

## SKILLS CHECK

QUESTION 1

A block of mass 200 kg is pulled along a rough horizontal surface by a rope inclined at an angle of  $30^\circ$  to the horizontal. The coefficient of friction between the box and the surface is 0.3. If the box is accelerating at  $2.2 \text{ ms}^{-2}$ , find the tension in the rope.

QUESTION 2

A ball is thrown vertically upwards from a point 1.8 m above a horizontal surface with velocity  $4.9 \text{ ms}^{-1}$ . Calculate the height of the first bounce if it will reach 70% of the maximum height reached previously.

QUESTION 3

Two particles of mass 0.4 kg and  $m$  kg are connected by a light inextensible string which hang vertically over a smooth fixed peg. The system is released from rest and the 0.4 kg mass moves upwards with a tension in the string of 5N. Find the value of  $m$ .

QUESTION 4

A uniform metal bar of mass 40 kg and length 4 m rests on supports at A and B. A is 1 m from one end of the bar and B is 2.25 m from A. Find the magnitude of the reaction forces acting on the bar at points A and B.

QUESTION 5

An object travelling with velocity  $(3i - 2j) \text{ ms}^{-1}$  underwent an acceleration of  $(i + 2j) \text{ ms}^{-2}$  for a period of 4 seconds. Calculate the magnitude of the displacement during this period.

WEEK 1

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WEEK 1

## SKILLS CHECK

QUESTION 1

A particle is projected from ground level with speed  $U$  at an angle of  $\theta^\circ$  to the horizontal. Show that the maximum height reached by the particle is  $\frac{U^2 \sin^2 \theta}{2g}$

QUESTION 2

A horizontal force of 80N is applied to a sledge of mass 30 kg resting on the snow. The sledge accelerates at  $2.2 \text{ ms}^{-2}$ . Find the force of the friction acting on the sledge.

QUESTION 3

A parked car begins to move with constant acceleration, reaching the entrance to a tunnel 45 seconds later. The car continues to accelerate at the same rate and takes a further 30 seconds to pass through the tunnel which is 600 m long. How far away from the entrance to the tunnel was the car parked?

QUESTION 4

A particle moves in a straight line beginning at the origin when  $t = 0$ . Its velocity at time  $t$  seconds is given by  $v = 6 + 24t^2 - 3t^3$ . Find the range of values for  $t$  for which the particle is accelerating (not decelerating)

QUESTION 5

A uniform rod AB of length 8 m and weight 50N hangs in equilibrium in a horizontal position supported by vertical strings at A and B. A mass of weight 40 N rests on the rod at point X which is 2.5 m from A. Calculate the tensions in the strings.

WEEK 2

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WEEK 2

## SKILLS CHECK

QUESTION 1

A body falls from rest from the top of a tower. During the last second of its motion it falls  $\frac{5}{16}$  of the total distance travelled. Find the height of the tower

QUESTION 2

A block of mass 10kg is at rest on a rough plane inclined at an angle  $\theta$  to the horizontal. The coefficient of friction between the block and the plane is  $\frac{1}{4}$ . Given that the block is on the point of slipping find  $\theta$

QUESTION 3

A block of mass 5kg rests on a horizontal table. It is connected by a light inextensible string passing over a smooth pulley at the edge of the table to a 6kg body hanging freely. If the friction force acting on the block is 10N, calculate the acceleration of the block.

QUESTION 4

A uniform rod AB of length 10m and weight 40N hangs in equilibrium in a horizontal position supported by vertical strings at A and B. A mass of weight 20 N rests on the rod at X such that the tension in the string at A is 20% higher than the tension at B. How far is X from B?

QUESTION 5

A particle moves so that its position vector at time  $t$  (seconds) is given by  $\mathbf{r} = (2t^2 - 3t)\mathbf{i} + (t^3 - 2t)\mathbf{j}$ . Calculate the magnitude of the acceleration when  $t = 4$

WEEK 3

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## SKILLS CHECK

QUESTION 1

A particle moves in a horizontal plane with position at time  $t$  given by  $\mathbf{r} = 5t + 3\sin t + 4\cos t$  m. Find the maximum velocity of the particle

QUESTION 2

At  $t = 0$  a particle P is at position vector  $(2\mathbf{i} - 5\mathbf{j})\text{m}$  relative to a fixed origin O, moving with a constant velocity of  $(\mathbf{i} + 3\mathbf{j}) \text{ms}^{-1}$ . Calculate the distance of P from the origin when  $t = 5$ .

QUESTION 3

A car accelerates from rest at a uniform rate of  $4 \text{ms}^{-2}$  for 5 seconds. It then travels at a constant velocity for 10 seconds before slowing to rest at a constant rate of  $1.5 \text{ms}^{-2}$ . Calculate the total distance travelled.

QUESTION 4

A ball is projected with a speed of  $10\text{ms}^{-1}$  at an angle of  $40^\circ$  to the horizontal from a point 1.6 m above the ground. The ball hits a wall 4m away. Calculate the height above the ground at which the ball hits the wall.

QUESTION 5

A block of mass 6 kg rests on a rough horizontal surface. A pulling force of 25 N is applied to the block at an angle of  $30^\circ$  to the horizontal. If the block is on the point of moving find the coefficient of friction between the block and the surface.

WEEK 4

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WEEK 4

## SKILLS CHECK

QUESTION 1

A block of mass 6 kg rests in limiting equilibrium on a rough plane inclined at an angle of  $22^\circ$  to the horizontal. Find the magnitude of the friction force acting on the block and the coefficient of friction between the block and the plane.

QUESTION 2

A ball is hit from horizontal ground with velocity  $(8\mathbf{i} + 24\mathbf{j}) \text{ m s}^{-1}$  where the unit vectors  $\mathbf{i}$  and  $\mathbf{j}$  are horizontal and vertically upwards respectively. Find the range of the ball when it hits the ground.

QUESTION 3

A stone of mass 0.2kg is released from rest on the surface of the water in a well. It takes 3 seconds to reach the bottom of the well. Given that the water exerts a constant resistance of 1.5N, find the depth of the well.

QUESTION 4

A particle has velocity  $\mathbf{v} = (3 - 2t)\mathbf{i} + (2t - 1)\mathbf{j} \text{ ms}^{-1}$  where  $\mathbf{i}$  and  $\mathbf{j}$  are unit vectors pointing East and North respectively. When  $t = 0$  the particle has position vector  $4\mathbf{i}$  from the fixed origin  $O$ . Calculate the distance of the particle from the origin when the particle is travelling due south.

QUESTION 5

Two forces  $A(3\mathbf{i} + 2\mathbf{j})\text{N}$  and  $B(4\mathbf{i} - 3\mathbf{j})\text{N}$  act on a mass of 400g. Calculate the magnitude of the acceleration of the particle

WEEK 5

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WEEK 5

## SKILLS CHECK

QUESTION 1

A block of mass 2 kg moving at a rate of  $10\text{m}^{-1}$  on a smooth horizontal surface goes onto a rough surface and is brought to a rest in a distance of 25m. Calculate the coefficient of friction between the block and the rough surface.

QUESTION 2

A particle has velocity  $v = (2t - 5)\mathbf{i} + (2\sin t - 3\cos t)\mathbf{j} \text{ ms}^{-1}$  where  $\mathbf{i}$  and  $\mathbf{j}$  are unit vectors pointing East and North respectively. Calculate the magnitude of the maximum velocity of the particle.

QUESTION 3

A uniform rod AB of length 10m and mass 40kg has loads of mass 50kg and 60 kg placed at A and B respectively. Find the distance from A at which a support should be placed so that the rod is in equilibrium when it is horizontal

QUESTION 4

A small gate is 1m wide. It is held shut by a block at the end of the gate opposite the hinge. A perpendicular force of 60 N is applied a distance of 80 cm from the hinge but the block is keeping it shup. Find the frictional force active through the block.

QUESTION 5

A particle of mass 3 kg is projected with velocity  $4 \text{ ms}^{-1}$  up a slope of a plane inclined at  $18^\circ$  to the horizontal. Assuming the plane is smooth, calculate the time for the particle to return to the base of the slope.

WEEK 6

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WEEK 6

## SKILLS CHECK

QUESTION 1

Two children sit on a seesaw formed from a uniform rod of length 3.5m balanced in the middle. One child of mass 35 kg sits on one end of the seesaw. The other child has a mass of 42kg. How far from the other child should the heavier child sit to ensure that the seesaw is balanced?

QUESTION 2

A block of mass  $m$  lies on a flat rough surface. One end of the surface is lifted to create an inclined plane. When the angle reaches  $40^\circ$  the block begins to move. Calculate the coefficient of friction between the block and the rough surface.

QUESTION 3

A stone is thrown upwards from a height of 1.7m with speed  $1.5 \text{ ms}^{-1}$  at an angle of  $40^\circ$  to the horizontal. The stone moves freely under gravity before hitting the ground. Calculate the speed of the ball when it hits the ground.

QUESTION 4

A block of mass 5 kg rests on a smooth plane inclined at  $30^\circ$  to the horizontal. It is connected by a light inextensible string passing over a smooth pulley at the top of the slope to a mass of 3kg. Find the acceleration of the system.

QUESTION 5

A particle of mass 8 kg is acted on by the three forces  $F_1 = (2i + 6j - k) \text{ N}$ ,  $F_2 = (i - 2j + 4k) \text{ N}$  and  $F_3 = (i - j + 2k) \text{ N}$ . If the particle starts from rest at position O and is at position A after 4 seconds, calculate the distance OA.

WEEK 7

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