P510/2
PHYSICS
Paper 2

Uganda Advanced Certificate of Education

PHYSICS

Paper 2
COVID-19 RECESS REVISION QUESTIONS 2020

Assume where necessary;

Acceleration due to gravity, g,	$= 9.81 ms^{-2}$
Speed of sound in air	$= 330 ms^{-1}$
Speed of light in vacuum, c,	$= 3.0 \times 10^{8} ms^{-1}$
Electronic charge, e,	$= 1.6 \times 10^{-19} C$
Electron mass	$= 9.11 \times 10^{-31} kg$
Plank's constant, h,	$= 6.63 \times 10^{-34} Js$
Permeability of free space, μ_o.	$= 4.0\pi \times 10^{-7} Hm^{-1}$
Permittivity of free space, ε_0,	$= 8.85 \times 10^{-12} Fm^{-1}$
The constant $\frac{1}{4\pi\varepsilon_0}$	$= 9 \times 10^{9} F^{-1} m$
One electron volt, (eV)	$= 1.6 \times 10^{-19} J$
Avogadro's number, N_A	$= 6.02 \times 10^{23} mol^{-1}$
Specific heat capacity of water	$= 4200 Jkg^{-1} k^{-1}$

SECTION A

1. (a) (i) State the **laws of reflection of light.**
   (ii) Show, with the aid of a ray diagram that the radius of curvature of a concave mirror is twice the focal length of the mirror.

   (b) A concave mirror forms an image half the size of the object. The object is then moved towards the mirror until the image size is three quarters that of the object. If the image is moved by a distance of 0.8cm, calculate the:-

(i) focal length of the mirror,
(ii) new position of the object.

(c) Describe how you would determine experimentally the angle of minimum deviation produced by a prism.

(d) A ray of light propagating in a liquid is incident on a prism of refracting angle 60^0 and refractive index 1.50 at an angle of 40^0. If the ray passes symmetrically through the prism, find the refractive index of the liquid.

(e) State **two** applications of total internal reflection.

2. (a) With the aid of ray diagrams, explain the following as applied to lenses.
(i) **Conjugate points.**
(ii) **Spherical aberration.**

(b) An object, O, placed in front of a converging lens forms a real image I on the screen. The distance between the object and its real image is'd' while that of the image from the lens is x.
Derive the expression for the least possible distance between the object
and its image.

(c) Give the properties of the lenses in an achromatic combination.

(d) A compound microscope consists of two converging lenses of focal length
1.0cm and 5.0cm respectively. An object is placed 1.1cm from the objective and the micro scope is adjusted so that the final image is formed 30cm from the eye piece.
Calculate:-
(i) the separation of the lenses.
(ii) the magnifying power of the lenses.

(e) State **two** differences between a compound microscope and an astronomical telescope.

3. (a) State the laws of reflection of light

(b) (i) Draw a ray diagram to show the formation of the image of a finite object by a diverging mirror.

(ii) Use the diagram drawn in b (i) above to derive the expression of the mirror formula.

(c) Describe an experiment to determine the focal length of a diverging mirror by a converging lens.

(d) An object is placed 15.0 cm in front of a concave mirror of focal length 10.0 cm, by what distance should the object be shift in order to obtain;

(i) a real image a half the size of the object.

(ii) a virtual image twice the size of the object.

4. (a) Distinguish between **Principal foci** and **Conjugate foci** of a lens.

(b) Explain Why two poles of different height appear to be the same height to an observer.

(c) (i) Describe an experiment to determine the focal length of a lens by displacement of the lens method

(ii) State **two** advantages of the method in c (i) above.

(d) (i)With the aid of diagram derive the expression for angular magnification of the Galilean Telescope.

(ii) A Galilean telescope is used to focus a distant object with the eye piece placed 50cm from the objective lens. The focal lengths of the objective and the eye piece are 100cm and 10 cm respectively. Find the distance from the objective lens where the final image will be formed.

(iii) State the Problem of the arrangement of the lenses in this telescope.

5. (a) What is meant by the following terms as applied to a telescope?

(i) Magnifying power.

(ii) Exit- pupil.

(b) (i) Draw a ray diagram to show the formation of the final image by an astronomical telescope in normal adjustment.

(ii) With the aid of a diagram in (b)(i), derive an expression for the magnifying power of an astronomical telescope in normal adjustment.

(iii) Give the disadvantage of the telescope in (b)(i) when used to view distant objects on earth, describe how the telescope can be modified to overcome this disadvantage.

(c) An astronomical telescope consists of two thin converging lenses of focal length 100cm and 10cm respectively. If the final image of a distant object is virtual and is 20cm from the eye piece, find the separation of the lenses.

(d) State two advantages of a Galilean telescope over astronomical telescopes.

6. (a) What is meant by the following terms as applied to a telescope?

(iv) Magnifying power.

(v) Exit- pupil.

(b) (i) Draw a ray diagram to show the formation of the final image by an astronomical telescope in normal adjustment.

(ii) With the aid of a diagram in (b)(i), derive an expression for the magnifying power of an astronomical telescope in normal adjustment.

(vi) Give the disadvantage of the telescope in (b)(i) when used to view distant objects on earth, describe how the telescope can be modified to overcome this disadvantage.

(c) An astronomical telescope consists of two thin converging lenses of focal length 100cm and 10cm respectively. If the final image of a distant object is virtual and is 20cm from the eye piece, find the separation of the lenses.

(d) State two advantages of a Galilean telescope over astronomical telescopes

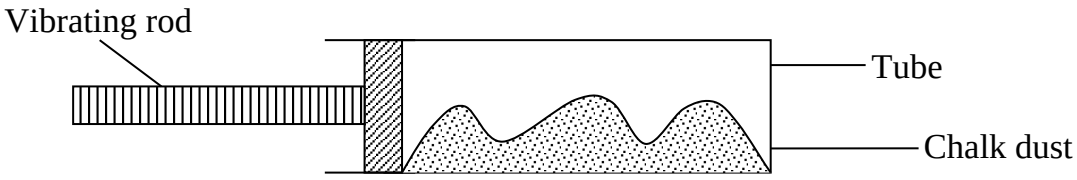
SECTION B

7. (a) What is meant by the following terms as applied to sound?

(i) **Resonance.**

(ii) **Fundamental frequency.**

(b) In an experiment to determine the speed of sound in air in a tube, chalk dust settled in heaps as shown in the diagram below:-



If the frequency of the vibrating rod is $220H_Z$ and the distance between
three consecutive heaps is 1.50m, calculate the speed of sound in air.

(c) (i) State the **principle of superposition of waves.**

(ii) Explain using the principle of superposition of waves the formation of beats.

(d) (i) Describe an experiment to show how the fundamental frequency varies with tension in a given wire.

(ii) A string of length 50cm and mass 5.0g is stretched between two points.

If the tension in the string is 100N, find the frequency of the second harmonic.

(e) (i) What is meant by **Doppler effect?**
(1 mark)

(ii) A car sounds its horn as it travels at a steady speed of $20ms^{-1}$ along a straight road between two stationary observers X and Y. Observer X hears a frequency of $560H_z$ while Y hears a lower frequency.

Calculate the frequency heard by Y assuming the speed of sound in air is $330ms^{-1}$

8.(a) What is a **diffraction grating?**

(b) Describe how the wavelength of monochromatic light can be measured using a diffraction grating.

(c) Two glass slides in contact at one end are separated by a sheet of paper 16cm from the line of contact to form an air – wedge.
When the air-wedge is illuminated normally by light of wavelength 5.8×10^{-7}m, interference fringes of separation 2.0 mm are found in reflection.
Find the thickness of the paper.

(d) (i) What is meant by **interference of waves?**
(ii) State **three** differences between constructive and destructive interference.

(e) In young's double – slit experiment, the 6^{th} bright fringe is formed 4mm away from the centre of the fringe system when the wave length of light used is 6.0×10^{-7}m. Calculate the separation of the two slits if the distance from the slits to the screen is 60cm.

9. (i) State the superposition principle as applied to wave motion.
(ii) What is meant by path difference?
(iii) State the conditions which must be satisfied in order to observe an interference pattern due to two waves.

(b) (i) Explain how beats occur in sound.
(ii) Two turning forks x and y are sounded together to produce beats of frequency 9Hz. Fork x has a known frequency of 514Hz. When y is loaded with small plasticine beats at a frequency of 2Hz are heard when the two tuning forks are sounded together. Determine the frequency of y when unloaded.

(c) (i) What is polarized light?
(ii) Give one application of polarized light.
(iii) Derive an expression for Brewster's law for ordinary light incident from optical medium A of refractive index, nA at a polarizing angle α, to medium B of refractive index nB.
(iv) A parallel beam of un polarized light incident on a transparent medium of refractive index 1.62 is reflected as plane polarized light. Calculate the angle of incidence in air and angle of refraction in the medium.

10.(a) Distinguish between progressive waves and standing waves.

(b) The diagram in figure 1 shows a progressive wave travelling in the positive x-direction from the origin O with a velocity of $15.0ms^{-1}$

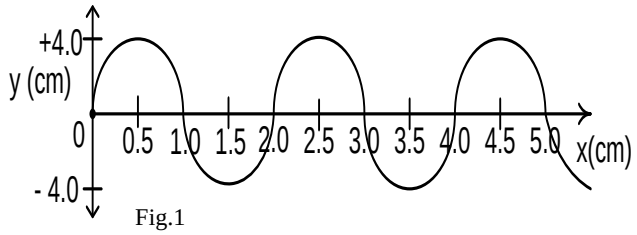


Fig.1

(i) Determine the frequency of the wave.

(ii) Deduce and write down the expression for the displacement of the wave from its equilibrium position in cm at any time t seconds .

(c) (i) State the factors affecting the frequency of sound produced by a guitar.

(ii) Describe an experiment to show the effect varying the length of a wire of the guitar on its frequency output when all the other factors are kept constant.

(d) (i) Define the term **resonance**.

(ii) In the dust tube experiment, the vibrating air due to a nearby loud speaker causes 7 consecutive heaps of powder to occupy a total distance of 0.60 m when the air in the tube is set into resonance at a frequency f. Determine the value of the frequency f.

9. (a) Define the following as applied to wave.
   (i) Harmonic
   (ii) Fundamental note

   (b) Explain why the amplitude of the wave decreases as a wave spreads away from the source.

   (c) (i) Explain how a standing wave is formed in a closed pipe.

   (ii) A progressive wave y = a sin $2\pi\left(\frac{t}{T}+\frac{x}{\lambda}\right)$ is reflected at a barrier to interfere with the incoming wave. Show that the resultant wave is a stationary wave.

   (d) Describe an experiment to show that sound waves exhibit interference by using loud speaker.

   (f) Calculate for the frequency of the beats heard by a stationery observer when a source of sound of frequency 80Hz is receding him with a speed of $5.0ms^{-1}$ towards a vertical wall.

(Take speed of sound in air as $340ms^{-1}$)

10. (a) Explain the formation of fringes by transmission grating.

(b) Describe how the wave lengths of monochromatic light can be measured using a diffraction grating and a spectrometer.

(c) Explain why an oil layer on water surface appears coloured on rainy day.

(d) Explain.
(i) What is meant by plane polarized light.
(ii) One application of polarized light.

SECTION C

11.(a) State **Coulomb's law of electrostatics.**

(b) Derive the relation between electric field intensity, E, and electric potential, V, due to a charge at a point.

(c) Two pith balls P and Q each of mass 0.1g are separately suspended from the same point by threads 30 cm long. When the balls are given equal charges, they repel each other and come to rest 18cm apart. Calculate the magnitude of charge on each ball.

(d) Describe how you would investigate the distribution of charge on a spear shaped conductor.

(e) Explain how a charged body attracts uncharged conductor.

(f) Describe how an electroscope can be used to distinguish a conductor from an insulator.

12.(a) Define the following:
(i) **Capacitance,**
(ii) **Dielectric material.**

(b) Describe an experiment that can be used to show how capacitance of a capacitor depends on the permittivity of a dielectric.

(c) A 10.0μF capacitor charged to 300V is connected across an

uncharged 60μF capacitor. Calculate the total energy stored in both capacitors before and after connection.

(d) Describe briefly how the sign of a charge on a given body can be determined using a gold leaf electroscope.

(e) Two point charges A and B of -17.6μC and -9.0μC respectively are placed in vacuum at a distance of 21cm apart. When a third charge, C is placed mid-way between A and B, the net force on B is zero.

(i) Determine the charge on C.

(ii) Sketch the electric field lines corresponding to the charge distribution.