Write your name here

Surname	Other names

Centre Number | Candidate Number

Edexcel GCE

Physics

Advanced Subsidiary
Unit 1: Physics on the Go

Thursday 12 January 2012 – Afternoon
Time: 1 hour 30 minutes

Paper Reference
6PH01/01

You must have:
Ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

Information

- The total mark for this paper is 80.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
  – *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*
- The list of data, formulae and relationships is printed at the end of this booklet.
- Candidates may use a scientific calculator.

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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P 3 9 8 4 7 A 0 1 2 8

PEARSON

SECTION A

Answer ALL questions.

For questions 1–10, in Section A, select one answer from A to D and put a cross in the box ☒. If you change your mind, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 Which statement about scalar and vector quantities is correct?

☒ **A** Scalars have direction only.

☒ **B** Scalars have distance only.

☒ **C** Vectors have magnitude and direction.

☒ **D** Vectors have magnitude and distance.

(Total for Question 1 = 1 mark)

2 Which of the following is a unit equivalent to the pascal?

☒ **A** kg m s^{-1}

☒ **B** kg m s^{-2}

☒ **C** kg m^{-1} s^{-2}

☒ **D** kg m^{-2} s^{-2}

(Total for Question 2 = 1 mark)

3 A model boat is crossing a stream. The stream is travelling east at a speed of 1.5 m s^{-1}.
The boat is heading north at a speed of 0.5 m s^{-1}.

The magnitude of the resultant velocity is

☒ **A** $(1.5 + 0.5)$ m s^{-1}

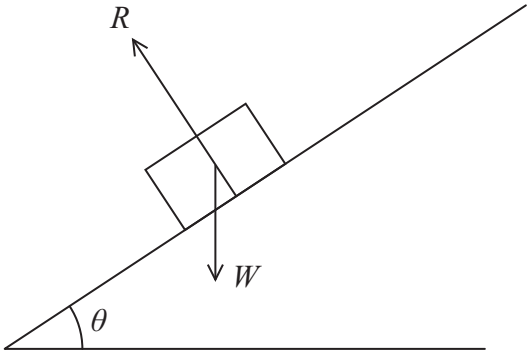
☒ **B** $(1.5^2 + 0.5^2)$ m s^{-1}

☒ **C** $\sqrt{(1.5+0.5)}$ m s^{-1}

☒ **D** $\sqrt{(1.5^2+0.5^2)}$ m s^{-1}

(Total for Question 3 = 1 mark)

Questions 4 and 5 refer to the diagram below.



The diagram shows the forces acting on an object on an inclined surface.

4 The component of R parallel to the inclined surface is

☒ **A** 0

☒ **B** 1

☒ **C** $R \cos \theta$

☒ **D** $R \sin \theta$

(Total for Question 4 = 1 mark)

5 The object in the diagram would

☒ **A** remain at rest on the surface.

☒ **B** move down the surface at constant speed.

☒ **C** accelerate down the surface.

☒ **D** move up the surface at constant speed.

(Total for Question 5 = 1 mark)

6 In the expression $F = 6\pi\eta rv$

- ☒ **A** η represents density and v represents viscosity.
- ☒ **B** r represents radius and η represents density.
- ☒ **C** r represents radius and v represents viscosity.
- ☒ **D** η represents viscosity and v represents velocity.

(Total for Question 6 = 1 mark)

7 A wire of cross-sectional area A and length x is stretched by a force F. The Young modulus of the material of the wire is E.

The extension Δx is given by

- ☒ **A** AE/Fx
- ☒ **B** Ex/FA
- ☒ **C** FA/Ex
- ☒ **D** Fx/AE

(Total for Question 7 = 1 mark)

8 On a newly discovered planet, an object of mass 8.0 kg has a weight of 60 N.

The gravitational field strength on this planet is

- ☒ **A** 0.13 N kg^{-1}
- ☒ **B** 7.5 N kg^{-1}
- ☒ **C** 9.8 N kg^{-1}
- ☒ **D** 480 N kg^{-1}

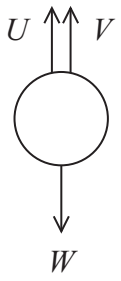
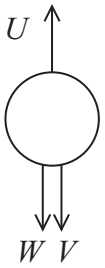
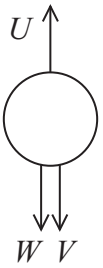
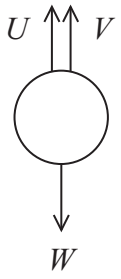
(Total for Question 8 = 1 mark)

9 A small bubble is rising through a liquid at a constant speed.

Which row of the table correctly summarises the forces in both the diagram and the equation?

V = viscous drag, U = upthrust, W = weight

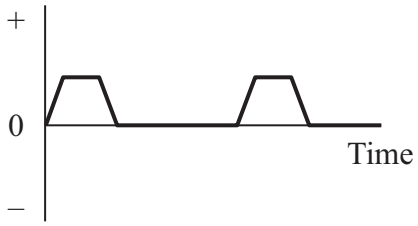
The force arrows are not drawn to scale.

☒	**A**		$W = V + U$
☒	**B**		$W = V + U$
☒	**C**		$U = W + V$
☒	**D**		$U = W + V$

(Total for Question 9 = 1 mark)

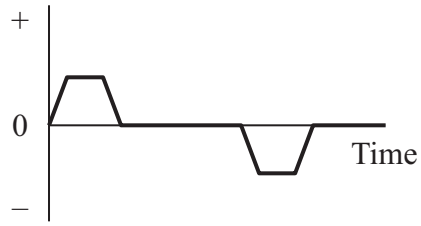
10 A lift carries people from one floor up to the floor above. Which graph shows how the acceleration of the lift varies with time for the complete journey? Assume that the upward direction is positive.

Acceleration



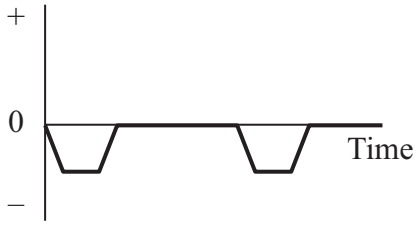
A

Acceleration



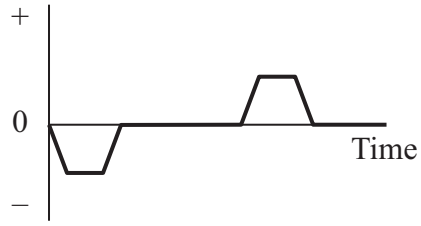
B

Acceleration



C

Acceleration



D

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(Total for Question 10 = 1 mark)

TOTAL FOR SECTION A = 10 MARKS

SECTION B

Answer ALL questions in the spaces provided.

11 Explain the difference between compressive strain and tensile strain.

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.....

(Total for Question 11 = 2 marks)

12 The photograph shows oil being poured into a cold frying pan and spreading out.

Explain the difference that using a hot pan would make to how the oil spreads.

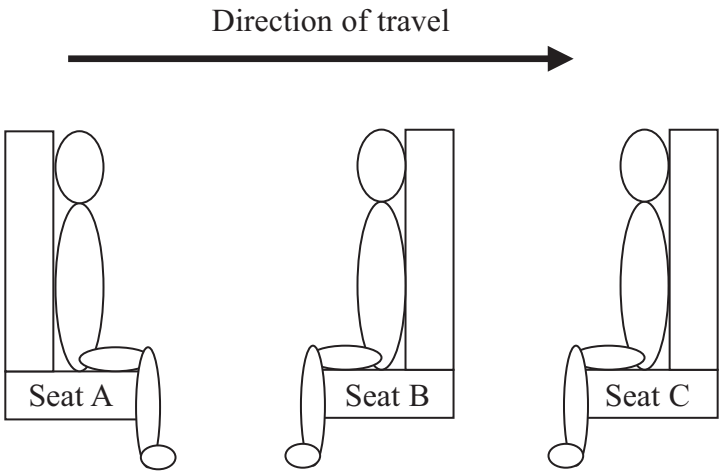
(Total for Question 12 = 2 marks)

***13** The metal copper probably gets its name from the Mediterranean island of Cyprus, which was an important source of the metal in ancient times. Copper was versatile because it could be beaten to make large flat objects, such as shields, as well as being drawn into wires which could be used decoratively.

Name and define the property of copper that makes it suitable for this method of making shields and the property that makes it suitable for making wires.

(Total for Question 13 = 5 marks)

***14**



The diagram shows three passengers sitting on a train that is travelling at a high speed in the direction shown. Seat belts are not used on trains.

With reference to one of Newton's laws of motion, explain why seat C is the safest seat for a passenger to be sitting on in the event of a rapid deceleration. You may assume that the seats all remain fixed firmly to the floor and do not break.

(Total for Question 14 = 4 marks)

15

The photograph shows a lawnmower being used to cut grass.

(a) (i) In order to push the lawnmower, a minimum force of 650 N must be applied to the handle of the lawnmower at an angle of 42° to the horizontal.

Show that the horizontal component of the force is about 500 N.

(2)

.....

.....

.....

.....

(ii) The lawnmower is used to cut 15 strips of grass, each 7 m long.

Calculate the work done by the person pushing the lawnmower.

(2)

.....

.....

.....

.....

Work done = ...

(b)

This photograph shows a lawnmower with the top section of the handle horizontal.

Explain how this changes the minimum force required to push the lawnmower.

(2)

.....

.....

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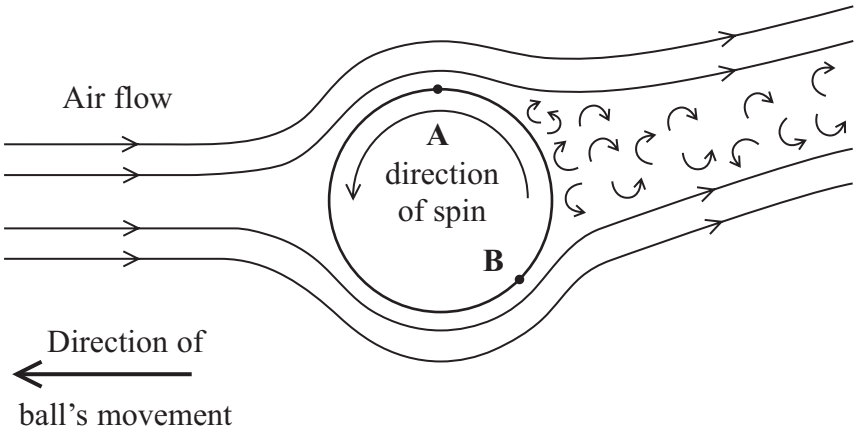
.....

.....

(Total for Question 15 = 6 marks)

16 In the game of table tennis a ball is hit from one end of the table to the other over a small net.

(a) Making a table tennis ball spin when it is hit can affect its flight. The diagram shows the path of air around a spinning ball. It contains regions of laminar flow and turbulent flow. The flow changes from one to the other at points A and B.



(i) Explain what is meant by laminar flow and turbulent flow.

(2)

Laminar flow

.....

.....

Turbulent flow

.....

.....

(ii) The ball is spinning in the direction shown in the diagram.

Suggest why there is a larger region of turbulent flow on the top of the ball than the bottom.

(1)

.....

.....

.....

.....

(b) The diagram shows that the air is deflected upwards after passing the ball.

Explain why this means there must be a downwards component of force on the ball in addition to its weight.

(2)

(c) Spinning a table tennis ball allows it to be hit harder and still hit the table on the other side of the net.

(i) A table tennis ball is hit, without any spin, from one end of a table so that it leaves the bat horizontally with a speed of 31 m s^{-1}. The length of the table is 2.7 m.

Show that the ball falls a vertical distance of about 4 cm as it travels the length of the table.

(3)

(ii) The net is 15 cm high. Explain how the spin helps the ball hit the table on the other side of the net.

(3)

(Total for Question 16 = 11 marks)

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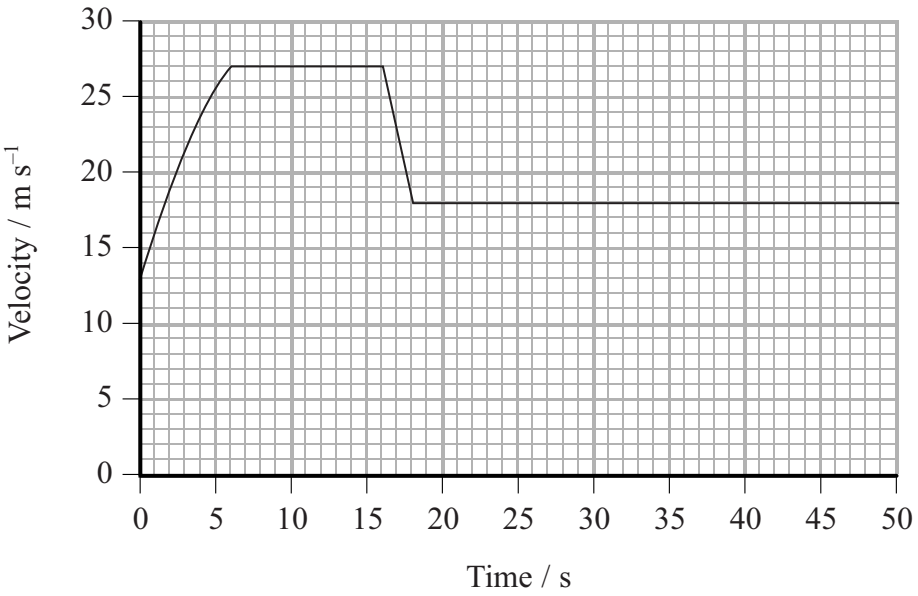
17 The speeds of cars travelling through roadworks on major roads are often monitored by 'average speed check' cameras. This is done by timing a car between two cameras a large distance apart.

The graph shows how the velocity of a car varies with time as it passes between two average speed check cameras. The car passes the cameras at time $t = 0$ s and $t = 50$ s.



A constant driving force is applied to the car for the first 6 s. At time $t = 16$ s the driver realises the car is travelling too fast for the 22 m s^{-1} speed limit (50 miles per hour) and applies the brakes until time $t = 18$ s.

(a) Calculate the acceleration at time $t = 3$ s.

(3)

Acceleration = ...

(b) Describe and explain the shape of the line in the first 6 s.

(4)

(c) Describe the resultant force on the car between times $t = 6$ s and $t = 16$ s.

(1)

(d) Show that the average speed of the car does not exceed the average speed limit of 22 m s^{-1}.

(4)

(Total for Question 17 = 12 marks)

18 The photograph shows a wind turbine. Kinetic energy of the wind is transferred to electrical energy by the turbine as the blades rotate.

(a) Explain why we can say that the wind is doing work on the blades.

(2)

(b) The area swept out by one blade, as it turns through 360°, is 6000 m^2. Wind at a speed of 9 m s^{-1} passes the turbine.

(i) Show that the volume of air passing through this area in 5 seconds is about 300 000 m^3.

(2)

(ii) Calculate the mass of this air.

density of air = 1.2 kg m^{-3}

(2)

Mass = ...

(iii) Calculate the kinetic energy of this mass of air.

(2)

Kinetic energy = ...

(iv) Betz's law states that a turbine cannot usefully transfer more than 59% of the kinetic energy of the wind.

Use this law to find the maximum power output of the wind turbine.

(2)

Maximum power = ...

(c) Suggest a reason why it is not possible to usefully transfer 100% of the kinetic energy of the wind.

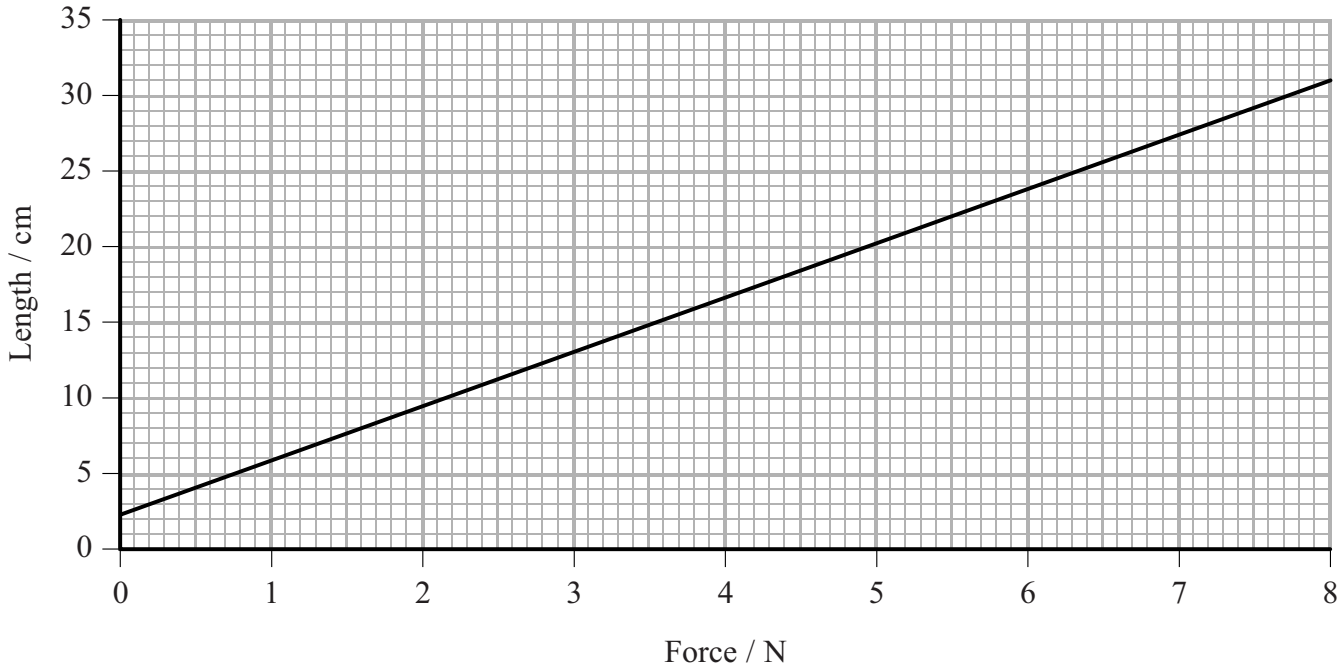
(1)

(d) Suggest the limitations of using wind turbines to provide power.

(2)

(Total for Question 18 = 13 marks)

19 A student investigates how the length of a spring varies with force by hanging masses on it. The graph shows the results.



(a) The student concludes that the spring does **not** obey Hooke's law because the line does not pass through the origin.

Explain why this conclusion is incorrect.

(2)

(b) Show that the spring constant is about 30 N m^{-1}.

(2)

(c) When the student is removing the masses the spring is accidentally released when its length is 23 cm. The spring flies up into the air.

(i) Show that the energy stored in the spring is about 0.6 J when its length is 23 cm.

(2)

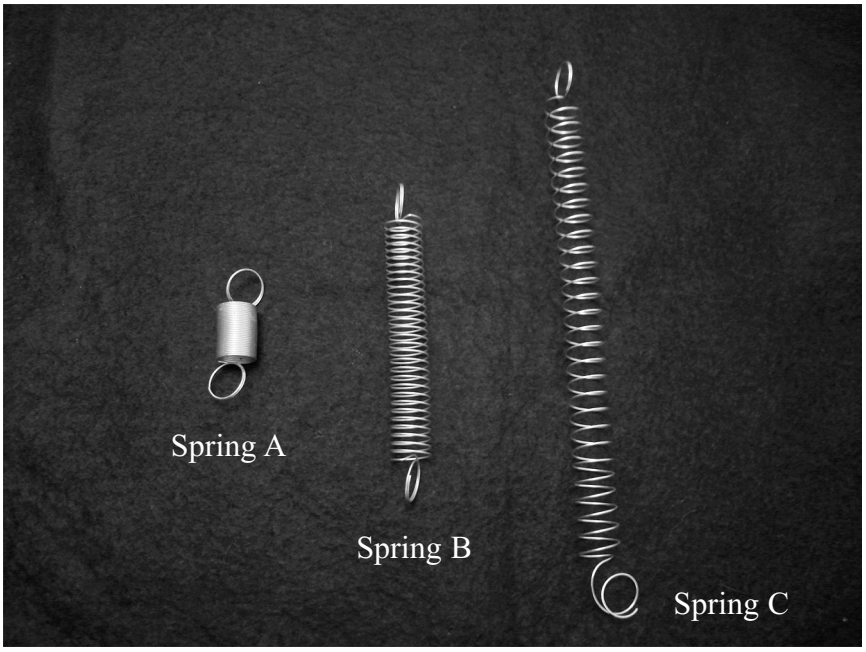
(ii) Calculate the maximum height the spring could reach above its point of release.

mass of spring = 5 g

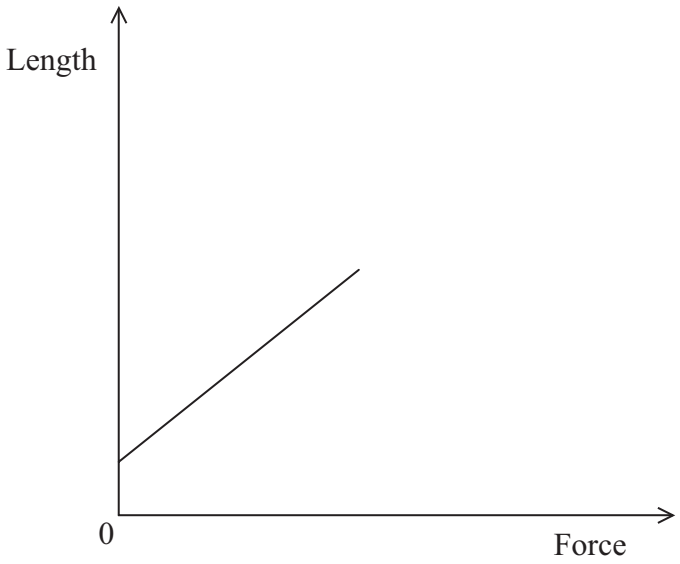
(3)

Maximum height = ...

(d) Several other students carry out similar investigations using identical springs. The photograph shows some of their springs at the end of their investigations.



Spring A is the same length before and after the investigation. The graph for this spring is shown below.



On the axes opposite sketch the graph for spring C and use it to help you describe the difference in the behaviour of springs A and C.

(6)

(Total for Question 19 = 15 marks)

TOTAL FOR SECTION B = 70 MARKS

TOTAL FOR PAPER = 80 MARKS

List of data, formulae and relationships

Acceleration of free fall	$g = 9.81\ \text{m s}^{-2}$	(close to Earth's surface)
Electron charge	$e = -1.60 \times 10^{-19}\ \text{C}$	
Electron mass	$m_e = 9.11 \times 10^{-31}\ \text{kg}$	
Electronvolt	$1\ \text{eV} = 1.60 \times 10^{-19}\ \text{J}$	
Gravitational field strength	$g = 9.81\ \text{N kg}^{-1}$	(close to Earth's surface)
Planck constant	$h = 6.63 \times 10^{-34}\ \text{J s}$	
Speed of light in a vacuum	$c = 3.00 \times 10^{8}\ \text{m s}^{-1}$	

Unit 1

Mechanics

Kinematic equations of motion	$v = u + at$ $s = ut + \frac{1}{2}at^2$ $v^2 = u^2 + 2as$
Forces	$\Sigma F = ma$ $g = F/m$ $W = mg$
Work and energy	$\Delta W = F\Delta s$ $E_k = \frac{1}{2}mv^2$ $\Delta E_{grav} = mg\Delta h$

Materials

Stokes' law	$F = 6\pi\eta rv$
Hooke's law	$F = k\Delta x$
Density	$\rho = m/V$
Pressure	$p = F/A$
Young modulus	$E = \sigma/\varepsilon$ where Stress $\sigma = F/A$ Strain $\varepsilon = \Delta x/x$
Elastic strain energy	$E_{el} = \frac{1}{2}F\Delta x$