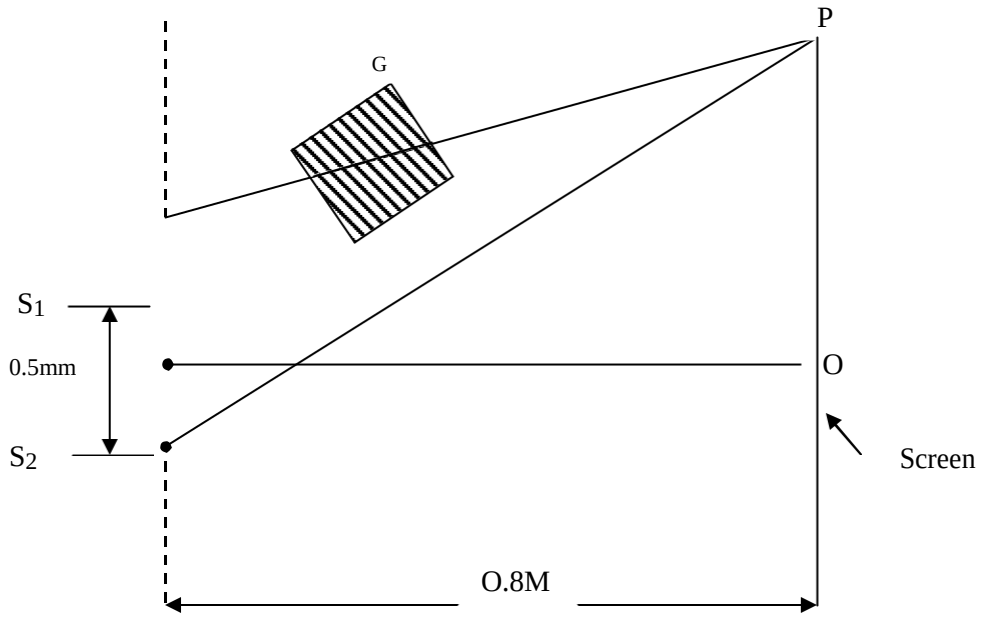
(iii) Discuss whether it is possible to observe an interference pattern when white light is shone on a young's double slit experiment.

(b) A grating has 500 lines per millimeter and is illuminated normally with monodromatic light of wavelength 5.89 x 10^{-7}m.

(i) How many diffraction maxima may be observed?

(ii) Calculate the angular separation

(c) In figure below S_1 and S_2 are two coherent light services in a young's double slits experiment separated by a distance 0.5mm and O is a point equidistant from S_1 and S_2 at a distance 0.8m from the slits. When a thin parallel sided piece of glass (G) of thickness 3.6 x 10^{-6}m is placed near S_1 as shown the central fringe system moves from O to a point P. Calculate OP. (The wavelength of light used = 6.0 x 10^{-7}m).



Given: Refractive index of glass is 1.5

24. (a) Define the following terms

(i) Damped oscillation

(ii) Forced oscillation

(iii) Resonance

(b) (i) What is meant by the statement that light is plane polarized.

(ii) State Brewster's law

(iii) Sunlight is reflected from a calm lake. The reflected sunlight is totally polarized. What is the angle between the sun and the horizon?

(c) (i) What is meant by crossed Polaroid's?

(ii) Give two differences between diffracting grating spectra and prism spectra.

(iii) State Huygens's principle of wave construction.

Electrostatics

25. (a) (i) What is capacitance?
(ii) List three factors that govern the capacitance of a parallel plate capacitor.

(b) Show that the energy per unit volume stored in a parallel plate capacitor is given by:-U = ½ $\mathcal{E}$ and define all the symbols in this equation.

(c) Given that the distance of separation between the parallel plates of a capacitor is 5mm, and the plates have an area of 5m? A potential difference of 10KV is applied across the capacitor which is parallel in vacuum compute:-

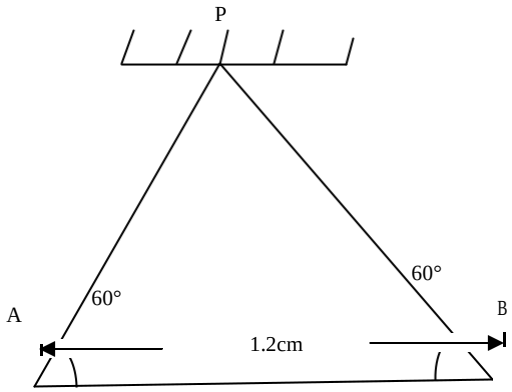
(i) The capacitance
(ii) The election intensity in the space between the plates
(iii) The change in the stored energy if the separation of the plates is increased from 5mm to 5.5mm.

26. (a) Explain the following observation
( ) A dressing table mirror becomes dusty when nipped with a dry cloth on a warm day.
(i) A charged metal ball comes into contact with an uncharged identical ball. (Illustrate your answer by using diagrams).

(b) (i) Show that the unit of CR (time constant) is seconds and prove that for a discharging capacitor it is the time taken for the charge to fall by 37%.

(ii) The variable radio capacitor can be charged from 50pf to 950pf by turning the dial from O° to 180°. With the dial at 180°, the capacitor is connected from the battery and the dial is turned to O°. What is the charge on the capacitor? What is the p.d cross the capacitor when the dial reads O° and the work done required to turn the dial to O°? (Neglect frictional effects).

27. (a) (i) State coulomb's law of electrostatics
( ) Define electric field strength, E at any point
(i) Mention two common properties of electric field lives.
(c) Two identical balls each of mass 0.8kg carry identical charge and they are separated by thread of equal length. At equilibrium they positioned themselves at a distance of 1.2cm as show in figure below. Calculate the charge in either ball.



28. (a) Define the following terms:-

( ) Capacitance

(i) Charge density

(ii) Equipotential surface

(b) By using the coulomb's law of electrostatic, device an expression for the electric field strength E, due to a point charge if the material is surrounded by a material of permittivity $\mathcal{E}$, and hence show how it relates with charge density 6.

(c) Describe the structure and mode of action of a simplified version of the Van de Graaff generator.