Prelim 2022 P3

Qn			Marks
1	(a)	**MMO** Metre rule clamped in stand and aligned vertically with bench using a set-square and Reading taken when mass hanger A is not moving or Repeated readings taken to obtain average height	2
	(b)	**MMO** $\frac{2.76+2.75+2.82+2.50}{4} = 2.71\ s$	1
	(c)	**MMO** M_A =60 g	1
	(d)	**PDO** $P = \frac{0.060 \times 10 \times 1.0}{2.71}$ = 0.221 J/s	1
	(e)	**PDO** $t_1 = \frac{1.40+1.38+1.26+1.42}{4}$ = 1.37 s $P_1 = \frac{0.070 \times 10 \times 1.0}{1.37}$ = 0.511 J/s	1
	(f)	**P** • the quantities that you should keep constant, ✓ the height *h* that mass hanger A falls through ✓ mass of mass hanger B ✓ the same type of string across the pulley ✓ the same pulley	1
		• a detailed description of how you will perform the experiment, a. Set up the apparatus as shown in Fig. 1.1. b. Adjust the position of the clamp so that the height h = 1.000 m for mass hanger A and mass hanger B is at rest on the floor. c. Carefully place a 10 g slotted mass on mass hanger A and hold this mass hanger in position. d. Release the mass hanger A and start the stop watch. e. Measure and record the mass of mass hanger A, mass hanger B and the average time taken for mass hanger A to fall to the floor in a table. f. Repeat steps (b) to (e) for 5 more sets of readings of average time taken for additional mass added to the mass hanger A. g. Calculate the $\frac{1}{t^2}$ / s^{-2} using the values for the average time taken.	1

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- a suitable table in which to display your measurements and calculated values (you do not need to enter any data into the table),

<table>
<tr><th rowspan="2">M_A / g</th><th rowspan="2">M_B / g</th><th rowspan="2">$1/(M_A - M_B)$ / g^{-1}</th><th colspan="3">time taken to fall height h</th><th rowspan="2">t^2 / s^{-2}</th></tr>
<tr><th>t_1 / s</th><th>t_2 / s</th><th>$t = (\frac{t_1 + t_2}{2})$ / s</th></tr>
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- a statement of the graph that you would plot to test the relationship,

Plot a graph of t^2 / s^{-2} against $1/(M_A - M_B)$ / g^{-1}

If the relationship is valid, $1/(M_A - M_B)$ will be linearly related to t^2 with a positive gradient.

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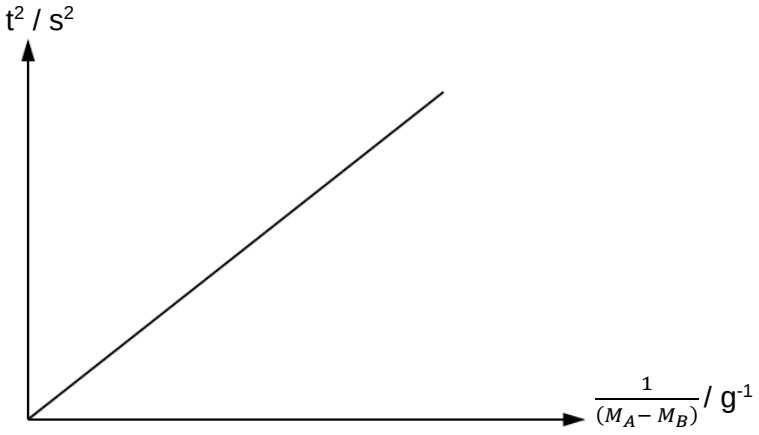
- a sketch of the graph that you would obtain if the suggested relationship is correct,



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- an explanation of how you would obtain a value of the constant *k* from your graph.

Constant k is the gradient of the graph plotted.

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<tr><td>2</td><td>(a)</td><td>

MMO

$f = \frac{10.0+10.0}{2}$

f = 10.0 cm

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	(b)	**MMO** x = 15.0 cm y = 30.0 cm	1 1
	(c)	**MMO** $f = \frac{(\mathbf{15})(\mathbf{30})}{\mathbf{15+30}}$ = 10.0 cm (9.0 to 11.0 cm)	1 1
	(d)	**ACE** ✓ The lens should be placed upright and parallel to the screen. This can be checked with a set square. ✓ Object must be directed at the centre of the lens ✓ The torchlight (the source), the lens and the screen must lie along a straight line. ✓ Avoid parallax error in reading from ruler scale by looking at right angle to it.	1
	(e)	**ACE** The image size becomes smaller and equal to object size, the image distance becomes nearer and equal to object distance.	1 1
3(a)		V_0 = 1.50 V **MMO** V_0 measured to appropriate no. of d.p. to the nearest 0.05 V with correct units	1
(b)		When taking reading from the voltmeter, view the pointer perpendicularly such that it covers its image in the reflecting strip to avoid parallax error. **ACE** Suggested reason directly addresses precision of apparatus used to record measurement.	1
(d)		V = 0.30 V I = 0.03 A **MMO** V measured to appropriate no. of d.p. to the nearest 0.05 V with correct units I measured to appropriate no. of d.p. to the nearest 0.01 A with correct units	1 1

(e)

x / cm	V / V	I / A
10.0	0.10	0.04
20.0	0.15	0.04
30.0	0.20	0.03
40.0	0.25	0.03
50.0	0.30	0.03
60.0	0.35	0.03
70.0	0.40	0.03
80.0	0.45	0.03
90.0	0.50	0.03

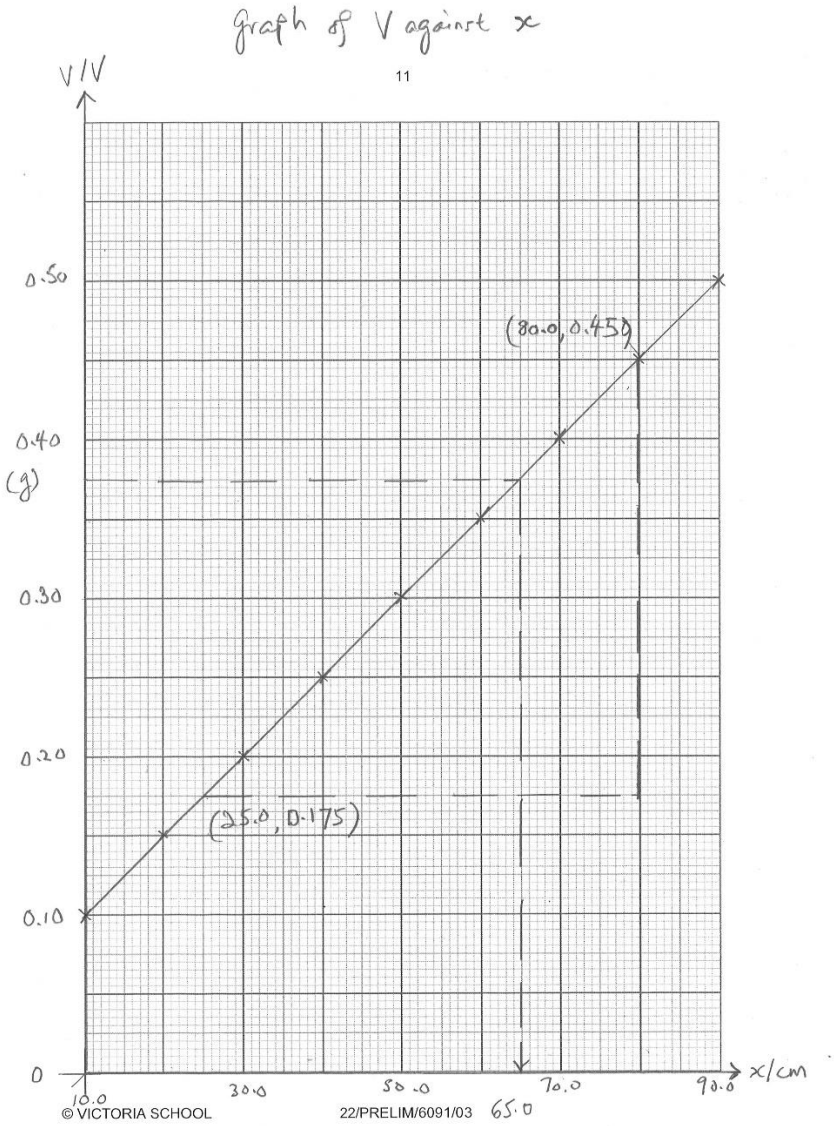
PDO
Column headings with quantities x, V and I correct units. 1

PDO
all values of x, V and I recorded to the correct no. of d.p. and s.f. 1

MMO
At least 6 sets of data with at least a range of 50.0 cm, and correct trend: as x ↑ , V ↑ 1

ACE
correct measurement of *I* with correct trend 1

(f)



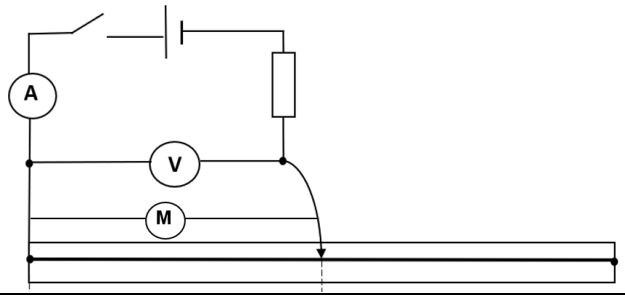
PDO
axes labelled with units and correct orientation — 1

PDO
Suitable scale, not based on 3, 6, 7 etc., with plotted data occupying ≥ half the page — 1

PDO
all points plotted correctly (points must be ≤ ½ small square from the correct position) — 1

PDO
best fit line — 1

(g)	x' = 65.0 cm **ACE** Dotted horizontal line drawn from 0.375 V to best fit line, and dotted vertical line drawn from that point to horizontal axis Correct reading of x-coordinate		 1 1
(h)	**1.**	$R = 2\sigma x'$ R = 2 (25.0)(65.0/100) R = 32.5 Ω **ACE** Correct substitution of x' from (g), and expressed R in correct no. of s.f. and units.	 1
	2.	There exists experimental errors such as the overheating of wires, kinks and bends in the wire and internal resistance of battery. **ACE** Suggestion is based on theoretical understanding of the experiment and shows understanding of the limitations in the apparatus used.	 1
(i)	G = $\frac{0.450-0.175}{80.0-25.0}$ = $\frac{0.275}{55.0}$ G = 5.00×10^{-3} V/ cm **ACE** Hypotenuse of gradient triangle larger than half the length of the best fit line Coordinates of gradient triangle shown on graph G computed correctly to the appropriate no. of s.f.		 1 1

(j)	Motor should be connected in parallel with the resistance wire so that the potential difference across the motor varies by 5.00×10^{-3} V /cm along the wire over the range of 0 V, when x = 0 cm, to 0.50 V, when x = 90.0 cm. As $P = \frac{V^2}{R}$, this varies the power output and thus the speed of the motor. **ACE** Explanation is clear with reference to results Position of motor correct drawn [do not accept if motor not connected to jockey]  	 1 1

MMO – 13

PDO – 8

ACE – 13

P – 6

Total: 40 marks

Practical Assessment (Paper 3)

Paper 3 will assess appropriate aspects of objectives C1 to C6 in the following skill areas:

- Planning (P)
- Manipulation, measurement and observation (MMO)
- Presentation of data and observations (PDO)
- Analysis, conclusions and evaluation (ACE)

The assessment of Planning (P) will have a weighting of 15%. The assessment of skill areas MMO, PDO and ACE will have a weighting of 85%.