**Question 17** (Answer: **B**)

- Convert the mass first: 100 g $= 0.100$ kg.
- $\Delta E_p = mgh = 0.100 \times 9.81 \times 10 = 9.81$ J.
- That is about 10 J; D comes from leaving the mass in grams.

**Question 18** (Answer: **C**)

- Gravitational potential energy is non-zero while he is above the ground.
- Elastic potential energy is non-zero only once the cord has gone taut and begun to stretch.
- Kinetic energy is non-zero only while he is moving, so all three overlap only on the way down as he decelerates – at the bottom he is stationary.

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**Question 17** (Answer: **C**)

- The derivation uses $W = Fs$, then $F = ma$, then $v^2 = u^2 + 2as$ to replace $s$.
- Substituting $s = v^2/2a$ into $W = mas$ gives $W = \frac{1}{2}mv^2$ directly.
- $E = \frac{1}{2}Fs$ is not a standard equation and plays no part in it.

**Question 18** (Answer: **A**)

- Gravitational potential energy depends only on the start and end heights, not on the path.
- X is at 2.4 m and Y at 1.8 m, so the change in height is $2.4 - 1.8 = 0.6$ m.
- D adds the descent and the rise together, but they partly cancel.

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**Question 17** (Answer: **B**)

- Only the *difference* in height matters: $58 - 32 = 26$ cm $= 0.26$ m.
- Energy conservation gives $\frac{1}{2}mv^2 = mg(0.26)$.
- $v = \sqrt{2 \times 9.81 \times 0.26} = 2.3$ m s$^{-1}$.

**Question 19** (Answer: **B**)

- A constant $g$ is what lets the simple product $mgh$ replace a more general calculation.
- That is precisely what a uniform gravitational field means.
- The object's own acceleration is irrelevant – it may be lifted slowly or dropped.

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**Question 17** (Answer: **D**)

- $\Delta E_p = mg\Delta h$, and $mg$ is exactly the weight.
- So the weight together with the change in height is enough.
- B gives mass and height but no $g$; A and C have no height at all.

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**Question 18** (Answer: **C**)

- The work done by the cushion equals the kinetic energy it removes.
- $E_k = \frac{1}{2}mv^2 = \frac{1}{2}(1.2)(3.0)^2 = 5.4$ J.
- The 0.020 m is not needed for the energy – it would give the average force instead.

**Question 18** (Answer: **D**)

- With no air resistance the total energy is constant, so $E_k = mg(H - h)$.
- That is a straight line falling as $h$ rises, reaching zero at the release height.
- So the graph is linear with a negative gradient, not a curve.

**Question 19** (Answer: **C**)

- Kinetic energy goes as $v^2$, so quadrupling the speed multiplies it by 16.
- $1500 \times 16 = 24\,000$ J.
- B assumes it scales with $v$ and gives only four times as much.



| | |
|---|---|
| 3(a) | $E_{(K)} = \frac{1}{2}mv^2$<br>$110 = \frac{1}{2} \times 5.5 \times v^2$ |
| | $v = 6.3$ m s$^{-1}$ |
| 3(b) | $(\Delta)E_{(P)}$ / 20 = $mg(\Delta)h$ OR $(\Delta)E_{(P)}$ / 20 = $mgx_0$ |
| | $(x_0 =)$ 20 / 5.5 × 9.81 = 0.37 (m)<br>Allow $(\Delta)h$ for $x_0$ |
| 3(c) | [max $(E_{(P)})$] = 110 + 20 = 130 J |
| 3(d) | (max) $E_{(P)}$ / 130 = $\frac{1}{2}F_{(0)}x_{(0)}$ |
| | $(F_0 =)$ 2 × 130 / 0.37 = 700 (N) |
| | **or** (max) $E_{(P)}$ / 130 = 1 / 2$k\,x_{(0)}^2$<br>$(F_0 =)$ $k\,x_{(0)}$ |
| | $(F_0 =)$ 2 × 130 × 0.37 / $(0.37)^2$ = 700 (N) |
| 3(e)(i) | (weight) = 5.5 × 9.81 |
| | resultant force = 700 – (5.5 × 9.81)<br>= 650 N |
| 3(e)(ii) | $F = ma$ |
| | $a$ = 650 / 5.5 **or** (700 / 5.5) – 9.81<br>$a$ = 120 m s$^{-2}$ |



**Question 15** (Answer: **B**)

- The vertical drop is $L \sin\theta$, not $L$ itself.
- Energy conservation: $\frac{1}{2}mv^2 = mgL\sin\theta$, so $v = \sqrt{2gL\sin\theta}$.
- $\sqrt{2g} = \sqrt{19.6} = 4.43$, giving $v = 4.43\sqrt{L\sin\theta}$.