Year 10

Physics booklet

Topic 4 – Motion

Name: _____

Force & Motion

Give a definition for each of these key words and units where appropriate:

Speed	
Velocity	
Distance	
Displacement	
Acceleration	
Newton's 1st law	
Newton's 2nd law	
Newton's 3rd law	
Inertia	
Terminal velocity	
Stopping distance	
Momentum	

Motion equations:

(write down equations that you need to know about motion)

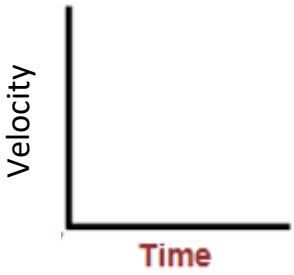
Distance-time graphs

Sketch suitable graphs for each of the following

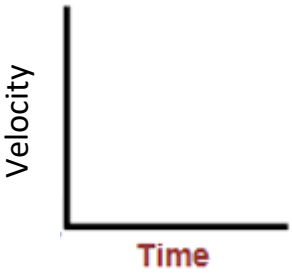
Constant speed

Accelerating

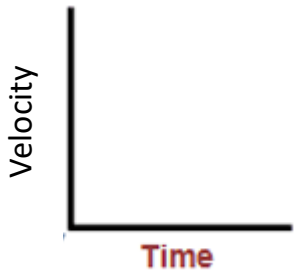
Stationary



Constant speed



Accelerating



Stationary

Terminal Velocity summary

Consider a skydiver:

1) At the start of her jump the air resistance is _____ so she _____ downwards.

2) As her speed increases her air resistance will _____

3) Eventually the air resistance will be big enough to _____ the skydiver's weight. At this point the forces are balanced so her speed becomes _____ - this is called TERMINAL VELOCITY

4) When she opens her parachute the air resistance suddenly _____, causing her to start _____ ____.

5) Because she is slowing down her air resistance will _____ again until it balances her _____. The skydiver has now reached a new, lower _____ _____.

Words – slowing down, decrease, increases, terminal velocity, weight, increase, small, constant, balance, accelerates

Draw force diagrams to show what is happening at each stage

	1	2
3	4	5

How does a car get moving?

To make a car move, the engine has to make the wheels turn. This causes a forward force on the car. To understand how, think first about a car trying to start on ice. If the ice is very slippery, the wheels will just spin. The car will not move at all. The spinning wheels produce no forward force on the car. Now imagine a car on a muddy track. The rally car below is throwing up a shower of mud as it tries to get going.

You can see that there is an interaction between the wheel and the ground. The wheel is causing a backwards force on the ground surface. This makes the mud fly backwards. Mud, however, moves when the force is quite small. The other force of the interaction pair is the forward force on the car. It is equal in size. So it is also small – and not big enough to get the car moving.

To answer

1 Underline the words which tell you the first step in making the car move.

2 Cross out 3 sentences which tell you what happens on ice.

3 Find the sentence telling you about the first interaction force on the car.
In **red**:

- draw a ring around its direction
- draw a ring around one of the things it pushes on

4 Find the other force of the interaction pair.
In **blue**:

- draw a ring around its direction
- draw a ring around the thing it pushes on

5 Draw a wavy line in **red** under the words that tell you what happens to the mud.

6 Draw a wavy line in **blue** under the words that tell you what happens to the car.

7 Draw a flowchart explaining what happens when you try to drive a car on mud. Use the information you have marked to help you.

Momentum calculations

1) Harry's mass is 70kg and he runs at 10m/s. What is his momentum?	**4) Greta's momentum is 420kgm/s and her velocity is 7m/s. What is her mass?**	**7) A Bike of mass 50 kg travelling at 15 m/s hits another bike of mass 70kg moving at 8 m/s. After the collision they stick together. What is their joint velocity after the collision?**
2) A lorry, 5,000kg is travelling at 20m/s. What is its momentum?	**5) A skydiver is falling at 50m/s with a momentum of 4,250kgm/s. What is her mass?**	**8) A cyclist of 60kg, initially travelling at 15m/s gains 600kgm/s of momentum. What was her final speed?**
3) Malcolm (the slug) has a mass of 0.1kg and travels at 0.1m/s. What is his mass?	**6) Malcolm (0.1kg) skydives, his momentum is 2.5kgm/s. What is his velocity?**	**9) A ball of mass 1.5kg travelling at 5 m/s hits window weighing 0.5kg. After the collision they stick. What is velocity after the collision?**

Show your working

Practice questions

The driver and passengers wear seatbelts.
Seatbelts reduce the risk of injury if the van stops suddenly.

backwards **downwards** **force** **forwards** **mass** **weight**

Complete the following sentences, using words from the list above, to explain why the risk of injury is reduced if the van stops suddenly.

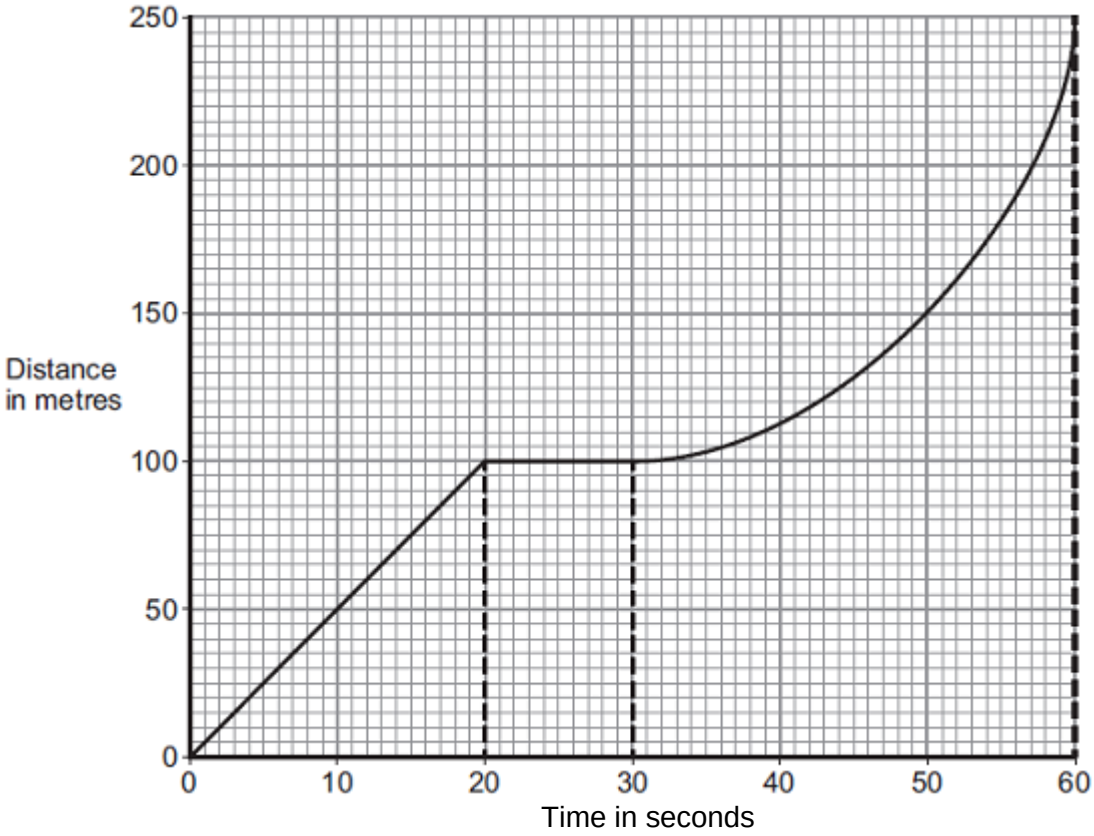
A large ..... is needed to stop the van suddenly.

The driver and passengers would continue to move ..... .

The seatbelts supply a ..... force to keep the driver and passengers in their seats.

Q2. A bus is taking some children to school.

(a) The bus has to stop a few times. The figure below shows the distance–time graph for part of the journey.



(i) How far has the bus travelled in the first 20 seconds?

Distance travelled = ... m

(1)

(ii) Describe the motion of the bus between 20 seconds and 30 seconds.

.....

.....

(1)

(iii) Describe the motion of the bus between 30 seconds and 60 seconds.

Tick (✓) **one** box.

	Tick (✓)
Accelerating	
Reversing	
Travelling at constant speed	

(1)

(iv) What is the speed of the bus at 45 seconds?

Show clearly on the figure above how you obtained your answer.

.....

.....

.....

Speed = ... m / s

(3)

(b) Later in the journey, the bus is moving and has 500 000 J of kinetic energy.

The brakes are applied and the bus stops.

(i) How much work is needed to stop the bus?

.....

Work = ... J

(1)

(ii) The bus stopped in a distance of 25 m.

Calculate the force that was needed to stop the bus.

.....

.....

Force = ... N

(2)

(iii) What happens to the kinetic energy of the bus as it is braking?

.....

.....

.....

.....

(2)

(Total 11 marks)