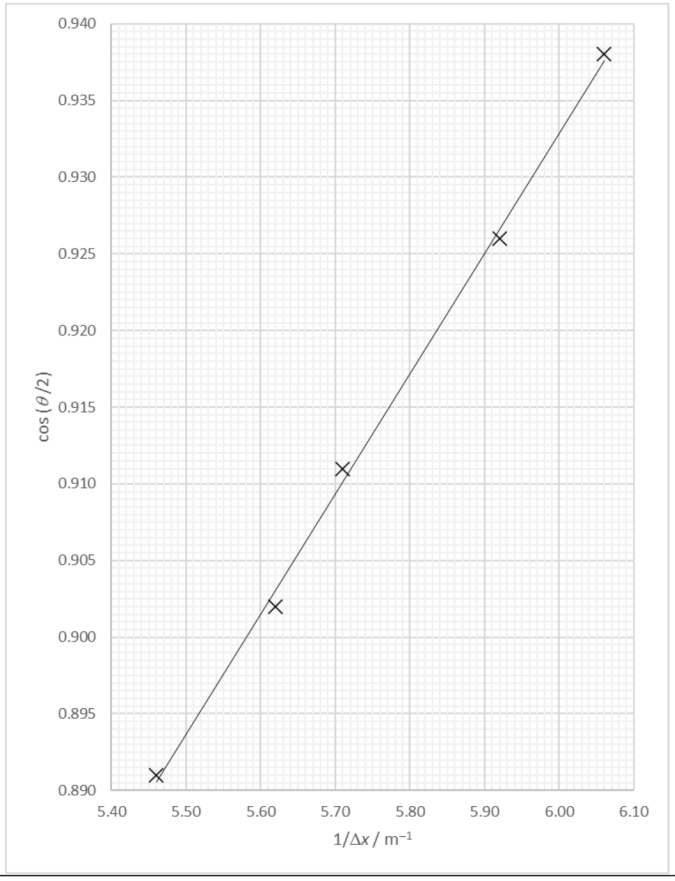
Question Number	Answer	Mark
4(a)	**EITHER** • The elastic cord may snap **(1)** • So, wear safety goggles **Or** use a safety screen **(1)** **OR** • The stands may topple over **(1)** • Clamp stands to the bench **Or** put a heavy mass on the stand base **(1)** **OR** • The mass may fall **(1)** • Wear safety gloves/boots **Or** keep hands/feet away from under the mass **Or** place cushion/box under the mass **(1)** MP2 is dependent on MP1	**2**
4(b)(i)	**Mark 4(b)(i) and (b)(ii) holistically** **Max TWO from** • Parallax error when using the metre rule [accept x] **Or** parallax error when using the protractor [accept θ] **(1)** • Error measuring θ due to thickness of cord **(1)** • (Zero of) protractor/rule not aligned correctly **Or** protractor/rule may move while measuring **(1)** • Applying an additional force to the cord while measuring **Or** cord/mass may move while measuring **(1)**	**2**
4(b)(ii)	**Max ONE from** • Ensure viewing measurement perpendicular to protractor/rule **Or** hold the protractor/rule close to the cord **(1)** • Mark the position of the centre of the cord **(1)** • Clamp metre rule and/or protractor **(1)** • Ensure the protractor/rule does not touch the cord/mass **(1)** [suggested modification must be linked to a source of uncertainty mentioned in (b)(i)]	**1**
4(c)(i)	• $\cos\left(\frac{\theta}{2}\right) = \left(\frac{mg}{k}\right)\frac{1}{x}$ is in the form $y = mx\ (+ c)$ **Or** gradient $= \frac{\cos\left(\frac{\theta}{2}\right)}{\frac{1}{x}}$ **(1)** • So, the gradient is $\left(\frac{mg}{k}\right)$ **Or** $g = \frac{\text{gradient} \times k}{m}$ **(1)**	**2**

Question Number	Answer		Mark
4(c)(ii)	• Correct values of $\frac{1}{\Delta x}$ rounded to 3 s.f. • Labels axes with quantities and units • Sensible scales • Plotting • Line of best fit	**(1)** **(1)** **(1)** **(2)** **(1)**	**6**

$\cos\left(\frac{\theta}{2}\right)$	Δx / m	$\frac{1}{\Delta x}$ / m^{-1}
0.938	0.165	6.06
0.926	0.169	5.92
0.911	0.175	5.71
0.902	0.178	5.62
0.891	0.183	5.46



4(c)(iii)	• Calculates gradient using large triangle • Gradient value between 0.076 and 0.079 (m) • Gradient rounded to 2 or 3 s.f. Example of calculation gradient = (0.9405–0.8935)/(6.1–5.5) = 0.047/0.6 = 0.078	**(1)** **(1)** **(1)**	**3**
4(c)(iv)	• Use of gradient = mg / k • Correct value of g from gradient given with a correct unit [ecf from 4(c)(iii)] Example of calculation $g = = \frac{\text{gradient} \times k}{m} = \frac{0.078 \times 145}{1.2} = 9.43$ m s^{-2}	**(1)** **(1)**	**2**
	Total for question 4		**18**