

Twenty-One Today

NUMBER 1 (Mechanics Year 1)



Work quickly, but accurately.

You have 40 minutes to answer as many questions as you can.

Take the value of g , the acceleration due to Earth's gravity, to be 9.8 ms^{-2}

Question 1

What is the weight, in Newtons, of a 10 kg mass on the surface of planet Earth ?

Answer : _____

Question 2

What does the area under a velocity-time graph represent ?

Answer : _____

Question 3

Which of the following is NOT a suvat equation ?

(a) $v = u - st$

(b) $v^2 = u^2 + 2as$

(c) $a = \frac{v-u}{t}$

(d) $s = ut + \frac{1}{2}at^2$

Answer : _____

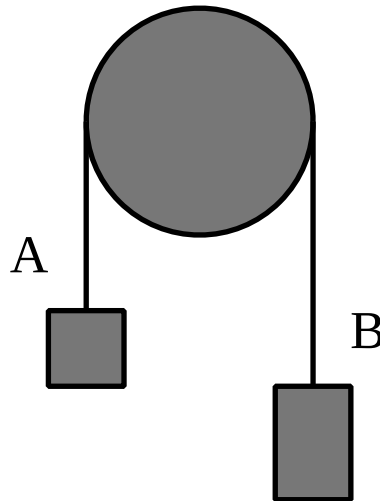
Question 4

What is the resultant of the forces A and B if $A = 3\mathbf{i} + 5\mathbf{j}$ and $B = 4\mathbf{i} + 7\mathbf{j}$

Answer : _____

Question 5

A pulley is described as smooth.



Which of the following does this imply ?

- (a) Mass A moves with the same velocity as mass B.
- (b) Mass A moves with the same acceleration as mass B.
- (c) The tension in the rope on side A is the same as on side B.
- (d) The effect of the weight of the rope can be ignored.

Answer : _____

Question 6

What is the force required to accelerate a mass of 3 kg at 8 ms^{-2} ?

Answer : _____

Question 7

What does the gradient on a velocity-time graph represent ?

Answer : _____

Question 8

An man fires a bullet vertically upwards.

As the bullet reaches its maximum height, which one the following is true ?

- (a) The acceleration of the bullet is zero
- (b) The overall force on the bullet is zero.
- (c) The velocity of the bullet is zero.
- (d) The mass of the bullet is zero.

Answer : _____

Question 9

A Go-Kart is moving with constant velocity.

Which one of the following must be true ?

- (a) The air resistance on the Go-Kart must be zero.
- (b) The resultant force on the Go-Kart must be zero.
- (c) The Go-Kart must be moving up a hill.
- (d) The Go-Kart must have negligible mass.

Answer : _____

Question 10



A mortar shell is fired vertically upwards.

As the shell returns to the ground, which one the following is true ?

- (a) The acceleration of the shell is zero
- (b) The distance travelled by the shell is zero.
- (c) The velocity of the shell is zero.
- (d) The displacement of the shell is zero.

Answer : _____

Question 11

A particle, moving in a straight line, has displacement from a fixed origin is given by,

$$s = 4t^4 - \frac{1}{t}$$

Find an expression for the velocity of this particle at time t

Answer : _____

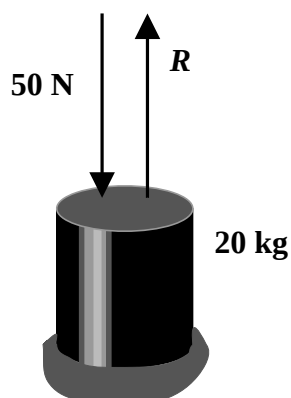
Question 12

An ice-hockey puck is hit at 15 ms^{-1} and travels 75 m before coming to rest.
Find its deceleration, assumed to be a constant.

Answer : _____

Question 13

A mass of 20 kg is placed on firm ground.
A force of 50 N then acts downward upon the mass, as shown.



What is the normal reaction, marked R ?

Answer : _____

Question 14

Write 5 ms^{-1} in kmh^{-1}

Answer : _____

Question 15

A stone is dropped (from rest) over the edge of a cliff.

It takes 4 seconds to fall into the water at the base of the cliff.

How high is the cliff ?

Answer : _____

Question 16

A particle is moving in a straight line such that its displacement from a fixed origin is given by,

$$s = 2t^3 - 15t^2$$

Find the acceleration when $t = 3$ seconds

Answer : _____

Question 17

The following three forces, in Newtons, act on a particle of mass 1.5 kg,

$$F_1 = 2\mathbf{i} + 4\mathbf{j} \quad F_2 = -5\mathbf{i} + 4\mathbf{j} \quad F_3 = 6\mathbf{i} - 5\mathbf{j}$$

Find the acceleration of the particle in the form $p\mathbf{i} + q\mathbf{j}$ where p and q are integers.

Answer : _____



A 64 kg crate is dropped from rest from a height of 240 metres by a helicopter. The crate falls without a parachute for 6 seconds, the parachute then opening.

Question 18

How far does the crate fall in this time ?

Answer : _____

Question 19

What is the velocity of the crate at the six second mark ?

Answer : _____

Question 20

After 6 seconds, the parachute opens and the crate's velocity is modelled as instantly becoming 7 ms^{-1} . It continues to fall with constant velocity of 7 ms^{-1} . How long, in total, has it taken for the crate to fall from the helicopter to the ground ?

Answer : _____

Question 21

A particle travels in a straight line. After t seconds its velocity, $v \text{ ms}^{-1}$ is given by,

$$v = 7 - 3t^2 \quad t \geq 0$$

What is the distance travelled by the particle in the third second of its motion ?

Answer : _____

This document is Licensed for use by staff and students at **Shrewsbury School, England**

To obtain a licence please visit www.NumberIsAll.com

© 2020 Number Is All

The photograph of an M224 mortar system being fired is by Senior Airman Cory D Payne

Taken 16th December 2015 during a live fire exercise near Camp Lemonnier, Djibouti, Horn of Africa