Multiple Choice Answers

Q20: A

Q21: D

Q23: C

Multiple Choice Answers

Q22: A

1	**Defining the problem**
	vary r and measure v **or** r is the independent variable and v is the dependent variable
	keep x constant
	Methods of data collection
	labelled diagram of workable experiment including: • one end of spring resting against block clamped to bench using G-clamp • light gate positioned at P • light gate connected to timer • apparatus shown on bench • labels for light gate **and** P **and** at least one other label from bench, block, stand, spring, ball, timer
	method to determine r, e.g. use calipers or micrometer to measure diameter d **and** $r = d / 2$
	description of method to determine v, use diameter of ball (to interrupt beam) ÷ measured time at light gate positioned at P
	instrument to determine x, e.g. rule(r) or calipers
	Method of Analysis
	plot a graph of $(2 \lg v)$ or $(\lg v^2)$ against $\lg r$ **or** plot a graph of $(\lg v)$ against $(\lg r)$ or equivalent, e.g. $(\ln v)$ against $(\ln r)$
	$n = -$gradient for $(2 \lg v)$ or $(\lg v^2)$ against $\lg r$ **or** $n = -2 \times$ gradient for $(\lg v)$ against $\lg r$

1	$Y = \frac{\rho \times 10^{y\text{-intercept}}}{kx^2}$ for (2 lg v) or (lg v^2) against lg r **or** $Y = \frac{\rho \times 10^{2 \times y\text{-intercept}}}{kx^2}$ for (lg v) against lg r	
	Additional detail including safety considerations	
	D1	precaution to <u>prevent ball leaving bench</u>, e.g. screens around apparatus / cushions on bench (to stop the ball)
	D2	keep k **and** ρ constant
	D3	description of method to determine k, e.g. add mass to spring and $k = mg$ / extension **or** use newton meter to measure force applied to spring and k = force / extension **or** take several readings of force and extension, plot a force–extension graph and k = gradient
	D4	description of experimental method to determine ρ, e.g. measure mass of ball using a balance **and** $\rho = \frac{m}{\frac{4}{3}\pi r^3}$
	D5	repeat measurements of <u>diameter</u> or <u>d</u> in different directions <u>and</u> determine the average value of d
	D6	method to keep x constant, e.g. use a pin / ruler / card to indicate the starting point each time <u>to keep x constant</u>
	D7	x = original length of spring – <u>compressed</u> length of spring
	D8	adjust (vertical) position of light gate so that the diameter of (each) ball cuts the beam
	D9	repeat experiment for the same value of r **and** determine the average v

1	D10	relationship valid <u>if</u> a straight line is produced (with y-intercept = $\lg\left(\frac{Ykx^2}{\rho}\right)$ or $\frac{1}{2}\lg\left(\frac{Ykx^2}{\rho}\right)$). Do not accept line through the origin.

Multiple Choice Answers

Q20: D

5(a)	the ratio of stress to strain
5(b)(i)	$A = FL / Ex$
	A = e.g. $(500 \times 0.81) / (95 \times 10^9 \times 4.0 \times 10^{-3})$
	$A = 1.1 \times 10^{-6}\ m^2$
	OR $A = kL / E$ **or** A = gradient $\times$ L / E k = e.g. $500 / 4.0 \times 10^{-3}$ $k = 1.25 \times 10^5$
	$A = 1.25 \times 10^5 \times 0.81 / 95 \times 10^9$
	$A = 1.1 \times 10^{-6}\ m^2$

5(b)(ii)	$E = ½ kx^2$ **or** $E = ½ Fx$ **or** E = area (under graph)
	$(\Delta)E = ½ \times 1.25 \times 10^5 \times ((3.0 \times 10^{-3})^2 – (2.0 \times 10^{-3})^2)$ **or** $(\Delta)E = (½ \times 375 \times 3.0 \times 10^{-3}) – (½ \times 250 \times 2.0 \times 10^{-3})$ **or** $(\Delta)E = ½ \times (375 + 250) \times 1.0 \times 10^{-3}$
	work done = 0.31 J

4(a)	stress per unit strain
4(b)(i)	straight line with positive gradient passing through origin
4(b)(ii)	spring constant
4(b)(iii)	elastic potential energy (stored in wire)
4(c)	length (of Q) is half (the length of P)
	extension is proportional to length, and inversely proportional to area and Young modulus
	extension of Q is $= ½ / (2 \times 2)$ $= ⅛$ times the extension of P