Resources available from kickstart tutors

Student number

Name _____

Date _____

Attempt/Time taken _____

GCSE
PHYSICS

Topic Paper: 5.7 Momentum (Higher tier only)
Part 2

Time allowed: 40 minutes

Materials

For this paper you must have:

- the Periodic Table/Data Sheet, provided as an insert (enclosed)
- a ruler with millimetre measurements
- a calculator, which you are expected to use where appropriate.

Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- All working must be shown.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The Periodic Table/Data Sheet is provided as in insert.
- You are reminded of the need for good English and clear presentation in your answers.
- When answering questions you need to make sure that your answer:
  - is clear, logical, sensibly structured
  - fully meets the requirements of the question
  - shows that each separate point or step supports the overall answer.

35 Marks

Q6. The diagram shows a child on a playground swing.
The playground has a rubber safety surface.

(a) The child, with a mass of 35 kg, falls off the swing and hits the ground at a speed of 6m/s.

(i) Use the equation in the box to calculate the momentum of the child as it hits the ground.

momentum = mass ×velocity

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

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.....

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Momentum = ...

(3)

(ii) After hitting the ground, the child slows down and stops in 0.25 s.
Use the equation in the box to calculate the force exerted by the ground on the child.

$$\text{force} = \frac{\text{change in momentum}}{\text{time taken for the change}}$$

Show clearly how you work out your answer.

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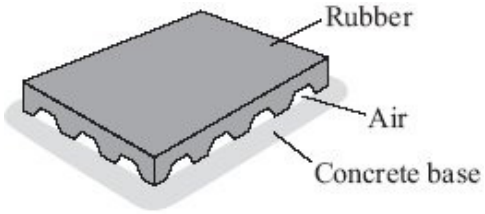
Force = ... N

(2)

(b) The diagram shows the type of rubber tile used to cover the playground surface.



Explain how the rubber tiles reduce the risk of children being seriously injured when they fall off the playground equipment.

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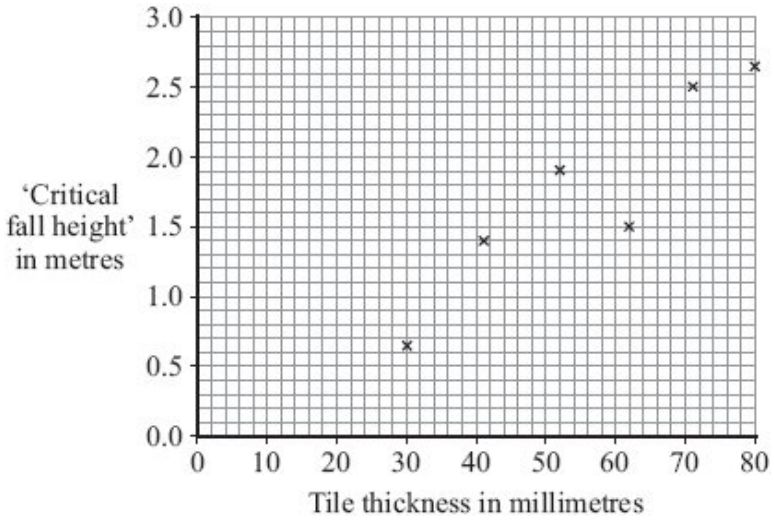
(3)

(c) The 'critical fall height' is the height that a child can fall and **not** be expected to sustain a life-threatening head injury.
A new type of tile, made in a range of different thicknesses, was tested in a laboratory using test dummies and the 'critical fall height' measured. Only one test was completed on each tile.

The results are shown in the graph.



The 'critical fall height' for playground equipment varies from 0.5 m to 3.0 m.

Suggest **two** reasons why more tests are needed before this new type of tile can be used in a playground.

1 .....

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2 .....

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(2)

(d) Developments in technology allow manufacturers to make rubber tiles from scrap car tyres.

Suggest why this process may benefit the environment.

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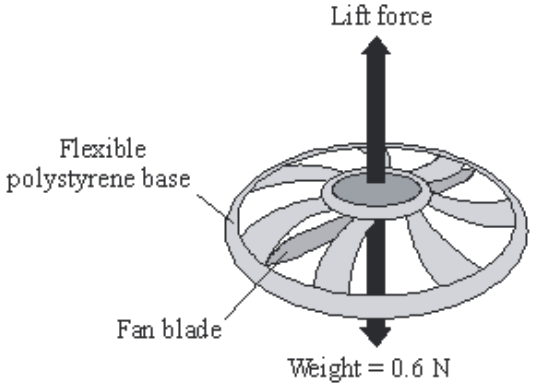
(1)

(Total 11 marks)

Q7. The diagram shows a small, radio-controlled, flying toy. A fan inside the toy pushes air downwards creating the lift force on the toy.



When the toy is hovering in mid-air, the fan is pushing 1.5 kg of air downwards every 10 seconds. Before the toy is switched on, the air is stationary.

(a) Use the equations in the box to calculate the velocity of the air when the toy is hovering.

momentum = mass ×velocity

$$\text{force} = \frac{\text{change in momentum}}{\text{time taken for the change}}$$

Show clearly how you work out your answer.

.....

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Velocity = ... m/s

(3)

(b) Explain why the toy accelerates upwards when the fan rotates faster.

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(2)

(c) The toy is not easy to control so it often falls to the ground.

Explain how the flexible polystyrene base helps to protect the toy from being damaged when it crashes into the ground.

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(3)
(Total 8 marks)

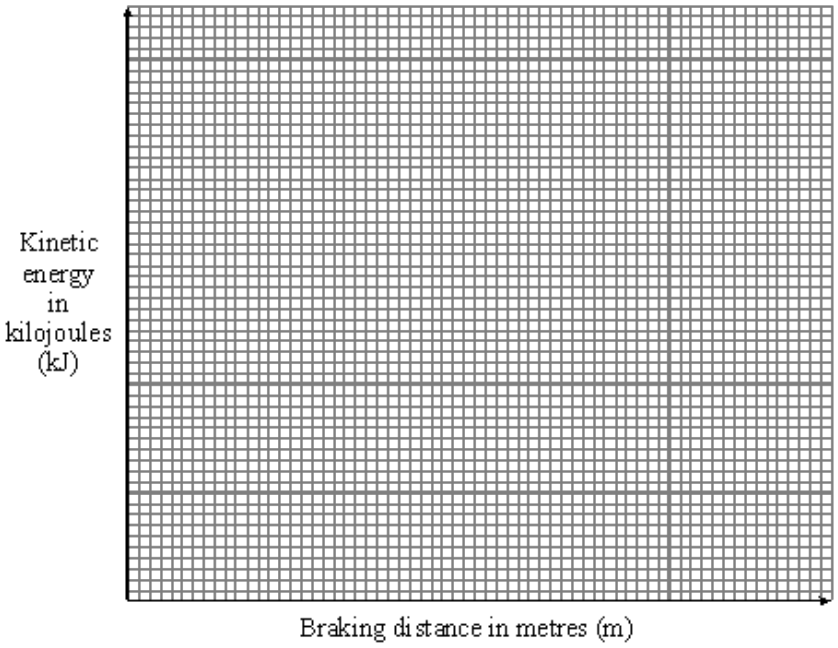
Q8.

The table shows the braking distances for a car at different speeds and kinetic energy. The braking distance is how far the car travels once the brakes have been applied.

Braking distance in m	Speed of car in m/s	Kinetic energy of car in kJ
5	10	40
12	15	90
20	20	160
33	25	250
45	30	360

(a) A student suggests, "*the braking distance is directly proportional to the kinetic energy*."

(i) Draw a line graph to test this suggestion.



(3)

(ii) Does the graph show that the student's suggestion was correct or incorrect? Give a reason for your answer.

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(1)

(iii) Use your graph and the following equation to predict a braking distance for a speed of 35 metres per second (m/s). The mass of the car is 800 kilograms (kg). Show clearly how you obtain your answer.

$$\text{kinetic energy} = \tfrac{1}{2}\ mv^2$$

.....

.....

Braking distance = ... m

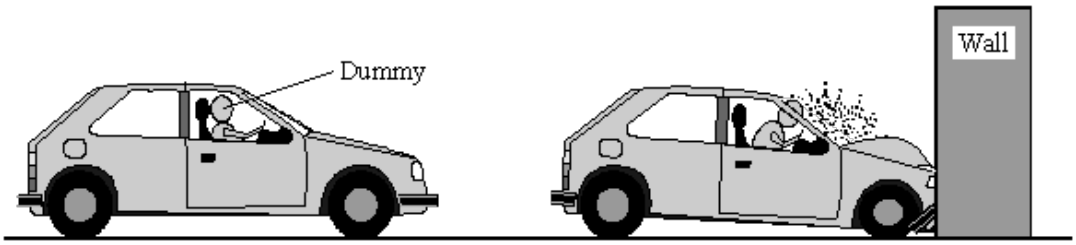
(2)

(iv) State **one** factor, apart from speed, which would increase the car's braking distance.

.....

(1)

(b) The diagram shows a car before and during a crash test. The car hits the wall at 14 metres per second (m/s) and takes 0.25 seconds (s) to stop.



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

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(1)

(ii) Calculate the deceleration of the car.

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Deceleration = ... m/s^2

(1)

(iii) In an accident the crumple zone at the front of a car collapses progressively. This increases the time it takes the car to stop. In a front end collision the injury to the car passengers should be reduced. Explain why. The answer has been started for you.

By increasing the time it takes for the car to stop, the .....

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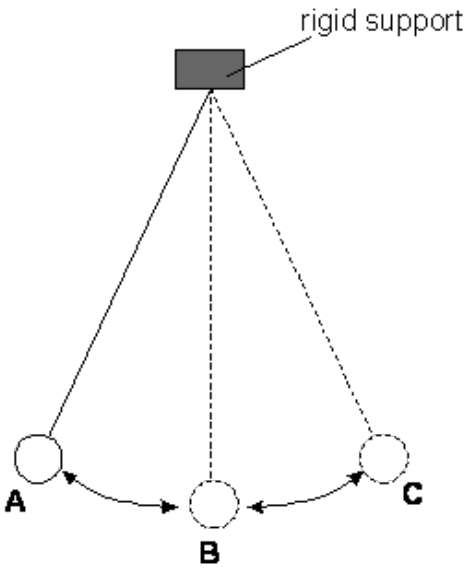
(2)

(Total 11 marks)

Q9. The diagram below shows an experiment where a pendulum swings backwards and forwards.
A pendulum is a small heavy weight suspended by a light string.



(a) (i) In which position, A, B or C, does the pendulum have least potential energy?
Explain your answer.

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(1)

(ii) In which position, A, B or C, does the pendulum have greatest kinetic energy?

Explain your answer.

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(1)

(iii) After a few minutes the size of the swings becomes smaller.
Explain why this happens.

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(1)

(b) If the experiment were repeated on the Moon the pendulum would swing more slowly.
Suggest a reason for this.

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(2)
(Total 5 marks)