

GCSE Physics (9 – 1)

Forces

Name:

Group:



Instructions

- Read each question carefully before you begin to answer it.
- Use black ink or black ball-point pen for your answers.
- Fill in the boxes at the top of this page with your name and group.
- Attempt to answer every question in the booklet.
- Answer the questions in the spaces provided – there may be more space than you need in some answer spaces.
- Calculators may be used for this booklet.
- For any calculations, you **must** show all your working.
- Any and all drawings or graphs should be completed in pencil.
- Feel free to use a compass.

For markers use	
Question	Mark
1	/6
2	/12
3	/12
4	/6
5	/9
6	/6
7	/9
8	/10
Total	/70
%	
Grade	

Information

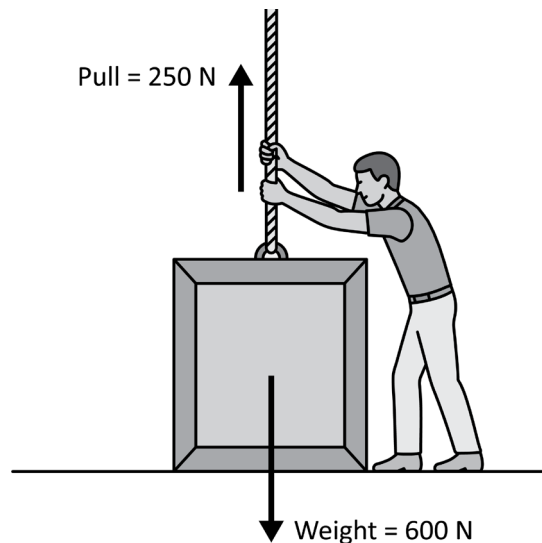
- The maximum mark for this paper is 70 marks.
- The marks for each question are shown in brackets.
- Please be aware that good English and clear presentation are required in your answers.



1. A force is simply a push or a pull that acts upon an object, holding the power to change its speed, direction, or shape. For each of the following questions **circle** the letter of the correct answer.

- a) A heavy crate of weight 600 N is resting on the floor.

A worker pulls vertically upwards on a rope attached to the crate with a force of 250 N, but the crate does not leave the ground. The figure below shows the worker and the crate.



What is the upward normal contact force provided by the floor?

- | | | | |
|----------|----------|----------|----------|
| A | B | C | D |
| 0 N | 250 N | 350 N | 850 N |

(1 mark)

- b) A heavy metal ball is dropped from a tall building.

As the ball falls and speeds up, the air resistance acting against it increases.

What happens to the acceleration of the ball as it falls, before it reaches terminal velocity?

- A** Its acceleration continually increases.
- B** Its acceleration stays constant at exactly 9.8 m/s^2 .
- C** Its acceleration decreases.
- D** Its acceleration becomes zero immediately.

(1 mark)

- c) Which of the following is an example of a force.

- | | | | |
|----------|----------|----------|----------|
| A | B | C | D |
| Density | Volume | Mass | Weight |

(1 mark)

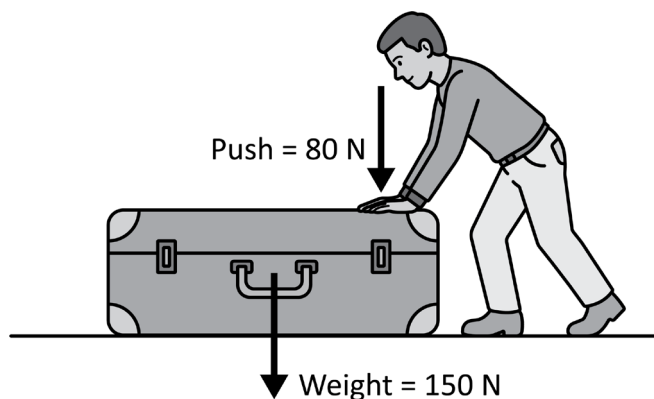
- d) A rover sent to explore Mars has a mass of 150 kg.
When resting on the surface of Mars, the rover has a weight of 555 N.
What is the gravitational field strength (g) on Mars?

A	B	C	D
0.27 N/kg	3.7 N/kg	9.8 N/kg	83 250 N/kg
(1 mark)			

- e) An elephant has a weight of 60 kN. Its four feet have a total area of 0.75 m^2 in contact with the ground.
Calculate the total pressure the elephant exerts on the ground.

A	B	C	D
45 Pa	80 Pa	45 000 Pa	80 000 Pa
(1 mark)			

- f) A suitcase of weight 150 N is resting on a flat floor.
A person leans on the suitcase, pushing vertically downwards with a force of 80 N.
The suitcase does not move or crush the floor beneath it.

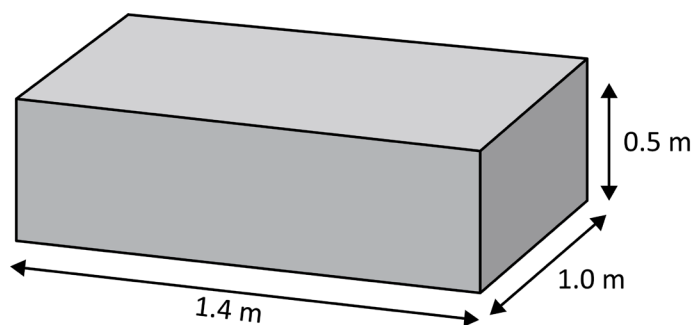


What is the upward normal contact force provided by the floor?

A	B	C	D
70 N	80 N	150 N	230 N
(1 mark)			

(Total for Question 1 is 6 marks)

2. A construction worker is moving a large, solid concrete block.



- a) The concrete block has a mass of 500 kg. Gravitational field strength (g) = 9.8 N/kg. Calculate the weight of the concrete block.

Weight = ... N

(2 marks)

- b) The concrete block is resting flat on the ground. Calculate the pressure the block exerts on the ground. Give the unit of pressure in your answer.

Pressure = ... Unit = ...

(5 marks)

- c) A crane lifts the concrete block vertically into the air.
The work done by the crane in lifting the block is 58,800 J.
Calculate the distance the block was lifted.

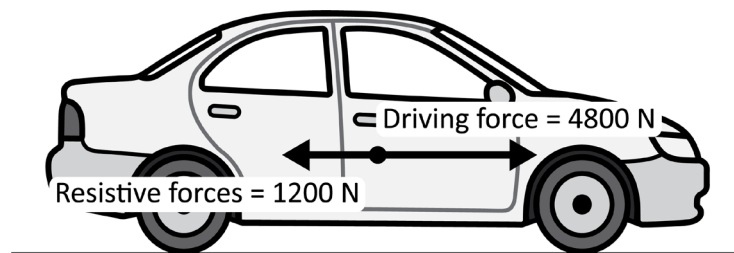
Distance lifted = ... m
(3 marks)

- d) Later, a tractor drags a different block horizontally across the rough ground.
The tractor does 15,000 J of work to drag the block a distance of 5 m.
Calculate the frictional force acting against the block.

Frictional force = ... N
(2 marks)

(Total for Question 2 is 12 marks)

3. A family is driving a car along a straight, level motorway.



- a) Calculate the resultant force acting on the car.

Resultant force = ... N
(1 mark)

- b) The car, including the passengers, has a total mass of 1600 kg.
Calculate the acceleration of the car.

Acceleration = ... m/s^2
(3 marks)

- c) After accelerating, the car travels at a steady speed of 30 m/s for a distance of 4500 m.
Calculate the time taken for this part of the journey.

Time taken = ... s
(3 marks)

d) A short time later, the car brakes sharply and stops.

Just before braking, the car had a momentum of 32,000 kg m/s.

Given that the mass of the car is 1600 kg, calculate the velocity of the car just before it braked.

Velocity = ... m/s

(3 marks)

e) Explain why it can potentially be unsafe for a car to travel with a very high momentum.

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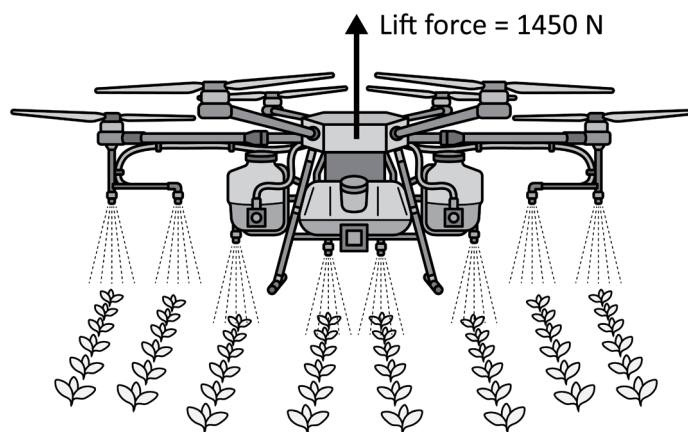
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(2 marks)

(Total for Question 3 is 12 marks)

4. A company is testing a delivery drone.



The total mass of the drone, including its full tanks of herbicide, is 120 kg.

The gravitational field strength (g) is 9.8 N/kg.

To climb the drone's rotors produce a constant upward lift force of 1450 N.

Calculate the upward acceleration of the drone.

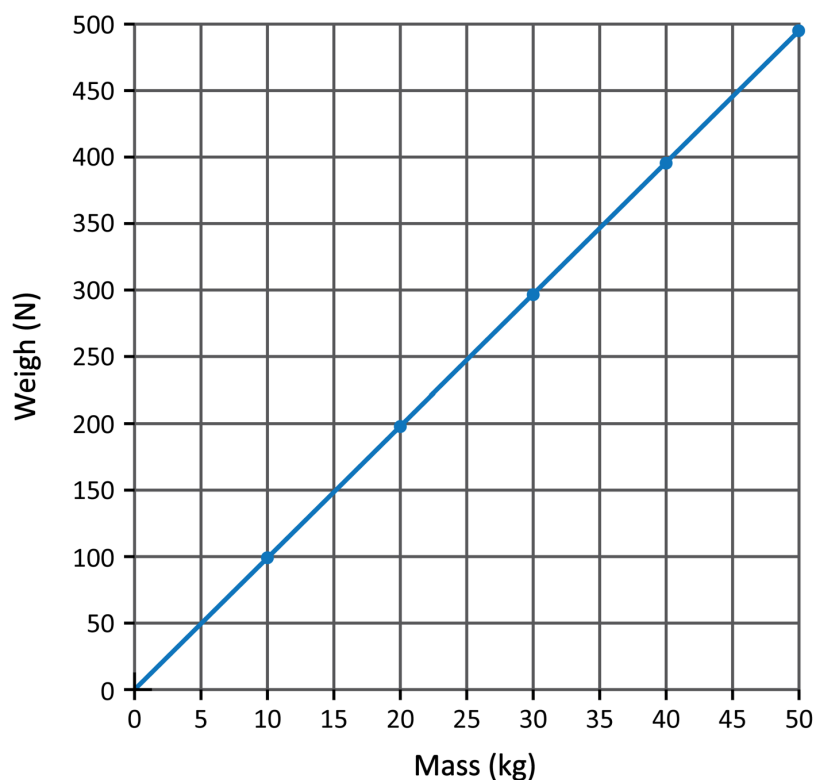
You must show all of your working.

Acceleration = ... m/s^2

(6 marks)

(Total for Question 4 is 6 marks)

5. A student investigates the relationship between the mass of an object and its weight on Earth. They measure the weight of several different masses and plot their results on the graph below.



- a) State the difference between mass and weight.

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(2 marks)

- b) The student adds a new object to the scale. The object has a mass of 45 kg. Use the graph to determine the weight of this object.

Weight = ... N

(1 mark)

- c) The student states: "*The graph shows that weight is directly proportional to mass.*" Explain how the graph supports this statement.

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(2 marks)

- d) Calculate the gradient of the line on the graph.
Show your working.

Gradient = ...

(2 marks)

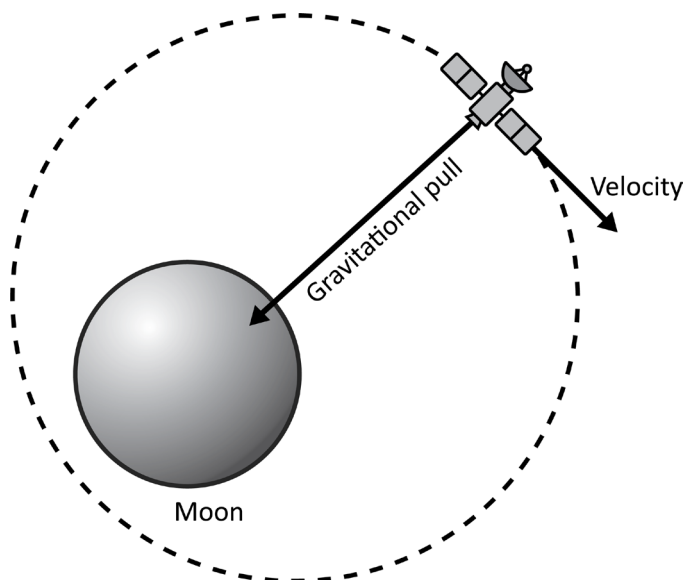
- e) The student takes the 45 kg object from part (b) and travels to the Moon.
The gravitational field strength (g) on the Moon is 1.6 N/kg.
Calculate the weight of the object on the Moon.

Weight on the Moon = ... N

(2 marks)

(Total for Question 5 is 9 marks)

6. Space agencies send robotic probes to the moon for scientific research.



- a) During launch, a rocket carrying the satellite accelerates steadily from rest and reaches a speed of 6000 m/s after travelling a distance of 900,000 m.

Calculate the time, **in minutes**, it takes the rocket to reach this speed.

..... minutes

(3 marks)

- b) The satellite is now in a stable circular orbit around the Moon, as shown in the diagram.

To keep the satellite in this exact orbit, its speed needs to stay at exactly 1600 m/s.

Suggest, by using ideas about gravitational and centripetal forces, why this specific speed must be maintained to keep it in a stable orbit.

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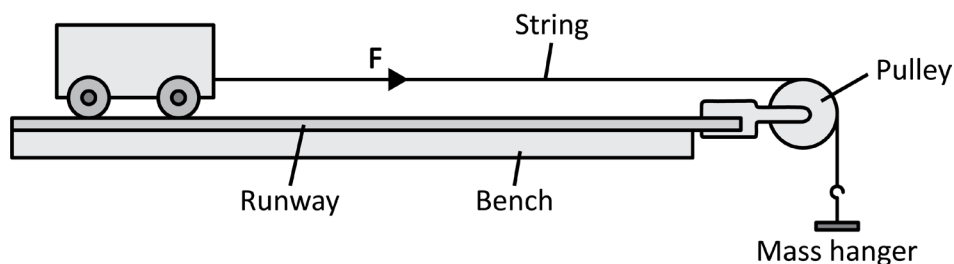
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(3 marks)

(Total for Question 6 is 6 marks)

7. A student investigated how the acceleration of a trolley varies with the mass of the trolley. The figure below shows some of the equipment used.



- a) To change the mass of the trolley, the student added metal blocks to it.

Identify the piece of equipment the student should use to measure the mass of the trolley and the blocks.

.....
(1 mark)

- b) Give **one** variable that must be a control variable in this specific investigation.

.....
(1 mark)

- c) In the original setup, the student used a manual stopwatch.

To improve accuracy, the teacher suggests attaching a piece of card to the trolley and using two light gates connected to a data logger.

Explain how the light gates and the card are used to calculate the acceleration of the trolley.

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(3 marks)

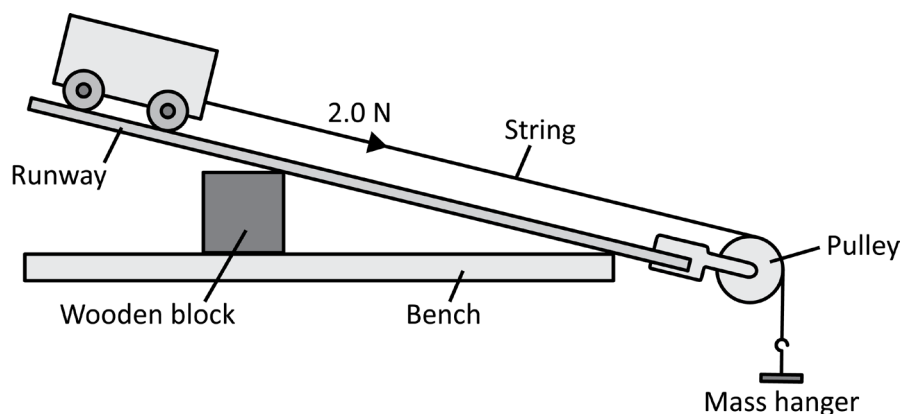
- d) For one specific mass, the student released the trolley three times and recorded the following values for acceleration:

2.15 m/s² 2.21 m/s² 2.18 m/s²

Calculate the uncertainty in these values of acceleration.

Uncertainty = $\pm$ m/s²
(2 marks)

- e) Before taking any results, the student raised one end of the runway using a wooden block.



- f) The student adjusted the height of the wooden block until the trolley moved down the runway at a constant speed when given a small push.

Explain why the student adjusted the runway in this way.

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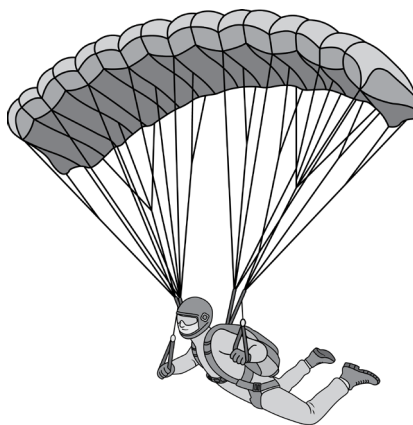
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(2 marks)

(Total for Question 7 is 9 marks)

8. The figure below shows a skydiver falling vertically towards the ground with an open parachute.



The skydiver is falling downwards at a constant vertical velocity (terminal velocity). Several upward and downward forces act on the skydiver as they fall.

- a) Explain how the forces keep the skydiver moving towards the ground at a constant vertical velocity.

Your answer should refer to all vertical forces acting on the skydiver. You may add to the diagram to help with your answer.

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(6 marks)

- b) The skydiver has a mass of 85 kg. Gravitational field strength (g) = 9.8 N/kg.
The skydiver falls at a constant terminal velocity for a time of 40 seconds, covering 200 m.
Calculate the power dissipated against air resistance as the skydiver falls this distance.

Power = ... W
(4 marks)

(Total for Question 8 is 10 marks)