**Q1.** (a) The diagram shows a car being driven at 14 rn/s. The driver has forgotten to clear a thick layer of snow from the roof.

	Snow	Mass of car = 750 kg Mass of driver = 80 kg Mass of snow = 35 kg
Which of the following has	the smallest mome	ntum? Draw a circle around your answer
the car	the driver	the snow
Give a reason for your answ	/er.	
Seeing an obstacle in the ro straight line.	oad, the driver appli	es the car brakes. The car slows down in
(i) Does the momentum	of the car increase	, decrease or stay the same?
Give a reason for you	r answer.	

(ii) As the car slows down the snow starts to slide. In which direction will the snow start to slide, backwards, forwards or sideways?

.....

Give a reason for your choice of direction.

(c) Draw a circle around the unit which can be used to measure momentum.

Nm J/s Ns

(b)

(1) (Total 7 marks)

(2)

(2)

а

**Q2.** The picture shows luggage which has been loaded onto a conveyor belt.



	Does the momentum of t	the luggage change	e as it turns left with	the conveyor belt?
	Give a reason for your ar	nswer.		
(b)	Draw a circle around the unit	which can be used	to measure mome	ntum.
	J/s	kg m/s	Nm	(1) (Total 7 marks)

**Q3.** The diagram shows the forces on a small, radio-controlled, flying toy.



(a) (i) The mass of the toy is 0.06 kg. Gravitational field strength = 10 N/kg

Use the equation in the box to calculate the weight of the toy.

weight = mass x gravitational field strength

Show clearly how you work out your answer and give the unit.

.....

.....

Weight = .....

(3)

(ii) Complete the following sentence by drawing a ring around the correct line in the box.

When the toy is hovering stationary in mid-air, the lift force is

	·		
	bigger than		
	the same as	the weight of the toy.	
	smaller than		
			(1)
When t	he motor inside th	e toy is switched off, the toy starts to accelerate downwa	ards.
(i) W	hat does the wor	d <i>accelerate</i> mean?	
			(1)
(ii) W	hat is the direction	n of the resultant force on the falling tov?	()
			(1)
(iii) D	oes the momentu	m of the toy increase, decrease or stay the same?	
G	ive a reason for y	our answer.	
			(2)
			(Total 8 marks)

**Q4.** The picture shows two children, **X** and **Y**, skating towards each other at an ice rink.

The children collide with each other, fall over and stop.

(b)



(a) Before the collision the children had different amounts of kinetic energy.

	(i)	What are the <b>two</b> factors that determine the kinetic energy of the children?	
		1	
		2	(2)
	(ii)	What was the total kinetic energy of the children after they had fallen over and stopped?	
			(1)
(b)	The	total momentum of the children before and after the collision is zero.	
	(i)	Use the equation in the box and the data given in the diagram to calculate the momentum of child Y before the collision.	
		Show clearly how you work out your answer.	
			(2)
	(ii)	Complete the following sentence using one of the words in the box.	
		conserved decreased increased	
		The total momentum of the two children was	
		(Total 6 n	(1) narks)

**Q5.** The diagram shows a child on a playground swing.



(a) The playground surface is covered in rubber safety tiles. The tiles reduce the risk of serious injury to children who fall off the swing.

The graph gives the maximum height that a child can fall onto rubber safety tiles of different thicknesses and be unlikely to get a serious head injury.



(ii) Momentum is lost more slowly falling onto a rubber surface than on a hard surface.

This reduces ..... the child.

(1) (Total 5 marks)

**Q6.** (a) The diagram shows three skiers, **X**, **Y** and **Z**, on a moving chairlift. The mass of each skier is given in the table.



Which **one** of the skiers, **X**, **Y** or **Z**, has the most momentum?

.....

Give the reason for your answer.

 (2)

(b) At one point in the journey, the chairlift accelerates to a higher speed.

What happens to the momentum of the three skiers as the chairlift accelerates?

 **Q7.** (a) The diagram shows three identical go-karts, **P**, **Q** and **R**, travelling at different speeds along the straight part of an outdoor racetrack.



(	ïi)	How would a wet track affect the braking distance of a go-kart?
١		

.....

(1) (Total 7 marks)

**Q8.** Motorway accidents have many causes.

(a) Which **one** of the following is most likely to increase the chance of a car being in an accident?

Tick ( $\checkmark$ ) the box next to your answer.	
The car has just had new tyres fitted.	
The driver has been drinking alcohol.	
A road surface in dry conditions	
Give a reason for your answer.	

Page 9 of 24

(2)

(b) The diagram shows three designs of motorway crash barriers.



A car of mass 1500 kg is driven at 30 m/s to hit the barrier at an angle of 20 degrees. This barrier must slow the car down and must not break.

Explain why the mass of the car, the speed of the car and the angle at which the car hits the barrier must be the same in every test.


(2)

(c) A group of scientists has suggested that new designs of crash barriers should be first tested using computer simulations.

Which **two** statements give sensible reasons for testing new barrier designs using a computer simulation?

Put a tick ( $\checkmark$ ) in the box next to each of your answers.

The design of the barrier can be changed easily.

Data for different conditions can be obtained quickly.

Simulations are more realistic than using cars and barriers.



(1) (Total 5 marks)

**Q9.** (a) (i) The diagram shows three vehicles travelling along a straight road at 14 m/s.

14m/s	→ <u>14m/s</u>	14 m/s	
			_
Motorbil Mass = 17	ke Lorry 5kg Mass = 10000 kg	Van Mass = 3000 kg	
Wass - 17	okg Mass – 10000 kg	Mass – 5000 kg	
VV	nich vehicle has the greatest momentum?		
Gi	ve the reason for your answer.		
			(2)
(ii)	Use the equation in the box to calculate the r travels at 14 m/s. momentum = mass $\times$ veloc	nomentum of the motorbike when it ity	
	Show clearly how you work out your answer		
	Momentum =	kg m/s	<b>(0</b> )
		(	2)
(b) The lorr	e motorbike follows the lorry for a short time, ar y and van.	d then accelerates to overtake both the	
(i)	Complete the following sentence by drawing	a ring around the correct line in the box.	
	When the motorbike starts to overtake, the k	inetic energy	

of the motorbike stays the same. increases.

(ii) Give a reason for your answer to part (b)(i).

.....

(iii) The graph shows the velocity of the motorbike up to the time when it starts to accelerate. The motorbike accelerates constantly, going from a speed of 14 m/s to a speed of 20 m/s in a time of 2 seconds. The motorbike then stays at 20 m/s.

Complete the graph to show the motion of the motorbike over the next 4 seconds.



(3) (Total 9 marks)

**Q10.** (a) A van has a mass of 3200 kg. The diagram shows the van just before and just after it collides with the back of a car.



Just before the collision, the van was moving at 5 m/s and the car was stationary.

(i) Use the equation in the box to calculate the momentum of the van just before the collision.

momentum = mass × velocity

Show clearly how you work out your answer.

(ii) The collision makes the van and car join together.

What is the total momentum of the van and the car just after the collision?

(1)

(iii) Complete the following sentence by drawing a ring around the correct line in the box.

	more than	
The momentum of the car before the collision is	the same as	the
	less than	
		-

momentum of the car after the collision.

(b) A seat belt is one of the safety features of a car.



In a collision, wearing a seat belt reduces the risk of injury.

Use words or phrases from the box to complete the following sentences.



In a collision, the seat belt stretches. The time it takes for the person held by the seat belt to lose momentum compared to a person not wearing a seat belt,

......

The force on the person's body	and so
reduces the risk of injury.	

(2) (Total 6 marks)



Skateboarder A is not moving.

(b)

Skateboarder **B** is moving towards the ramp at a constant speed. Skateboarder **C** is moving on the ramp at a constant speed.

(a) The skateboarders have different amounts of kinetic energy.

Which two factors affect the kinetic energy of the skateboarders?

Put a tick ( $\checkmark$ ) in the box next to your answer.

direc	tion and mass		
mass	and speed		
spee	d and direction		(1)
The	skateboarders also have di	fferent amounts of momentum.	
(i)	Which one of the skatebo	arders has the smallest amount of momentum?	
	Draw a ring around your a	inswer.	

A B C Give a reason for your answer.

(2)

(ii) Skateboarder **B** has a mass of 55 kg.

Use the equation in the box to calculate the momentum of skateboarder  ${\bf B}$  when moving at 4 m/s.

	momentum	= mass	×	velocity	]	
Show clearly h	ow you work out yo	our answer.				
	Momentum =			kg	m/s	(2)
						(Total 5 marks)

Q12. (a) The diagrams, A, B and C, show the horizontal forces acting on a moving car.

Draw a line to link each diagram to the description of the car's motion at the moment when the forces act.

Draw only three lines.



stationary



slowing down

accelerating forwards

(3)

(b) The front crumple zone of a car is tested at a road traffic laboratory. This is done by using a remote control device to drive the car into a strong barrier. Electronic sensors are attached to a dummy inside the car.



(i) Draw an arrow in **Box 1** to show the direction of the force that the car exerts on the barrier.

(1)

(ii) Draw an arrow in **Box 2** to show the direction of the force that the barrier exerts on the car.

(1)

(iii) Complete the following by drawing a ring around the correct line in the box.

The car exerts a force of 5000 N on the barrier. The barrier does not move. The force

	more than	
exerted by the barrier on the car will be	equal to	5000 N.
	less than	

(1)

(iv) Which **one** of the following gives the most likely reason for attaching electronic sensors to the dummy?

Put a tick ( $\checkmark$ ) in the box next to your answer.

To measure the speed of the car just before the impact.

To measure the forces exerted on the dummy during the impact.

To measure the distance the car travels during the impact.



**Q13.** (a) The diagram shows a cricketer bowling a ball.



(i) The cricketer bowls the ball at 20 m/s.

How could the kinetic energy of this ball have been increased?

.....

(1)

(ii) The ball has a mass of 0.16 kg.

Use the equation in the box to calculate the momentum of the ball when it is bowled at 20 m/s.

momentum = mass x velocity

Show clearly how you work out your answer and give the unit.

Choose the unit from the list below.

kg m/s	m/s²	Nm
Mama		

Momentum = .....

(3)

(b) The batsman misses the ball and the ball hits the cricket stumps.



As the ball hits the stumps, the ball loses both kinetic energy and momentum.

(i) What happens to the kinetic energy lost by the ball?

.....

(ii) Even though the ball loses momentum, the total momentum of the ball and stumps just before the ball hits the stumps is the same as the total momentum of the ball and stumps just after the collision.

Explain how this is possible.

.....

(2) (Total 7 marks)

- **Q14.** Part of a bus route is along a high street.
  - The distance-time graph shows how far the bus travelled along the high street and how long it took.



(a) Between which two points was the bus travelling the slowest?

Put a tick ( $\checkmark$ ) in the box next to your a	nswer.

Points	Tick ( 🗸 )
A – B	
C – D	
D – E	

Give a reason for your answer.

.....

.....

(2)

- The bus and passengers have a total mass of 16 000 kg. Use the equation in the box to calculate the momentum of the bus and passengers between points **A** and **B**. momentum = mass x velocity Show clearly how you work out your answer. Momentum = ..... kg m/s (2) (c) A cyclist made the same journey along the high street. The cyclist started at the same time as the bus and completed the journey in 220 seconds. The cyclist travelled the whole distance at a constant speed. Draw a line on the graph to show the cyclist's journey. (i) (2) (ii) After how many seconds did the cyclist overtake the bus? The cyclist overtook the bus after ..... seconds. (1) (Total 7 marks)
- **Q15.** Some students designed and built an electric-powered go-kart. The go-kart is shown below.

The bus travels at 5 m/s between points **A** and **B**.

(b)



(a) Suggest **two** changes that could be made to the design of the go-kart to increase its top speed.

(2)

- (b) A go-kart with a new design is entered into a race.
  - The velocity-time graph for the go-kart, during the first 40 seconds of the race, is shown below.



(i) Between which two points did the go-kart have the greatest acceleration?

	A-B	
	B-C	
	C-D	
	Give a reason for your answer.	
		(2)
(ii)	The go-kart travels at a speed of 13 m/s between points <b>D</b> and <b>E</b> . The total mass of the go-kart and driver is 140 kg.	
	Calculate the momentum of the go-kart and driver between points ${f D}$ and ${f E}$ .	
	Use the correct equation from the Physics Equations Sheet.	
	Momentum = kg m/s	(2)

(2) (Total 6 marks)

Tick ( ✓) **one** box.