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

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Name of the Student:_____
Max. Marks : 23 Marks **Time : 23 Minutes**

Mark Schemes

Q1.

(a) arrow parallel to slope labelled (M+2m)gsin35 and label parallel to slope labelled tension OR T ✔



Ignore arrows not parallel to ground e.g. weight
Ignore friction
W not acceptable for (M +2m)g

1

(b) T – Mgsin35 = Ma
AND (M+2m)gsin35 – T = (M+2m)a ✔

add two equations

(M + 2m)gsin35 – Mg sin35 = Ma + (M +2m)a ✔

HENCE
(a= mgsin35 / (M+m))

OR
(M +2m)gsin35 – Mgsin35 ✔ (= (2M+2m)a)

a = 2mgsin35 /(2M +2m) ✔

HENCE
(a= mgsin35 / (M+m))

1
1

(c) SECOND MARK CONDITIONAL ON FIRST
mass / impulse / acceleration (of trollies) is the same ✔
momenta (trolley A and B) the same

SECOND MARK CONDITIONAL ON FIRST
both have same <u>speed / magnitude of velocity</u> but different masses ✔
(hence) momentum of A is greater / momenta in opposite directions ✔

1

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1

(d) $\text{acceleration} = \frac{1}{4} \times \frac{30 \times 9.81 \times \sin 35°}{(30 + 95)} = 0.338$ ✔

(use of $v^2 = 2as$)

$v = \sqrt{(2 \times 0.338 \times 9.0)} = 2.47$ ✔

$t = \frac{2.47}{0.338} = 7.3\text{s}$ ✔

OR
(use of $s = 1/2at^2$)
$9 = ½ \times 0.338 \times t^2$ ✔
$t = 7.3$ s ✔

CE from acceleration calculation
If used g for acceleration then no marks awarded

1
1
1

(e) number of journeys = (1800/(12 + 7.3) = 93 or 94 ✔

number of blocks = 2 × 93 = 186 or 2 × 94 = 188 ✔

Allow CE from 06.4
Allow between 93 to 94
Allow CE from incorrect number of journeys
Allow 186 to 188

1
1

[10]

Q2.

(a) $p_0 = 198.4$ (cm) ✔

only acceptable answer

1

(b) all x values correct and recorded to nearest mm ✔

n	p/cm	x/cm
0	198.4	174.6
2	157.0	133.2
4	125.4	101.6
6	101.3	77.5
9	75.4	51.6
13	53.8	30.0

allow ecf for $x = p – 23.8$ if $p_0 \neq 198.4$
penalise 2 sf $x = 30$ for $n = 13$

1

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(c) six values of ln(*x*/cm) recorded consistently i.e. all to (minimum) 2 dp; confirm that value of ln(*x*) for *n* = 6 corresponds to tabulated value of *x* $_1$✔

vertical axis labelled ln(*x*/cm) i.e. bracket required;

suitable vertical scale (points should cover at least half the grid with a frequency of not less than 5 cm) $_2$✔

points plotted for *n* = 0, 2, 4, 6, 9 and 13;

check *n* = 6 point is plotted within half a grid square of tabulated position;

suitable continuous ruled line of negative gradient from *n* = 0 to (at least) *n* = 13 $_3$✔

expected data:

n	*p*/cm	*x*/cm	ln(*x*/cm)
0	198.4	174.6	5.162
6	101.3	77.5	4.350

for n = 0, x = 0, ignore missing or incorrect ln(x) and ignore missing/wrongly-plotted point

for $_2$✔ vertical axis should be labelled ln(x/cm) (note that bracket is essential); expect vertical scale to start at 3 with major divisions of 0.2

for $_3$✔ a suitable line must pass through all points if these have been correctly calculated;

for any errant plotted points the line must be the best line in the opinion of the marker;

line must not be thicker than half a grid square and width must not vary;

points must not be thicker than half a grid square (reject any dots or blobs)

3

(d) graph is <u>linear</u> and has <u>negative</u> gradient ✔

*allow 'straight line' for 'linear'; statement must be confirmed by **Figure 4***

allow 'negative slope' or 'slopes downwards' for 'negative gradient'

no ecf for non-linear graph

1

(e) gradient triangle for **Figure 4;**

correct read offs (± 1 mm) for all points or for both steps in triangle $_1$ ✔

expected gradient result is –0.135

for gradient between –0.139 to –0.133 (allow this intermediate answer shown as a fraction)

award two marks for minimum 3 sf *x* when *n* = 20 in range 11.2 to 12.2 (cm) $_{23}$ ✔✔

OR

one mark for *x* when *n* = 20 in range 10.8 to 12.7 (cm) $_{23}$ ✔

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OR (if gradient out of range)

marker uses candidate's gradient (<u>which must be negative</u>) and
(marker must read off) intercept on Figure 4 to calculate x when $n = 20$

minimum 3 sf result in range ± 4% $_{23}$ ✔✔

OR

1 mark minimum 3 sf result in range ± 8% $_{23}$ ✔

(theoretical result for x when $n = 20$ is 11.7(3) cm)

for $_1$ ✔
allow 1 mark for sufficient evidence of working and a valid calculation of the gradient of a <u>linear</u> graph even if graph has a positive gradient
for $_2$ ✔ and $_3$ ✔
give no credit if graph drawn has a positive gradient
allow 1 mark for using a positive value for the (negative) gradient in the calculation for x when n = 20 (this leads to 2592 cm); result must be in range ± 4% $_{23}$ ✔
allow 'similar triangles' method;
eg $\frac{5.16-3}{16}=\frac{5.16-\ln x_{20}}{20}$ *$_1$ ✔*
ln x_{20} = 2.46 $_2$ ✔; x_{20} = 11.7(0) cm $_3$ ✔
allow ecf x when n = 20 based on Figure 4 if scales used enable value to be read directly using an extrapolated line; do not allow such working to extend beyond the grid into the margin $_1$ ✔; value in range 11.2 to 12.1 cm $_{23}$ ✔ = 1 MAX

3

(f) valid procedure 1

described $_1$ ✔

explained $_2$ ✔;

valid procedure 2

described $_3$ ✔

explained $_4$ ✔

explanation mark ($_2$ ✔) is only awarded when it is relevant to a correct procedure ($_1$✔); one procedure/explanation allowed per response
no credit for conflicting statements or wrong physics
any two from:
repeat experiment and average calculated (p) $_1$✔
to reduce (impact of) random [human] error $_2$✔
and/or
repeat readings to detect anomalies $_1$✔
<u>so these can be discarded</u> (before averaging) $_2$✔
and/or
view air track at right angles [at eye level] $_1$✔

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to reduce [eliminate] (impact of) parallax error $_2$✔

and/or

repeat experiment with track direction reversed and average calculated (p) $_1$✔

to account for the effect of non-level bench $_2$✔

and/or

use <u>video</u> (camera) technology [or a <u>motion sensor</u> linked to a <u>data logger</u> or <u>laser ranger</u>] to view [record] the position of the glider as it reaches the top of the track $_1$✔

to reduce (impact of) random [human] error [to identify and eliminate anomalous results] $_2$✔

reject any suggestion that involves changing the glider, its initial position on the track or the air track itself including the position of the scale

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[13]

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