ASSIGNMENT - FORCE FIELDS

DATE: _____ NAME: _____

K _/15 C _/10 T/I _/13 A _/11

K ① FIND THE GRAVITATIONAL FIELD STRENGTH OF THE EARTH,

a) ON THE EARTH'S SURFACE. ($M_{EARTH} = 5.98 \times 10^{24}$ kg)
($r_{EARTH} = 6.38 \times 10^{6}$ m)

/2

b) 1 EARTH RADIUS ABOVE THE EARTH'S SURFACE.

/2

K ②a) FIND THE ELECTRIC FIELD STRENGTH OF A PROTON ($Q = +1e = +1.6 \times 10^{-19}$C), 1nm AWAY.

/2

b) FIND THE ELECTRIC FORCE OF A PROTON ACTING ON AN ELECTRON 1nm AWAY.

/2

K ③ A CHARGE SOURCE Q EXERTS AN ELECTRIC FIELD OF STRENGTH $\vec{E}$. ASSUME Q IS A POINT SOURCE.

a) DRAW A FIELD DIAGRAM FOR,
i) $Q > 0$ ii) $Q < 0$

/2

b) AT A POINT r UNITS AWAY FROM THE SOURCE, A CHARGE q IS PLACED.
WHAT IS THE MAGNITUDE OF THE ELECTRIC FORCE OF Q ON q?

T

c) BY WHAT FACTOR DOES THAT FORCE IN b) CHANGE IF....

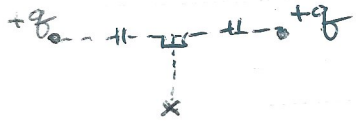
T i) q IS TRIPLED

T ii) r IS TRIPLED

$\frac{}{2}$ iii) r IS HALVED, Q IS DOUBLED, AND q IS DOUBLED. (SHOW WORK)

C ④ TWO EQUIVALENT CHARGES, $+q$, $+q$ ARE SHOWN BELOW. SKETCH THE NET ELECTRIC FIELD VECTOR, $\vec{E}$, AT POINT X. JUSTIFY YOUR SKETCH USING A COMPONENTS ARGUMENT.

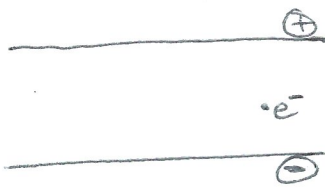
$\frac{}{4}$



C ⑤ CONSIDER THE PARALLEL PLATE CONDUCTOR CONFIGURATION OF CHARGE.

T a) STATE THE SIGNIFICANCE OF THIS CONFIGURATION WITH PERTINANCE TO ITS ELECTRIC FIELD.

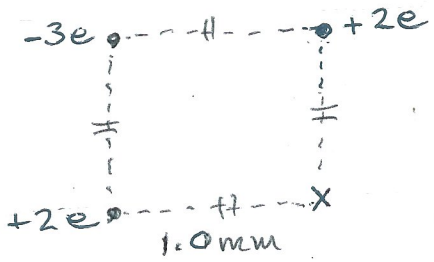
$\frac{}{3}$ b) FOR THE DIAGRAM, DRAW IN THE ELECTRIC FIELD LINES IN BETWEEN THE PLATES, AND AROUND THE LEFT PERIPHERY. DRAW AN ARROW AT THE "e^-" TO SHOW ITS DIRECTION OF MOTION IN THIS FIELD.



C ⑥ DEFINE "ELECTRIC POTENTIAL DIFFERENCE", AND RELATE IT TO "ELECTRIC POTENTIAL ENERGY DIFFERENCE"

$\frac{}{3}$

T/I /6 ⑦ CALCULATE THE ELECTRIC FIELD STRENGTH AT POINT X. EXPRESS THE DIRECTION AS A ROTATION, θ WHERE $0° \leq \theta \leq 360°$ (AS DONE IN CLASS).



T/I /2 ⑧ AN ELECTRON MOVES FROM REST AT ONE POINT, ACROSS A POTENTIAL DIFFERENCE OF 9.0V WITHIN AN ELECTRIC FIELD.

a) FIND THE WORK DONE ON THE ELECTRON.

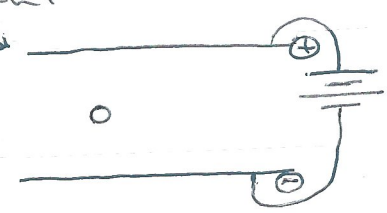
/3 b) FIND THE SPEED REACHED BY THE ELECTRON.

/2 c) IF THE MASS OF AN ELECTRON IS 9.1×10^{-31} kg, THEN FIND THE MOMENTUM OF A BEAM OF 6.02×10^{23} ELECTRONS WHEN THEY REACH THIS SPEED.

A /3 ⑨ A UNIFORM ELECTRIC FIELD WHOSE INTENSITY HAS MAGNITUDE, $\mathcal{E}$, ACCELERATES A CHARGE q FROM REST TO SPEED v. IF THE CHARGE TRAVELS A DISTANCE Δd, AND ITS MASS IS m, THEN SHOW THAT,

$$\mathcal{E} = \frac{mv^2}{2q\Delta d}$$

A (10) A VERY SMALL, STATICALLY-CHARGED SPHERE IS SUSPENDED IN BETWEEN TWO OPPOSITELY-CHARGED PARALLEL, METAL PLATES, AS SKETCHED. THERE IS A VACUUM IN BETWEEN THE PLATES.



a) WHAT ARE THE FORCES ACTING ON THIS SPHERE? — 2

b) WHAT MUST BE THE SIGN OF THE CHARGE ON THE SPHERE? — 1

c) IF THE POTENTIAL DIFFERENCE BETWEEN THE PLATES IS 16.8V, AND THE PLATE SEPARATION IS 5.0mm, AND THE MASS OF THE SPHERE IS 5.5×10^{-16} kg, THEN DETERMINE THE FOLLOWING: — 5

a) THE CHARGE ON THIS SPHERE, AND HENCE...

...b) THE NUMBER OF (EXCESS) ELEMENTARY CHARGES ON THE SPHERE.