

Question			Expected response	Max mark	Additional guidance
3.	(a)		$v^2 = u^2 + 2as$ (1) $v^2 = 0^2 + 2 \times (-)9.8 \times (-)1.27$ (1) $v = 5.0 \text{ m s}^{-1}$ (1)	3	Accept: 5, 4.99, 4.989 <i>a</i> and <i>s</i> must have the same sign, otherwise max 1 mark. For alternative methods: 1 mark for all relationships 1 mark for all substitutions 1 mark for final answer eg $E_p = mgh$ $E_p = 1.59 \times 10^{-2} \times 9.8 \times 1.27$ $E_k = \frac{1}{2}mv^2$ $(1.59 \times 10^{-2} \times 9.8 \times 1.27) = \frac{1}{2} \times 1.59 \times 10^{-2} \times v^2$ $v = 5.0 \text{ ms}^{-1}$
	(b)		$Ft = mv - mu$ (1) $0.14 = (1.59 \times 10^{-2} \times v) - (1.59 \times 10^{-2} \times -5.0)$ (1) $v = 3.8 \text{ m s}^{-1}$ (1)	3	Or consistent with (a) Accept: 4, 3.81, 3.805 <i>Ft</i> and <i>u</i> must have opposite signs otherwise max 1 mark. Accept: $\Delta p = mv - mu$ $p = mv$ Do not accept $p = mv - mu$
	(c)		<u>Kinetic energy</u> is greater before (the collision) than after. OR <u>Kinetic energy</u> is lost (during the collision)	1	Do not accept E_k before not equal to E_k after. Do not accept E_k is not conserved.
	(d)		(Softer material would) increase the time of contact (1) and decrease the (maximum/average) force (1)	2	Independent marks

Q3(a)**Maximum mark: 3****Response A****Marks**

$$v^2 = u^2 + 2as$$

$$v^2 = 0^2 + 2 \times -9.8 \times 1.27$$

$$v = \underline{5 \text{ ms}^{-2}}$$

Response B

$$v^2 = u^2 + 2as$$

$$v^2 = 0 + 2 \times 9.81 \times 1.27$$

$$v = \underline{5 \text{ m/s}^2}$$

Response C

$$v^2 = u^2 + 2as$$

$$= 0^2 + 2 \times 9.8 \times 1.27$$

$$= \underline{5.0 \text{ ms}^{-1}}$$

Q3(b)**Maximum mark: 3****Response A****Marks**

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$F_t = \Delta p$
 $F_t = mv - mu$
 $0.14 = (1.59 \times 10^{-2})v - (1.59 \times 10^{-2}) \times 5$
 $1.59 \times 10^{-2}v - 0.0795 = 0.14$
 $1.59 \times 10^{-2}v = 0.2195$
 $v = 13.8 \text{ ms}^{-1}$

Q3(c) **Maximum mark: 1**

Response A

Energy is lost in collision

Marks

Response B

E_k goes down and E_p goes
up

Response C

In collision E_k gets lost.

Q3(d)**Maximum mark: 2****Response A**

$t \uparrow \therefore F \downarrow$

Marks**Response B**

t increased so F decreases

3(a)	A	3	1	The candidate has selected an appropriate relationship but has incorrectly substituted values (a and s must have the same sign).
	B	3	2	The candidate has selected an appropriate relationship, correctly substituted values (a and s have the same sign) but has not given an acceptable final answer (the unit should be m s^{-1} rather than m s^{-2}).
	C	3	3	The candidate has selected an appropriate relationship, correctly substituted values (a and s have the same sign) and has given the correct final answer.
3(b)	A	3	1	The candidate has selected an appropriate relationship but has incorrectly substituted

Question	Candidate response	Max mark	Mark awarded	Commentary
				values (Ft and u must have opposite signs).
3(c)	A	1	0	The candidate's explanation is not sufficiently precise. <i>Kinetic</i> energy should be specified.
	B	1	0	The candidate's explanation is not sufficiently precise. 'Goes down' and 'goes up' are not acceptable alternatives to 'decreases' and 'increases'.
	C	1	1	The candidate's explanation is acceptable.
3(d)	A	2	0	' $\uparrow$ ' and ' $\downarrow$ ' are not acceptable alternatives to 'increases' and 'decreases'.
	B	2	1	The candidate has not specified an increase in time of contact but has specified a decrease in force.