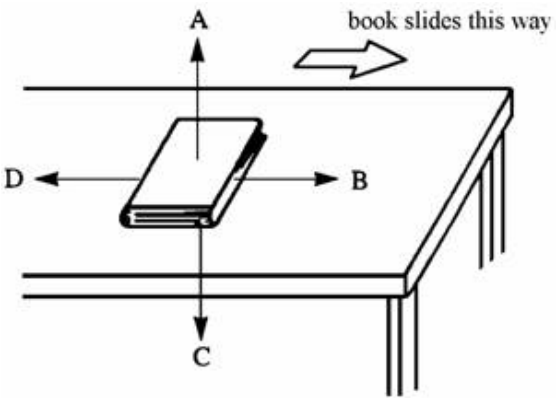
Q1. When you slide a book across a table, there is a force of friction between the book and the table.



(a) Which arrow shows the force of friction that acts on the book? .....

(1)

(b) The force of friction will slow the book down.
Write down **one** other effect that the force of friction will have on the book.

.....

(1)

(Total 2 marks)

Q2. Choose words from this list to complete the sentences below.

balanced	electricity	gravity
joules	magnetism	newtons

When you drop something it falls.

This is because it is pulled to the Earth by .....

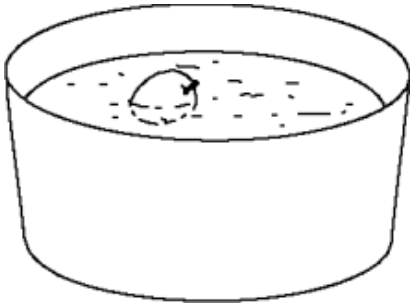
We measure forces in units called .....

When a falling object reaches the ground, it stops moving.

This means that the forces acting on it are now .....

(Total 3 marks)

Q3.



In a science lesson, some children float an apple on some water.

One of the children says:

"The apple is not moving. That means that there cannot be any forces acting on it."

Do you agree?
Explain your answer as fully as you can.

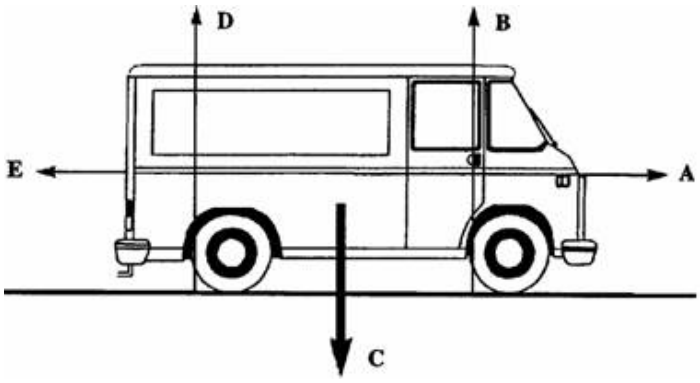
.....

.....

.....

(Total 3 marks)

Q4.



Five forces, **A**, **B**, **C**, **D** and **E** act on the van.

(a) Complete the following sentences by choosing the correct forces from **A** to **E**.

Force ..... is the forward force from the engine.

Force ..... is the force resisting the van's motion.

(1)

(b) The size of forces **A** and **E** can change.
Complete the table to show how big force **A** is compared to force **E** for each motion of the van.
Do this by placing a tick in the correct box.
The first one has been done for you.

MOTION OF VAN	FORCE **A** SMALLER THAN FORCE **E**	FORCE **A** EQUAL TO FORCE **E**	FORCE **A** BIGGER THAN FORCE **E**
Not moving		✓	
Speeding up			
Constant speed			
Slowing down			

(3)

(c) When is force **E** zero?

.....

(1)

(d) The van has a fault and leaks one drop of oil every second.
The diagram below shows the oil drops left on the road as the van moves from **W** to **Z**.

Describe the motion of the van as it moves from:

W to X .....

X to Y .....

Y to Z .....

(3)

(e) 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 ..... .

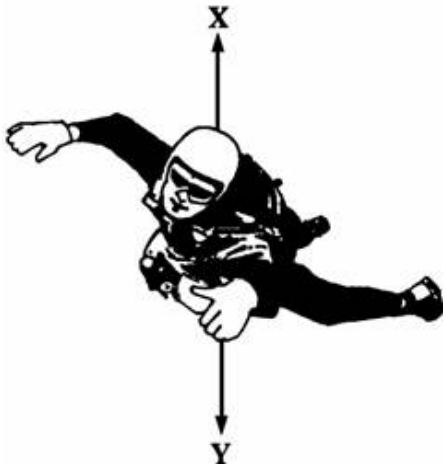
The seatbelts supply a ..... force to keep the driver and passengers

in their seats.

(3)
(Total 11 marks)

Q5. A sky-diver jumps from a plane.

The sky-diver is shown in the diagram below.



(a) Arrows **X** and **Y** show two forces acting on the sky-diver as he falls.

(i) Name the forces **X** and **Y**.

X .....

Y .....

(2)

(ii) Explain why force **X** acts in an upward direction.

.....

.....

(1)

(iii) At first forces **X** and **Y** are unbalanced.

Which of the forces will be bigger? .....

(1)

(iv) How does this unbalanced force affect the sky-diver?

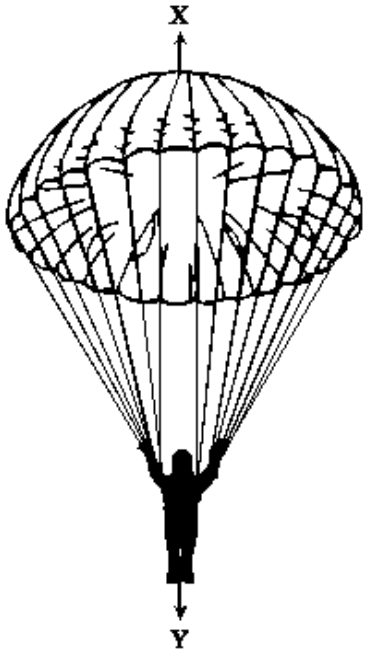
.....

.....

(2)

(b) After some time the sky-diver pulls the rip cord and the parachute opens.

The sky-diver and parachute are shown in the diagram below.



After a while forces **X** and **Y** are balanced.

Underline the correct answer in each line below.

Force **X** has

increased / stayed the same / decreased.

Force **Y** has

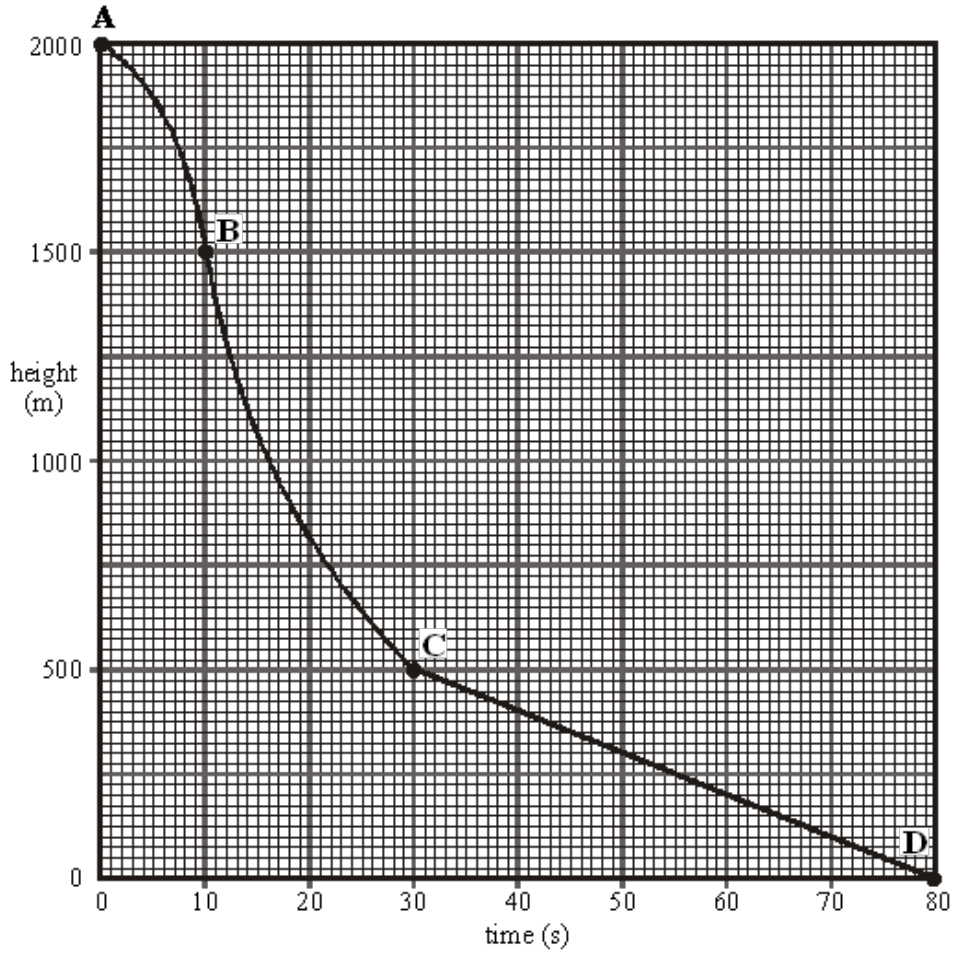
increased / stayed the same / decreased.

The speed of the sky-diver will

increase / stay the same / decrease.

(3)

(c) The graph below shows how the height of the sky-diver changes with time.



(i) Which part of the graph, **AB**, **BC** or **CD** shows the sky-diver falling at a constant speed?

.....

(1)

(ii) What distance does the sky-diver fall at a constant speed?

Distance ..... m

(1)

(iii) How long does he fall at this speed?

Time ..... s

(1)

(iv) Calculate this speed.

.....

.....

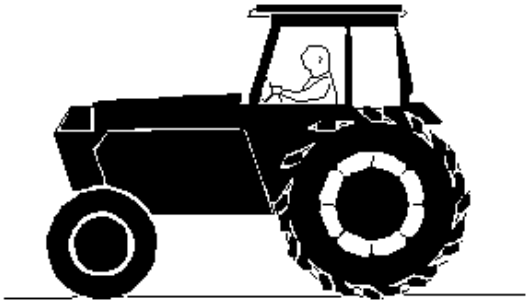
.....

Speed ..... m/s

(2)

(Total 14 marks)

Q6. (a) The diagram below shows a moving tractor. The forward force from the engine exactly balances the resisting forces on the tractor.



(i) Describe the motion of the tractor.

.....

(ii) The tractor comes to a drier part of the field where the resisting forces are less. If the forward force from the engine is unchanged how, if at all, will the motion of the tractor be affected?

.....

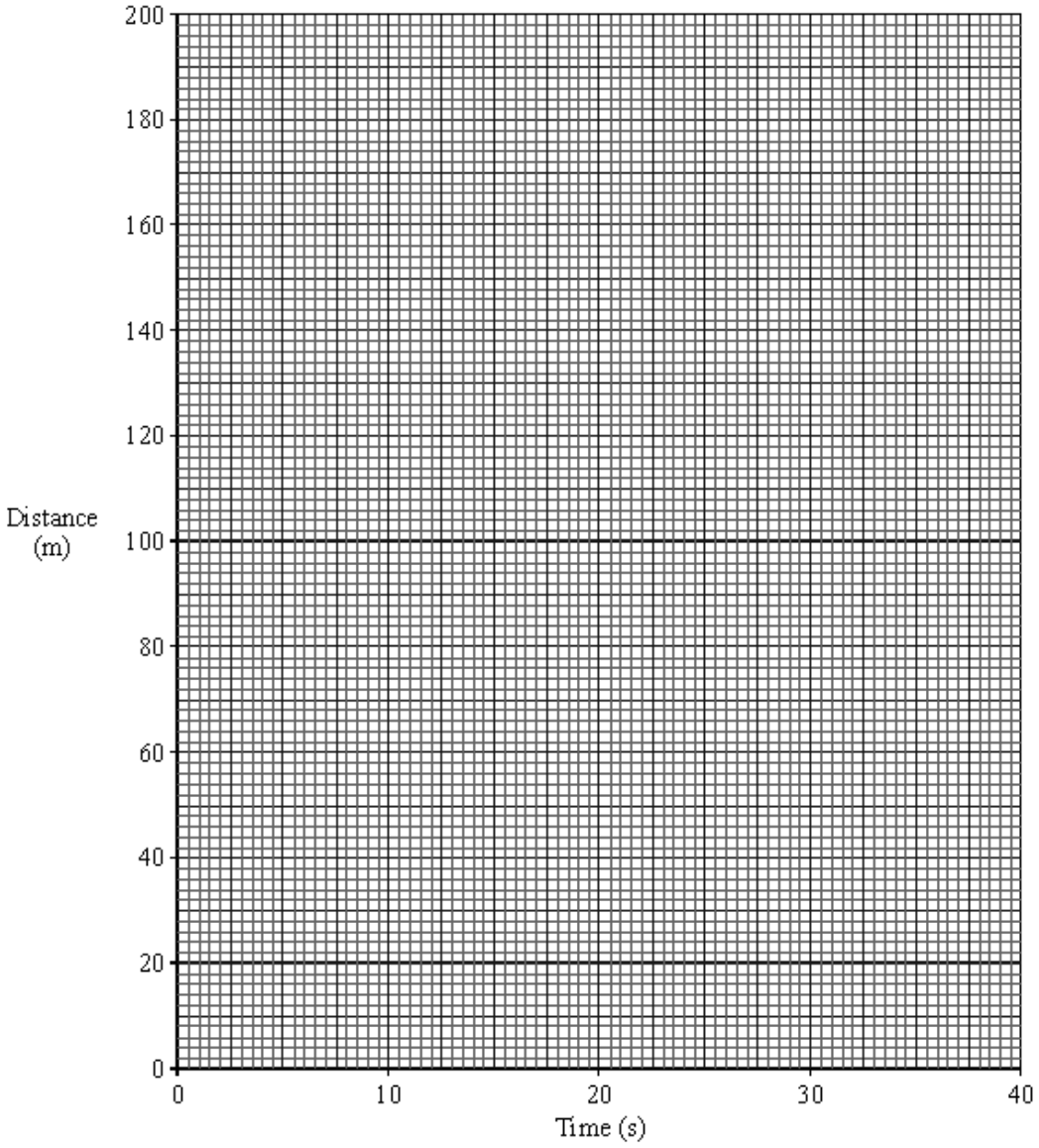
.....

(3)

(b) Two pupils are given the task of finding out how fast a tractor moves across a field. As the tractor starts a straight run across the field the pupils time how long it takes to pass a series of posts which are forty metres apart. The results obtained are shown in the table below.

Distance travelled (m)	0	40	80	120	160	200
Time taken (s)	0	8	16	24	32	40

(i) Draw a graph of distance travelled against time taken using the axes on the graph below. Label your graph line A.



(2)

(ii) Calculate the speed of the tractor.

.....

.....

(3)

(c) In another, wetter field there is more resistance to the movement of the tractor. It now travels at 4 m/s.

(i) Calculate the time needed to travel 200m.

.....

.....

.....

(ii) On the graph in part (b) draw a line to represent the motion of the tractor across the second field. Label this line B.

(4)

(d) On a road the tractor accelerates from rest up to a speed of 6 m/s in 15 seconds.

Calculate the acceleration of the tractor.

.....

.....

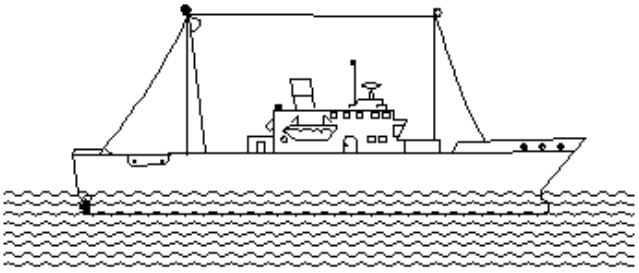
.....

.....Acceleration = ...m/s^2

(3)

(Total 15 marks)

Q7. The diagram below shows an empty cargo ship. It is not moving.

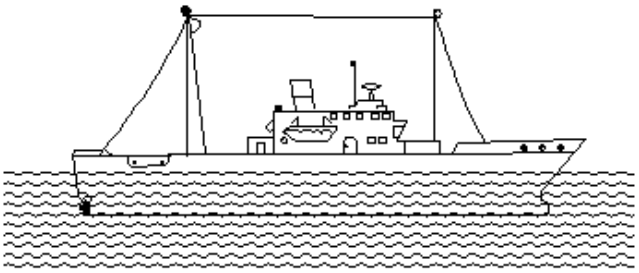


(a) The water exerts a force on the ship. In which direction does this force act?

.....

(1)

(b) The diagram below shows the same cargo ship. This time it has a full load of cargo.



(i) How does the force exerted by the water on the ship change as the ship is loaded?

.....

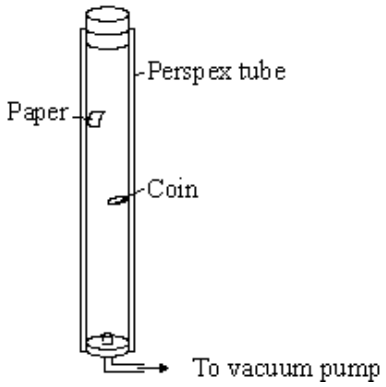
(1)

(ii) Why has the force exerted by the water changed?

.....

(1)
(Total 3 marks)

Q8. The apparatus shown is used to compare the motion of a coin with the motion of a piece of paper as they both fall.



(a) When the tube is filled with air the coin falls faster than the piece of paper. Why?

.....

.....

(1)

(b) The air in the tube is removed by the vacuum pump. The tube is turned upside down. State **two** ways in which the motion of the coin and piece of paper will change compared to when there was air in the tube.

1 .....

.....

.....

2 .....

.....

.....

(2)
(Total 3 marks)

Q9. (a) The arrows in the diagram represent the size and direction of the forces on a space shuttle, fuel tank and booster rockets one second after launch. The longer the arrow the bigger the force.

Thrust force

Weight of shuttle, fuel tanks and booster rockets plus air resistance

(i) Describe the upward motion of the space shuttle one second after launch.

.....

(1)

(ii) By the time it moves out of the Earth's atmosphere, the total weight of the space shuttle, fuel tank and booster rockets has decreased and so has the air resistance.

How does this change the motion of the space shuttle? (Assume the thrust force does not change).

.....

(1)

(b) The space shuttle takes 9 minutes to reach its orbital velocity of 8100 m/s.

(i) Write down the equation that links acceleration, change in velocity and time taken.

.....

(1)

(ii) Calculate, in m/s^2, the average acceleration of the space shuttle during the first 9 minutes of its flight. Show clearly how you work out your answer.

.....

.....

average acceleration = ... m/s^2

(2)

(iii) How is the velocity of an object different from the speed of an object?

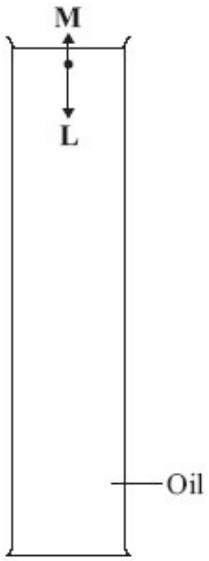
.....

.....

(1)

(Total 6 marks)

Q10. (a) The diagram shows a steel ball-bearing falling through a tube of oil.
The forces, **L** and **M**, act on the ball-bearing.

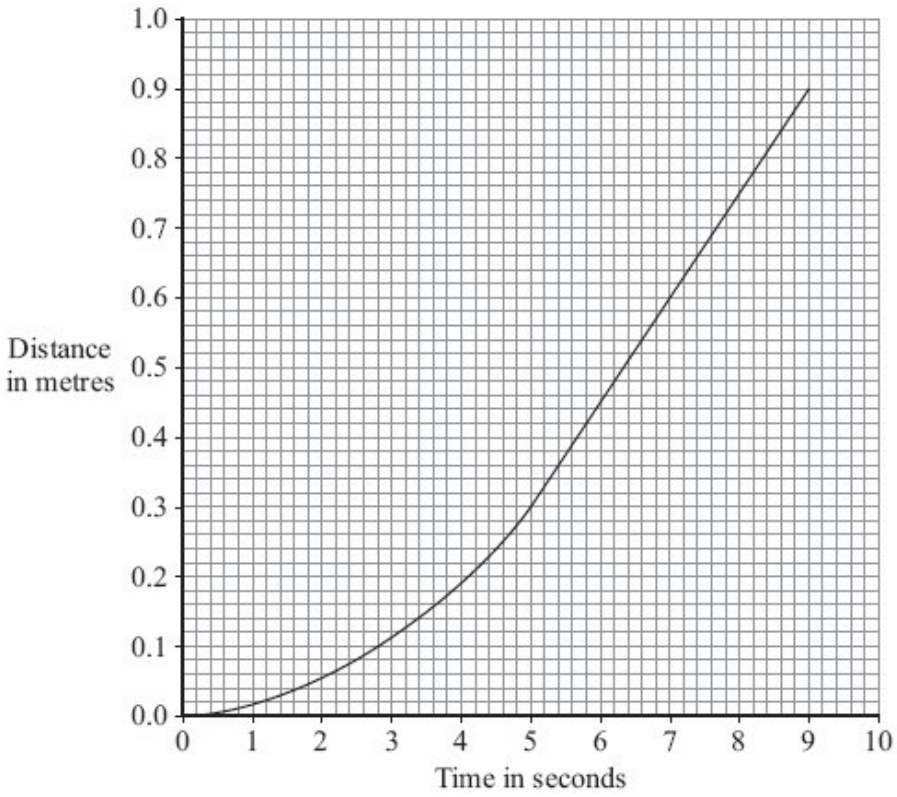


What causes force **L**?

.....

(1)

(b) The distance – time graph represents the motion of the ball-bearing as it falls through the oil.



(i) Explain, in terms of the forces, **L** and **M**, why the ball-bearing accelerates at first but then falls at constant speed.

.....

.....

.....

.....

.....

.....

(3)

(ii) What name is given to the constant speed reached by the falling ball-bearing?

.....

(1)

(iii) Calculate the constant speed reached by the ball-bearing.

Show clearly how you use the graph to work out your answer.

.....

.....

.....

Speed = ... m/s

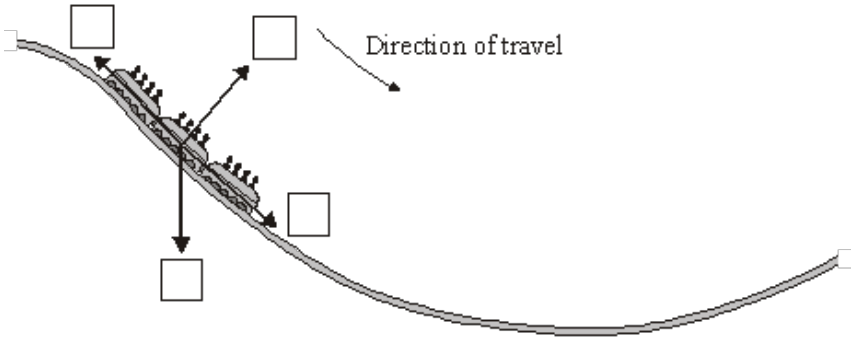
(2)

(Total 7 marks)

Q11. The diagram shows the passenger train on part of a rollercoaster ride.

(a) Which arrow shows the direction of the resultant force acting on the passenger train?

Put a tick (✓) in the box next to your choice.



(1)

(b) At the bottom of the slope, the passengers in the train all have the same speed but they each have a different kinetic energy.

Why is the kinetic energy of each passenger different?

.....

.....

(1)

(c) For part of the ride, the maximum gravitational field strength acting on the passengers seems 3 times bigger than normal.

Normal gravitational field strength = 10 N/kg

(i) Calculate the maximum gravitational field strength that seems to act on the passengers during the ride.

.....

.....

Maximum gravitational field strength = ... N/kg

(1)

(ii) One of the passengers has a mass of 80 kg.

Use the equation in the box to calculate the maximum weight this passenger seems to have during the ride.

weight = mass × gravitational field strength

Show clearly how you work out your answer.

.....

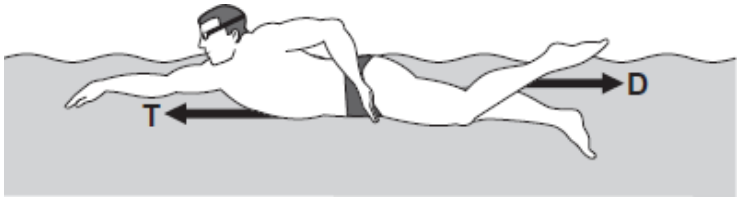
.....

Maximum weight = ... N

(2)

(Total 5 marks)

Q12. (a) The diagram shows the horizontal forces acting on a swimmer.



(i) The swimmer is moving at constant speed.
Force **T** is 120 N.

What is the size of force **D**?

..... N

(1)

(ii) By increasing force **T** to 140 N, the swimmer accelerates to a higher speed.

Calculate the size of the initial resultant force acting on the swimmer.

.....

.....

Initial resultant force = ... N

(1)

(iii) Even though the swimmer keeps the force **T** constant at 140 N, the resultant force on the swimmer decreases to zero.

Explain why.

.....

.....

.....

.....

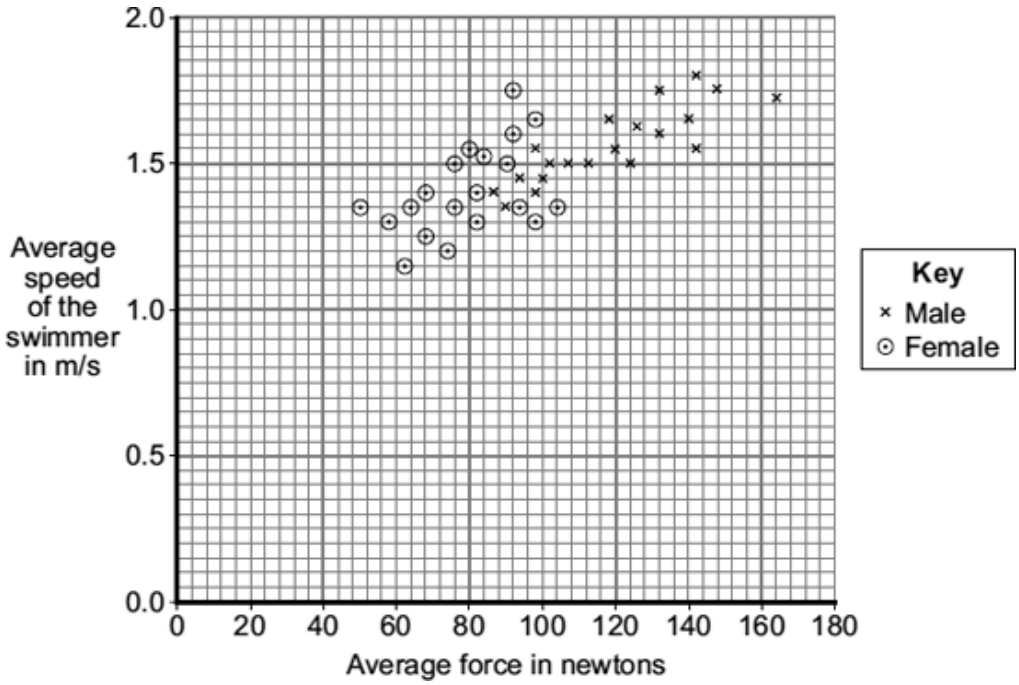
.....

.....

(3)

(b) A sports scientist investigated how the force exerted by a swimmer's hands against the water affects the swimmer's speed.
The investigation involved 20 males and 20 females swimming a fixed distance.
Sensors placed on each swimmer's hands measured the force 85 times every second over the last 10 metres of the swim.
The measurements were used to calculate an average force.
The average speed of each swimmer over the last 10 metres of the swim was also measured.

The data from the investigation is displayed in the graph.



(i) What was the dependent variable in this investigation?

.....

(1)

(ii) Explain **one** advantage of measuring the force 85 times every second rather than just once or twice every second.

.....

.....

.....

.....

(2)

(iii) Give **one** way in which the data for the male swimmers is different from the data for the female swimmers.

.....

.....

(1)

(iv) Considering only the data from this investigation, what advice should a swimming coach give to swimmers who want to increase their average speed?

.....

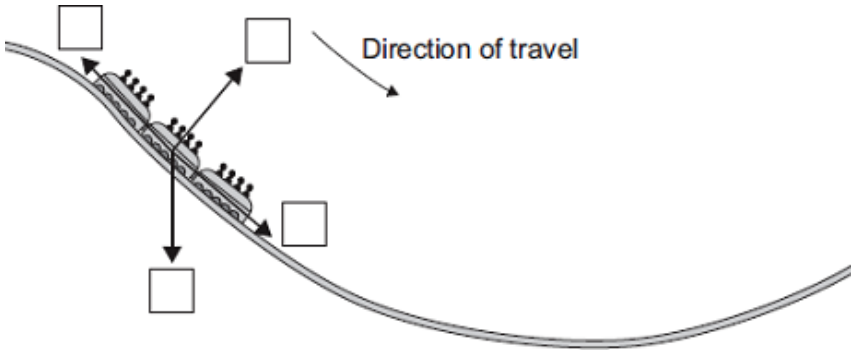
.....

(1)

(Total 10 marks)

Q13. The diagram shows the passenger train on part of a rollercoaster ride.

(a) Which arrow shows the direction of the resultant force acting on the passenger train? Put a tick (✓) in the box next to your choice.



(1)

(b) For part of the ride, the maximum gravitational field strength acting on the passengers seems 3 times bigger than normal.

Normal gravitational field strength = 10 N/kg

(i) Calculate the maximum gravitational field strength that seems to act on the passengers during the ride.

.....

.....

Maximum gravitational field strength = ... N/kg

(1)

(ii) One of the passengers has a mass of 75 kg.

Use the equation in the box to calculate the maximum weight this passenger seems to have during the ride.

weight = mass × gravitational field strength

Show clearly how you work out your answer.

.....

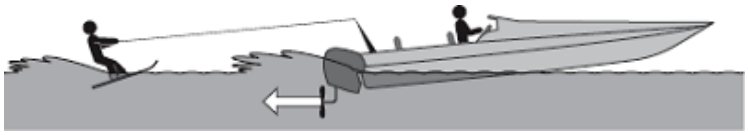
.....

Maximum weight = ... N

(2)

(Total 4 marks)

Q14. The diagram shows a boat pulling a water skier.



(a) The arrow represents the force on the water produced by the engine propeller. This force causes the boat to move.

Explain why.

.....

.....

.....

.....

(2)

(b) The boat accelerates at a constant rate in a straight line. This causes the velocity of the water skier to increase from 4.0 m/s to 16.0 m/s in 8.0 seconds.

(i) Calculate the acceleration of the water skier and give the unit.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Acceleration = ...

(3)

(ii) The water skier has a mass of 68 kg.

Calculate the resultant force acting on the water skier while accelerating.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Resultant force = ... N

(2)

(iii) Draw a ring around the correct answer to complete the sentence.

The force from the boat pulling the water skier forwards

will be | less than / the same as / greater than | the answer to part **(b)(ii)**.

Give the reason for your answer.

.....

.....

(2)

(Total 9 marks)