

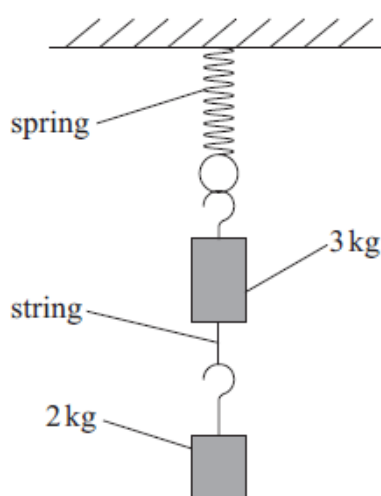
Questions

Q1.

Answer the question with a cross in the box you think is correct (☒). If you change your mind about an answer, put a line through the box (☒) and then mark your new answer with a cross (☒).

A student hangs a 3 kg mass and a 2 kg mass from a spring, as shown.

The forces on the 3 kg mass are in equilibrium.



The string holding the 2 kg mass breaks.

Which expression gives the initial upward acceleration of the 3 kg mass in terms of g ?

- ☒ A $\frac{2g}{3}$
- ☒ B $\frac{5g}{3}$
- ☒ C $2g$
- ☒ D $5g$

(Total for question = 1 mark)

Q2.

A student used a falling sphere to determine the acceleration of free fall.

A camera produced images of the sphere at constant time intervals as it fell.

The positions of the sphere in the first two images are shown. Image 1 shows the sphere's position at the instant it was released.

☒ Image 1

☒ Image 2

☐ P

☐ Q

☐ R

☐ S

Which of the positions P, Q, R or S will the sphere be at in Image 3?

(1)

☒ **A** P

☒ **B** Q

☒ **C** R

☒ **D** S

(Total for question = 1 mark)

Q3.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

A coin and a feather are dropped from the same height, through air.

Which row of the table is correct as the coin and feather fall to the ground?

	Initial acceleration	Time taken to reach the ground
☐ A	Greater for coin	Less for coin
☐ B	Greater for coin	Same for coin and feather
☐ C	Same for coin and feather	Less for coin
☐ D	Same for coin and feather	Same for coin and feather

(Total for question = 1 mark)

Q4.

A lorry has a mass of 4500 kg.

The forward force on the lorry is 6700 N.

The total resistive force on the lorry is 900 N.

Calculate the acceleration of the lorry.

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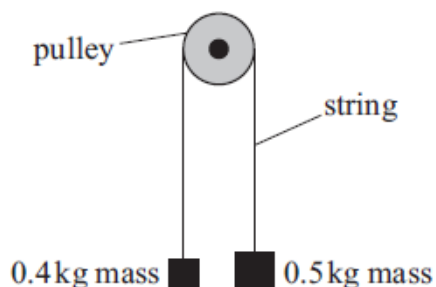
Acceleration = ...

(Total for question = 2 marks)

Q5.

Answer the question with a cross in the box you think is correct (☐). If you change your mind about an answer, put a line through the box (☒) and then mark your new answer with a cross (☐).

A student uses a piece of string to attach a mass of 0.4 kg to a mass of 0.5 kg. She then places the string over a pulley, as shown.



Which of the following gives the acceleration of the 0.5 kg mass in ms^{-2} ?

☐ A $\frac{(0.5 - 0.4) \times 9.81}{0.5}$

☐ B $\frac{(0.5 - 0.4) \times 9.81}{0.5 + 0.4}$

☐ C $\frac{0.5 \times 9.81}{0.5 - 0.4}$

☐ D $\frac{0.5 \times 9.81}{0.5 + 0.4}$

(Total for question = 1 mark)

Q6.

Answer the question with a cross in the box you think is correct ☐. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☐.

A student determined the acceleration of free fall g .

She measured the time t for a ball bearing to fall from rest through a distance s .
She repeated this for a range of values of s .

Which row of the table shows the graph that would give a gradient equivalent to g ?

	y -axis	x -axis
☐ A	s	$2t^2$
☐ B	$2s$	t^2
☐ C	s	$2t$
☐ D	$2s$	t

(Total for question = 1 mark)

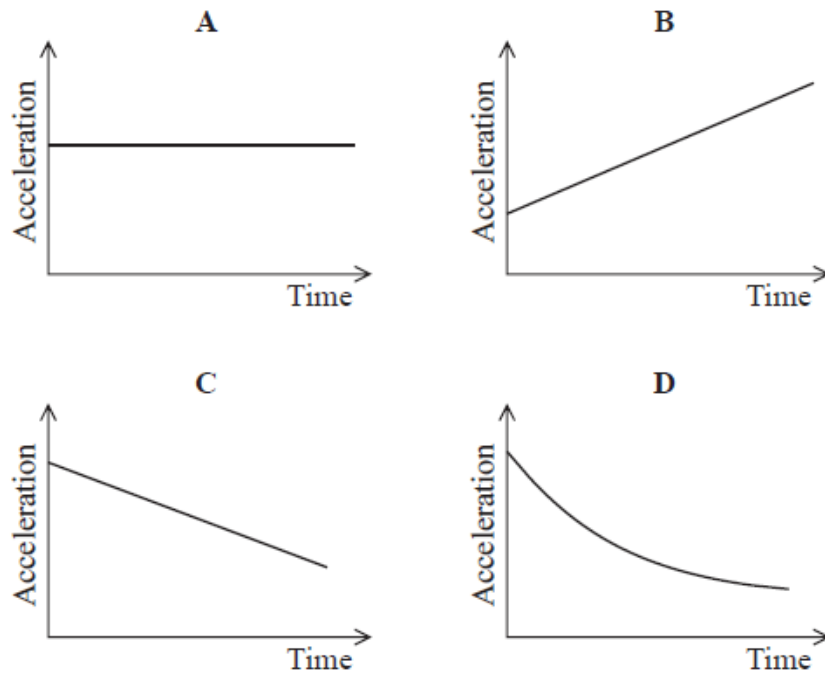
Q7.

Answer the question with a cross in the box you think is correct (☒). If you change your mind, put a line through the box (☒) and then mark your new answer with a cross (☒).

A rocket is accelerating horizontally due to a constant resultant force.

The mass of the rocket decreases steadily as it uses up its fuel.

Which graph shows how the acceleration of the rocket could change?



☐ A

☐ B

☐ C

☐ D

(Total for question = 1 mark)

Q8.

A resultant force of 4800 N acts on a boat.

The acceleration of the boat is 0.31 m s^{-2} .

Calculate the weight of the boat.

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Weight of boat = ...

(Total for question = 3 marks)

Q9.

The photograph shows a rocket. This rocket is launched vertically.



(Source: <https://www.nasa.gov/image-feature/the-spacex-falcon-9-rocket-in-vertical-position-on-the-launch-pad>)

(a) The rocket's engines give a total upward thrust of $7.3 \times 10^7 \text{ N}$.

Calculate the initial acceleration of the rocket.

mass of rocket = $5.0 \times 10^6 \text{ kg}$

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Initial acceleration = ...

(b) Give one reason why the acceleration will increase as the rocket rises.

(1)

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(Total for question = 4 marks)

Q10.

A student used two different methods to investigate the acceleration of a freely falling object.

(a) In the first method, the student dropped a ball from rest at a known height. He used a stopwatch to measure the time taken for the ball to reach the ground. He repeated this several times. He then calculated the mean acceleration of the ball.

Explain why there was a large uncertainty in the calculated value of acceleration.

(2)

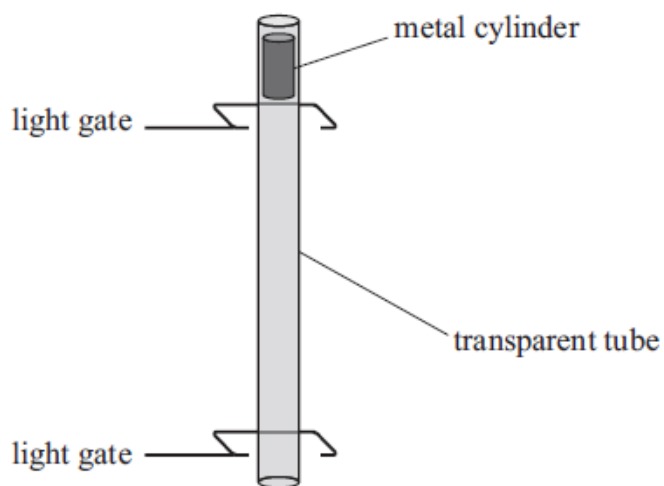
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(b) In the second method, the student positioned light gates near the top and bottom of a transparent vertical tube. He dropped a metal cylinder into the tube, as shown.



The time taken for the metal cylinder to pass through each light gate was recorded by a data logger.

The student measured the distance between the light gates.

(i) Give one other measurement needed to determine the acceleration of the metal cylinder.

(1)

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(ii) The speed of the metal cylinder through the first light gate was 1.39 ms^{-1} .

The speed of the metal cylinder through the second light gate was 2.96 ms^{-1} .

The distance between the light gates was 355 mm.

Calculate the acceleration of the metal cylinder.

(2)

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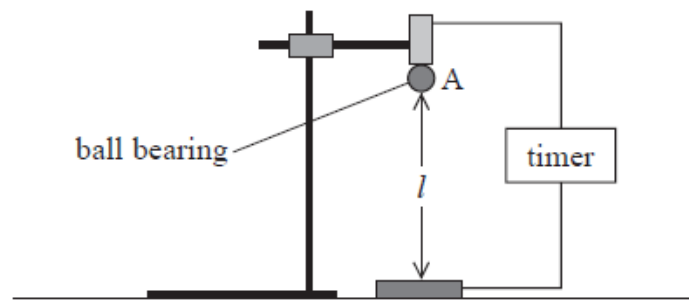
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Acceleration = ...

(Total for question = 5 marks)

A student carried out an experiment to measure the acceleration of free-fall g .

A ball bearing was released from position A. The time t for the ball bearing to fall a distance l was measured. This was repeated for decreasing values of l .



Explain how the measurements obtained can be used to determine a value for g in m s^{-2} . Your answer should include a sketch on the axes below of the graph that the student would expect to obtain.

(5)



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(Total for question = 5 marks)

Q12.

* The photograph shows a toy car that contains a spring. Pulling the car backwards along the floor compresses the spring. Energy is stored in the compressed spring.



The car is released and the spring returns to its original state. There is a forward force on the car from the floor and the car moves forwards.

Explain why the floor exerts a forward force on the car and how this force affects the motion of the car as the spring returns to its original state.

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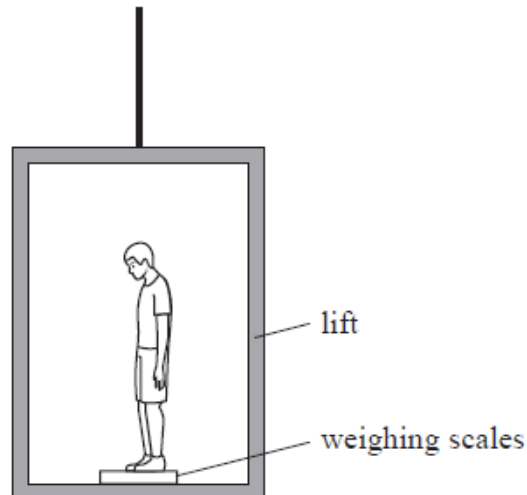
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Q13.

* A student of weight 600 N is standing on weighing scales in a lift. The scales are calibrated to give readings in newtons.



The lift moves upwards at constant velocity, then decelerates to rest. As the lift moves, the student looks at the readings on the scales.

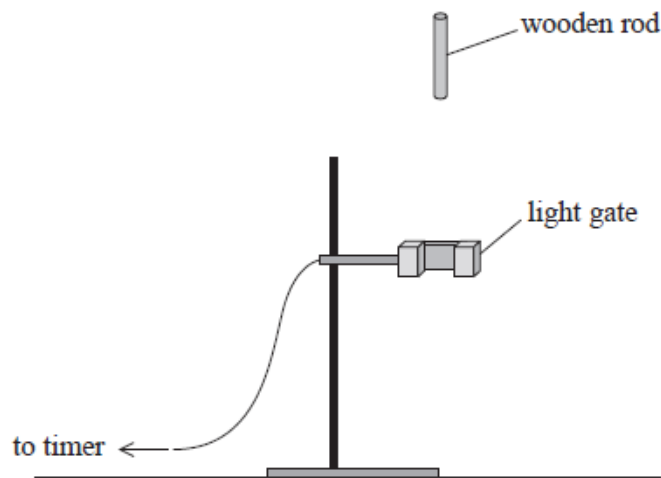
Explain the readings on the scales.

[illegible]

Q14.

A student carries out an experiment to determine a value for g , the acceleration of free fall. A short wooden rod is released above a light gate. A timer connected to the light gate is used to measure the time taken for the wooden rod to pass through the light gate.

The experimental arrangement is shown.



The student uses the equation $v^2 = u^2 + 2as$, where $u = 0$, and a graphical method to determine a value for g .

(a) State the additional measurements the student should take.

(2)

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(b) Describe how the velocity v of the wooden rod as it passes through the light gate can be determined accurately.

(2)

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(c) Describe how the student can determine a value for g using a graphical method.

(3)

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(Total for question = 7 marks)