

# SKILLS CHECK - MECHANICS

QUESTION 1

A particle moves along a straight line with constant acceleration  $2 \text{ ms}^{-2}$ . The particle moves 48 m in 5 s. Find the initial speed of the particle

QUESTION 2

An object is thrown vertically upwards from a height of 1.5 m at an initial velocity of  $2.5 \text{ ms}^{-1}$ . Calculate the maximum height reached.

QUESTION 3

A motorcyclist starting from rest reaches a speed of  $50 \text{ kmh}^{-1}$  in 10 seconds. Calculate the acceleration.

QUESTION 4

A particle of mass 2 kg is acted on by two forces  $F_1 = 2i + 5j$  and  $F_2 = -i + 3j$ . Find the magnitude of the acceleration of the particle

QUESTION 5

A lift with passengers has a mass of 350 kg is moving downwards at a constant speed of  $1.5 \text{ ms}^{-1}$ . Calculate the tension in the cable supporting the lift.

**WEEK 1**

# SKILLS CHECK - MECHANICS

QUESTION 1

Three forces  $F_1 = 2i - 3j$ ,  $F_2 = 5j$  and  $F_3 = 2i + 8j$  act on a particle ( $i$  and  $j$  are perpendicular). Find the angle of the resultant force with  $i$

QUESTION 2

Blocks A (15kg) and B(20kg) are attached to the ends of an inextensible string which hang over a smooth pulley. The blocks are released from rest, calculate the acceleration of block A.

QUESTION 3

A particle moves in a straight line and the distance from P is given by  $r = 3t^3 + \frac{3}{2}t^2 - 2t + 4$ . Calculate the acceleration when the particle is at rest.

QUESTION 4

A puck of mass 2kg is initially moving with a speed of  $4\text{ms}^{-1}$  and glides to rest over a distance of 20 m. Assuming that the force of resistance is constant, calculate the magnitude of the resistive force.

QUESTION 5

An object moves in a straight line with acceleration at time  $t$  given as  $a = 16 - 20t$  starting at a fixed origin with velocity  $4 \text{ ms}^{-1}$ . Calculate the greatest speed reached.

WEEK 2

# SKILLS CHECK - MECHANICS

QUESTION 1

A particle of mass 0.2 kg is acted on by forces  $F_1 = 6i - 2j$  and  $F_2 = 4i + 5j$ . Calculate the magnitude of the acceleration of the particle.

QUESTION 2

A train travels between 2 stations, stopping at each. The speed of the train at time  $t$  is modelled by  $v = \frac{1}{10}t(80 - t)$ . Calculate the distance between the 2 stations.

QUESTION 3

An object is thrown vertically upwards from a height of 1.2 m with a velocity of  $1.5 \text{ ms}^{-1}$ . Calculate the maximum height reached.

QUESTION 4

A man of mass 80 kg stands in a lift which is moving vertically upwards with acceleration  $1.8 \text{ ms}^{-2}$ . Calculate the normal reaction of the floor of the lift on the man.

QUESTION 5

A car of mass 900 kg is pulling a trailer of mass 500 kg connected by a towbar. The resistive forces of the car and trailer are 300 N and 200 N respectively. If the driving force of the car is 1200 N, calculate the tension in the towbar.

**WEEK 3**

# SKILLS CHECK - MECHANICS

QUESTION 1

A particle moves along a straight line so that its position at time  $t$  is given by  $r = 3t^3 - 2t^2 + t$   
Calculate the acceleration of the particle when  $t = 3$

QUESTION 2

Emily throws a stone vertically upwards with an initial velocity of  $20\text{ms}^{-1}$ . Calculate the time it takes to return to her hand

QUESTION 3

Two objects of masses  $3\text{kg}$  and  $5\text{kg}$  are connected by a light inextensible string. The objects hang vertically  $0.3\text{ m}$  above the ground with the string passing over a smooth pulley above them. Find the greatest height reached by the  $3\text{ kg}$  object when the objects are released.

QUESTION 4

The position of a particle is given by  $r = 5 + t(t + 3)$  for  $0 \leq t < 10$ . Find the displacement of the particle relative to its initial position, when  $t = 5$ .

QUESTION 5

A car travels  $60\text{ km}$  from A to B at an average speed of  $40\text{ kmh}^{-1}$ . It stops at B for  $1\text{ hour and }30\text{ minutes}$  and then returns to A. The average speed of the whole journey is  $30\text{ kmh}^{-1}$ . Find the average speed from B to A

**WEEK 4**

# SKILLS CHECK - MECHANICS

QUESTION 1

A stone is projected upwards from point P with an initial speed of  $10 \text{ ms}^{-1}$ . At the same time another particle is dropped from a point 4m above P. Find the height above P at which the particles collide

QUESTION 2

A lift (including passengers) of mass 360 kg is moving downwards at a constant speed of  $1.5 \text{ ms}^{-1}$ . Calculate the tension in the cable.

QUESTION 3

A particle at rest is acted on by 3 forces  $2F_1$ ,  $F_2$  and  $F_3$  where  $F_1 = -i + 3j$  and  $F_2 = 4i - 2j$ . Find  $F_3$

QUESTION 4

An object of mass 30kg is initially at rest at point O. The particle starts to move in a straight line such that  $v = 9t^2 - t^3 + 4$  for  $t > 0$ . Find an expression for the force acting on the object

QUESTION 5

A train takes 12 minutes to travel between 2 stations. The train accelerates at a rate of  $0.4 \text{ ms}^{-2}$  for 50 seconds and then travels at a constant speed before decelerating at a constant rate for 20 seconds coming to rest at the second station. Find the distance between the stations

**WEEK5**

# SKILLS CHECK - MECHANICS

QUESTION 1

The acceleration of a particle in  $\text{ms}^{-2}$  is given by  $a = 2t - 3$  starting at the origin with initial velocity  $5\text{ms}^{-1}$ . Find the velocity when  $t = 5$

QUESTION 2

A particle is projected vertically upwards with velocity  $12\text{ms}^{-1}$  from a height of 5m. How much time elapses from the time of release until the particle hits the floor?

QUESTION 3

A lady of mass 60 kg stands in a lift which is moving downwards with acceleration  $1.5 \text{ ms}^{-2}$ . Find the normal reaction of the lift floor on the lady.

QUESTION 4

A particle moves along a horizontal path with constant acceleration passing through points XY and Z. The distance  $XY = 200\text{m}$  and  $XZ = 420\text{m}$ . The particle takes 20m to travel between X and Y and 10 seconds to travel between Y and Z. Calculate the acceleration

QUESTION 5

A particle of mass 0.5 kg is acted on by 2 forces  $F_1 = 10\mathbf{i} - 4\mathbf{j}$  and  $F_2 = -4\mathbf{i} + 12\mathbf{j}$ . Calculate the magnitude of the acceleration of the particle.

**WEEK 6**

# SKILLS CHECK - MECHANICS

QUESTION 1

A train takes 15 minutes to travel between 2 station stops A and B. The train accelerates from A at a rate of  $0.5 \text{ ms}^{-2}$  for 40 seconds and then travels at a constant speed before decelerating at a constant rate for 1 minute coming to rest at the second station. Find the distance between the stations

QUESTION 2

A particle of mass 5 kg is moving along a rough surface due to a horizontal force of 20N. The acceleration of the particle is  $2.5 \text{ ms}^{-2}$ . Find the magnitude of the resistive force acting on the particle.

QUESTION 3

An object is thrown vertically upwards with velocity  $8 \text{ ms}^{-1}$  from a height of 2.5 m. Calculate the maximum height reached.

QUESTION 4

A particle moves in a straight line and the distance from P is given by  $r = 25t - 2t^3 + \frac{5}{2}t^2 + 5$ . Calculate the acceleration when the particle is at rest.

QUESTION 5

Three forces  $F_1 = 4i - 2j$ ,  $F_2 = 6i$  and  $F_3 = -2i + 7j$  act on a particle ( $i$  and  $j$  are perpendicular). Find the angle of the resultant force with  $i$