Physics
Standard Grade

Unit 5
Transport
General & Credit Past Paper Questions

Record Sheet

General - Section	Question	Attempted	RED	AMBER	GREEN
Multiple Choice	1				
	2				
	3				
	4				
	5				
	6				
	7				
1. On The Move	8				
	9				
	10				
2. Forces At Work	11				
	12				
	13				
	14				
	15				
	16				
	17				
3. Movement Means Energy	18				
	19				
	20				

Credit - Section	Question	Attempted	RED	AMBER	GREEN
1. On The Move	21				
	22				
	23				
	24				
	25				
	26				
2. Forces At Work	27				
	28				
	29				
	30				
	31				
3. Movement Means Energy	32				
	33				
	34				
	35				

RED - I don't understand the question
I NEED HELP!

AMBER - I understand most of the question
I NEED TO REVISE A LITTLE MORE!

GREEN - I got the correct answer first time!!
I UNDERSTAND THIS TOPIC

General Level

Answer questions in your Homework Jotter.
Show working for each question.

KU	PS

1.

A fish of mass 2 kilograms is hung on a Newton balance. The fish and the balance are dropped and fall freely to the sea below.

What is the reading on the Newton balance **while falling?**

A 0 newton
B 1 newton
C 2 newtons
D 10 newtons
E 20 newtons

2.

A newton balance is used to measure

A distance
B force
C gravitational potential energy
D kinetic energy
E power.

3.

A 20 Newton weight is hung on a spring balance. The spring extends by 0.10 metre. The weight is removed and a bag of potatoes is hung on the balance. The spring extends by 0.15 metre.

A 10 newtons
B 15 newtons
C 20 newtons
D 30 newtons
E 50 newtons

4.

A car designer wants to increase the maximum acceleration of a car.

Which entry shows what should be done to the engine and the mass of the car?

	Engine force	*Mass*
A	keep the same	increase
B	increase	decrease
C	increase	keep the same
D	decrease	increase
E	decrease	keep the same

1

5.

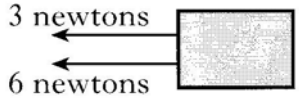
The diagrams below show the forces acting on a number of moving objects.

Which object is moving at constant speed?

A 

1

B 

C 

D 

E 

1

1

General Level

Answer questions in your Homework Jotter.
Show working for each question.

KU	PS

6.

Which row gives the correct units for work done, energy and power?

	Work done	*Energy*	*Power*
A	newton	joule	watt
B	joule	joule	watt
C	newton	watt	joule
D	watt	newton	watt
E	joule	watt	newton

1

7.

Which row of values would result in the greatest kinetic energy?

	Mass (kilograms)	*Speed* (metres per second)
A	45	8
B	45	4
C	50	10
D	50	8
E	50	4

1

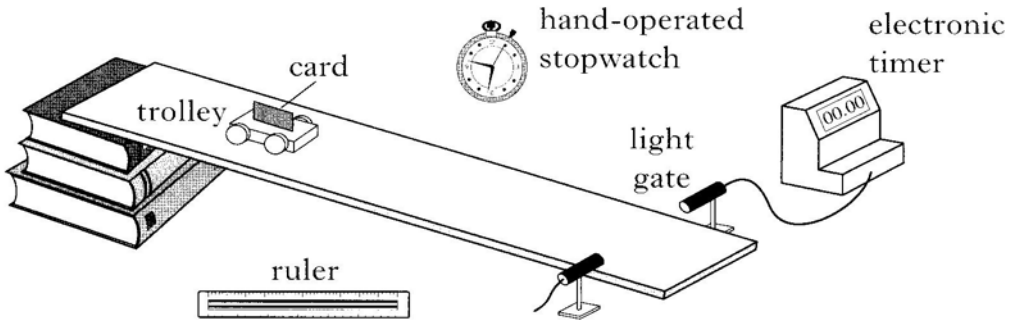
General Level

Answer questions in your Homework Jotter.
Show working for each question.

KU	PS

8.

A group of students is using the apparatus shown to study the motion of a trolley.



The trolley is released from rest at the top of the slope. The stopwatch measures the time taken for the trolley to reach the light gate.

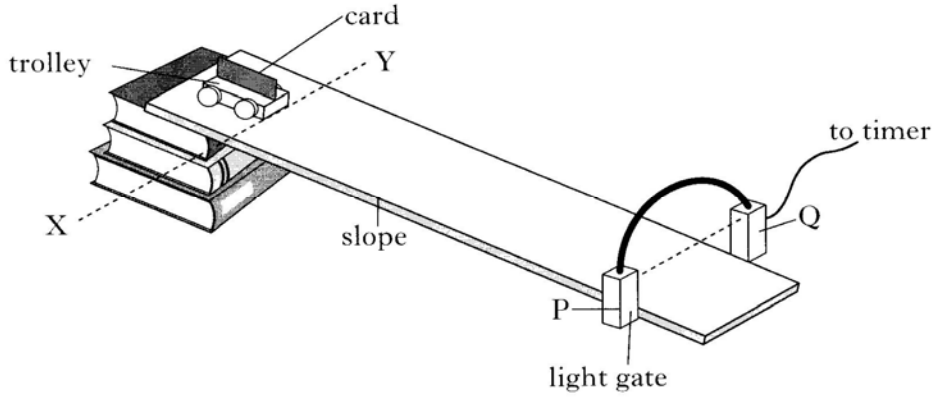
(*a*) Describe how to find the instantaneous speed of the trolley as it passes through the light gate.
You must state the measurements that are made and how they are used. **3**

(*b*) During one run, the instantaneous speed of the trolley through the light gate is calculated to be 0·8 metres per second. The stopwatch reading is 2·0 seconds.
Calculate the acceleration of the trolley down the slope. **2**

(*c*) The light gate is moved closer to the top of the slope and the experiment is repeated. One student suggests that the value of acceleration obtained is more accurate, because the reading on the stopwatch is less.
Explain whether the student is correct or not. **2**

9.

A student releases a trolley from rest at XY near the top of a slope. The trolley moves down the slope. A card attached to the trolley passes through a light gate at PQ near the bottom of the slope.



Answer questions in your Homework Jotter.
Show working for each question.

KU	PS

9. continued

(*a*) The student records the following information.

distance from XY to PQ	1·25 metres
length of card	0·1 metre
time for trolley to travel from XY to PQ	5·0 seconds
time for card to pass through light gate	0·2 second.

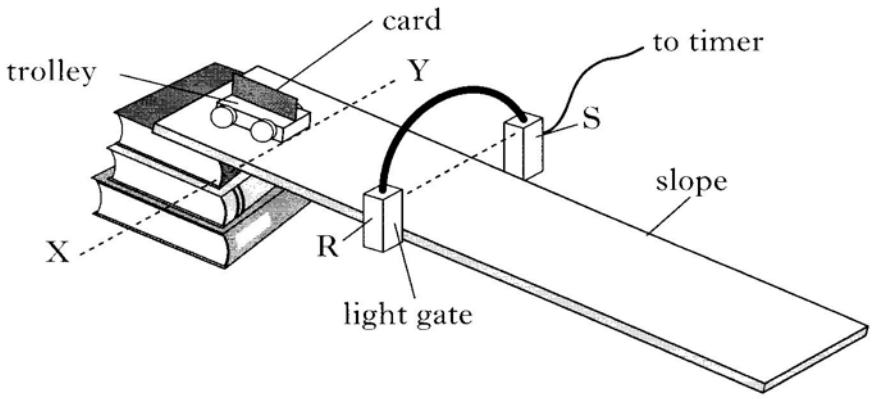
(i) Show that the speed of the trolley **at PQ** is 0·5 metre per second. **2**

(ii) Calculate the acceleration of the trolley down the slope. **2**

(iii) Draw a speed-time graph for the motion of the trolley from when it is released at XY until it passes through PQ.

Units and numerical values **must** be shown on both axes. **3**

(*b*) The student moves the light gate up the slope to RS, as shown, and repeats the experiment.



No other changes are made to the apparatus. The trolley is again released from rest at XY.

Complete the sentences below by circling the correct answers.

Compared to the first part of the experiment:

(i) the speed of the trolley at the light gate is {less / the same / greater} **1**

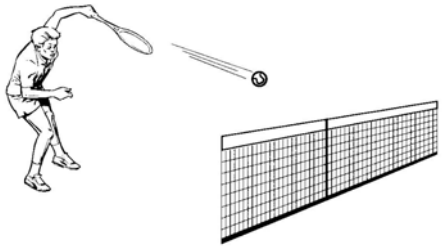
(ii) the acceleration of the trolley down the slope is {less / the same / greater} **1**

General Level

Answer questions in your Homework Jotter.
Show working for each question.

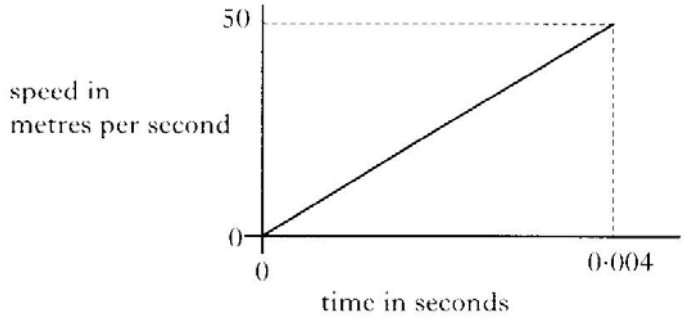
KU	PS

10. In a tennis match, the player hits the ball to serve.



(*a*) The ball travels 24 metres from the server's racquet to the opponent's racquet at an average speed of 40 metres per second.
Calculate the time taken. **2**

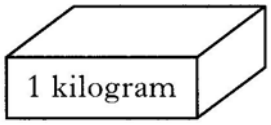
(*b*) A graph showing how the speed of the ball changes while in contact with the racquet during the serve is shown.



Calculate the acceleration of the ball during the serve. **2**

(*c*) For a second serve, the server hits the ball with a smaller force.
What effect does this have on the speed of the ball when it leaves the racquet? **1**

11. A student carries out an experiment to measure the weight of a block. The block is marked as having a mass of 1 kilogram as shown.



(*a*) Complete the following passage.

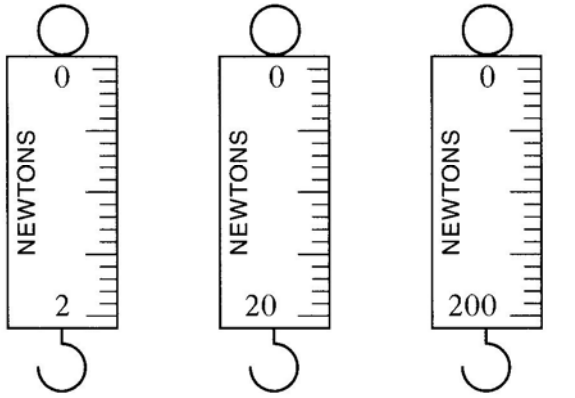
Weight is a ..... and is the Earth's pull on an object. **1**

The weight of a mass of 1 kilogram is..... **1**

KU	PS

11. continued

(*b*) In doing the experiment, the student has the choice of the Newton balances shown below to measure the weight of the block.



Balance P Balance Q Balance R

(i) Which balance could **not** be used to measure the weight of the block?

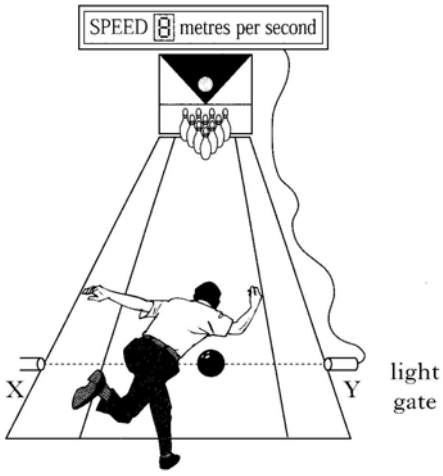
Give a reason for your choice. **2**

(ii) The student decides to use balance R.

Why is this **not** the best balance to use? **1**

12.

At a bowling alley the speed of a ball is measured as it starts to roll along a horizontal lane.



(*a*) A light gate is positioned at X–Y. The light gate is connected to a computer. The speed of the ball is measured using the light gate and the computer.

(i) What **two** pieces of information does the computer need to calculate the speed of the ball? **2**

General Level

Answer questions in your Homework Jotter.
Show working for each question.

KU	PS

12 (a). continued

(ii) How is this information used to calculate the speed of the ball? — PS: 1

(*b*) During one shot, a ball passes X–Y at a speed of 8 metres per second. Four seconds later, the ball is moving at 6 metres per second.

(i) Name the force that causes the ball to slow down as it travels along the lane. — KU: 1

(ii) Calculate the acceleration of the ball. — KU: 2

(iii) The ball has a mass of 5 kilograms.
Calculate the size of the force that causes the ball to slow down. — KU: 2

13.

During a football match, one player heads the ball towards the goal.

(*a*) When the ball is headed, the player applies a force to the ball. This force has three effects on the ball.

Complete the sentence below to describe the **three** effects.

The force changes the ....., the ....., and the ..... of the ball. — KU: 3

(*b*) Later in the match, another player takes a penalty kick. The player kicks the stationary ball with a force of 27 newtons. The mass of the ball is 0·6 kilogram.

Calculate the acceleration of the ball. — KU: 2

14.

A battery-powered model car has a mass of 0·8 kilogram. The car has an electric motor that provides a constant force of 1·2 newtons.

(*a*) The car travels 25 metres at constant speed along a horizontal track.

(i) State the value of the force of friction acting against the car. — PS: 1

(ii) Calculate the work done by the car's electric motor. — KU: 2

(*b*) The car then climbs up a sloping part of the track. The car travels a further 25 metres gaining 2 metres in height.

(i) Calculate the gravitational potential energy gained by the car when it is at the top of the climb. — KU: 2

(ii) The force of friction remains the same as in part (*a*).
Calculate the total work done during the climb. — PS: 1

(iii) The car takes 5 seconds to complete the climb.
Calculate the output power of the motor during the climb. — KU: 2

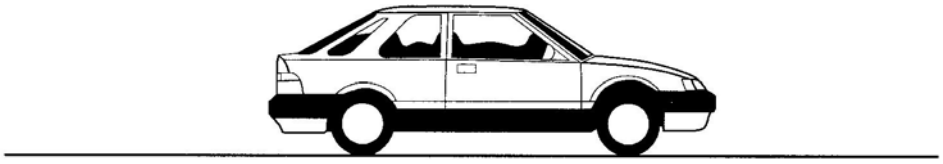
General Level

Answer questions in your Homework Jotter.
Show working for each question.

KU	PS

15. A car travels forwards along a level road at a constant speed.

(*a*) Label the diagram to show the horizontal forces acting on the car.
You must indicate the direction of each force. **2**



(*b*) The car brakes suddenly.

(i) Explain, in terms of forces, why it is important for the passengers to be wearing seat belts. **2**

(ii) A force of 8000 newtons stops the car when the brakes are applied. The mass of the car is 1000 kilograms. The car stops in a distance of 23 metres.

(A) Calculate the acceleration of the car as it comes to rest. **2**

(B) How much work is done stopping the car? **2**

(iii) What is the main energy transformation in the car brakes? **1**

16. A rowing crew takes part in a race.

The time for their boat at each stage of the race is shown.

		Time from start	
		minutes	*seconds*
Start:	0 metres	00	00
	500 metres	01	40
	1000 metres	03	50
	1500 metres	05	50
Finish:	2000 metres	07	45

(*a*) **Describe** how to find the average speed of the boat from the start of the race to the finish. **3**

(*b*) Calculate the average speed of the boat during the first 500 metres of the race. **2**

KU	PS

16. continued

(*c*) The crew supplies a force to move the boat forward. When the boat is moving, a force opposes the motion of the boat.

(i) Name the force that opposes the motion of the boat. **1**

(ii) During the first 500 metres, there is a constant unbalanced force acting on the boat.

Describe the motion of the boat during this section of the race. **1**

(iii) During one stage of the race, the speed of the boat is constant.

What can be said about the forces acting on the boat during this stage? **1**

17.

A skier takes part in a downhill competition.

(*a*) State **two** ways the skier can reduce friction in order to reach high speeds. **2**

(*b*) When the skier reaches the maximum speed of 65 metres per second, this speed is maintained over the rest of the course.

State how the size of the downhill force compares with the size of the frictional force during this part of the course. **1**

(*c*) At the end of the course, the frictional force brings the skier to rest over a horizontal distance of 500 metres. During this distance, the average frictional force is 346 newtons.

Calculate the work done to bring the skier to rest. **2**

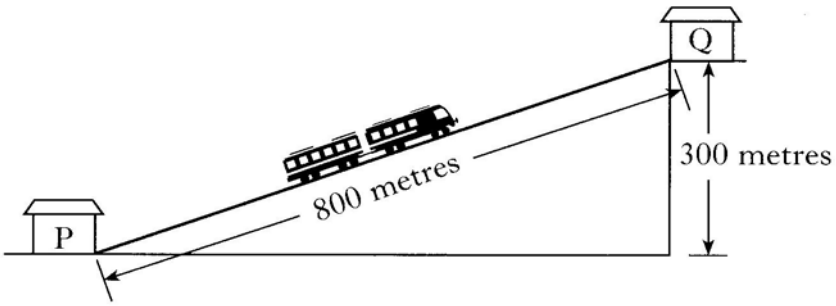
General Level

Answer questions in your Homework Jotter.
Show working for each question.

KU	PS

18.

A train carries passengers up the side of a mountain. The mass of the loaded train is 20 000 kilograms.



(*a*) Calculate the weight of the loaded train. **2**

(*b*) As it moves up the mountain, the forces acting on the train are balanced. Describe the motion of the train. **1**

(*c*) The train climbs up the mountain from P to Q in 8 minutes.

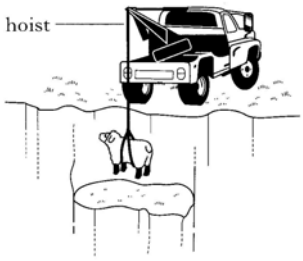
(i) Calculate the potential energy gained by the loaded train as it moves from P to Q. **2**

(ii) Calculate the minimum power output of the motor used to raise the loaded train. **2**

(iii) Why is the actual power output of the motor greater than that calculated in (*c*)(ii)? **1**

19.

A sheep of mass 40 kilograms is trapped on a ledge. A farmer uses a hoist to lift the sheep from the ledge.



(*a*) Calculate the weight of the sheep. **2**

(*b*) What is the minimum force needed to lift the sheep at a steady speed? **1**

(*c*) The sheep is lifted 7·5 metres.
Calculate the work done lifting the sheep. **2**

(*d*) The hoist takes 2 minutes to lift the sheep.
Calculate the minimum power output of the hoist. **2**

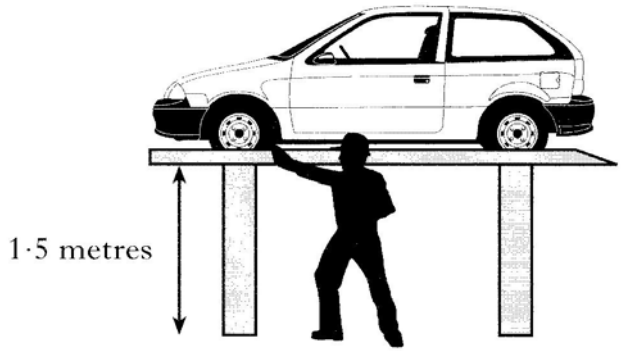
General Level

Answer questions in your Homework Jotter.
Show working for each question.

KU	PS

20.

A car is being repaired in a garage. The car is on a ramp and is raised to a height of 1·5 metres.



The car has a mass of 1200 kilograms.

(*a*) Calculate the weight of the car. **2**

(*b*) Calculate how much gravitational potential energy the car has gained when it is 1·5 metres above the garage floor. **2**

(*c*) The car is raised in 12 seconds.

(i) Calculate the minimum power needed to lift the car 1·5 metres in 12 seconds. **2**

(ii) In practice, the power needed to raise the car in this time is greater than the minimum power.

Explain why. **1**

Creditl Level

Answer questions in your Homework Jotter.
Show working for each question.

KU	PS
2	
	3

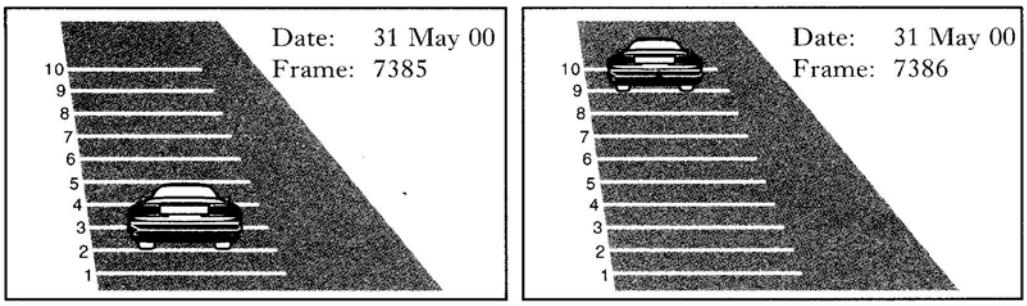
21. On one road the speed limit is 90 km/h.

(*a*) Show by calculation that this speed limit is 25 m/s.

(*b*) A speed camera is used to detect motorists breaking the speed limit on this road. A section of the road in view of the camera is marked out with white lines spaced 2 m apart.

The camera unit is fitted with a radar speed sensor. When a passing vehicle breaks the speed limit, the camera takes a pair of photographs 0·4 s apart.

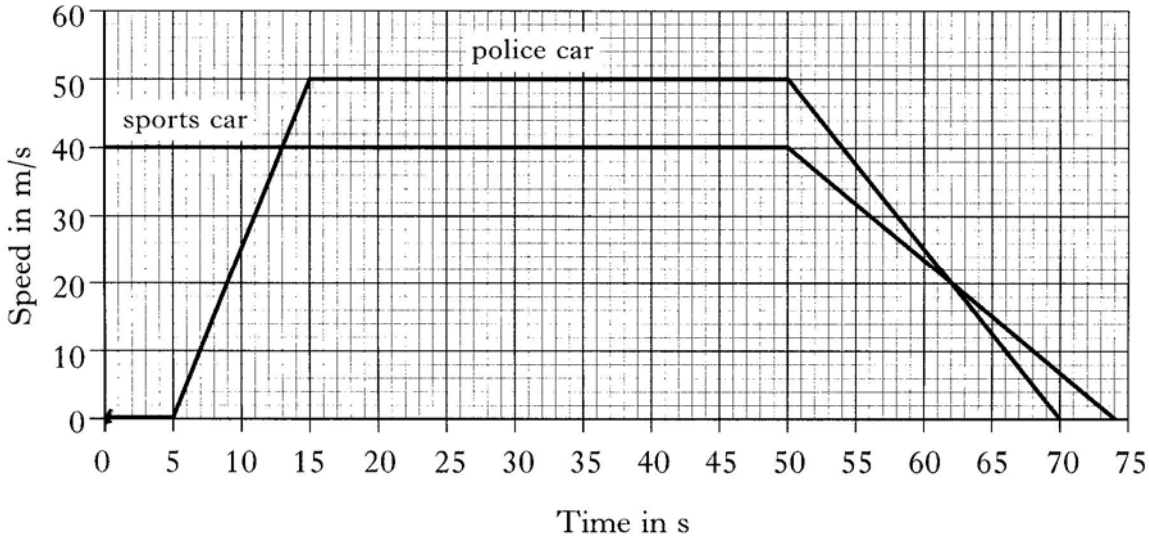
When the speed camera film is later analysed, the following pair of photographs is obtained.



Calculate how much **faster** than the speed limit of 25 m/s this car was travelling.

(*c*) Further along the road, a sports car travelling at a constant speed of 40 m/s passes a police car which is parked in a lay-by. The police car follows the sports car.

The speed-time graph shows the motion of both cars from the time the sports car passes the parked police car.



KU	PS

21 (c). continued

(i) How long does it take for the police car to start to move? **1**

(ii) Calculate the acceleration of the police car when it sets off. **2**

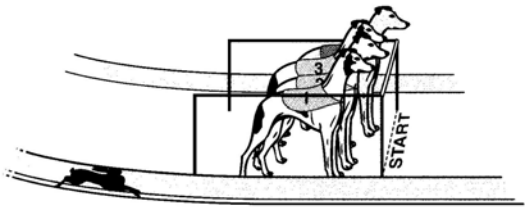
(iii) Fifty seconds (50 s) after being passed by the sports car, the police car has travelled 2000 m.

Show by calculation that the cars are side by side at this time. **2**

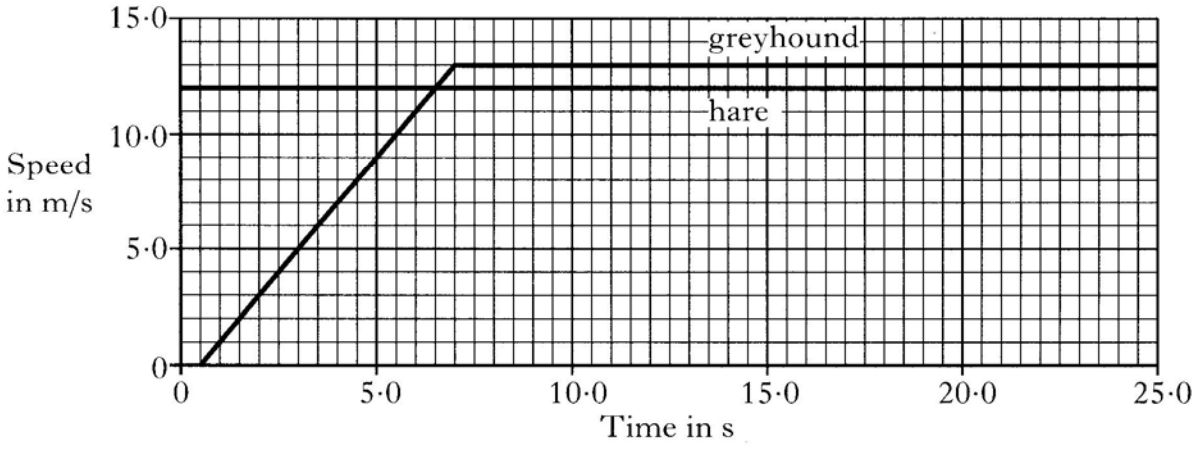
(iv) By calculating the distance travelled by each car while decelerating, show which car stops in front **and** the distance between them when both cars are stopped. **3**

22.

At a greyhound racing track, the greyhounds are automatically released when an artificial hare crosses the starting line.



The speed-time graph shows the motion of one greyhound and the hare from the time when the hare crosses the starting line.



(*a*) How long does it take for the greyhound to start moving after the hare crosses the starting line? **1**

(*b*) Calculate the acceleration of the greyhound when it starts moving. **2**

(*c*) The hare crosses the finishing line 20 s after crossing the starting line.

(i) Over what distance is the race run? **2**

(ii) How far behind the hare is the greyhound when the **hare** finishes the race? **3**

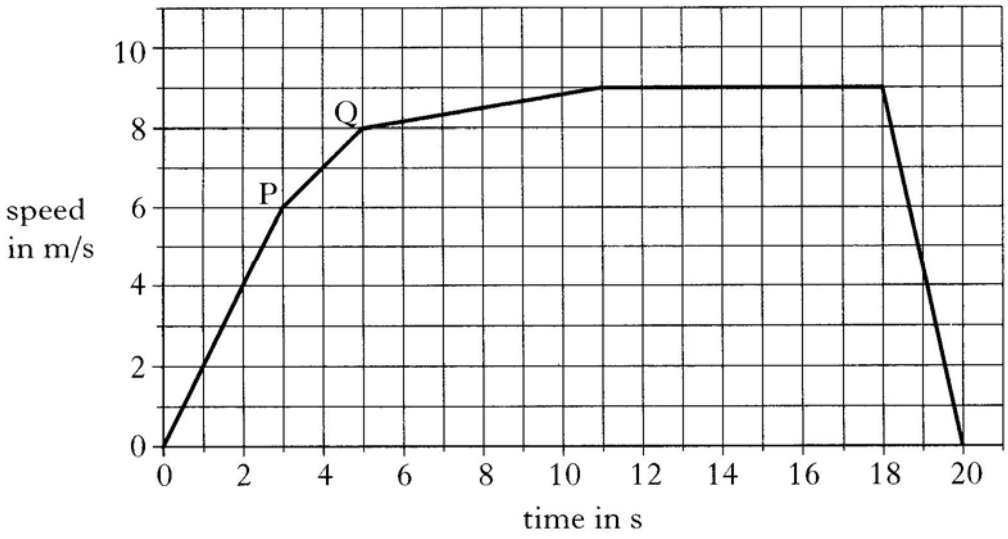
Creditl Level

Answer questions in your Homework Jotter.
Show working for each question.

KU	PS

23.

A cyclist starts a journey in first gear and uses two other gears during the journey. After a short time the cyclist is forced to brake sharply and comes to a halt. A speed-time graph of the journey is shown.



At point P the cyclist changes from first gear to second gear.
At point Q the cyclist changes from second gear to third gear.

(*a*) (i) Before braking, which gear is the cyclist using when the acceleration is greatest? — 1

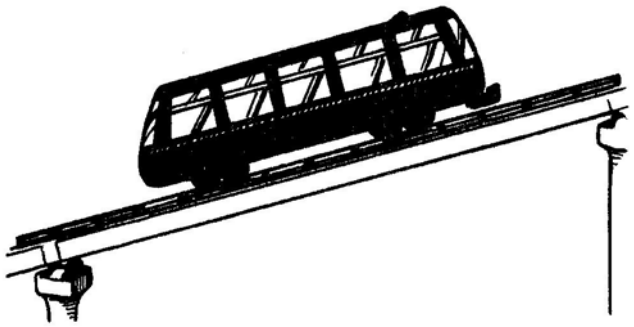
(ii) Which gear does the cyclist use for the shortest time? — 1

(*b*) Calculate how far the cyclist travels in second gear. — 3

(*c*) Calculate the deceleration. — 2

24.

A train travels up a mountain carrying skiers in winter and tourists in summer.



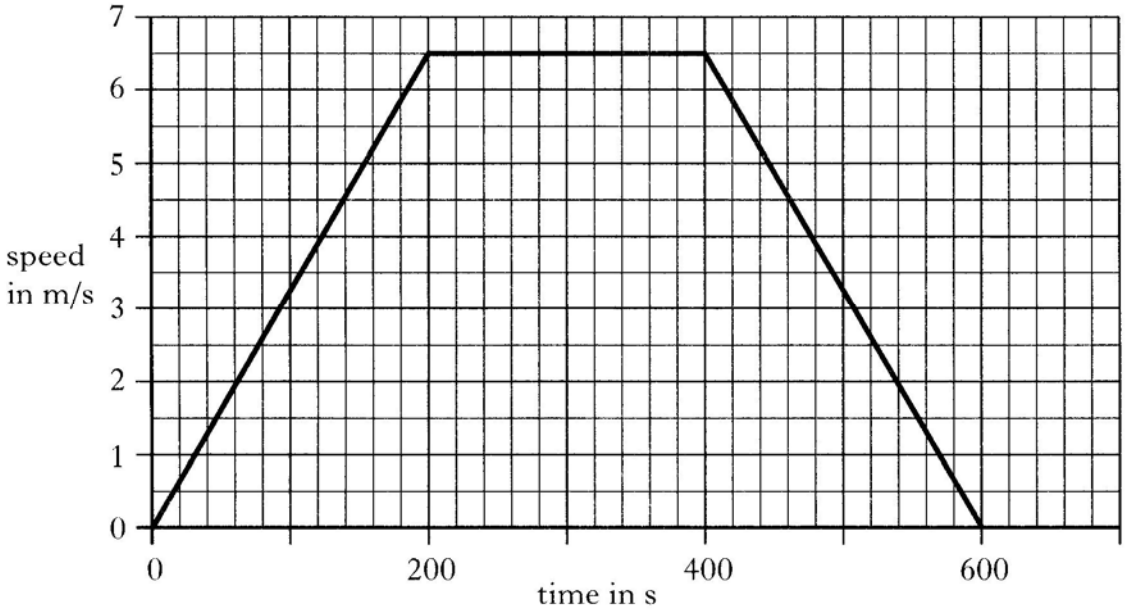
(*a*) The graph shows how the speed of the train varies with time for the journey in winter.

Creditl Level

Answer questions in your Homework Jotter.
Show working for each question.

KU	PS

24 (a). continued



(i) Calculate the acceleration of the train during the first 200 s. **2**

(ii) Calculate the length of the journey. **2**

25.

A table from the Highway Code giving overall stopping distances for vehicles is shown.

The overall stopping distance is made up of:

the **thinking distance** – the distance travelled while the driver "thinks" about braking. This distance depends on the driver's reaction time.
plus
the **braking distance** – the distance travelled while braking.

Speed of vehicle (m/s)	*Overall stopping distance* (m)
8·9	6 6
13·4	9 14
17·8	12 24
26·7	18 55
thinking distance	braking distance

Creditl Level

Answer questions in your Homework Jotter.
Show working for each question.

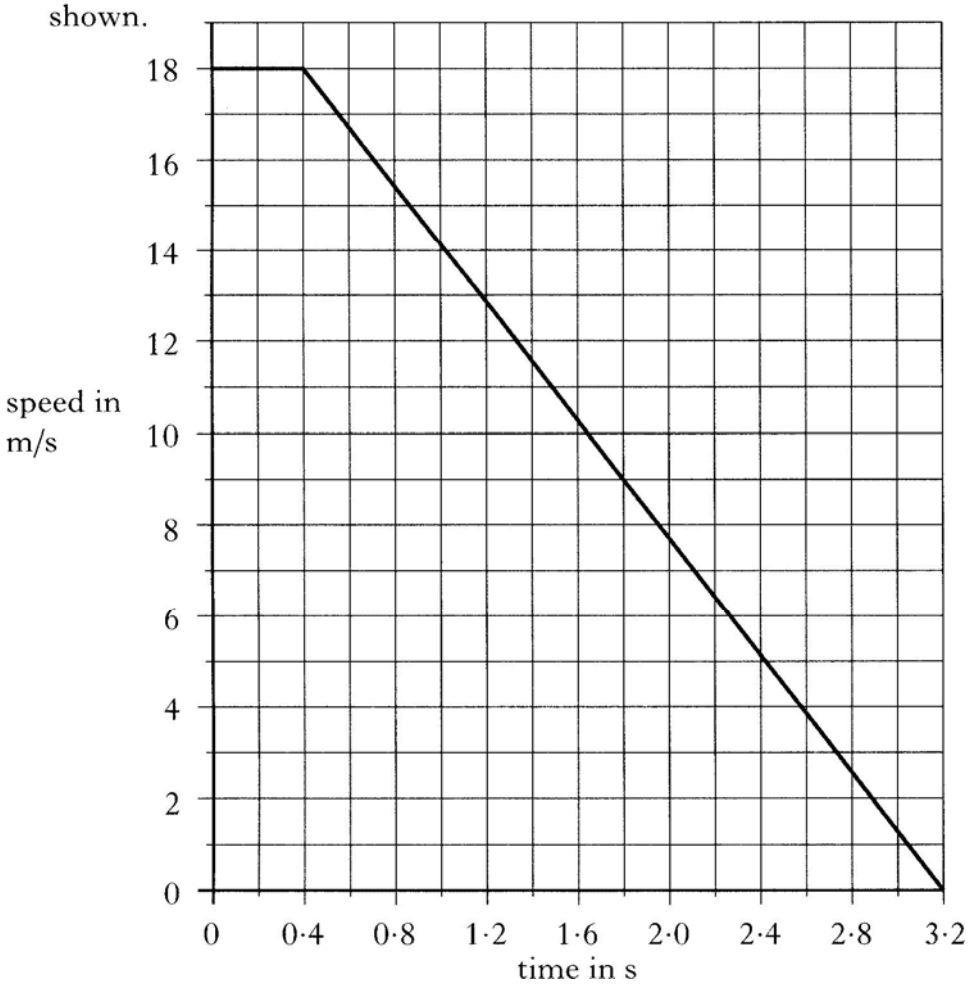
KU	PS

25. continued

(*a*) (i) How far does a vehicle travelling at 13·4 m/s travel while the driver thinks about braking? **1**

(ii) Use information **from the table** to calculate the reaction time. **2**

(*b*) A car travels along a road. The driver sees traffic lights ahead ch from green and starts to brake as soon as possible. A graph of the motion, from the moment the driver sees the traffic lights chang shown.



(i) What is **this** driver's reaction time? **1**

(ii) Calculate the overall stopping distance. **3**

(iii) Calculate the acceleration of the car from the time the driver applies the brakes. **2**

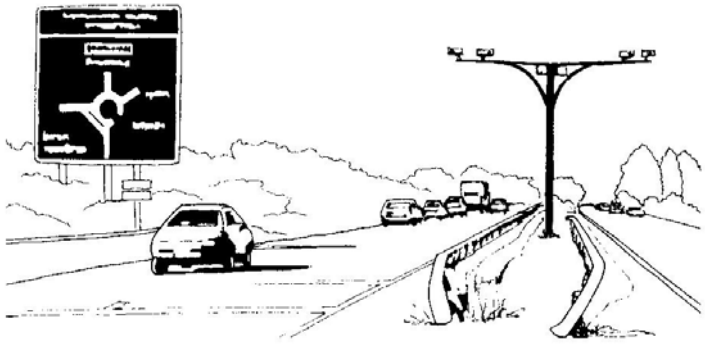
Creditl Level

Answer questions in your Homework Jotter.
Show working for each question.

KU	PS

26.

Cameras placed at 5 km intervals along a stretch of road are used to record the average speed of a car.



The car is travelling on a road which has a speed limit of 100 km/h. The car travels a distance of 5 km in 2·5 minutes.

(*a*) Does the average speed of the car stay within the speed limit?

You must justify your answer with a calculation. **3**

(*b*) At one point in the journey, the car speedometer records 90 km/h.

Explain why the average speed for the entire journey is not always the same as the speed recorded on the car speedometer. **2**

27.

During the Apollo 11 expedition to the Moon, 21 kg of soil samples were brought from the Moon to the Earth. The gravitational field strength was not constant throughout the journey.

(*a*) What is meant by gravitational field strength? **1**

(*b*) Complete the table to show the mass and weight of the soil samples at various stages of the journey.

Stage	*Gravitational field strength* (N/kg)	*Mass* (kg)	*Weight* (N)
on the Moon	1·6	21	
at a point during the journey	0		
on the Earth	10		

3

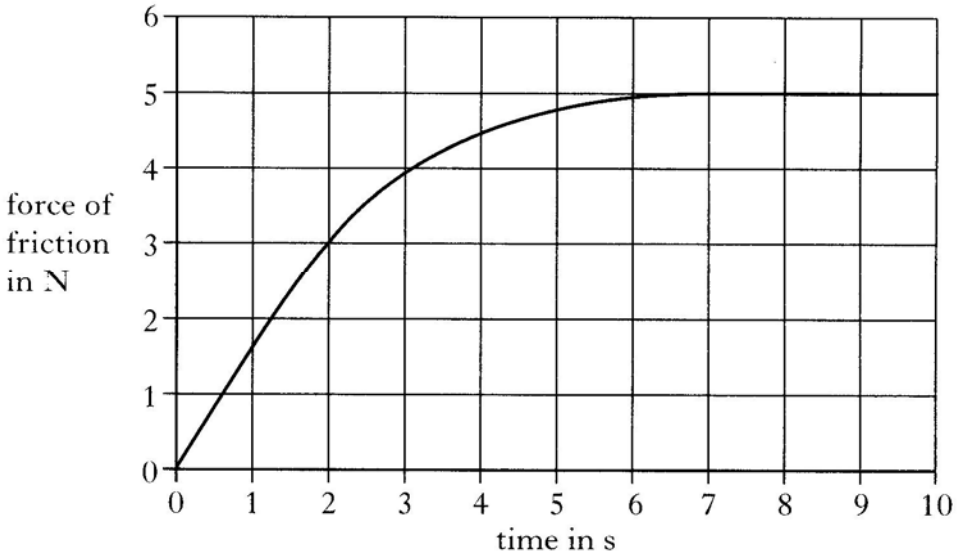
Creditl Level

Answer questions in your Homework Jotter.
Show working for each question.

KU	PS

28.

A model motor boat of mass 4 kg is initially at rest on a pond. The boat's motor, which provides a constant force of 5 N, is switched on. As the boat accelerates, the force of friction acting on it increases. A graph of the force of friction acting on the boat against time is shown.



(*a*) (i) State the force of friction acting on the boat 2 s after the motor is switched on. — 1

(ii) Calculate the acceleration of the boat at this time. — 3

(*b*) Describe and explain the movement of the boat after 7 s. — 2

29.

Land speed records are calculated by timing a vehicle as it travels a measured distance of 2·0 km.

(*a*) Explain whether the average speed or the instantaneous speed of the vehicle can be calculated from these measurements. — 2

(*b*) A vehicle travels the measured distance at a constant speed of 220 m/s.

Calculate the time taken. — 2

Creditl Level

Answer questions in your Homework Jotter.
Show working for each question.

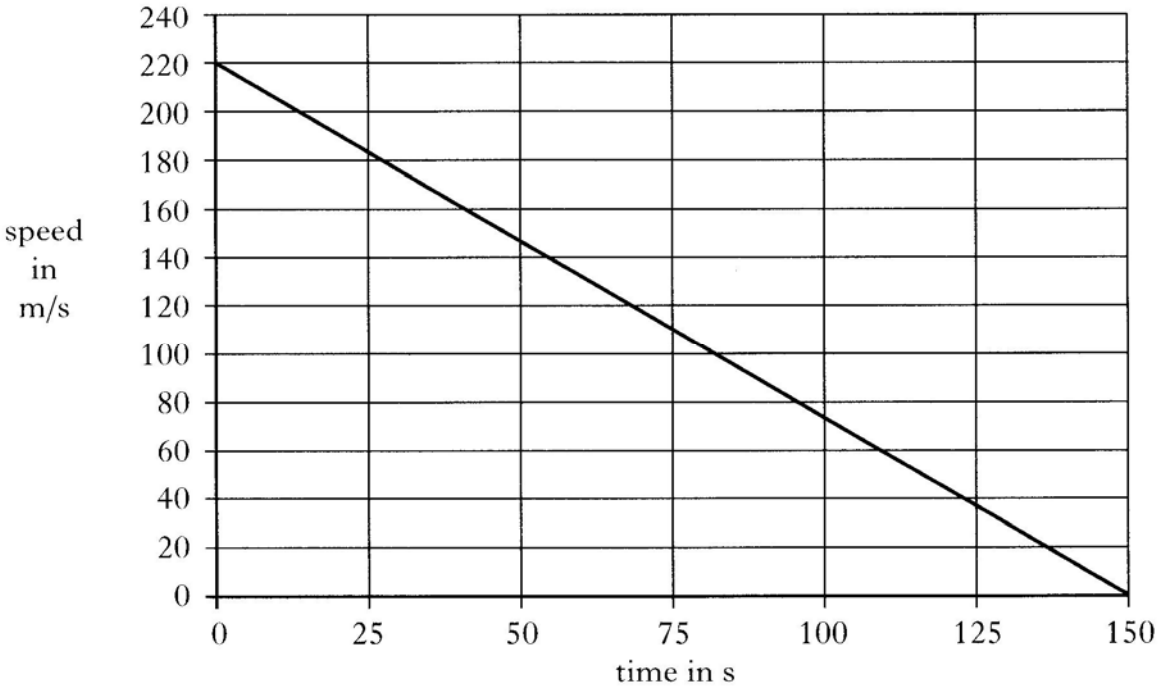
KU	PS

29. continued

(*c*) At the end of the measured distance, the driver switches off the engine and opens a parachute to brake.

The speed-time graph shows the motion of the vehicle from this time.

The mass of the vehicle is 3000 kg.



(i) Explain how the parachute helps to reduce the speed of the vehicle. **1**

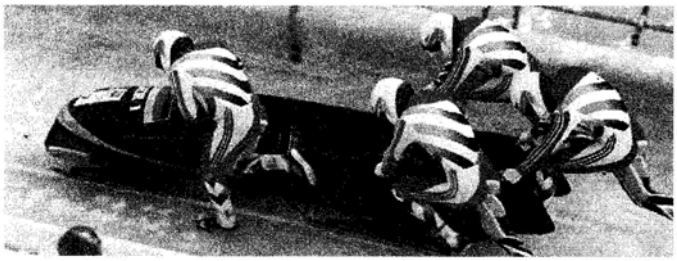
(ii) Calculate the distance travelled by the vehicle from the time the parachute opens until the vehicle stops. **2**

(iii) Calculate the acceleration of the vehicle while it is slowing down. **2**

(iv) Calculate the unbalanced force on the vehicle while it is slowing down. **2**

30.

A bobsleigh team competes in a race.



Creditl Level

Answer questions in your Homework Jotter.
Show working for each question.

KU	PS

30. continued

(*a*) Starting from rest, the bobsleigh reaches a speed of 11 m/s after a time of 3·2 s.

Calculate the acceleration of the bobsleigh. **2**

(*b*) The bobsleigh completes the 1200 m race in a time of 42·0 s.

Calculate the average speed of the bobsleigh. **2**

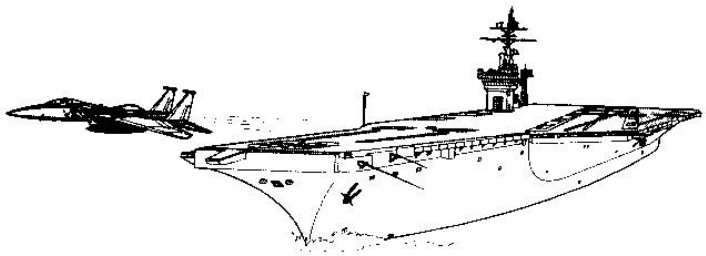
(*c*) Describe how the instantaneous speed of the bobsleigh could be measured as it crosses the finish line. **2**

(*d*) To travel as quickly as possible, frictional forces must be minimised.

State **two** methods of reducing friction. **2**

31.

An aeroplane on an aircraft carrier must reach a minimum speed of 70 m/s to safely take off. The mass of the aeroplane is 28 000 kg.



(*a*) The aeroplane accelerates from rest to its minimum take off speed in 2 s.

(i) Calculate the acceleration of the aeroplane. **2**

(ii) Calculate the force required to produce this acceleration. **2**

(iii) The aeroplane's engines provide a total thrust of 240 kN. An additional force is supplied by a catapult to produce the acceleration required.

Calculate the force supplied by the catapult. **1**

(*b*) Later, the same aeroplane travelling at a speed of 65 m/s, touches down on the carrier.

(i) Calculate the kinetic energy of the aeroplane at this speed. **2**

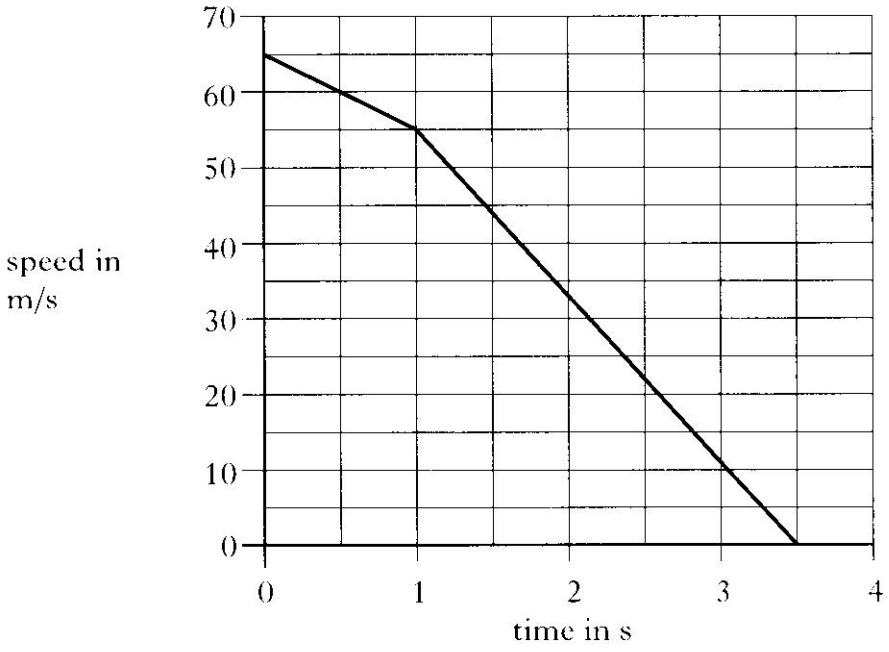
Creditl Level

Answer questions in your Homework Jotter.
Show working for each question.

KU	PS

31 (b). continued

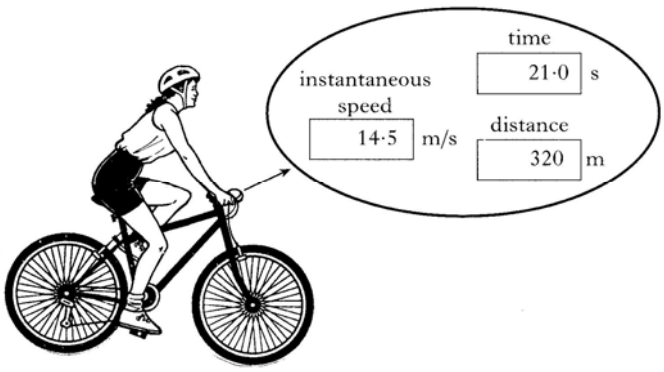
(ii) The graph shows the motion of the aeroplane from the poi when it touches down on the carrier until it stops.



Calculate the distance travelled by the aeroplane on the carrier. 2

32.

A cyclist has a small computer attached to her bike. The computer gives information on the cyclist's instantaneous speed, distance travelled and time taken.



At a point during a journey, the readings on the display are as shown above.

(*a*) (i) Calculate the average speed of the cyclist up to this point.

(You must use an appropriate number of significant figures in your answer to this question.) 3

Creditl Level

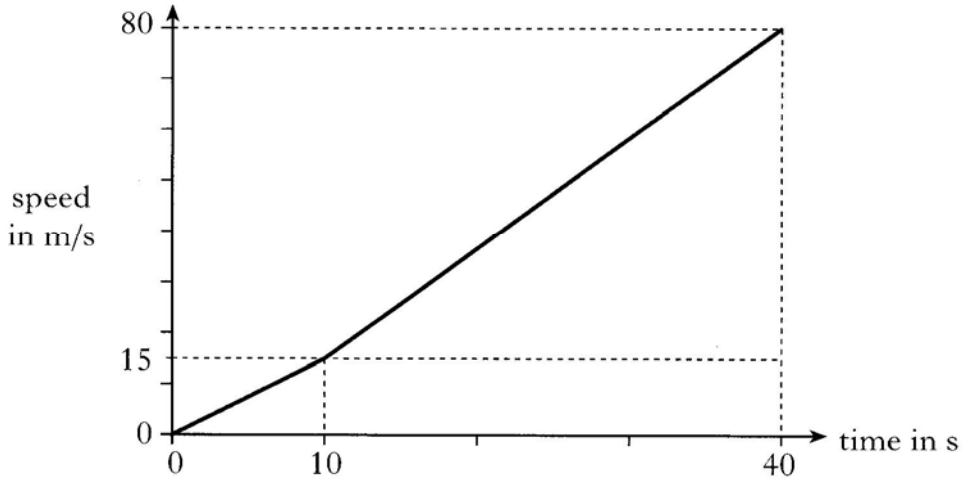
Answer questions in your Homework Jotter.
Show working for each question.

KU	PS

33.

An aircraft has a mass of 268 000 kg. The aircraft accelerates from rest along a straight runway. It takes 40 s for the aircraft to reach its take-off speed of 80 m/s.

(*a*) The speed-time graph of the aircraft is shown.



(i) Calculate the acceleration of the aircraft **during the first 10 s**. **2**

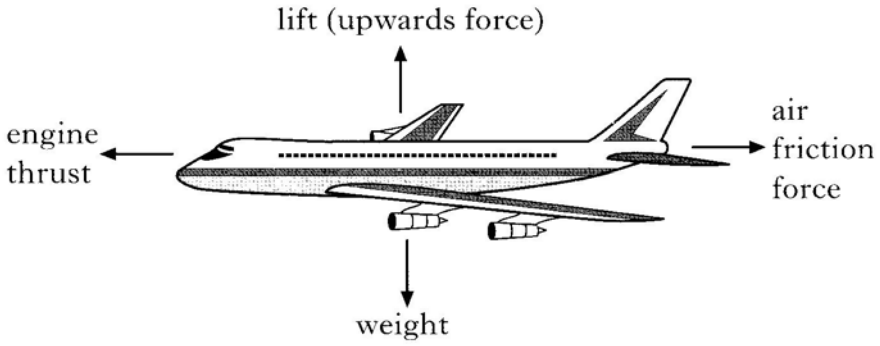
(ii) Calculate the unbalanced force acting on the aircraft **during the first 10 s**. **2**

(iii) By using information **from the graph**, explain whether the unbalanced force on the aircraft is greater during the time period 0–10 s or 10 s–40 s. **2**

(iv) Calculate the length of runway required to allow the aircraft to reach its take-off speed. **3**

(*b*) After take-off, the aircraft flies at a constant height of 10 000 m. The pilot increases the speed of the aircraft at this height.

The diagram shows the forces acting on the aircraft at this height.



Creditl Level

Answer questions in your Homework Jotter.
Show working for each question.

KU	PS

33. continued

Complete the statements about the sizes of the forces acting on the aircraft by using phrases from the following list.

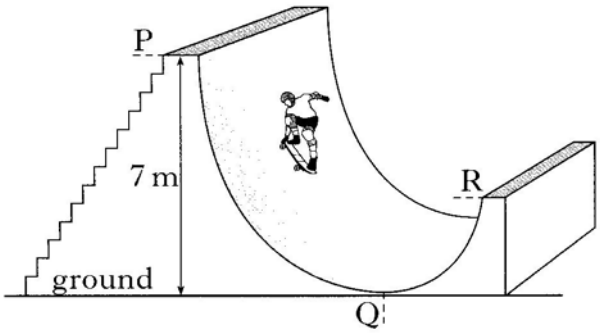
equal to **greater than** **less than**

(i) The engine thrust is ..... the air friction force. **1**

(ii) The lift is ..... the weight. **1**

34.

A skateboarder is practising on a ramp. The total mass of the skateboarder and the board is 60 kg.



(*a*) Calculate the increase in potential energy of the skateboarder and board in moving from the ground to position P. **2**

(*b*) The skateboarder moves along the ramp from P to R, and rises into the air above R.

(i) At what point **on the ramp** is the kinetic energy of the skateboarder greatest? **1**

(ii) The vertical speed of the skateboarder at R is 6 m/s.
Calculate the height that the skateboarder rises to, above R. **3**

(iii) Explain why the skateboarder does not rise to the same height as P. **2**

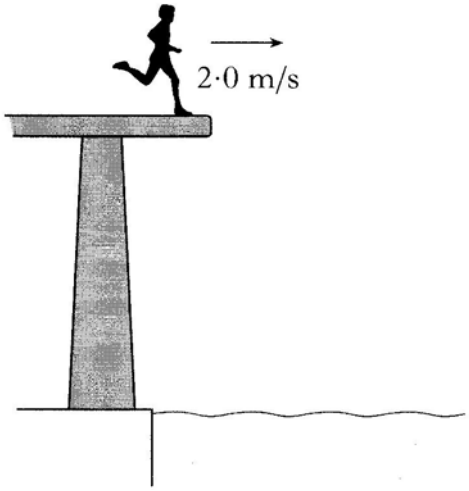
Creditl Level

Answer questions in your Homework Jotter.
Show working for each question.

KU	PS

35.

A student runs along a diving platform and leaves the platform horizontally with a speed of 2·0 m/s. The student lands in the water 0·3 s later. Air resistance is negligible.



(*a*) (i) Calculate the horizontal distance travelled by the student before landing in the water. **2**

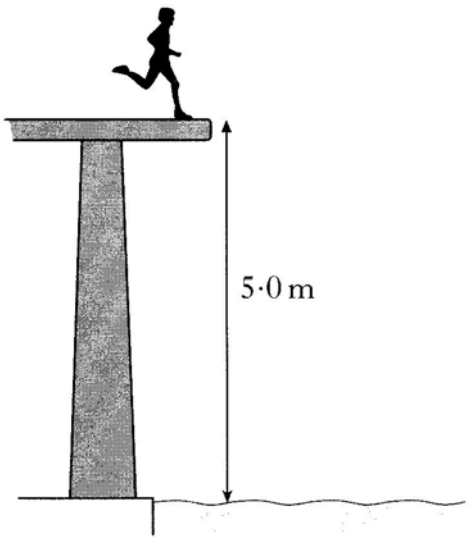
(ii) The student has a vertical acceleration of 10 m/s^2.

Calculate the vertical speed as the student enters the water. **2**

(*b*) Later the student runs off the end of the same platform with a horizontal speed of 3·0 m/s.

How long does the student take to reach the water this time? Explain your answer. **2**

(*c*) The student climbs from the water level to a higher platform. This platform is 5·0 m above the water. The student has a mass of 50 kg.



Creditl Level

Answer questions in your Homework Jotter.
Show working for each question.

KU	PS

35 (c). continued

(i) Calculate the gain in gravitational potential energy of the student. **2**

(ii) The student drops from the edge of the platform and lands in the water.

Calculate the vertical speed as the student enters the water. **2**

SQA Source Papers

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	3	2005	3
	4	2005	4
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2. Forces At Work	11	2001	13
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3. Movement Means Energy	18	2000	14
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Credit - Section			
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2. Forces At Work	27	2002	13
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3. Movement Means Energy	32	2001	9
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