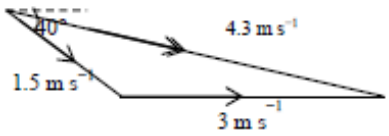
Kinematics MS 1

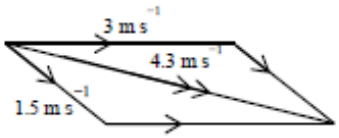
1

Answer		Mark
The <u>horizontal</u> speed/velocity/ is constant **Or** the ball will move the same distance <u>horizontally</u> between every image **Or** there is no <u>horizontal</u> acceleration/deceleration **Or** there is no <u>horizontal</u> (resultant) force acting on the ball **Or** air resistance is negligible	**(1)**	**1**
There is a vertical deceleration of the ball **Or** there is a negative/downwards acceleration **Or** the vertical speed/velocity of the ball is decreasing **Or** the idea that there is an unbalanced force acting downwards on the ball **Or** the ball is accelerating vertically at $-9.81\ m\ s^{-2}$ (a correct direction must be included in the answer)	**(1)**	**1**

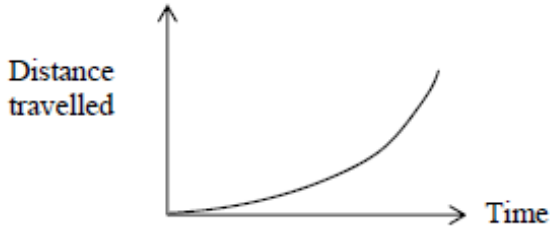
2

Vector diagram constructed with labels (and directions correct) (accept labels using the scale e.g. 3 cm and 6 cm)	**(1)**	
To scale	**(1)**	
Velocity = 4.2 – 4.4 m s^{-1}	**(1)**	**3**
(MP3 only for candidates that resolve 1.5 m s^{-1} into its two components and then use Pythagoras or draw right angled triangle. Also MP3 only if cosine rule used)		





3

Answer		Mark
Diagram 2 (resultant) force is W/mg **Or** the acceleration is g	**(1)**	
Diagram 1 the (resultant) force is the component of the weight (along the plane) **Or** see a reference to $(F =) mg\sin\theta$ **Or** see a reference to $(a =) g\sin\theta$ (This can be inferred from a diagram)	**(1)**	
A comparison between either $mg\sin\theta$ *or* $g\sin\theta$ **and** mg or g leading to a smaller acceleration in diagram 1	**(1)**	**3**
(Max 2 for answer in terms of energy: Initial GPE in diagram 1 is less than in diagram 2, so KE at bottom is less, so max/final velocity is less (1) Objects move the same distance, so time for diagram 1 is longer(1))		
Use of or see $g\sin35$ **Or** $g\cos55$	**(1)**	
Acceleration = 5.6 m s^{-2}	**(1)**	**2**
<u>Example of calculation</u> $mg\sin35° = ma$ $a = 9.81$ N kg^{-1} × sin35° $a = 5.63$m s^{-2}		
Straight line or curve of time initially increasing with distance from the origin	**(1)**	
Correct shape curve	**(1)**	**2**
		
Time taken = $\sqrt{1/2}\,(t)$ **Or** $t/\sqrt{2}$ **Or** $\frac{\sqrt{2}}{2}t$ **Or** $0.71t$ **Or** $t/1.4$	**(1)**	**1**
Similar results indicate reliability/repeatability **Or** variation in pulse means results (on another day) might be different/unreliable	**(1)**	
The time was to nearest second so measurements were not precise	**(1)**	**2**
Rule	**(1)**	
video camera **Or** light gates (connected to a) data logger/computer/timer **Or** electromagnet, trap door(s), timer	**(1)**	**2**

4

Answer		Mark
The ball has bounced **Or** the ball would be below initial height **Or** the ball has landed before reaching the goal **Or** the ball has hit the ground	**(1)**	**1**
Correct shape of at least one trajectory, starting at the kick and ending at/beyond the goal	**(1)**	**2**
Range/position of the higher angle > range/position of lower angle ball seen with paths labelled	**(1)**	
Example of response scoring 2 marks 		
Use of $(u_H) = u \cos 15$ **Or** $u \sin 75$ **Or** see 25(.1) m s^{-1}	**(1)**	**6**
Use of $u = s/t$ to calculate the time to the goal **Or** see 0.44 s	**(1)**	
Use of $(u_V) = u \sin 15$ **Or** $u \cos 75$ **Or** see 6.7 m s^{-1}	**(1)**	
Use of $s = ut + \frac{1}{2} at^2$ (a must be negative)	**(1)**	
$s = 2.0$ m	**(1)**	
Use of (value obtained + the 0.22 m (or 0.11 m)) to make a sensible statement as to whether or not the goal will be scored e.g. the top of the ball on reaching the goal 2.23 m. (This is less than 2.4 m and) the goal will be scored	**(1)**	
(Answer must be consistent with calculated distance. For calculated heights greater than 2.4 m, candidates do not need to refer to radius /diameter but a comparison of heights is needed.)		
<u>Example of calculation</u> $t = \frac{11 \text{ m}}{26 \text{ m s}^{-1} \times \cos 15°} = 0.44$ s $s = (26 \text{ m s}^{-1} \times \sin 15°)(0.44 \text{ s}) + (\frac{1}{2})(-9.81 \text{ N kg}^{-1})(0.44 \text{ s})^2$ $s = 2.01$ m Height of the top of the ball on reaching the goal = 2.01 m + 0.22 m = 2.23 m		
Air resistance is in the opposite direction to the ball's motion **Or** air resistance adds a backwards force **Or** work is done against air resistance	**(1)**	**2**
The ball will decelerate (horizontally) **Or** the ball will have a decreasing velocity/speed **Or** the ball will not travel as far **Or** this reduces the maximum height the ball reaches **Or** the ball is in the air for less time **Or** the ball will take longer to reach the goal	**(1)**	

5

Answer		Mark
Use of $s = ut + \frac{1}{2} at^2$ with $u = 0$ (or equivalent) Time = 6 x 1/20 (= 0.30 s) s = 0.44 (m) Example of calculation $s = 0 + \frac{1}{2} \times 9.81\ \text{N kg}^{-1} \times (0.30\ \text{s})^2$ s = 0.44 m	(1) (1) (1)	3
Measured vertical distance = 5.7 cm ± 0.1 cm **Or** correct horizontal distance between two points ± 0.1 cm (e.g. X to Y = 2.0 cm, 1st to 2nd bounce = 3.8 cm, 1st to 3rd bounce 7.1 cm total distance = 9.1 cm) Use of scale calculation to calculate a horizontal distance Use of $v = s/t$ v = 0.49 to 0.61 m s^{-1} (ecf value from (a)(i) (Use of show that value (0.4 m) gives 0.44 to 0.56 m s^{-1}) Example of calculation $\frac{5.7\ \text{cm}}{3.8\ \text{cm}} = \frac{0.44\ \text{m}}{s}$ $s = 0.293$ m $v = \frac{0.293\ \text{m}}{11/20\ \text{s}} = 0.53\ \text{m s}^{-1}$	(1) (1) (1) (1)	4