Practice Paper B _____

MECHANICS ONE

crashMATHS

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| Duration | 1 HOUR & 30 MINUTES |
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| Total Marks Available | 75 MARKS |

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| 1 | A delivery van is driving on the motorway at a constant speed of 60 mph for 20 | |
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| | minutes. As it passes the point P_1 , the van then decelerates uniformly for 5 minutes | |
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| | reaching a speed x mph at the point P_2 . | |
| | (a) Sketch a speed-time graph to illustrate the motion of the van. | (3) |
| | The total distance travelled by the van in the 25 minutes is 35 miles. | |
| | (b) Work out the value of x. | (4) |
| | (c) Calculate the deceleration of the van between the points P_1 and P_2 . | (2) |
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| 2 | Two particles A and B have masses 1kg and 3kg respectively. The particles are moving towards each other on a smooth horizontal plane and collide directly. The speeds of A and B before the collision are $2u$ and $6u$ respectively. After the collision, the direction of motion of A is reversed and A moves with a speed x . | |
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| | Given that A receives an impulse of $\frac{13}{2}u$ from B, | |
| | (a) Show that $x = \frac{9}{2}u$. | (3) |
| | (b) Find the speed and direction of motion of B after the collision. | (4) |
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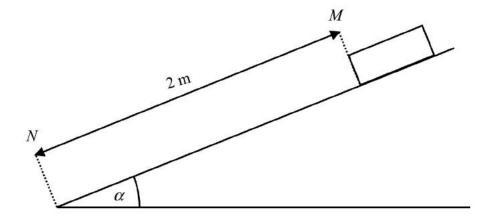
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rough inclined plane,



Items on a delivery chute are released from the point M and are collected at the point N. A box is held in place at M on the conveyer belt which is inclined at an angle α to the horizontal, where $\sin \alpha = \frac{3}{5}$. The mass of the box is 45 kg and the distance between M and N is 2 m. The box is released from rest and is moving with a speed 3.2 m s⁻¹ when it reaches N. By modelling the box as a particle and the conveyer belt as a

- (a) Find the coefficient of friction between the box and conveyer belt. (9) Another item of mass 90 kg is to be released from rest at M t seconds after the box is released. Given that the item will reach N with a speed of 4.6 m s⁻¹,
- (b) Find the minimum value of t so that the item doesn't collide with the box. (5)

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| 4 | A particle P is thrown vertically upwards with a speed of 18 m s ⁻¹ at a height h_1 m | |
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| | above the ground. The particle hits the ground 5s after projection. | |
| | (a) Find h_1 . | (2) |
| | P is then dropped vertically downwards from rest at another point that is h_2 m above | |
| | the ground. At the same time, another particle ${\it Q}$ is thrown vertically upwards from | |
| | the ground at a speed of 9 m s ⁻¹ . The two particles collide at a time t and height h_3 | |
| | above the ground. | |
| | (b) Show that $h_2 = 9t$. | (4) |
| | Given that immediately before the collision, Q had a speed of 4 m s ⁻¹ , | |
| | (c) (i) Find h_2 . | |
| | (ii) Find h_3 . | (4) |
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| 5 | A uniform rod AB of mass 16kg has length 8m. The rod is held in equilibrium by two | |
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| | strings at positions C and D on the rod, such that $AC = 2 \text{ m}$ and $AD = x \text{ m}$. The | |
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| | tension in the string attached to D is greater than the tension in the string attached to | |
| | C by a factor of $\frac{3}{2}$. | |
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| | Find | |
| | (i) the tension in the strings. | |
| | (ii) x. | (8) |
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| 6 | [In this question, \mathbf{i} and \mathbf{j} are unit vectors due east and due north respectively and position ve | ctors |
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| | are given with respect to a fixed origin.] | |
| | A boat B is moving with constant velocity. The position vector of B at time t seconds ($t \ge 0$ | 0) |
| | is given by \mathbf{r} metres, relative to a fixed origin O . | 17 |
| | At time $t = 0$, the position vector of B is $3\mathbf{i} - 4\mathbf{j}$. After 5 seconds, B passes through the | |
| | point with position vector $8\mathbf{i} + 6\mathbf{j}$. | |
| | (a) Show that | |
| | $\mathbf{r} = (3+t)\mathbf{i} + (2t-4)\mathbf{j}$ | (4) |
| | A lighthouse L has position vector $\frac{5}{2}\mathbf{i} + 10\mathbf{j}$. | |
| | (b) Find the distance of B from L at time $t = 3$. | (4) |
| | (c) Find the distance of B from L when the B is due south of L . | (4) |
| | (d) Find the time at which B is $\frac{5}{4}$ m from L. | (5) |
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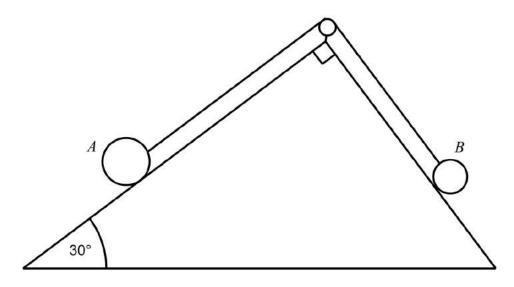
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The diagram shows two particles, A and B, that are connected by a light inextensible string passing over a smooth pulley. The two particles rest on two different rough surfaces of a triangular wedge. A has mass 6kg and B has mass 4kg. The coefficient of friction between A and the surface of the wedge is $\frac{1}{3}$. The frictional force that acts on B from the surface is 10N. The coefficient friction between B and the surface of the wedge is μ .

(a) Show that
$$\mu = 0.29$$
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The system is released from rest.

| (b) Find the acceleration of the particles and the tension in the string. | (7) |
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