Name …………………………………….............Class………..H'se………

Signature…………………………………

END OF TERM ONE EXAMINATIONS, 2017

S.5 PHYSICS

PAPER 2

*2 hours 30 minutes*

Instructions:

- *Attempt **FIVE** questions in all.*

- *Where necessary, assume the constants*

  | | | |
  |---|---|---|
  | *Permittivity of free space, $\varepsilon_0$* | = | *$8.85 \times 10^{-12}$ Fm$^{-1}$* |
  | *Acceleration due to gravity* | = | *9.81 ms$^{-2}$* |
  | *Electronic charge, e* | = | *$1.6 \times 10^{-19}$C* |
  | *Mass of an electron, $m_e$* | = | *$9.1 \times 10^{-31}$ kg* |
  | *The constant $\dfrac{1}{4\pi\varepsilon_0}$* | = | *$9.0 \times 10^{9}$ mF$^{-1}$* |

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| Question | | | | | | TOTAL |
|---|---|---|---|---|---|---|
| Marks | | | | | | |

## SECTION A

1(a)    (i) State the laws of reflection of light.    (2)

(ii) Describe an experiment to verify the laws of reflection.    (6)

(b)    With the aid of a labeled diagram, describe how an optical lever mirror galvanometer operates.    (6)

(c)    Two plane mirrors are inclined at an angle of $(90^\circ + \beta)$, where $\beta$ is a small  positive angle.

(i) Using the laws of reflection of light, derive an expression the deviation, in terms of $\beta$, of a ray of light incident on any one of these plane mirrors.
Hence show that the deviation is independent of the angle of incidence.
    (4)

(ii) A ray is incident on one of the mirrors in c(i) above and the deviation is found to be $130^\circ$.  Find the angle at which the reflecting surfaces of the mirrors are inclined.    (2)


2(a)    (i) State the characteristics of images formed in plane mirrors.    (2)

(ii) Describe how the position of a virtual image in a plane mirror can be located by the no-parallax method.    (4)

(iii) With the aid of a ray diagram, describe how a plane mirror can be used to form a real image.    (2)

(b)    Two plane mirrors are parallel to, and facing, each other with a separation of 4.0 cm. A point object lies between the mirrors at a distance, **1.5 cm** from one of them. What is the distance, from the object, of the image produced by two reflections in each mirror?    (4)

(c)    With the aid of a well labeled diagram, describe the action of the sextant, in determining the angle of elevation of a star.    (6)

(d)   With the aid of an accurate ray diagram, show that the minimum height of a plane mirror required to view the full image of a person is always half their height.                                        (2)

3 (a)   (i) What is meant by the term radius of curvature?               (1)

(ii) Show, with the aid of a ray diagram, that the radius of curvature of a concave mirror is twice the focal length.                          (4)

(b)   (i) Show that the image formed in a plane mirror is as far behind the mirror as the object is in front.                                        (4)

(ii) With the aid of a ray diagram, show that the angle of rotation of the reflected ray is twice the angle of rotation of the plane mirror provided the direction of the incident ray is kept constant.                (4)

(c)   A point object is placed on the principal axis of a concave mirror of focal length, $f$, at a distance, $u$, from the mirror. A real image of the object is formed at a distance, $v$, from the mirror.

(i) Draw a ray diagram to show the formation of the image.     (2)

(ii) Use the diagram in c(i) above to derive the mirror formula. (5)

## SECTION D

4(a)   Explain;

(i) What is meant by electrostatic induction?                     (2)

(ii) Why a neutral conductor is attracted by a charged body.     (2)

(b)   (i) With the aid of a labeled diagram, describe how a van de graaff generator works.                                                        (6)

(ii) In which ways may the maximum p.d of this machine be increased?
(3)

(c)      (i) State coulomb's law of electrostatics. (1)

(ii) Define electric potential at a point. (1)

(iii) Derive an expression for the electric potential at a point located a distance **r** from a point charge, **Q** in a medium of permittivity, ε. (5)

5(a)      With the aid of a diagram, describe an experiment to investigate the charge distribution over the surface of a conductor. (5)

(b)      Show that the electric normal flux through a spherical surface enclosing a charge in vacuum is $Q/\varepsilon$ (3)

(c)



Three point charges $Q_1$, $Q_2$, and $Q_3$ of magnitudes +5µC, +6 µC and -20µC respectively are situated along a straight line as shown in the figure above. Calculate the resultant force on $Q_3$ due to $Q_1$ and $Q_2$. (4)

(d)      (i) Describe an experiment to show that no excess charge resides inside a charged hollow conductor. (5)

(ii) Explain why a charged spherical conductor loses charge faster when a pin is attached to it. (3)

6(a)      Explain how an object gets charged by rubbing. (3)

(b)      Two metal spheres **A** and **B** are supported on insulating stands and placed in contact as shown in the diagram below.
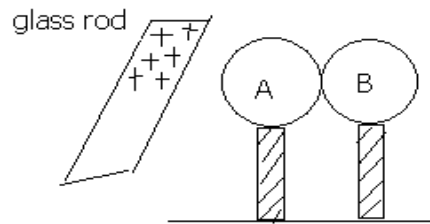
A positively charged glass rod is held close to sphere A. The spheres are then separated while the glass rod is still in place.

(i)     Sate the charge acquired by each of the spheres.                    (1)

(ii)    Sketch the electric field pattern between the spheres.              (2)

(iii)   Explain how the p.d between the spheres varies as the spheres are moved further apart.                                                          (2)

(c)     (i) Define the terms Electric field intensity and surface density.     (2)

(ii) Sketch, on separate axes, graphs of the variation of electric potential and electric field intensity with distance from the centre of a charged conducting sphere.                                                       (2)

(iii) Charges $Q_1$ and $Q_2$ of -2.0 μC and +2.0 μC respectively are placed at two corners of a rectangle of sides 5 cm and 10 cm as shown below.
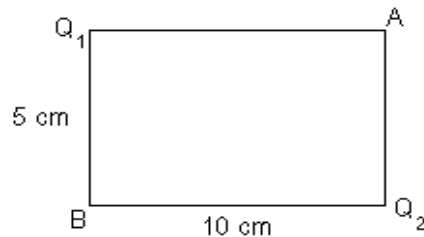


Calculate the electric potential at A.                                    (4)

(d)     A negatively charged ebonite rod is brought up to an uncharged pith-ball suspended by a silk thread. The pith-ball first moves to the rod, touches it and then moves away. Explain these observations.            (4)

## END