1. A teacher connects a sealed syringe of gas with a moveable piston to a pressure gauge as shown in **Fig. 20.1**.

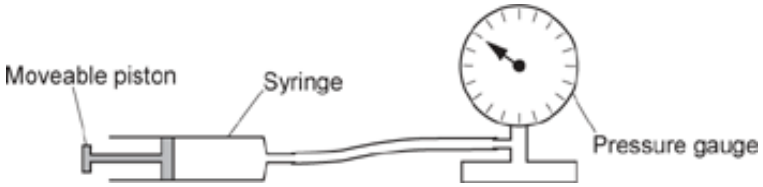


Fig. 20.1

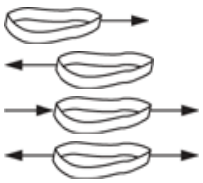
State **one** way the teacher can increase the reading on the pressure gauge.

_____ **[1]**

2. The arrows on these scale diagrams represent forces acting on an elastic band.

In which diagram will the elastic band stretch?

A
B
C
D



Your answer ☐ **[1]**

3. A large rock on the dwarf planet Pluto has a mass of 200 kg and a weight of 124 N.

What is the gravitational field strength on Pluto?

Use the Equation Sheet.

A 0.62 N / kg
B 1.61 N / kg
C 76 N / kg
D 24 800 N / kg

Your answer ☐ **[1]**

4(a). A spring has a spring constant of 28 N / m.

Calculate the work done stretching this spring by 0.20 m.

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

Work done = ... J **[2]**

(b). A teacher stretches an elastic band by increasing the force applied and measures the extension during loading.
The teacher then reduces the force applied and measures the extension during unloading.

Fig. 18.1 shows the force–extension graph of their results.

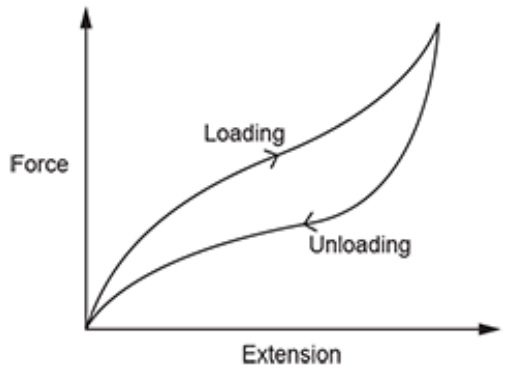


Fig. 18.1

The teacher writes some facts about the experiment.

State if each fact is **correct** or **incorrect**. Put a (ring) around the correct option.
Explain your answers.

i. The elastic band obeys Hooke's Law.

correct **incorrect**

Reason _____

_____ **[1]**

ii. The elastic band undergoes plastic deformation.

correct **incorrect**

Reason _____

_____ **[1]**

iii. There is a linear relationship between force and extension for the elastic band.

correct **incorrect**

Reason _____

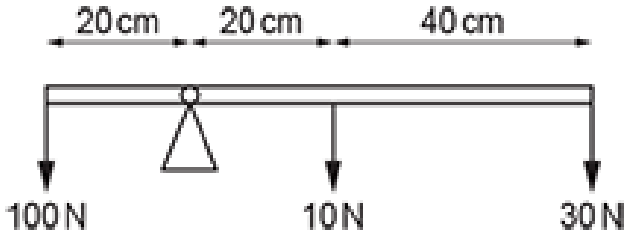
_____ **[1]**

5. Which row describes properties of electric fields and gravitational fields?

	Electric fields	**Gravitational fields**
A	attractive only	attractive only
B	attractive only	attractive and repulsive
C	attractive and repulsive	attractive only
D	attractive and repulsive	attractive and repulsive

Your answer ☐ **[1]**

6. A student investigates moments using a beam placed on a pivot as shown in the diagram. The student holds the beam.



What happens to the beam when the student releases it?

A It rotates anti-clockwise with a net moment of 60 N cm.
B It rotates anti-clockwise with a net moment of 600 N cm.
C It rotates clockwise with a net moment of 2000 N cm.
D It stays in equilibrium.

Your answer ☐ **[1]**

7. Which sentence is correct when a lever is used as a force multiplier?

A The effort force and load force are both situated at the pivot.
B The effort force is closer to the pivot than the load.
C The load force and the effort force are the same distance from the pivot.
D The load is closer to the pivot than the effort force.

Your answer ☐ **[1]**

8. 0.090 J of energy is transferred when stretching a spring.

The spring constant of the spring is 50 N / m.

What is the extension of the spring?

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

A 0.0036 m
B 0.030 m
C 0.060 m
D 0.084 m

Your answer ☐ **[1]**

9. The energy stored in a stretched spring is 5 J.

What is the energy stored in the spring when the extension doubles?
Use the Data sheet_J249 01/02/03/04, June 2022.

A 5 J
B 10 J
C 20 J
D 25 J

Your answer ☐ **[1]**

10(a). A manufacturer has a choice of three different springs to use in a mattress for a bed as shown in the table.

Mattress spring	Spring Constant (N / m)
R	6000
S	9000
T	12 000

Explain which mattress spring, **R, S**, or **T,** compresses the most when a person lies on it.

Mattress spring _____

Reason _____

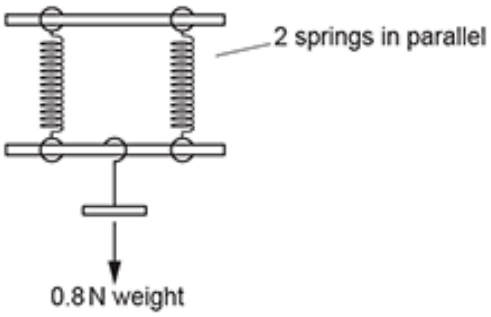
_____

[1]

(b). A student investigates the extension of springs in parallel.

The student attaches a 0.8 N weight to two, four, six and eight springs in parallel.
They then measure the extension using a ruler.

The diagram shows the experiment with two springs in parallel.



The results are shown in the table.

Number of springs in parallel	Extension(cm)
2	1.2
4	0.6
6	0.4
8	0.3

i. Explain why the student found it difficult to measure the extensions shown in the table.

_____

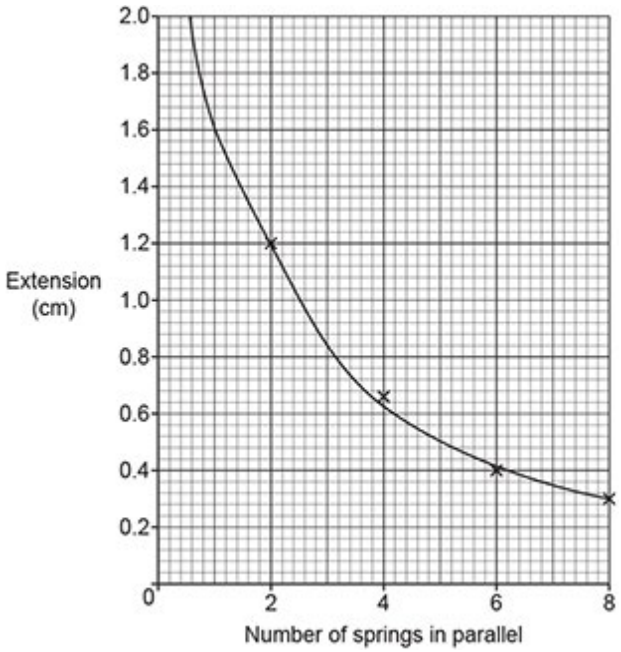
[1]

ii. Suggest how the student could change the experiment to produce extensions that are easier to measure.

_____

[1]

(c). The graph shows these results.



i. One point has been incorrectly plotted.
Circle the incorrectly plotted point and then plot it in the correct place.

[2]

ii. Describe the relationship between the number of springs in parallel and their extension.

_____

_____

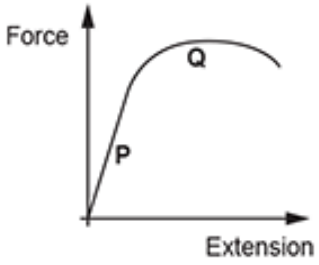
[2]

(d). Use the graph to calculate the spring constant for a single spring.

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

Spring constant = ... N / m **[5]**

11. The graph shows how a copper wire behaves when it is stretched.

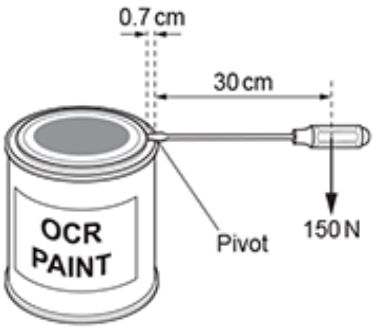


Which row in the table describes part **P** and part **Q** on the graph?

	Part P	**Part Q**
A	linear	elastic
B	linear	plastic
C	non-linear	elastic
D	non-linear	plastic

Your answer ☐ **[1]**

12. A decorator uses a screwdriver as a lever to open a tin of paint. The edge of the tin acts as a pivot.



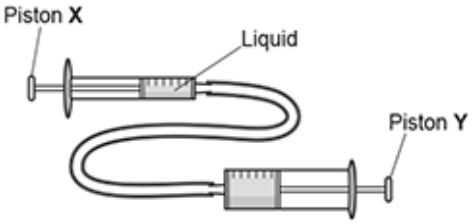
What is the clockwise moment of the screwdriver about the pivot?
Use the Data sheet_J249 01/02/03/04, June 2022.

A 5.0 Nm
B 45 Nm
C 46 Nm
D 500 Nm

Your answer ☐ **[1]**

13. The diagram shows when a hydraulic machine uses a liquid to transmit a force.
When piston **X** is pressed, the force is transmitted and piston **Y** moves.

The area of piston **X** is 4.0 cm^2 and the area of piston **Y** is 20 cm^2.



Piston **X** is pressed with a force of 10 **N**.
What is the force produced at piston **Y**?

Use the equation: pressure = $\frac{\text{force normal to a surface}}{\text{area of that surface}}$

A 2.0 N
B 40 N
C 50 N
D 200 N

Your answer ☐ **[1]**

14. A student of mass 65 kg climbs a flight of 50 steps. Each step is 0.30 m high.

What is the gravitational potential energy gained by the student?

Use the equation: potential energy = mass × height × gravitational field strength

Gravitational field strength = 10 N / kg.

A 195 J
B 9750 J
C 19500 J
D 975000 J

Your answer ☐ **[1]**

END OF QUESTION PAPER