1. A student writes a summary about gravitational fields.

The student has made **two** mistakes in their summary.

Gravitational Fields
All matter has a gravitational field.
Gravitational fields cause repulsion.
More massive objects have a smaller gravitational field strength.

Identify the **two** mistakes and write down the correct word for each mistake.

Mistake 1: _____

Correct word 1: _____

Mistake 2: _____

Correct word 2: _____ **[4]**

2(a). A teacher fills up a plastic bottle with water.

The teacher makes a small hole in the side of the bottle so that the water flows out.

i. At what angle to the side of the bottle does the water flow out?

_____ **[1]**

ii. Explain why the water flows out of the bottle at this angle.

_____

_____ **[1]**

(b). A force of 1.8 N acts on a 0.12 m^2 area of ground.

i. Calculate the pressure exerted on the ground.

Use the Equation Sheet **June 2024, J249-01-02-03-04**.

Pressure = ...Pa **[3]**

ii. The force is kept constant and the area the force acts on is halved.

What happens to the pressure exerted on the ground?

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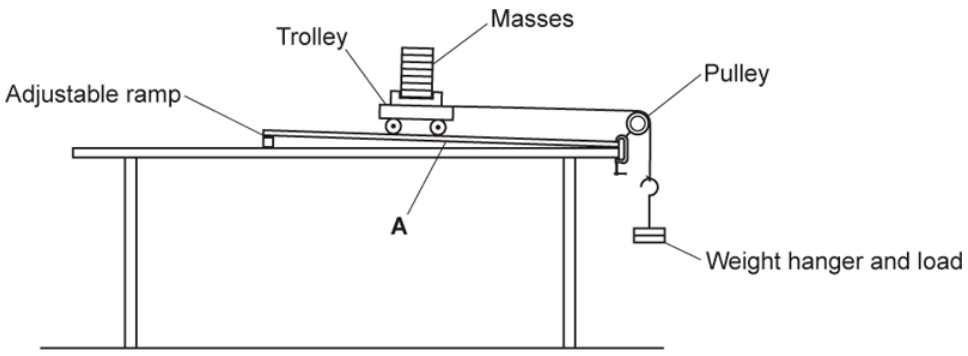
[1]

3. A student does an experiment to investigate how the resultant force on an object affects the acceleration of the object (Newton's second law).

The diagram shows some of the equipment the student uses.



This is their method:

- Release the trolley from position **A** on the ramp.
- Measure the acceleration using light gates and a data logger (**not** shown in the diagram).
- Repeat for three different loads by moving masses from the trolley to the weight hanger.

These are their results:

Load (N)	**Acceleration (m / s^2)**
2	1.5
4	3.12
8	6

Describe the trend shown by the student's results.

Suggest how the student could improve their method to obtain more accurate and precise results.

[6]

4. A spring is stretched by a load but does **not** return to its original length when the load is removed.

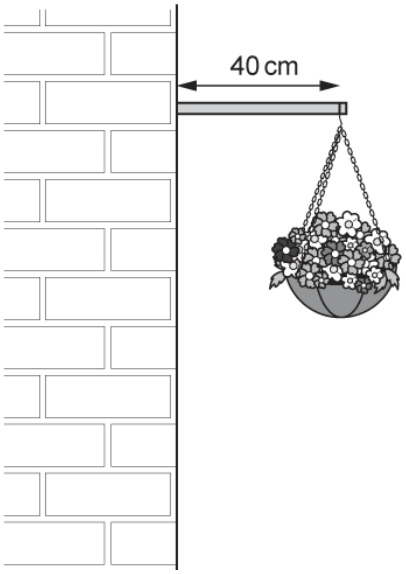
Which statement correctly describes the spring?

A The force-extension graph for the spring is linear.
B The spring has plastic deformation.
C The spring is elastic.
D The spring obeys Hooke's Law.

Your answer ☐ **[1]**

5. A basket of flowers hangs at the end of a horizontal pole attached to a vertical wall.

The basket weighs 8 N and hangs from a point on the pole 40 cm away from the wall.



What is the moment of the basket about the point where the pole is attached to the wall?

Use the equation: moment of a force = force × distance

A 3.2 N m anti-clockwise
B 3.2 N m clockwise
C 320 N m anti-clockwise
D 320 N m clockwise

Your answer ☐ **[1]**

6. A book is lifted a vertical distance, x, from the floor to a table.

The gravitational potential energy store of the book increases by 10 J.

The book is then lifted a further vertical distance, x, from the table onto a shelf.

What is the **total** increase in the gravitational potential energy store of the book when it is lifted from the floor to the shelf?

A 5 J
B 10 J
C 20 J
D 40 J

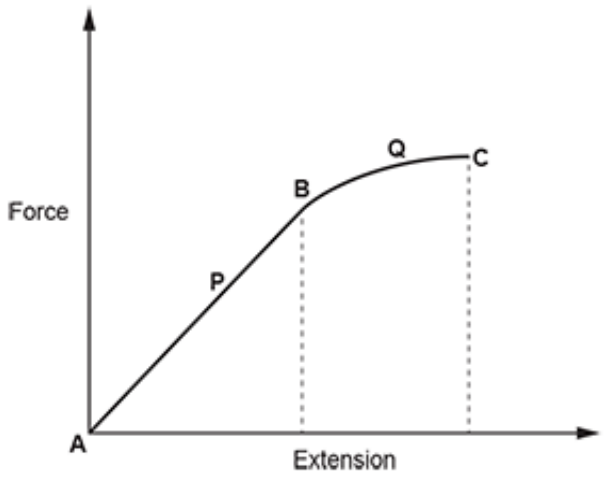
Your answer ☐ **[1]**

7(a). A student applies different forces to a spring and measures the extension of the spring each time. The force–extension graph shows their results.

A, **B** and **C** are points on the graph.

P is the region on the graph between points **A** and **B**.

Q is the region on the graph between points **B** and **C** where the spring is permanently deformed.



Use the letters **A**, **B**, **C**, **P** and **Q** to answer the following questions about the graph.

i. Which letter represents where the spring has elastic deformation?

_____ **[1]**

ii. Which letter represents where the spring obeys Hooke's Law?

_____ **[1]**

iii. Which letter represents the elastic limit of the spring?

_____ **[1]**

iv. Which letter represents where the graph is non-linear?

_____ **[1]**

(b). State the **minimum** number of forces that need to be applied to a spring in order to stretch it.

_____ **[1]**

(c). The spring constant of a spring is 28 N / m.

i. Calculate the force exerted by the spring when it is extended by 0.15 m.

Use the equation: force exerted by a spring = spring constant × extension

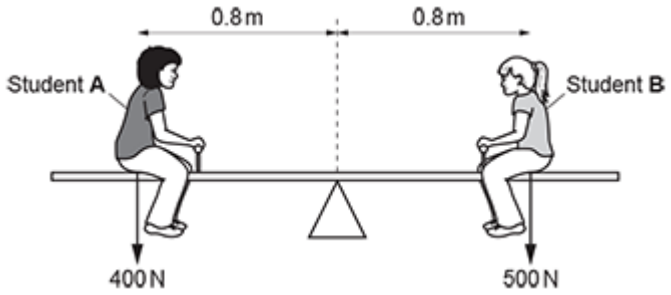
Force = ... N **[2]**

ii. Calculate the energy transferred when the spring is extended by 0.15 m.

Use the Equation Sheet June 23 J249-01-02-03-04.

Energy transferred when stretching = ... J **[2]**

8. The diagram shows two students sitting on a seesaw.



i. Explain what happens to the seesaw when both students lift their feet off the ground.

_____

_____

_____ **[2]**

ii. Calculate the distance from the pivot that student **B** sits to balance the seesaw when student **A** sits 0.6 m from the pivot.

Use the equation: moment of a force = force × distance

Distance = ... m **[3]**

9. A student investigates the gears on their bicycle.

The larger cog has 60 teeth and the smaller cog has 20 teeth.

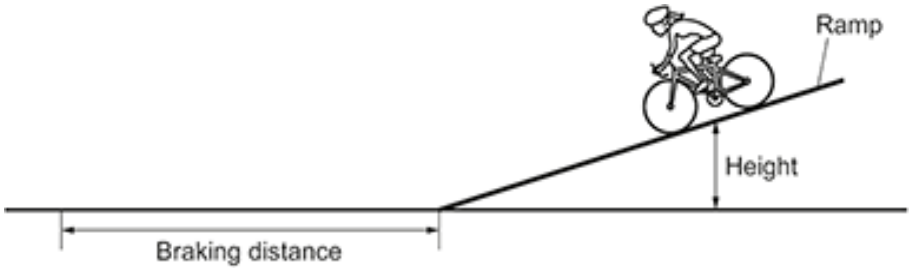
If the larger cog rotates once, how many times does the smaller cog rotate?

A 1
B 3
C 40
D 80

Your answer ☐ **[1]**

10. Student **A** is investigating braking distance using a bicycle. This is their method:

- Freewheel down a ramp **without** pedalling.
- At the bottom of the ramp, press the brakes until the bicycle comes to a stop.
- Measure the braking distance of the bicycle from the bottom of the ramp.



The mass of student **A** and the bicycle is 80 kg.

The height of student **A** and the bicycle at the top of the ramp is 2.0 m.

Gravitational field strength = 10 N / kg.

Calculate the gravitational potential energy of student **A** and the bicycle at the top of the ramp.
Use the Data sheet_J249 01/02/03/04, June 2022.

Gravitational potential energy = ... J **[3]**

11. A swimmer has a mass of 75 kg. Calculate their weight.

Use the equation: gravitational force = mass × gravitational field strength

Weight = ... N **[3]**

12(a). A climber investigates how a rope stretches with different forces. The climber's results are shown in the table.

Force (N)	Extension (m)
0	0.00
10	0.15
20	0.3
30	0.45
40	0.60

The climber has made a mistake when recording their results.

Identify the mistake and suggest how it could be corrected.

Mistake: _____

Correction: _____

[2]

(b).

i. Calculate the spring constant for the rope.

Give your answer to **two** significant figures.

Use the equation: force = extension × spring constant

Spring constant = ... N / m **[4]**

ii. Calculate the energy transferred when the rope is stretched with a force of 40 N.

Use the Data sheet_J249 01/02/03/04, June 2022.

Energy transferred in stretching = ... J **[2]**

iii. A 200 N force is attached to the rope.

Suggest what extension the rope would have if it does not exceed its elastic limit.

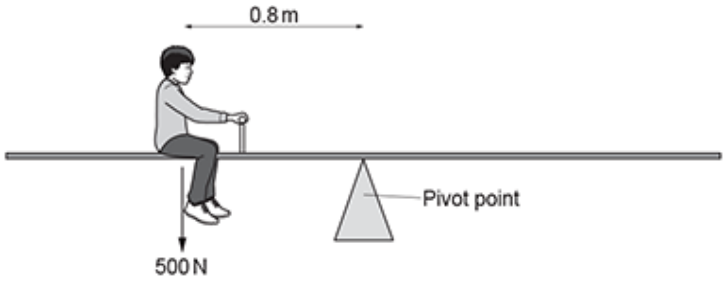
_____ **[1]**

(c). When a force of 500 N is applied to a rope, the rope exceeds its elastic limit.

Explain what this means.

[2]

13. A student with a weight of 500 N sits on the left-hand side of a see-saw, 0.8 m from the pivot point. Another student then sits on the right-hand side of the pivot point.



Which student will balance the see-saw when they sit on the right-hand side of the pivot point?
Use the equation: moment of a force = force × distance (normal to direction of the force)

	Moment of the student's weight (N)
A	40
B	62.5
C	400
D	625

Your answer ☐ **[1]**

14. All objects have a gravitational field that causes attraction.
Which property affects the gravitational field strength of an object?

A Charge
B Mass
C Specific heat capacity
D Temperature

Your answer ☐ **[1]**

END OF QUESTION PAPER