Uniform Electric Fields

Mark Scheme 1

Level	International A Level
Subject	Physics
Exam Board	CIE
Topic	Electric Fields
Sub Topic	Uniform Electric Fields
Paper Type	Theory
Booklet	Mark Scheme 1

Time Allowed: **58 minutes**

Score: **/48**

Percentage: **/100**

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 **(a** a region/space/area where a (stationary) charge experiences an (electric) force B1 [1]

(b) (i) at least four parallel equally spaced straight lines perpendicular to plates B1

consistent direction of an arrow on line(s) from left to right B1 [2]

(ii) electric field strength $E = V/d$ C1

$E = (450/16 \times 10^{-3})$
$= 28 \times 10^3$ (28 125) V m^{-1} A1 [2]

(iii) $W = Eqd$ or Vq C1

$q = 3.2 \times 10^{-19}$ (C)

$W = 28\,125 \times 3.2 \times 10^{-19} \times 16 \times 10^{-3}$ or $450 \times 3.2 \times 10^{-19}$

$= 1.4(4) \times 10^{-16}$ J A1 [3]

(iv) ratio $= \dfrac{450 \times 3.2 \times 10^{-19}}{450 \times -1.6 \times 10^{-19}}$ *(evidence of working required)*

= (–) 2 A1 [1]

2 **(a** electric field strength is force per unit positive charge B1 [1]

(b) mass = volume × density (any subject, allow usual symbols or defined symbols) C1

$= 4/3 \times \pi \times (1.2 \times 10^{-6})^3 \times 930$ (= 6.73×10^{-15})

weight = $4/3 \times \pi \times (1.2 \times 10^{-6})^3 \times 930 \times 9.81 = 6.6 \times 10^{-14}$ N M1 [2

(c) (i) $E = 1.9 \times 10^3 / 14 \times 10^{-3}$ C1
$= 1.4\ (1.36) \times 10^5$ V m^{-1} A1 [2]

(ii) $F = QE$

$Q = 6.6 \times 10^{-14} / 1.36 \times 10^5$ C1
$= 4.9\ (4.86) \times 10^{-19}$ C [allow 4.7×10^{-19} C if 1.4×10^5 used] A1 [2]

(iii) <u>electric</u> force increases / is greater (than weight) B1
charge (on S) is negative to give resultant / net / sum / total force up B1 [2]

3	(a)	(i) the direction of the fields is the same OR fields are uniform OR constant electric field strength OR $E = V/d$ with symbols explained	81	[1]
	(ii)	reduce p.d. across plates	81	
		increase separation of plates	81	[2]
	(iii)	a opposite charge to 13(as deflection in opposite direction)	81	
		13 has a range of velocities OR energies (as different deflections) and a all have same velocity OR energy (as constant deflection)	81	
		a are more massive (as deflection is less for greater field strength)	81	[3]
	(b)	$W = 234$ and $X = 90$	81	
		$Y = 4$ and $Z = 2$	81	[2]
	(c)	$A = 32$ and $B = 16$ and $C = 0$ and $D = -1$	81	[1]

4	**(a)**	**(i)**	six vertical lines from plate to plate equally spaced across plates [only allow if greatest to least spacing is < 1.3, condone slight curving on the two edges. There must be no area between the plates where an additional line(s) could be added.]	B1
			arrow downwards on at least one line	B1 [2]
		(ii)	$E = V / d$	C1
			$= 1200 / 40 \times 10^{-3} = 3.0 \times 10^{4}$ V m^{-1} (allow 1 s.f.)	A1 [2]
	(b)	**(i)**	$F = Ee$	C1
			$= 3 \times 10^{4} \times 1.6 \times 10^{-19} = 4.8 \times 10^{-15}$ N	A1 [2]
		(ii)	couple = $F \times$ separation of charges	C1
			$= 4.8 \times 10^{-15} \times 15 \times 10^{-3} = 7.2 \times 10^{-17}$	A1
			unit: N m or unit consistent with unit used for the separation	B1 [3]
		(iii)	A at top/next to +ve plate B at bottom/next to –ve plate vertically aligned [could be shown on the diagram]	M1
			forces are equal and opposite in same line / no resultant force and no resultant torque	A1 [2]
5	**(a)**		electric field strength is the force <u>per unit positive</u> charge (acting on a stationary charge)	B1 [1]
	(b)	**(i)**	$E = V / d$	C1
			$= 1200 / 14 \times 10^{-3}$	
			$= 8.57 \times 10^{4}$ V m^{-1}	A1 [2]
		(ii)	$W = QV$ or $W = F \times d$ and therefore $W = E \times Q \times d$	C1
			$= 3.2 \times 10^{-19} \times 1200$	
			$= 3.84 \times 10^{-16}$ J	A1 [2]
		(iii)	$\Delta U = mgh$	C1
			$= 6.6 \times 10^{-27} \times 9.8 \times 14 \times 10^{-3}$	
			$= 9.06 \times 10^{-28}$ J	A [2]
		(iv)	$\Delta K = 3.84 \times 10^{-16} - \Delta U$	
			$= 3.84 \times 10^{-16}$ J	A1 [1]
		(v)	$K = ½mv^2$	C1
			$v = [(2 \times 3.8 \times 10^{-16}) / 6.6 \times 10^{-27}]^{1/2}$	
			$= 3.4 \times 10^{5}$ m s^{-1}	A1 [2]