

Multiple Choice Answers

Q13: B

Q14: C

Q16: B

Multiple Choice Answers

Q9: A

3(a)	an arrow horizontally on the page to the left labelled F
	two arrows horizontally on the page to the right each labelled T
3(b)(i)	$T = 110 / 2$ $= 55 \text{ N}$
3(b)(ii)	$x = F / k$
	$= 110 / 250$
	$= 0.44 \text{ m}$
3(c)(i)	extension $= 55 / 250$ or $110 / (2 \times 250)$
	extension $= 0.22 \text{ m}$
3(c)(ii)	$E = \frac{1}{2} Fx$ or $E = \frac{1}{2} kx^2$ or $E = \frac{1}{2} F^2 / k$
	$E_1 / E_2 = (\frac{1}{2} \times 110 \times 0.44) / (2 \times (\frac{1}{2} \times 55 \times 10.22))$
	or
	$E_1 / E_2 = (\frac{1}{2} k \times 0.44^2) / (2 \times (\frac{1}{2} k \times 0.22^2))$
	or
	$E_1 / E_2 = (\frac{1}{2} \times 110^2 / k) / (2 \times (\frac{1}{2} \times 55^2 / k))$
	$E_1 / E_2 = 2.0$ (no ECF from 3(b)(ii) and 3(c)(i))

2(a)	Raw values of d to the nearest mm and final value in range 5.00 to 7.00 cm.
2(b)	Correct calculation of T given to 3 or 4 significant figures
2(c)(i)	Raw value (s) of x to nearest mm
	Evidence of repeat readings of x
2(c)(ii)	Absolute uncertainty of 2 mm to 6 mm and correct method of calculation to obtain percentage uncertainty in x . If several readings have been taken, then the absolute uncertainty can be half the range, provided the working is shown clearly, but not zero if values are equal.
2(c)(iii)	Correct calculation of y
2(d)	Second value of T
	Second value of x
	Quality – second x less than first x
2(e)(i)	Two values of k calculated correctly. Final values not written as fractions or given only to one significant figure.
2(e)(ii)	Justification based on the significant figures in T , x and y .
2(f)	Calculation of percentage difference between candidate's two k values.
	Comparison of percentage difference with 20% leading to a consistent conclusion.
2(g)(i)	1 mark for each point up to a maximum of 4.
	A Two readings are <u>not enough to draw a conclusion</u> owtte e.g. reference to relationship OR Not enough k values to draw a conclusion.
	B Difficulty with F with reason, e.g. maintaining steady reading or 5.0 N / keeping newton meter steady / checking value of F at the same time as measuring x / holding newton meter horizontally / zero error on newton meter
	C x has a large percentage uncertainty.
	D Difficulty with x with reason e.g. parallax / no reference point at start or end position / hard to hold ruler steady / checking newton meter at the same time as measuring x (<i>award checking newton meter/checking value of F only once</i>).
	E Friction over nails affects I .
	F Difficulty with g with reason e.g. nails not aligned vertically / judging the centre of the nails
2(g)(ii)	1 mark for each point up to a maximum of 4.
	A Take more readings (for different values of M) <u>and</u> plot a graph OR calculate more k values <u>and</u> compare.
	B Clamp newton meter / use (spirit) level to ensure newton meter is horizontal / video / record / film with newton meter and ruler in view / use mass hanger over pulley
	C Increase d / increase F / decrease T
	D Use of a vertical reference e.g. plumb line / string between bottom two nails / grid behind string / clamped pointer (for x) or clamped ruler (for x)
	E Replace nails with pulleys / use smoother string with example e.g. waxed thread / nylon string
	F Use plumb line / measure from the top of one nail to the top of the other nail owtte / use (vernier) caliper and subtract or add diameter (<i>award plumb line only once</i>).

Multiple Choice Answers

Q13: D