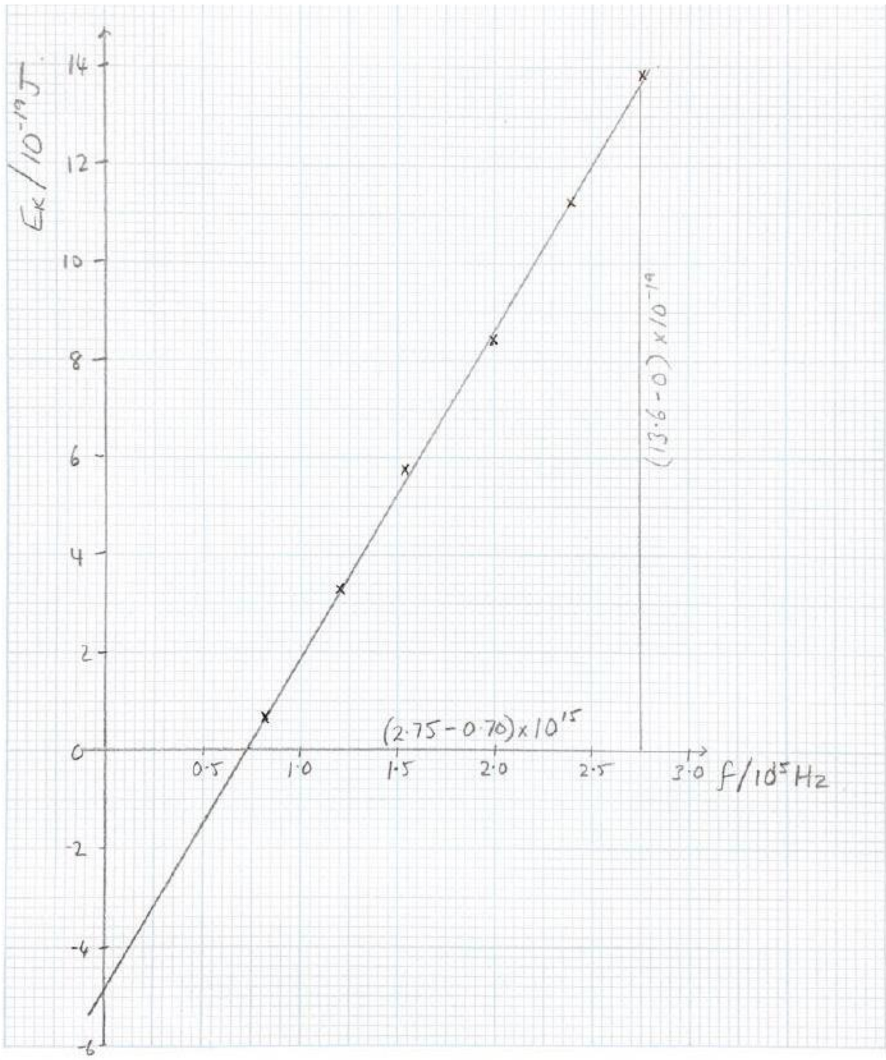
Mark scheme (Unused)

January 2022

Pearson Edexcel
International Advanced Subsidiary Level
in Physics (WPH13)
Paper 1

Question Number	Answer	Mark
1ai	Use a water bath and measure temperature of water (1) Use ice to bring water down to 0 °C (1)	**2**
1aii	Minimise the time between removing ball from the water bath and dropping it (1) Because the ball changes temperature as soon as it is removed from the water bath (1) **OR** Keep the ball in the water for sufficient time (1) So that ball is at same temperature as the water (1) **OR** Stir the water (1) To ensure the water is all at the same temperature (1) (ai and aii to be marked holistically)	**2**
1b	Keep ball near to the metre rule (1) View bounce height perpendicular to the metre rule (1) Measure to the bottom of the ball (1) Use a video camera (1) [Scrutiny comment: the bottom of the ball should be in line with the zero on the metre rule when the ball is released?]	**Max 2**
1c	Hot water can cause burns (1) Handle ball with tongs **Or** wear safety glasses to prevent splashes to eyes (1) **Or** Clamp beaker to avoid knocking it over when ball removed quickly	**2**
1d	**Max two from:** No unit for temperature (1) Temperature does not start at zero (1) Mean not given to consistent significant figures (1) Only mean bounce height recorded (1)	**2**
1e	There is a linear relationship (1) (But) it is not proportional **Or** the line does not pass through the origin **Or** best fit line drawn that does not pass through origin (1)	**2**
1fi	Zero error (allow systematic error) (1)	**1**
1fii	Subtract 2.1 °C from all readings (1)	**1**
	Total for question	**14**

Question Number	Answer		Mark
2a	Measure x using a second metre rule	(1)	
	Ensure second metre rule is vertical using a set square	(1)	
	(allow spirit level or plumb line instead of set square, **Or** align with door or window frame)		
	Use set square (between second metre rule and loaded metre rule) to reduce parallax error	(1)	**3**
2b	Micrometer or vernier callipers	(1)	
	Repeat and calculate a mean	(1)	
	Take readings at different places along the metre rule	(1)	**3**
2ci	Mean x = <u>278</u> (mm)	(1)	
	Use of half range **Or** maximum difference from the mean	(1)	
	%U = 2 % (1 or 2 sf)	(1)	**3**
	<u>Example Calculation.</u>		
	Mean x = (272+276+279+283)/4 = 278 mm		
	%U = (5.5 / 278) × 100 = 2.0 %		
2cii	Use of $E = \frac{4l^3W}{xwt^3}$	(1)	
	$E = 1.14 \times 10^{10}$ (Pa) (ecf from ci)	(1)	
	Use of 4% of given value of E.	(1)	
	E is above upper limit so student's results do not agree	(1)	**4**
	(allow method using 2% uncertainty in value of x)		
	<u>Example Calculation.</u>		
	$E = (4 \times (0.800\text{ m})^3 \times 5.80\text{ N}) / (0.278\text{ m} \times 3.00 \times 10^{-2}\text{ m} \times (5.00 \times 10^{-3}\text{ m})^3)$		
	$E = 1.14 \times 10^{10}$ (Pa)		
	$10.8 \times 10^9\text{ Pa} \times 1.04 = 1.12 \times 10^{10}\text{ Pa}$		
	Total for question		**13**

Question Number	Answer	Mark
3a	Compares $E_\mathrm{k} = hf - \phi$ to y=mx+c (may be implicit) (1) Identifies h as gradient [or m] and states this is constant (1)	**2**
3b	y-axis labelled E_k / 10^{-19} J and x-axis labelled f / 10^{-15} Hz (1) Sensible scales (1) Plotting (2) Line of best fit (1)	**5**
3c	ϕ in range 4.6×10^{-19} J to 5.0×10^{-19} J (1) Large triangle for gradient (1) h in range 6.5 – 6.7 Js (1) <u>Example Calculation.</u> ϕ found from y axis intercept Gradient = 13.6×10^{-19} J / $(2.75 \times 10^{-15} - 0.70 \times 10^{-15})$ = 6.6×10^{-34} Hz h = gradient = 6.6×10^{-34} Js  	**3**
	Total for question	**10**

Question Number	Answer		Mark
4ai	Vernier reading = 3.34 cm	(1)	**2**
	s = 0.08 cm	(1)	
	<u>Example Calculation.</u>		
	3.34 cm – 3.26 cm = 0.08 cm		
4aii	Uncertainty = 0.01 cm	(1)	**2**
	Percentage uncertainty = 13 % (allow ecf from ai)	(1)	
	<u>Example Calculation.</u>		
	Uncertainty = 2 × 0.005 cm = 0.01 cm		
	Percentage uncertainty $= \frac{0.01}{0.08} \times 100 = 13$ %		
4bi	There is a whole number of wavelengths path difference between the light arriving from the two different slits / sources	(1)	**2**
	So the waves arrive at the screen in phase	(1)	
4bii	Uncertainty in locating the centres of the bands is constant	(1)	**2**
	Measuring a larger distance decreases the percentage error	(1)	
4ci	Use of $w = \frac{\lambda D}{s}$ with $w = \frac{60}{5}$ mm	(1)	**2**
	$\lambda = 6.7 \times 10^{-7}$ m	(1)	
	<u>Example Calculation.</u>		
	$w = \frac{60}{5} = 12$ mm		
	$\lambda = \frac{0.012\text{ m} \times 3.0 \times 10^{-4}\text{ m}}{5.4\text{ m}} = 6.67 \times 10^{-7}$ m		
4cii	$\%U_D = 0.19$ %	(1)	**3**
	$\%U_w = 1.7$ %	(1)	
	$\%U_s$ is the largest value so s is most significant	(1)	
	<u>Example Calculation.</u>		
	$\%U_D = (0.01\text{ m} / 5.4\text{ m}) \times 100 = 0.19$ %		
	$\%U_w = (1\text{ mm} / 60\text{ mm}) \times 100 = 1.7$ %		
	3.2 % > 1.7 % and 0.19 %		
	Total for question		**13**