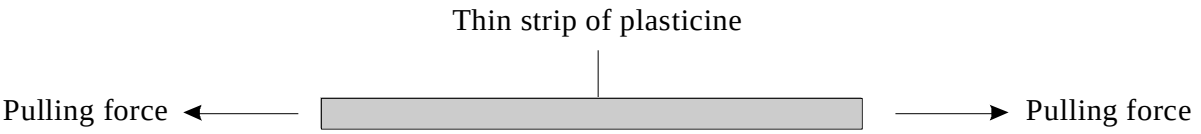
1. (a) The diagrams below show pairs of forces acting on different objects. In each case describe what happens when the forces are increased. Then describe what happens when the forces are removed.

(i)



When the forces are increased

.....

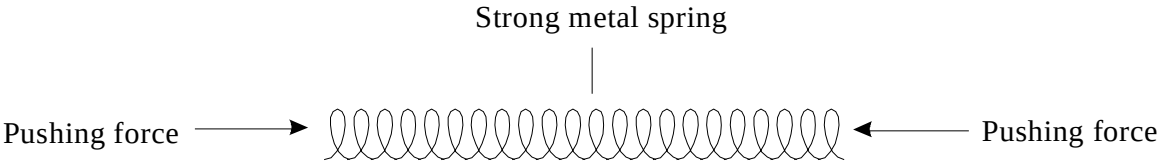
.....

When the forces are removed

.....

.....

(ii)



When the forces are increased

.....

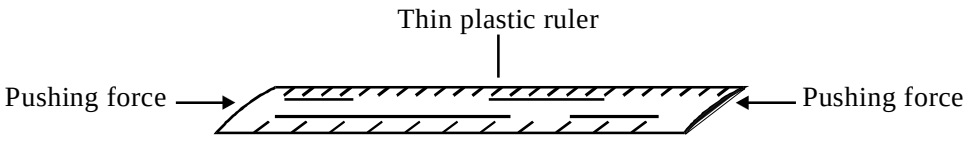
.....

When the forces are removed

.....

.....

(iii)



When the forces are increased

.....

.....

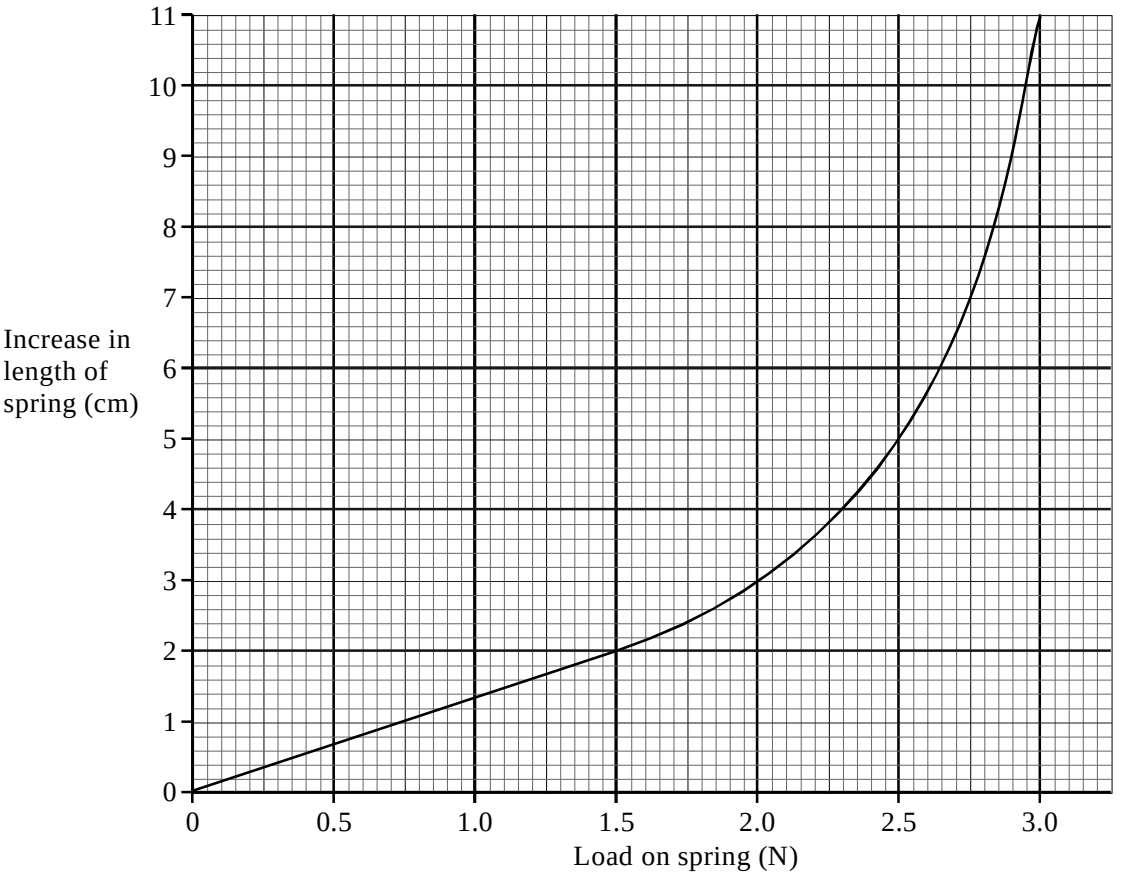
When the forces are removed

.....

.....

(6)

(b) The graph shows the increase in length of a spring against **load** (force).



The length of the spring with no load was 15 cm.

Use the graph to find:

(i) The load needed to produce an increase in length of 2 cm.

.....

(ii) The increase in length produced by a load of 2.3 N.

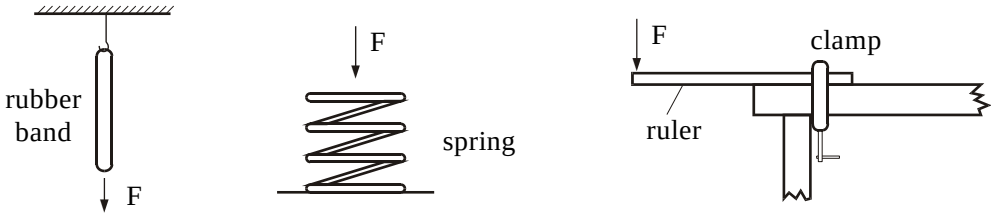
.....

(iii) The **length** of the spring when the load was 2.3 N.

.....

(3)

2. (a) The diagrams below show force **F** acting on various objects.



Choose words from the list below to complete the following sentences.

bend **compress** **stretch**

When force **F** acts:

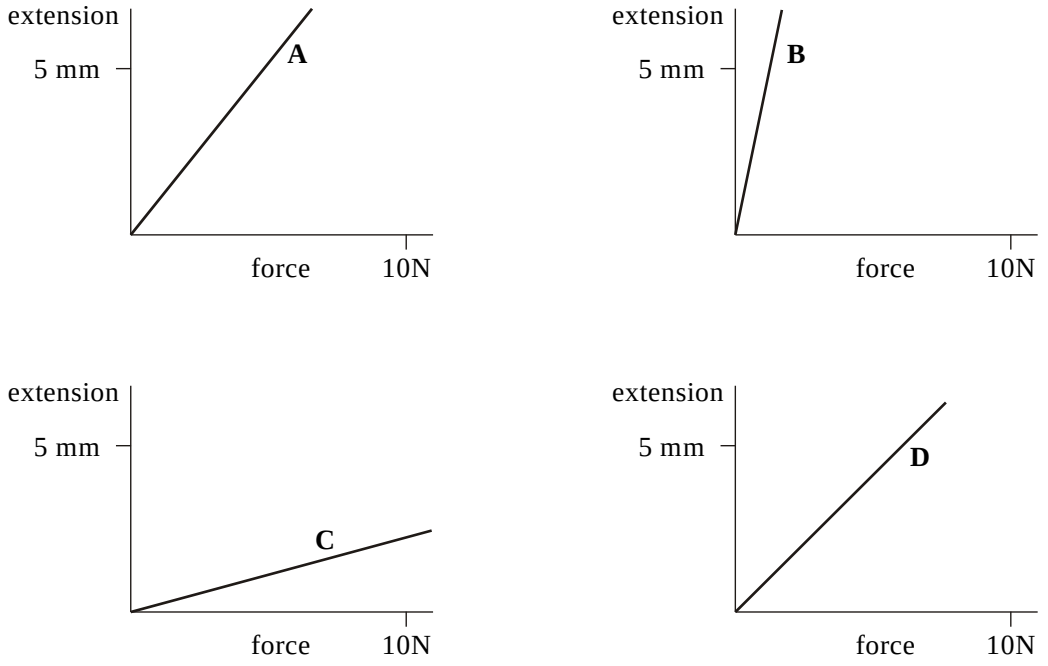
(i) the rubber band will .....

(ii) the spring will .....

(iii) the ruler will .....

(3)

(b) The graphs below show how the extension of four materials **A**, **B**, **C** and **D** varies with the force applied.



Which of the materials **A**, **B**, **C** or **D** is:

(i) easiest to stretch, ...

(ii) hardest to stretch? .....

(2)

3. (a) Two skydivers jump from a plane. Each holds a different position in the air.

A

B

Adapted from Progress with Physics by Nick England, reproduced by permission of Hodder Arnold

Complete the following sentence.

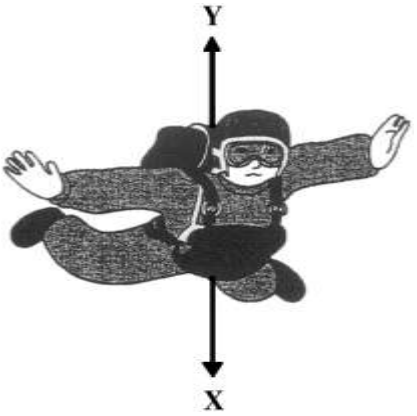
Skydiver ..... will fall faster because.....

.....

.....

(2)

The diagram shows the direction of the forces acting on one of the skydivers.



Adapted from Progress with Physics by Nick England, reproduced by permission of Hodder Arnold

(b) In the following sentences, cross out in each box the **two** lines that are wrong.

(i) Force **X** is caused by

air resistance
friction
gravity

(1)

(ii) Force **Y** is caused by

air resistance
gravity
weight

(1)

(iii) When force **X** is bigger than force **Y**, the speed of the

skydiver will

go up
stay the same
go down

(1)

(iv) After the parachute opens, force **X**

goes up
stays the same
goes down

(1)

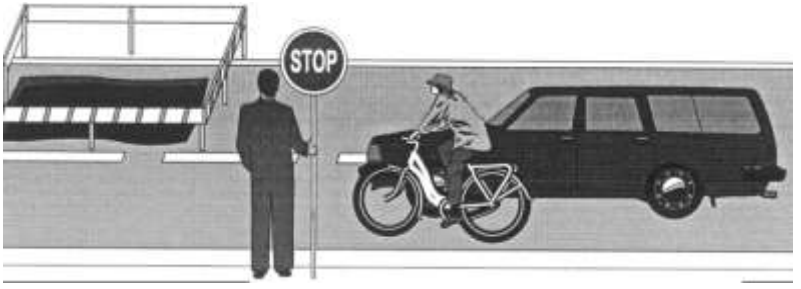
(c) How does the area of an opened parachute affect the size of force **Y**?

.....

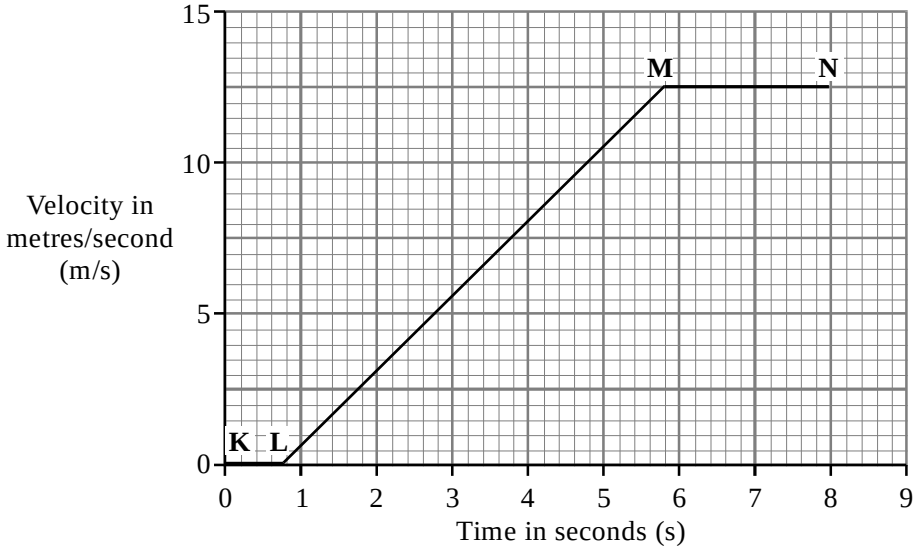
.....

(1)
(Total 7 marks)

4. A car and a bicycle are travelling along a straight road. They have stopped at road works.



The graph shows how the velocity of the car changes after the sign is changed to GO.



(a) Between which two points on the graph is the car moving at constant velocity?

.....

(1)

(b) Between which two points on the graph is the car accelerating?

.....

(1)

(c) Between the sign changing to GO and the car starting to move, there is a time delay. This is called the reaction time.

(i) What is the reaction time of the car driver?

Reaction time = ... seconds

(1)

(ii) Which **one** of the following could increase the reaction time of a car driver? Tick the box next to your choice.

Drinking alcohol	☐
Wet roads	☐
Worn car brakes	☐

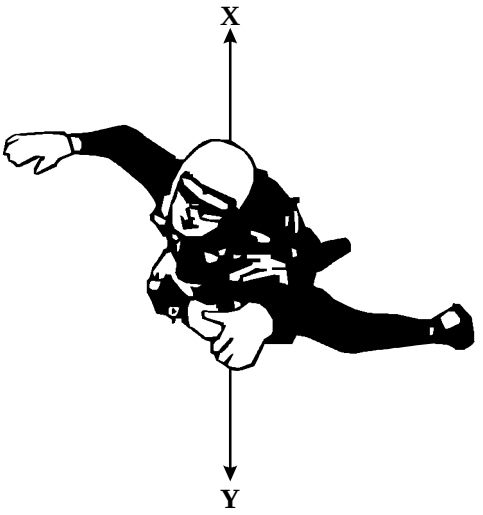
(1)

(d) The cyclist starts to move at the same time as the car. For the first 2 seconds the cyclist's acceleration is constant and is greater than that of the car.

Draw a line on the graph to show how the velocity of the cyclist might change during the first 2 seconds of its motion.

(2)
(Total 6 marks)

5. The diagram shows a sky-diver in free fall. Two forces, **X** and **Y**, act on the sky-diver.



(a) Complete these sentences by crossing out the **two** lines in each box that are wrong.

(i) Force **X** is caused by [friction / gravity / weight].

(1)

(ii) Force **Y** is caused by [air resistance / friction / gravity].

(1)

(b) The size of force **X** changes as the sky-diver falls. Describe the motion of the sky-diver when:

(i) force **X** is smaller than force **Y**,

.....

.....

(2)

(ii) force **X** is equal to force **Y**.

.....

.....

(1)

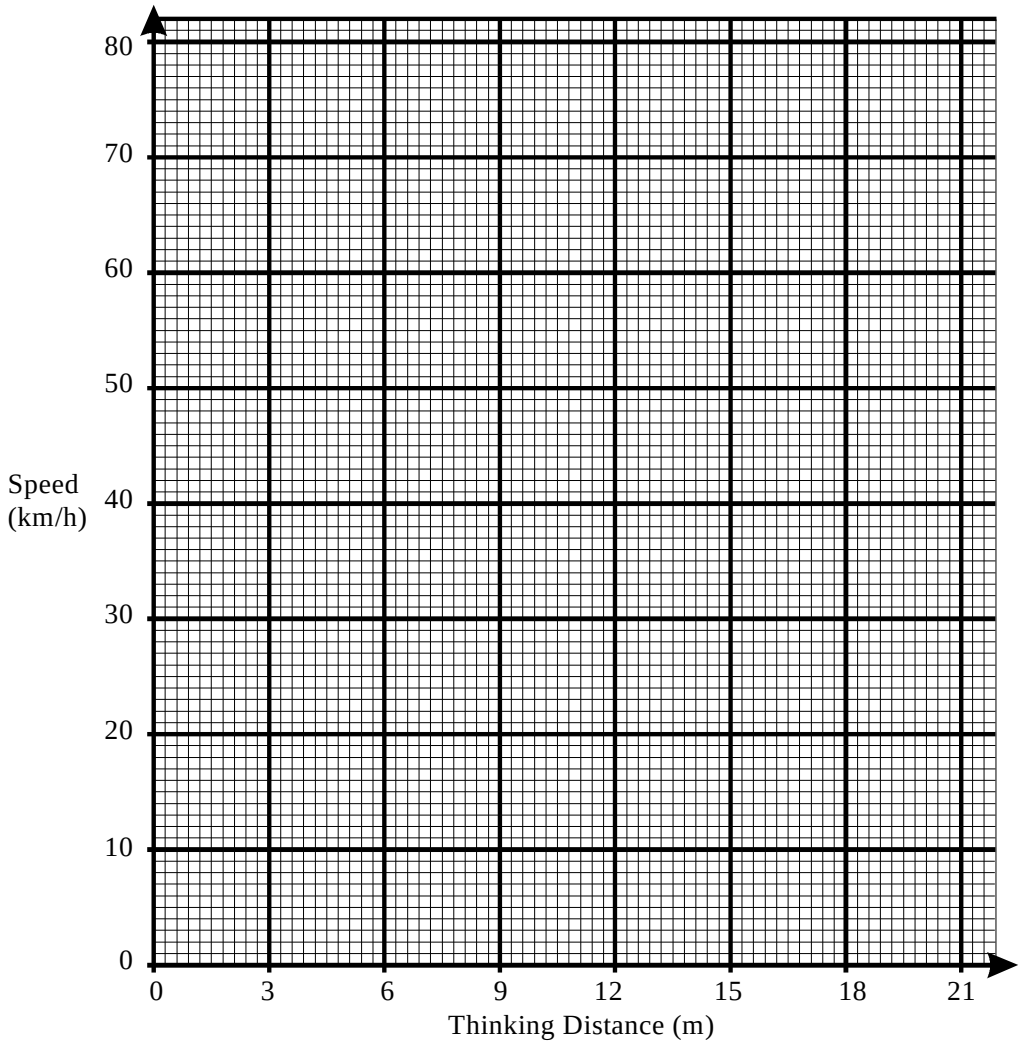
(Total 5 marks)

6. When a car driver has to react and apply the brakes quickly, the car travels some distance before stopping. Part of this distance is called the "thinking distance". This is how far the car travels while the driver reacts to a dangerous situation.

The table below shows the thinking distance (m) for various speeds (km/h).

Thinking distance (m)	0	9	12	15
Speed (km/h)	0	48	64	80

(a) On the graph paper below, draw a graph of the thinking distance against speed.



(2)

(b) Describe how thinking distance changes with speed.

.....

.....

(1)

(c) The time the driver spends thinking before applying the brakes is called the "thinking time".

A driver drank two pints of lager. Some time later the thinking time of the driver was measured as 1.0 seconds.

(i) Calculate the thinking distance for this driver when driving at 9 m/s.

.....

.....

Answer ..... m

(1)

(ii) A speed of 9 m/s is the same as 32 km/h. Use your graph to find the thinking distance at 32 km/h for a driver who has not had a drink.

.....

Answer ..... m

(1)

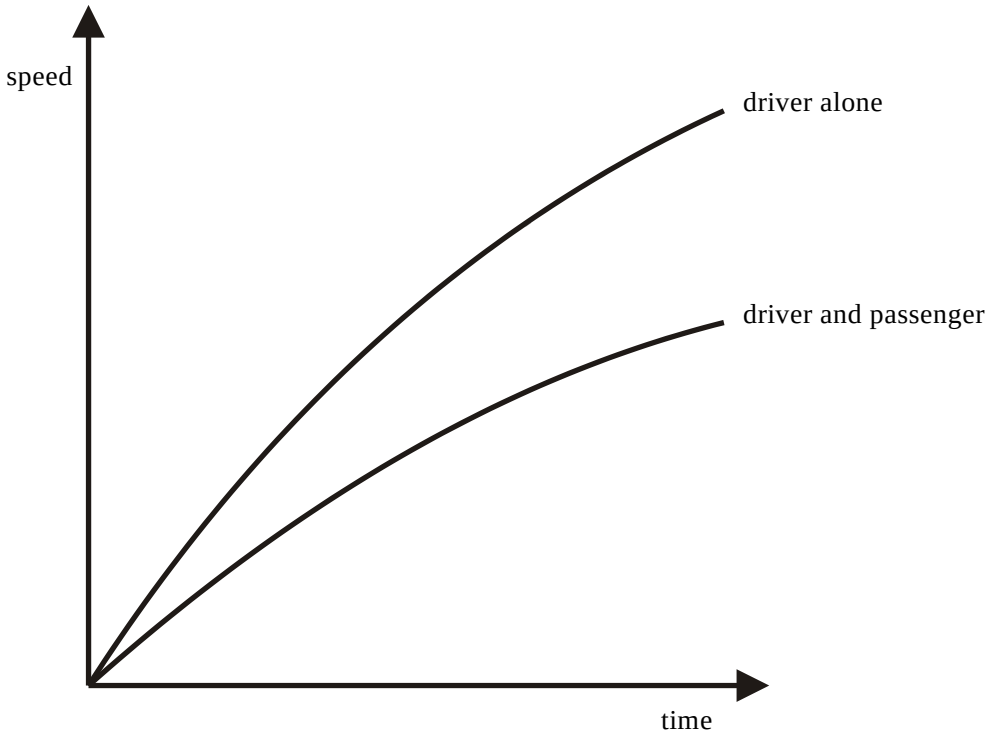
(iii) What has been the effect of the drink on the thinking distance of the driver?

.....

.....

(1)

7. (a) When a car is driven efficiently the engine gives a constant forward pull on the car as the car accelerates to its maximum speed. During this time frictional forces and air resistance oppose the forward motion of the car. The sketch graphs below show how the car's speed increases when only the driver is in the car, and when the driver has a passenger in the car.



(i) How does the acceleration of the car change with time?

.....

.....

(1)

(ii) What conclusion can be made about the resultant (net) forward force on the car as its speed increases?

.....

.....

(1)

(ii) On the graph, draw a line to show how you would expect the car's speed to vary if it carried three passengers.

(1)

(b) The manufacturer of a family car gave the following information.

Mass of car 950g

The car will accelerate from 0 to 33 m/s in 11 seconds.

(i) Calculate the acceleration of the car during the 11 seconds.

.....

.....

.....

Answer .....

(2)

(ii) Calculate the force needed to produce this acceleration.

.....

.....

.....

Answer ..... N

(2)

(iii) The manufacturer of the car claims a top speed of 110 miles per hour. Explain why there must be a top speed for any car.

.....

.....

(2)

8. The manufacturer of a family car gave the following information.

Mass of car 950 kg

The car will accelerate from 0 to 33 m/s in 11 seconds.

(a) Calculate the acceleration of the car during the 11 seconds.

.....

.....

.....

(2)

(b) Calculate the force needed to produce this acceleration.

.....

.....

.....

(2)

(c) The manufacturer of the car claims a top speed of 110 miles per hour. Explain why there must be a top speed for any car.

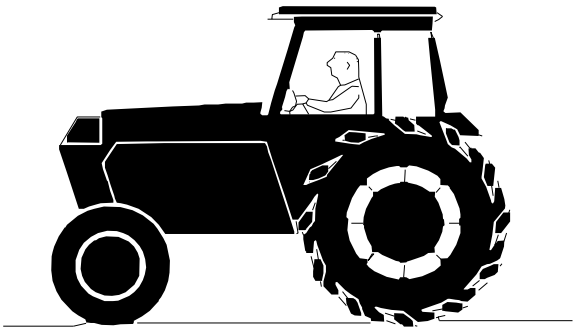
.....

.....

.....

(3)

9. (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?

.....

.....

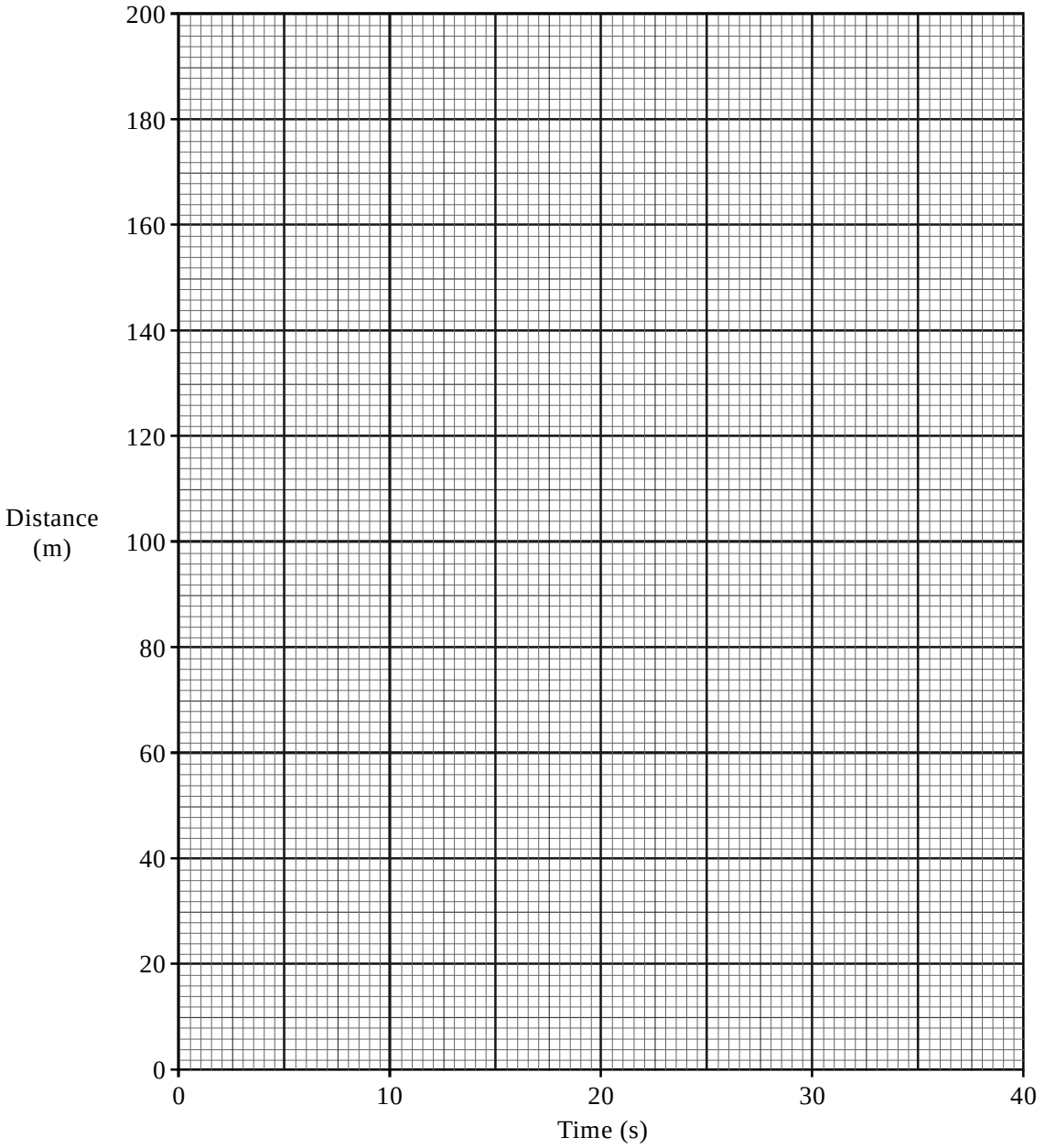
(3)

(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.

.....

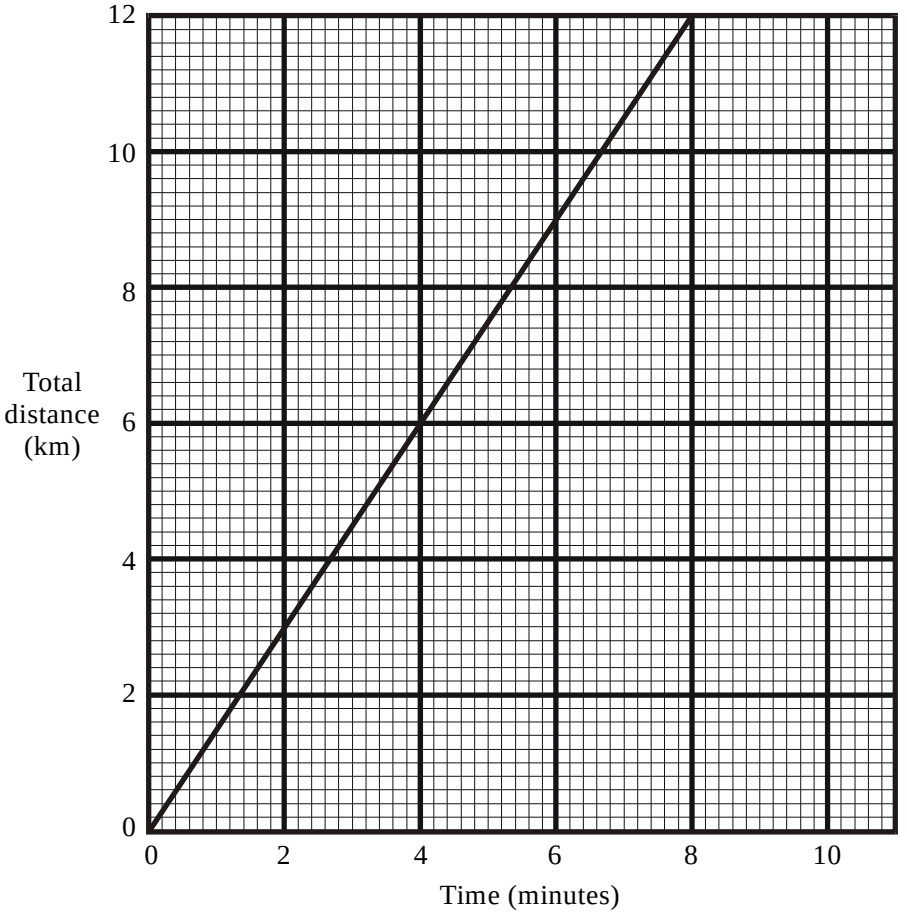
.....

.....

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

(3)

10. Below is a distance-time graph for part of a train journey.
The train is travelling at a constant speed.



(a) Use the graph to find

(i) how far the train travels in 2 minutes ..... km.

(ii) how long it takes the train to travel a distance of 10 kilometres ..... minutes.

(2)

(b) Calculate the speed of the train.

.....

.....

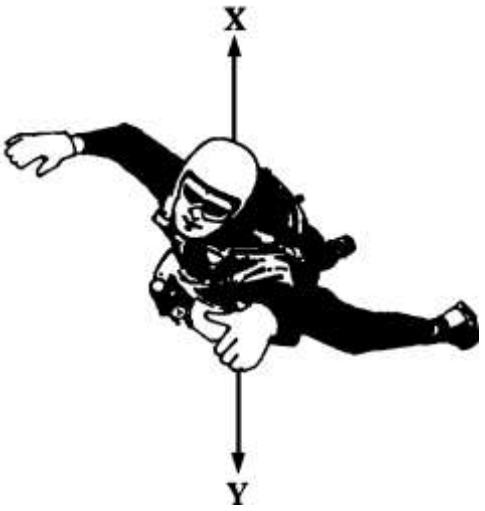
.....

.....

(4)

11. 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?

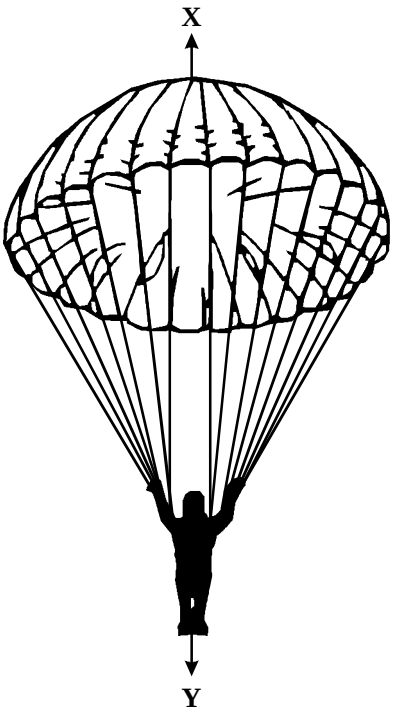
.....

.....

(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

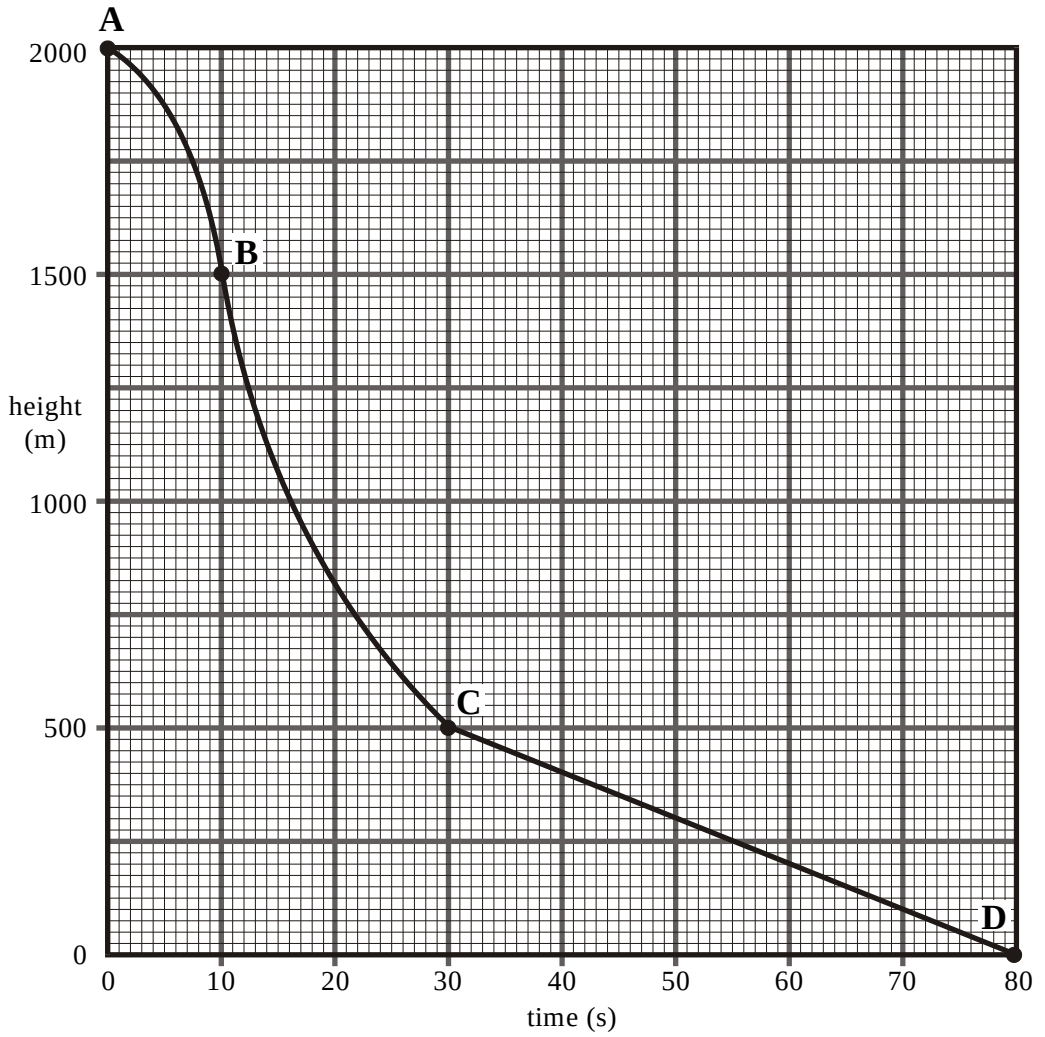
increased / stayed the same / decreased.

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)

12. Astronomers use telescopes to observe stars and galaxies.

(a) (i) What is a galaxy?

.....

.....

(1)

(ii) Briefly explain how stars are formed.

.....

.....

.....

.....

.....

(2)

(b) The Hubble space telescope is in orbit round the Earth.

Astronomers can take better photographs through the Hubble telescope than by using telescopes on the ground.
Explain why.

.....

.....

.....

.....

.....

(2)

13. (a) (i) plasticine stretches/snaps 2
stays stretched/snapped
for 1 mark each

(ii) spring compresses OWTTE
returns to **original** length/shape or
gets longer
for 1 mark each 2

(iii) ruler bends/breaks
returns to original shape or stays broken
for 1 mark each 2

(b) (i) 1.5N
for 1 mark 1

(ii) 4 cm
for 1 mark 1

(iii) 19 cm
for 1 mark 1

[9]

14. (a) (i) stretch 1

(ii) compress 1

(iii) bend 1

(b) (i) B 1

(ii) C 1

[5]

15. (a) B 1

more aerodynamic or
most streamlined shape **or**
smaller (surface) area 1
*accept less air/wind resistance **or** less drag **or** less friction*
*clothing traps less air **or** rolled up into ball **or** arms, legs drawn in*
accept converse

(b) (i) gravity 1

(ii) air resistance 1

(iii) go up 1

(iv) stays the same 1

(c) bigger the area, the bigger force Y 1
accept the converse

or bigger the area more drag
accept when the parachute opens then force Y bigger

or bigger the area more air resistance
need the relation of area to force

[7]

16. (a) MN 1

accept 5.8, 8 seconds
must include unit

(b) LM 1

accept 0.8, 5.8 seconds
must include unit

(c) (i) 0.8 1

(ii) drinking alcohol 1

(d) straight (by eye) line starting at 0.8 seconds 1

line drawn steeper than LM starting before L 1

ignore lines going beyond 2 seconds but line must exceed 2.5 metres per second before terminating

[6]

17. (a) (i) friction 1

accept any way of indicating the correct answer

(ii) gravity 1

accept any way of indicating the correct answer

(b) (i) accelerates **or** speed / velocity increases 1

accept faster and faster (1 mark)

*do **not** accept faster pace / falls faster*
or suggestions of a greater but constant speed

downwards / falls 1

accept towards the Earth / ground

this may score in part (b)(ii) if it does not score here and there is no contradiction between the two parts

(ii) constant speed / velocity **or** terminal velocity / speed or zero acceleration 1

stays in the same place negates credit

[5]

18. (a) 3 2

gains 1 mark

m/s^2

gains 1 mark

else working *gains 1 mark*

(b) 2850 ecf 2

gains 1 mark

N

gains 1 mark

else working

gains 1 mark

(c) friction/air resistance increases with speed; 3
till frictional = max forward force;
then force/acceleration is zero
for 1 mark each

alternative limitation for safety
gains 1 mark only

[7]

19. (a) (i) decreases 1
for 1 mark

(ii) decreases 1
for 1 mark

(iii) lower speed everywhere 1
for 1 mark

(b) (i) 3 $a = \frac{s}{t}$ or $a = \frac{33}{11}$ 1
gains 1 mark

ms^{-2} 1
gains 1 mark

(ii) 2850 ecf 2
gains 2 marks

else working
gains 1 mark

(iii) air resistance/frictional forces increase with speed; 2
till frictional force = max forward engine force;
when acceleration is zero
(incorrect statement - 1 mark)

or
(limitation on maximum speed for safety-1 mark)
any two for 1 mark each

[9]

20. (a) (i) Constant speed 2

(ii) Accelerates to higher constant speed

(b) (i) Points correct (allow one major or two minor mistakes) 2
Line correct (for their points)

(ii) 5 m/s 3
or 5
gets 2 marks

or correct unit
gets 1 mark mark

(c) (i) 50 s 3
or 50
gets 2 marks

or t = d/v
gets 1 mark

(ii) Line correct (of gradient 4 and spans 30 consecutive seconds) 1

(d) (i) 0.04 3
or 6/15
gets 2 marks

or a = v/t
gets 1 mark

[15]

21. (a) (i) 3km [allow 2.9 to 3.1] 1
for 1 mark

(ii) 6.6 min [allow 6.5 to 6.8] 1
for 1 mark

(b) can be in any units, 1.5 km/min, 1500 m/min, 25 m/s, 90 km/h 4
Sp = d/t
=12/8
=1.5
km/min
for 1 mark each
(see marking of calculations)

22. (a) (i) air resistance/drag/friction (or upthrust) 1
weight/gravitational pull/gravity
for 1 mark each

(ii) air resistance/friction acts in opposite direction to motion 1

(iii) Y 1

(iv) the sky-diver accelerates/his speed increases 2
in downward direction/towards the Earth/falls
for 1 mark each

(b) force X has increased 3
force Y has stayed the same
the speed of the sky-diver will stay the same
for 1 mark each

(c) (i) CD 1

(ii) 500 } (but apply e.c.f. from (i)) 2

(iii) 50 }

(iv) 10 (but apply e.c.f. from (ii) and (iii)) 2
gets 2 marks

or 500/50 or d/t
gets 1 mark

[14]

23. (a) (i) A galaxy is a group of a large number of stars. 1
Ignore planets. Etc.
for 1 mark

(ii) Stars are formed from gas which occur in space 2
Pulled together by gravitational attraction
Causes high temperature/fusion/energy release
any 2 for 1 mark each

(b) No atmosphere in the way/atmosphere absorbs/scatters/distorts light 2
Artificial lights interfere
Clouds/storms etc. get in way
any 2 for 1 mark each

Ignore references to being closer to stars/planets

[5]