Practice Question Set For A-Level
Subject : Physics
Paper-3 Topic: Section A(Practical Skills)

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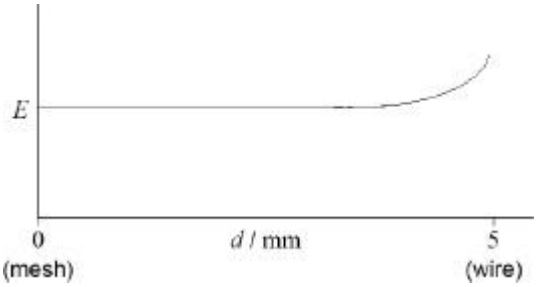
Name of the Student:_____
Max. Marks : 21 Marks **Time : 21 Minutes**

Mark Schemes

Q1.

(a) Horizontal line above zero for > half the distance ✔

(then) curves upwards ✔



Marks are independent.

2

(b) statement that (kinetic) energy is the same

OR

correct substitution of data into equation/ratio ✔

ratio $\left(= \sqrt{\frac{6.64\times10^{-26}}{9.11\times10^{-31}}} \right)$ = 270 ✔

Some factors (e.g. ½) that cancel may be absent.

2

(c) Due to collisions argon loses more energy / speed / momentum (than electron)

OR

Electron is less ionising (than argon) / Argon is more ionising (than electron)

so ratio is larger. ✔

Mark is for the explanation

Do not allow explanations that suggests the particles have different distances to travel. Do not allow references to air resistance.

Accept idea that "argon has higher probability of collision (than electron)"

Accept reverse arguments

1

(d) Evidence of suitable test for student A suggestion involving 2+ data points ✔1

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✔$_1$ *test inverse square:*

e.g. Nh^2 = constant

Evidence of suitable test for student B suggestion involving 2+ sets of data ✔$_2$

✔$_2$ *test exponential:*

e.g. N should decrease by half in equal intervals of h

***OR** test $N = k\,e^{-h}$: show that $N\,e^{h}$ is not constant*

Accept log/ln interpretations of the test.

Both tests performed **AND** rejects both suggestions ✔$_3$

✔$_3$

Expect to see for student A $10 \times 1.0^2 = 10$ and $4 \times 1.34^2 = 7.18$ or similar

Expect to see for student B N = 10 to N = 5 changes h by 0.25 and N = 5 to N = 2.5 changes h by 0.31 or similar

reject both students' suggestions with reasons eg Nh^2 is not constant and N does not fall by the same fraction in equal intervals of h

Allow answer accepting B if a reference to experimental error is made and the difference is small.

3

[8]

Q2.

(a) 4.5×10^{-2} ✔

CAO

1

(b) (short T_1)

so images are not blurred (or wtte)

must refer to quality / property of images, eg 'images are sharp' / 'focused' / 'clear' / 'defined';

allow '(images of) ball are circular' / 'spherical' / 'not elongated' or wtte: accept sketch

'increasing distance between images' / 'image is accurate' are neutral

OR

to determine position of the ball (in each image or wtte) ✔

allow 'to see (point) where ball is' / idea that (centre of) ball needs to be a 'single point' / 'ball does not move during each flash (T_1)'

comments about the motion / trajectory of ball eg 'see a clear pattern' are neutral

comments about the duty cycle / flash rate are neutral

1

(c) correct rearrangement to a three-term equation;

1

$\frac{H-h}{n}$ as the subject eg $\frac{H-h}{n} = \frac{u_0}{f} + \frac{gn}{2f^2}$ $_1$✔

valid suggestion for quantity plotted on *x*-axis;

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allow use of $y = mx + c$ aligned with $\frac{H-h}{n} = \frac{u_0}{f} + \frac{gn}{2f^2}$

suitably annotated to identify x ₂✔

explains how g found using the gradient for **their** x-axis;

insist on g as subject whether explanation is in words or expressed as an equation ₃✔

for ₁✔ *condone* $\frac{H-h}{n} = \frac{u_0}{f} + \frac{g}{2n}\left(\frac{n}{f}\right)^2$

₃✔ *is contingent on* ₂✔*;*

for a correct equation or if no equation is seen mark ₂✔ *and* ₃✔ *as below:*

for ₂✔	for ₃✔
n	g = gradient × $2f^2$
$\frac{n}{2}$	g = gradient × f^2
$\frac{n}{f}$	g = gradient × $2f$
$\frac{n}{2f}$	g = gradient × f
$\frac{n}{f^2}$	g = gradient × 2
$\frac{n}{2f^2}$	g = gradient

for an incorrect equation with n in the 'mx' term allow ECF for ₂✔ *and* ₃✔

2

(d) $n = 17 \pm 1$ ₁✔

¹✔ *expect integer n = 17 ± 1 but see valid unusual approach below*

1

use of $H = \frac{u_0 n}{f} + \frac{g}{2}\left(\frac{n}{f}\right)^2$

OR

use of $H = u_0 t + \frac{1}{2} gt^2$ (eg with t from $\frac{n}{31}$) ₂✔

u_0 correctly evaluated to (minimum) 2 sf ₃✔

for ₂✔ *either approach 'use of' means full substitution without error (with h = 0 shown or implied by omission) so that* u_0 *is the only unknown;*

condone g = ± 9.79 OR ± 9.8(1);

condone POT error / mixed units for H and g

1

valid alternative method:

use of **Figure 1** to determine non-zero h for integer $n > 0$

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for $_1$✔ a valid h for their integer n (≤ 16)

eg when $n = 5$, $h = \frac{89\,(\text{mm})}{99\,(\text{mm})} \times 1550\,(\text{mm}) = 1393\,(\text{mm})$

for $_2$✔ full sub including a valid h for their n

for $_3$✔ u_0 correct for their n and h

eg for $n = 5$ and $h = 1393$, $u_0 = 0.18(4)\ (\text{m s}^{-1})$ $_3$✔

for $_3$✔ see table for u_0 with n = 16 OR 18 AND/OR for the (intermediate) rounding of t;

accept > 3 sf that rounds to values in table:

	subs n, f	truncates t	
expected	t = 17/31	3 sf	2 sf
t / s	(0.548387)	0.548	0.55
u_0 / m s^{-1}	0.14	0.15	0.13

ECF	t = 16/31	3 sf	2 sf
t / s	(0.516129)	0.516	0.52
u_0 / m s^{-1}	0.48	0.48	0.44

ECF	t = 18/31	3 sf	2 sf
t / s	(0.580645)	0.581	0.58
u_0 / m s^{-1}	-0.17	-0.18	-0.17

1

(e) calculates the horizontal velocity;

divides a valid horizontal displacement $s_2 - s_1$ by a time $_1$✔

for $_1$✔ $s_2 - s_1$ in range 490 to 1000 (mm);

*expect time to be found from counting intervals between flashes but allow use of **their (f)** result;*

condone use of distance between contacts with time of $\frac{19}{31}$ and $\frac{20}{31}$;

horizontal velocity in range 1550 and 1650 (mm s^{-1}) $_2$✔

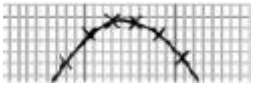
$_2$✔ is not contingent on $_1$✔

allow 2 sf 1.6×10^3 (mm s^{-1})

2

(f) determines h_{max} (at top of bounce) using an annotation to **Figure 3** $_1$✔

eg



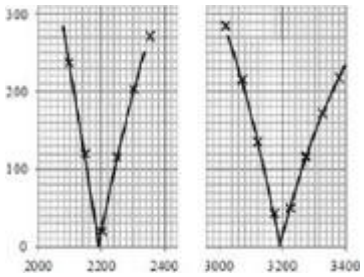
valid attempt to find time t between contacts by using *suvat* with $u = 0$, eg time = $(2\times)\sqrt{\frac{2 \times \text{their } h_{max}}{9.81 \text{ OR } 9.79}}$ $_2$✔

OR

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determines *s* for <u>both</u> contacts OR determines $s_2 - s_1$ using annotations to **Figure 3** $_1$✔

eg



valid attempt to find *t* by = $\frac{\text{their } s_2 - s_1}{\text{their horizontal velocity in 01.5}}$ $_2$✔

time in range 0.61(0) to 0.65(0) (s) $_3$✔

for $_1$✔ annotation should be a smooth curve through (at least) top 4 points, n = 51 to 54; don't insist on seeing a horizontal line to the h axis

for $_2$✔ accept mixed units / POT in substitution / time to maximum height calculated / valid working in ***(e)***

OR

for $_1$✔ annotation should be at least one smooth (allow straight) line to define each contact;

eg (at least) through n = 41/42 OR 43/44 to h = 0 AND through n = 61/62 OR 63/64 to h = 0

for $_1$✔or $_2$✔ accept valid working in ***(e)****;*

accept use of horizontal distance = 1000 (mm)

for $_2$✔do not condone use of integer number of intervals, eg $t = \frac{19}{31} = 0.61(3)$ *OT*

$t = \frac{20}{31} = 0.645$

$_3$✔ is contingent on $_2$✔;

exception: award $_3$✔ for t in range if obtained by estimating a ***non-****integer number of intervals, eg* $t = \frac{19.5}{31}$

3

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