Practice Question Set For A-Level
Subject : Physics
Paper-1 Topic: Further Mechanics

Name of the Student:_____
Max. Marks : 25 Marks **Time : 25 Minutes**

Mark Schemes

Q1.

(a) Evidence of distance travelled = area under graph = 1755 + 1440 + 1620 = 4815 ✔

Full marks can be credited for use of suvat.

Average speed = total distance/time taken = 4815/240

= 20.1 m s^{-1} ✔ (at least 3sf)

Which is less than (speed) limit, (and therefore the answer is No). ✔

Allow ecf for distance in MP2

Only award MP3 for incorrect speed if attempt made to calculate distance correctly e.g. area under graph OR a.e. in distance or speed

Alternative for MP2 and MP3

Calculation of distance travelled at speed limit = 5280 m ✔

Which is greater than distance travelled (so no). ✔

Alternative for MP1 and MP2:

Total area = 80.25 m s^{-1} min ✔

Time = 4 min

Average = 20.1 m s^{-1} ✔

3

(b) Using reaction time of 2.0 s ✔

1

Use of distance = speed × time = 62 m.

62 m (would be appropriate). ✔

Award MP2 if 1.6 s (to give 50 m) or 1.8 s (to give 56 m) or 1.7 s (to give 53 m) or average of two distances used

Allow 60 m.

1

(c) Use of F = ma to calculate acceleration.

a = 6800/1200 ✔ = 5.7 m s^{-2}

evidence of use of suvat to calculate s or t, ✔

to give *t* = 5.5 s ✔

s = 85 m. ✔

If no other mark given, allow 1 mark for

mv = 1200 × 31 (= 37200)

Alternative for MP1 and MP2

$t = \frac{mv-mu}{F}$

Allow ce for a.

Allow ce for either incorrect s or t.

4

(d) (It is assumed that) the car in front would take the same time/travel the same distance as the car behind when braking/ only difference is reaction time of the driver of car behind. ✔
Or
Car in front cannot stop instantaneously (so car behind will have time/distance to bring car to rest).or words to that effect

Alternative:
suggestion that total stopping distance is too large (drivers would ignore it/inefficient use of motorway)

1

(e) Correct use of cos (5) ✔

E.g.

$mg = N \cos(5)$

Correct use of sin (5) ✔

E.g.

$N \sin(5)$ (= mv^2/r)

So

mv^2/r seen ✔

And $v = (rg \tan(5))^{½}$

Gives $v = (200 \times 9.81 \times \tan(5))^{½} = 13$

So speed limit = 13 m s^{-1} ✔

May see cos (85) for sin (5)

Alternative for MP1 and MP2: Evidence of mg tan (5)

fourth mark is for answer and suggesting this as the speed limit.

Max 3 if mg = N used

4

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Q2.

(a) Arrow pointing up labelled magnetic force or F_M and arrow pointing down labelled electric force or F_E ✔

As location A is given in the question the base of the arrows do not need to sit exactly on A but arrows, if extended, should pass through A.

Care – in some cases A can look like an arrow head.

1

(b) Statement that electric and magnetic forces balance
OR
$qE = Bqv$
OR
$E = vB$
OR
$1.5 \times 10^5 \times 0.12$ ✔

electric field strength = $E = 1.8 \times 10^4$ (V m^{-1}) ✔
A correct final answer gains both marks

2

(c) (centripetal force or $F_c = \frac{mv^2}{r}$, equals force due to the magnetic field or $F_m = Bqv$)

$\frac{mv^2}{r}$ and hence $\frac{mv}{Bq}$ ✓
Condone use of F to represent both F_c and F_m
Allow an interchange between use of q and Q.
Note F = is required

1

(d) $r\left(=\frac{mv}{Bq}=\frac{1.0\times10^{-26}\times1.5\times10^{5}}{0.12\times1.6\times10^{-19}}\right)=0.078(1)$ ✓

distance (= 2r) = 0.16 (m) ✔ (0.156 m)
ecf on second mark.
second mark given only if mv/Bq used in a calculation.

2

(e) (using an energy approach)

work done by field equals gain in KE $qV = \frac{1}{2}mv^2$ ✔$_{1a}$

$(\text{so } v=\sqrt{\frac{2qV}{m}} \quad =\left(\frac{2\times1.6\times10^{-19}\times\frac{6000}{2}}{1.2\times10^{-26}}\right)^{1/2})$

mark for using the V/2 either in an equation or via a substitution ✔$_{2a}$

= 2.8(3) × 10^5 (m s^{-1}) ✔$_{3a}$
OR
(using a force approach)

Force on ion = $ma = qE$ ✔$_{1b}$

$$a=\frac{6000\times1.6\times10^{-19}}{1.2\times10^{-26}\times d}=8.0\times10^{10}/d$$

Using $v^2 = u^2+2as$)
Mark for using equation for E and equation of motion either in symbols or via a substitution ✔$_{2b}$
v = 2.8 × 10^5 (m s^{-1}) ✔$_{3b}$

$_{1a}$ in words or equation which can be awarded even if the ion is not singly charged (candidates can wrongly think it has a charge of 3e)

2a for making use of half the pd ie 3000 V

3a Only allow ecf using 6000V giving

$v = 4.0 \times 10^5\ m\ s^{-1}$

3

(f) A smaller mass gives a smaller time interval ✔1

(The explanation can come from a Force or a Work done approach)
The ions are given the same force ✔2a
(so) smaller mass has higher acceleration and smaller time interval ✔3a
OR
Work done on ions or kinetic energy gained is the same ✔2b
(so) smaller mass is given greater speed and smaller time interval ✔3b

Award any two of the three marks

condone use of 'lighter' for 'smaller mass'

3 max 2

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