Question 1(a)	Answer MMO				
	h in the range of 6.5 to 6.9 cm with a precision of 0.1 cm and correct unit given.	1			
	Show working of more than one measurement of the height is taken and average is determined.	-			
	MMO	1			
1(b)(i)	Show at least 2 sets of readings obtained and average is determined. average $t_1 = 2.32$ s				
(b)(ii)	$x_1 = 0.989$ m. Answers to correct precision and unit	1			
	ММО				
1(c)(i)(ii)	Show at least 2 sets of readings obtained and average is determined. average $t_2 = 1.64$ s $X_2 = 0.489$ m. Answers to correct precision and unit	1			
	PDO				
1(d)	Correct s.f. (2 or 3 s.f.) Correct unit written Accuracy to between 0.135 m/s ² to 0.289 m/s ² . (Human reaction time error is \pm 0.3 s) ACE				
1(e)	Based on the students' value and give an appropriate justification				
1 (f)	ACE				
	The angle $ heta$ can be increased by moving block B towards the centre of gravity of the metre rule.	1			
	X	1			

x θ h

1

2(a)	ММО					
(i)	$V = 75.0 \text{ cm}^3$ (Correct precision and unit used)					
(ii)	$T_{ m i}$ is a sensible room temperature value precise to 0.5 °C with correct unit					
2(b)	MMO					
(i)	Final temperature of liquid = 68.0 °C					
(ii)	ΔT = 43.0 °C. Correct subtraction, precision and unit					
2(c)	PDO P = (43.0 x 75.0 x 1.05 x 4.0) / (2.0 x 60) = 110 W or 113 W Correct substitution of values. Working must be shown Correct s.f. (2 or 3 s.f.) Correct unit written					
2(d)	ACE Reduce the time taken to heat the liquid. By reducing the time, the final temperature will be lower and hence less thermal energy is lost to the surrounding. The change in temperature recorded will be more accurate. Or: Bring the Bunsen burner nearer to the beaker when heating so that less thermal energy is lost to the surrounding. The change in temperature recorded will be more accurate.	1				
2(e)	 Independent variable: volume of liquid Dependent variable: change in temperature Control variable: 1. Initial temperature of the liquid. Start the investigation at the same room temperature. 2. time taken to heat the liquid. Keep this time to 2.0 minutes Procedure: 1. Measure the volume, V = 50 cm³ of liquid A and transfer it into the 100 cm³ beaker. Measure and record the temperature, <i>T</i>_i of the liquid. 2. Calculate and record 1/V. 	2				
	 3. Heat the beaker of liquid strongly for time <i>t</i> = 2.0 minutes using a Bunsen burner. At the end of 2.0 minutes, measure and record the final temperature of the liquid, <i>T</i>_f. 4. Calculate the change in temperature of the liquid, Δ<i>T</i>. 5. Repeat step 1 to 4 for five more different sets of volume of liquid A. 6. Plot a graph of change in temperature, Δ<i>T</i> against volume of liquid, 1/<i>V</i>. 	1				
	Δ1 / °C 1/V/ cm ⁻³	1				

Determine the gradient of the straight line graph. The value of K is the gradient of the straight line obtained.

Question	Answer							
3(a)(i)	MMO							
	V _{AB} =1.45 V (sensible reading, 2dp correct unit)							
3(a)(ii)	$\frac{1}{1}$ = 0.690 V ⁻¹ (3 sf, correct unit)							
	v_{AB}							
	$\frac{1}{R} = 1/10 = 0.10 \ \Omega^{-1}$ (2 sf, correct unit)							
3(b)	V _{AB} =2.00 V							
2()	$R = 10 + 10 = 20\Omega$							
3(C)	$V_{AB} = 1.00 V (\pm 10\%)$							
	$\frac{1}{R}$ = 1/10 +1/10 = 1/20 (working must be shown)							
2(1)								
3(d)				1 1	4			
	R/Ω	1/R/Ω⁻¹	V/V	1/V/V ⁻¹				
	5.0	0.20	0.95	1.05				
	10	0.10	1.45	0.690				
	15	0.067	1.80	0.555				
	20	0.050	2.00	0.500				
	30	0.033	2.30	0.435				
	40	0.025	2.45	0.408				
	50	0.020	2.55	0.392				
	60	0.017	2.65	0.377				
	Range ($R \ge 25$) [1] 5 Set of values with 5 Ω , 10 Ω and 20 Ω included in table [1] Calculation (all checked and correct) and least or plus 1 for sf [1]							
3(f)	On graph Label of axes [1] Suitable scale [1] 5 points marked with small crosses [1] Best fit line drawn cutting y axis [1]							
3(g)(i)	Triangle to find gradient clearly shown on graph							
	Calculation shown either on graph paper of answer booklet							
	$Q = 3.67 \Omega V^{-1}$							
3g(ii)	P = 0.315 V ⁻¹ 1m for value read from graph to $\frac{1}{2}$ a square and 1m for unit							
3h When covered by black paper light intensity decreases and resistance LDR increases. Hence V _{ldr} will increase.								