

Question Number	Answer	Mark
1	<p><b>D is the correct answer</b></p> <p>A is not the correct answer as work done is a scalar quantity            B is not the correct answer as time is a scalar quantity            C is not the correct answer as temperature is a scalar quantity</p>	(1)

8	<p><b>The correct answer is A (The ball bearing is moving downwards when the student starts the stopwatch)</b></p> <p>B is incorrect because time would be greater giving a lower value            C is incorrect because time would be greater giving a lower value            D is incorrect because time would be greater giving a lower value</p>	1
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9	<p><b>D is the correct answer</b></p> <p>A is not the correct answer as the stiffness constant only applies to objects            B is not the correct answer as the Young modulus only applies to materials            C is not the correct answer as the stiffness constant only applies to objects and the Young modulus only applies to materials</p>	(1)
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4	<p><b>D is the correct answer</b></p> <p>A is not the correct answer as the velocity is not constant at all times.            B is not the correct answer as the velocity is still not constant at all times.            C is not the correct answer as the air resistance does not act in the opposite direction to gravity when an object travels upwards.</p>	(1)
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<p><b>19(a)</b></p>	<p>Use of moment = <math>F \times</math> (1)            Anticlockwise moment = 25.2 (Nm)  <b>and</b> (maximum) clockwise moment = 24.2 (Nm) (1)            As angle to the ground increases, clockwise moment from the weight decreases  <b>Or</b> (1)            If line of action of weight moves outside base cannot regain equilibrium. (1)  <math>25.2 &gt; 24.2 \therefore</math> blows over</p> <p><u>Example of calculation</u>            moment from wind = <math>14 \text{ N} \times 1.8 \text{ m} = 25.2 \text{ N m}</math>            moment from weight = <math>110 \text{ N} \times 0.22 \text{ m} = 24.2 \text{ N m}</math>  <math>25.2 &gt; 24.2 \therefore</math> blows over</p>	<p><b>4</b></p>
<p><b>19(b)</b></p>	<p>Horizontal component = <math>T \times \sin 44^\circ</math>  <b>Or</b>            Distance to line of action of <math>T = 1.5 \times \sin 44^\circ</math> (1)            Equates clockwise to anticlockwise moments about centre of base to determine <math>T</math> (1)            Use of trigonometry to calculate vertical component of tension (1)            Adds weight to vertical component            Force exerted on the ground = 141 N (1)            (1)</p> <p><u>Example of calculation</u>            Horizontal component of tension = <math>T \times \sin 44^\circ</math>  <math>\text{CWM} = 1.5 \text{ m} \times T \times \sin 44^\circ = 1.04 \text{ m} \times T</math>  <math>\text{ACWM} = 25 \text{ N} \times 1.8 \text{ m} = 45.0 \text{ N m}</math>  <math>1.04 \text{ m} \times T = 45.0 \text{ N m}</math>  <math>T = 45.0 \text{ N m} \div 1.04 \text{ m} = 43.2 \text{ N}</math>            Vertical component of <math>T = 43.2 \text{ N} \times \cos 44^\circ = 31.1 \text{ N}</math>            Total downward force = <math>110 \text{ N} + 31.1 \text{ N} = 141.1 \text{ N}</math></p>	<p><b>5</b></p>
<p><b>Total for question 19</b></p>		<p><b>9</b></p>

<b>18(a)</b>	No resultant force No resultant moment (about any point)	(1) (1) <b>2</b>
<b>18(b)</b>	The point at which the weight of an object is considered to act	(1) <b>1</b>
<b>18(c)(i)</b>	<p>Use of <math>W = mg</math> (1)</p> <p>Horizontal distance from edge of door to centre of gravity identified as <math>\frac{w}{2}</math> (1)</p> <p>Use of moment of force = <math>Fx</math> (1)</p> <p>Use of clockwise moment = anticlockwise moment (1)</p> <p>Horizontal component of force of hinge Y on door = 37.5 (N) (1)</p> <p><b>OR</b></p> <p>Use of <math>W = mg</math> (1)</p> <p>Use of <math>\tan \theta</math> with dimensions of door (1)</p> <p>Use of vertical component of force of hinge Y on door = <math>W/2</math> (1)</p> <p>Use of <math>\tan \theta</math> with vertical and horizontal components of force of hinge Y on door (1)</p> <p>Horizontal component of force of hinge Y on door = 37.5 (N) (1)</p> <p><u>Example of calculation</u></p> <p><math>W = 14.4 \text{ kg} \times 9.81 \text{ N kg}^{-1} = 141 \text{ N}</math></p> <p><math>141 \text{ N} \times \frac{0.85 \text{ m}}{2} = F_{\text{horizontal}} \times 1.60 \text{ m}</math></p> <p><math>F_{\text{horizontal}} = \frac{60.0 \text{ N m}}{1.60 \text{ m}} = 37.5 \text{ N}</math></p>	<b>5</b>

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<b>18(c)(i)</b>	<p>Use of <math>W = mg</math> (1)</p> <p>Horizontal distance from edge of door to centre of gravity identified as <math>\frac{w}{2}</math> (1)</p> <p>Use of moment of force = <math>Fx</math> (1)</p> <p>Use of clockwise moment = anticlockwise moment (1)</p> <p>Horizontal component of force of hinge Y on door = 37.5 (N) (1)</p> <p><b>OR</b></p> <p>Use of <math>W = mg</math> (1)</p> <p>Use of <math>\tan \theta</math> with dimensions of door (1)</p> <p>Use of vertical component of force of hinge Y on door = <math>W/2</math> (1)</p> <p>Use of <math>\tan \theta</math> with vertical and horizontal components of force of hinge Y on door (1)</p> <p>Horizontal component of force of hinge Y on door = 37.5 (N) (1)</p> <p><u>Example of calculation</u></p> <p><math>W = 14.4 \text{ kg} \times 9.81 \text{ N kg}^{-1} = 141 \text{ N}</math></p> <p><math>141 \text{ N} \times \frac{0.85 \text{ m}}{2} = F_{\text{horizontal}} \times 1.60 \text{ m}</math></p> <p><math>F_{\text{horizontal}} = \frac{60.0 \text{ N m}}{1.60 \text{ m}} = 37.5 \text{ N}</math></p>	<b>5</b>

<p><b>18(c)(ii)</b></p>	<p>Use of appropriate trigonometry to determine <math>\theta</math> (1)</p> <p><math>\theta = 28^\circ</math> (allow ecf from 18(c)(i)) (show that answer gives <math>30^\circ</math>) (1)</p> <p>Use of Pythagoras' theorem to determine <math>F</math></p> <p><b>Or</b></p> <p>Use of appropriate trigonometry to determine <math>F</math> (1)</p> <p><math>F = 80 \text{ N}</math> (allow ecf from 18(c)(i)) (show that answer gives <math>81 \text{ N}</math>) (1)</p> <p><u>Example of calculation</u></p> $\theta = \tan^{-1} \left( \frac{37.5}{\left(\frac{141}{2}\right)} \right) = 28.0^\circ$ $F = \sqrt{(37.5 \text{ N})^2 + \left(\frac{141 \text{ N}}{2}\right)^2} = 80.0 \text{ N}$	<p><b>4</b></p>
<p><b>18(c)(iii)</b></p>	<p>Moment of weight of door (about X) remains the same.</p> <p><b>Or</b></p> <p><math>mg \times \frac{w}{2} = F_{\text{horizontal}} \times L</math> (and <math>m</math>, <math>g</math> and <math>w</math> remain the same). (1)</p> <p>(So) horizontal (component of) force increases (when <math>L</math> decreases). (1)</p> <p>Vertical (component of) force remains the same.</p> <p><b>Or</b></p> <p>Each hinge still holds half the weight of the door. (1)</p> <p>(So) <math>F</math> increases and <math>\theta</math> increases. (1)</p>	<p><b>4</b></p>
<p><b>Total for question 18</b></p>		<p><b>16</b></p>

<p><b>14(a)</b></p>	<p>The weight of the grain is equal to the sum of the drag and upthrust acting on it  <b>Or</b>  Resultant force = 0  <b>Or</b>  The sum of the upward forces is equal to the sum of the downward forces  <b>Or</b>  The (vector) sum of the forces is zero</p>	<p>(1)      <b>1</b></p>
<p><b>14(b)</b></p>	<p>Use of weight = upthrust + drag  Use of viscous drag = <math>6\pi\eta r v</math>    <math>v = 1.7 \text{ m s}^{-1}</math> <b>and</b> comparison with <math>0.050 \text{ m s}^{-1}</math> <b>and</b> consistent conclusion.  (allow correctly calculated values for other quantities given in the question, with consistent conclusion)    <u>Example of calculation</u>  Drag = <math>4.3 \times 10^{-5} \text{ N} - 1.5 \times 10^{-5} \text{ N} = 2.8 \times 10^{-5} \text{ N}</math>  <math display="block">v = \frac{2.8 \times 10^{-5} \text{ N}}{6 \times \pi \times 1.2 \times 10^{-3} \text{ Pa s} \times \left(\frac{1.5 \times 10^{-3} \text{ m}}{2}\right)} = 1.65 \text{ m s}^{-1}</math> <math>1.65 \neq 0.05</math> so Stokes' law does not apply</p>	<p>(1)  (1)  (1)      <b>3</b></p>
<p><b>14(c)</b></p>	<p>As temperature increases, viscosity decreases    So (value of) <u>terminal</u> velocity increases (to make drag equal to weight) (dependent on MP1)    Allow converse argument</p>	<p>(1)  (1)      <b>2</b></p>
<p><b>Total for question 14</b></p>		<p><b>6</b></p>

<p><b>14(a)</b></p>	<p>The weight of the grain is equal to the sum of the drag and upthrust acting on it  <b>Or</b>  Resultant force = 0  <b>Or</b>  The sum of the upward forces is equal to the sum of the downward forces  <b>Or</b>  The (vector) sum of the forces is zero</p>	<p>(1)      <b>1</b></p>
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<p><b>14(c)</b></p>	<p>As temperature increases, viscosity decreases    So (value of) <u>terminal</u> velocity increases (to make drag equal to weight) (dependent on MP1)    Allow converse argument</p>	<p>(1)  (1)      <b>2</b></p>
<p><b>Total for question 14</b></p>		<p><b>6</b></p>

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<p><b>14(c)</b></p>	<p>As temperature increases, viscosity decreases    So (value of) <u>terminal</u> velocity increases (to make drag equal to weight) (dependent on MP1)    Allow converse argument</p>	<p>(1)  (1)      <b>2</b></p>
<p><b>Total for question 14</b></p>		<p><b>6</b></p>