



## Mark schemes

|   |  |                     |
|---|--|---------------------|
| <b>1</b>  | (a) from K to L  | 1                   |
|   | (b) the same as  | 1                   |
|   | smaller than   | 1                   |
|   | <i>correct order only</i>  |                     |
|   | (c) 4 N  | 1                   |
|   | (d) the limit of proportionality is reached when a weight of 7N is added to the spring<br><i>accept any number from 6.8 to 7.2 inclusive</i>   | 1                   |
| (e) the extension is directly proportional to the weight. | 1  |                     |
| (f) C   | 1  |                     |
|   | <b>[7]</b>   |                     |
| <b>2</b>  | (a) Third Law  | 1                   |
|   | (b) elastic potential  | 1                   |
|   | (c) weight = mass × gravitational field strength<br><i>accept gravity for gravitational field strength</i><br><br><i>accept <math>W = mg</math></i><br><i>accept correct rearrangement ie mass = weight / gravitational field strength or <math>m = W / g</math></i> | 1                   |
|   | (d) $343 = m \times 9.8$<br><br>$m = \frac{343}{9.8}$<br><br>$m = 35$  | 1<br><br>1<br><br>1 |

allow 35 with no working shown for 3 marks

(e) force = spring constant  $\times$  compression

accept force = spring constant  $\times$  extension

accept  $F = k e$

accept correct rearrangement ie constant = force / extension **or**  $k = F / e$

1

(f) compression = 0.07m

1

$$343 = k \times 0.07$$

1

$$k = 343 \div 0.07$$

1

$$k = 4900$$

1

allow 4900 with no working shown for 4 marks

allow 49 with no working shown for 3 marks

[11]

3

(a) accept any value between 12 (mm) and 13 (mm) inclusive

1

(b) to reduce the error in measuring the extension of the spring

accept length for extension throughout

1

as the ruler at an angle would make the measured extensions shorter

1

(c) 1 (N) to 6 (N)

accept from 0 (N) to 6 (N)

1

(d) gives a straight line through the origin

1

(e) any practical technique that would improve the accuracy of length measurement eg

use a set square

1

to line up the bottom of the spring with the ruler scale

**or**

attach a horizontal pointer to the bottom of the spring (1)

so that the pointer goes across the ruler scale (1)

1

(f) the spring has been inelastically deformed

1

because it went past its limit of proportionality

*accept elastic limit for limit of proportionality*

1

*accept it does not go back to its original length when the weights are removed*

[9]

4

(a) elastic potential

1

(b) (i) line is straight

*accept line does not curve*

1

(ii) 400

*allow 1 mark for correct substitution of any pair of numbers correctly taken from the graph e.g.  $160 = k \times 0.40$*

2

newtons per metre **or** N/m

*if symbols are used they must be correct*

1

(iii) 300

*allow 1 mark for correctly obtaining force on 1 spring = 100N*

2

(c) 52

*allow 2 marks for calculating change in gpe for 1 chin-up as 260 (J)  
or for 12 chin-ups as 3120 (J)*

*an answer 4.3 gains 2 marks*

*allow 1 mark for correct substitution into gpe equation ie  $\text{gpe} = 65 \times 10 \times 0.4 (\times 12)$*

**or**

*correct use of power equation with an incorrect value for energy transferred*

3

[10]

|          |                              |   |            |
|----------|------------------------------|---|------------|
| <b>5</b> | (a) 3 (.0)                   | <i>allow 1 mark for correct substitution i.e. <math>25 \times 0.12</math> provided no subsequent step</i>   | 2          |
|          | (b) (i) elastic potential    | <i>correct order only</i>   | 1          |
|          |                              | kinetic   | 1          |
|          | (ii) increases               |   | 1          |
|          |                              | to 80 (mm) (or more)  |            |
|          |                              | <i>accept any number greater than 75</i>  |            |
|          |                              | <i>an answer 'it (more than) doubles' gains both marks</i>  | 1          |
|          | (c) (i) weight               |   | 1          |
|          |                              | (ii) downward speed increases   | 1          |
|          |                              |   | <b>[8]</b> |
| <b>6</b> | (a) (i) any <b>two</b> from: | <ul style="list-style-type: none"> <li>• length of coils increased</li> <li>• coils have tilted</li> <li>• length of loop(s) increased</li> <li>• increased gap between coils</li> <li>• <i>spring has stretched / got longer</i></li> <li>• <i>spring has got thinner</i></li> </ul> | 2          |
|          | (ii) remove mass             | <i>accept remove force / weight</i>   | 1          |
|          |                              | <i>observe if the spring returns to its original length / shape (then it is behaving elastically)</i>   | 1          |
|          | (b) (i) 8.0 (cm)             |   | 1          |

extension is directly proportional to force (*up to 4 N*)

*for every 1.0 N extension increases by 4.0 cm (up to 4 N)*

*evidence of processing figures eg 8.0 cm is half way between 4.0 cm and 12.0 cm*

1

*allow spring constant ( $k$ ) goes from to  $\frac{1}{4}$  to  $\frac{5}{22}$*

1

(ii) any value greater than 4.0 N and less than or equal to 5.0 N

1

*the increase in extension is greater than 4 cm per 1.0 N (of force) added  
dependent on first mark*

1

(c) (i) elastic potential energy

1

(ii) misread stopwatch

1

*timed too many complete oscillations*

1

(iii) 4.3 (s)

*accept 4.33 (s)*

1

(iv) stopwatch reads to 0.01 s

1

*reaction time is about 0.2 s*

**or**

*reaction time is less precise than stopwatch*

1

(v) use more masses

1

*smaller masses eg 50 g*

*not exceeding limit of proportionality*

1

[17]

7

(a) (i) **B C**

*either order*

1

(ii) elastic potential (energy)

*accept strain for elastic*

1

(b) (i) *mark both parts together*

1

measured / recorded the length of the spring (and not extension)

*accept measured **A–C** (and not **B–C**)*

*accept did not work out/measure the extension*

extension does not equal zero when force = 0

*accept line should pass through the origin*

1

(ii) point marked at 5.5 (N)

*accept any point between 5.0 and 5.6 inclusive*

1

up to that point force and extension are (directly) proportional

*accept it's at the end of the straight part (of the graph line)*

*accept past that point force and extension are no longer (directly) proportional*

*accept the line starts to curve*

1

(c) 1.8

*allow 1 mark for correct substitution, ie  $25 \times 0.072$  provided no subsequent step shown*

*an answer 1800 gains 1 mark*

*an incorrect conversion from mm to m with a subsequent correct calculation gains 1 mark*

2

[8]

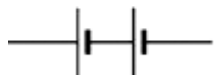
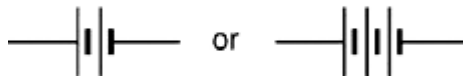
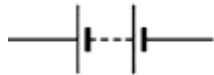
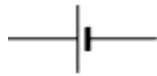
8

(a) (i) ammeter and battery **in series** with the **gauge**

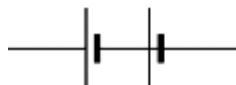
*symbols must be correct*

*ignore a voltmeter drawn in series*

**accept**



**not**



*or cells reversed to cancel out*

1

voltmeter in parallel with the gauge  
symbol must be correct  
accept a freestanding circuit  
diagram provided strain gauge is labelled or a resistor symbol used  
for the strain gauge

1

(ii) d.c. flows only in one direction  
a.c. changes direction is insufficient

1

(b) (i) 75  
this answer only  
allow 1 mark for correct substitution **and** transformation,  
ie resistance =  $\frac{3.0}{0.040}$

2

(ii) increases

1

(iii) elastic / strain potential  
do **not** accept potential

1

[7]

9

(a) **B** or bungee cords

1

**C** or springs or playground ride  
each additional answer loses 1 mark minimum mark zero

1

will go back to original shape/size

1

(b) (i) newton

1

(ii) 0 – 5 (N) or 5  
accept 1 – 5 (N)  
do **not** accept 4

1

(iii) 16 (cm)

1

(iv) 2.5 (N)  
accept answer between 2.4 and 2.6 inclusive

1

[7]



10

(a) Z

1

weight **or** mass acts through pivot

*accept rod **or** base for pivot*

*accept centre of gravity in line with pivot*

1

no (resultant) (turning) moment

*accept clockwise moment equals anticlockwise moment*

*do **not** accept same weight on each side of rod*

1

(b) (i) 30

*allow 1 mark for  $2 \times 15$*

***or**  $2 \times 0.15$*

2

N cm

**or**

*for full credit the unit must be consistent with the numerical answer*

0.3

Nm

*do **not** accept joules*

1

(ii) 1.5 (N)

*allow 1 mark for correct transformation*

*allow 2 marks ecf their part (b)(i)/20 (ecf only if correct physics)*

2

(c) 5 (cm)

*allow 1 mark for 6.0 (cm)*

*allow 1 mark for a subtraction of 1 from a value clearly obtained from the graph*

*allow 2 marks for correct ecf using an incorrect value for (b)(i)  $\pm 0.2\text{cm}$*

*allow 1 mark for clearly showing correct use of graph using an incorrect value for (b)(ii)*

2

[10]

11

(a) (i) plasticine stretches/snaps  
stays stretched/snapped

*for 1 mark each*

2

(ii) spring compresses OWTTE  
returns to **original** length/shape or gets longer

*for 1 mark each*

2

(iii) ruler bends/breaks  
returns to original shape or stays broken

*for 1 mark each*

2

(b) (i) 1.5N

*for 1 mark*

1

(ii) 4 cm

*for 1 mark*

1

(iii) 19 cm

*for 1 mark*

1

**[9]**

**12**

(a) plasticine stretches/snaps  
stays stretched/snapped/same

*for 1 mark each*

2

(b) spring compresses OWTTE  
returns to original length/gets longer

*for 1 mark each*

2

**[4]**

**13**

(a) weight or gravity or gravitational

*for 1 mark*

1

(b) (i) only force A acts / force A > air resistance / gravity / weight

*for 1 mark*

1

(ii) force A > force B

*for 1 mark*

1

(iii) force C > force A

*for 1 mark*

*(Forces A, B and C need not be used, description of forces are OK)*

1

(c) (i) graph points all correct  $\pm$  little square  
*gains 2 marks*

one point wrong

*gains 1 mark*

2+ points wrong

*gains 0 mark*

appropriate line – good freehand OK

*gains 1 mark*

***Bar chart gets 0, but if points clear can get 2***

3

(ii) 16 or candidates own intercept should be 16 m in range 1-19  
if no kinks on graph line

*for 1 mark*

1

**[8]**

14

(a) **F** 50 cm on first part of graph

*tolerance + or – 3cm*

1

(b) **S** at the far right

*credit anywhere to right of last trough*

1

(c) **M** on any two tops of peaks **or** bottoms of troughs

*both are required for the mark M needs to be central to the trough  
or peak, except if F is in the way in one case*

1

**[3]**