Name of the Student:_____
Max. Marks : 22 Marks **Time : 22 Minutes**

Mark Schemes

Q1.

Question Number	Acceptable Answers	Additional guidance	Mark
	• Light rays pass through the image **Or** Light rays converge to a point where the image is formed (1)		1

Q2.

Question Number	Acceptable answers	Additional guidance	Mark
(i)	• Object/star is at infinity, so (intermediate) image formed at focal length of objective lens (1) • (Final image at infinity), so object (intermediate image) must be at focal length of eyepiece lens (1) **Or** • Objective lens, $1/v + 1/u = 1/f$, and u = infinity, so $v = f$ • Eyepiece lens, $1/v + 1/u = 1/f$, v = infinity so $u = f$	Appropriate references to parallel rays may be equivalent to object/image at infinity Example Objective: $1/v + 1/u = 1/f$, $u = \infty$, so $1/v + 1/\infty = 1/f$ $1/v + 0 = 1/f$ $v = f$ Eyepiece: $1/v + 1/u = 1/f$, $v = \infty$, so $1/\infty + 1/u = 1/f$ $0 + 1/u = 1/f$ $u = f$ Note: If both lenses are considered, $1/v + 1/u = 1/f$ does not have to be quoted twice	2

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Question Number	Acceptable answers	Additional guidance	Mark
(ii)	• The rays cross over after the objective lens **Or** (1) • The objective lens inverts the image **Or** • The image formed by the eyepiece lens is on the same side as its object, so remains the same way up		1

Q3.

Question Number	Acceptable Answer	Additional Guidance	
(i)	• Wear safety glasses (to protect eyes from breaking wire) **Or** wear suitable footwear (to protect feet from falling masses) **Or** place sand tray under masses (to catch them if they fall)		1

Question Number	Acceptable Answer	Additional Guidance	
(ii)	• $\lambda = 2L$ substituted into $v = f\lambda$ (1) • v substituted into $v = \sqrt{\frac{T}{\mu}}$ (1) • Correct re-arrangement into $y = mx + c$ format (1)	$v = f\lambda$ and $\lambda = 2L$ so $v = 2fL$ $v = \sqrt{\frac{T}{\mu}}$, so $4f^2L^2 = \frac{T}{\mu}$ $L^2 = \left(\frac{T}{4\mu}\right).\frac{1}{f^2}$, so gradient is $\frac{T}{4\mu}$	3
(iii)	• Gradient calculated (1) • Use of gradient = $\frac{T}{4\mu}$ (1) • $\mu = 1.8$ (g m^{-1}) (1) • SWG consistent with their calculated value of μ (24 swg) (1)	Example of calculation gradient = $\frac{(0.043 - 0)\text{m}^2}{(15.0 - 0.0) \times 10^{-6}\text{s}^2} = 2.87 \times 10^3\text{m}^2\text{s}^{-2}$ $\mu = \frac{2.1\text{ kg} \times 9.81\text{ m s}^{-2}}{4 \times 2.87 \times 10^3\text{m}^2\text{s}^{-2}} = 1.79 \times 10^{-3}\text{ kg m}^{-1}$ $\therefore \mu = 1.79\text{ g m}^{-1}$	4

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Q4.

Question Number	Acceptable Answer	Additional Guidance	
	• Waves are reflected from the opposite bridge **(1)** • Waves meet in phase (at mid-point of wire) and superpose **(1)** • Constructive interference occurs giving a maximum displacement **(1)**		**3**

Q5.

Question Number	Acceptable Answer	Additional Guidance	
(i)	An explanation that makes reference to the following points: **Either** • Take readings in different positions/orientations along the wire (and calculate a mean) (1) • As wire diameter may not be uniform (1) **OR** • Check (and correct for) for zero error (1) • Zero error reduces the accuracy of the measurement (1) Or Zero error moves the value away from the true value	**Accept:** use ratchet to close up micrometer to avoid squashing the wire MP2 accept cross section for diameter MP2: accept to reduce the effect of random error MP2 accept systematic error not changed by repeat measurements	**2**

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