Forces in Action

Q1.(2018)

A ✓

Q2.(2018)

C ✓

Q3.(2018)

B ✓

Q4.(2018)

A ✓

Q5.a(2018)

(upwards force) thrust / engine force / AW ✓ (downwards force) weight / drag / air resistance ✓	**2**	1.2 1.2	**DO NOT ALLOW** upthrust / engine power **ALLOW** gravity / gravitational force **IGNORE** mass

Q5.b(2018)

2000(N)

Q5.c(2018)

FIRST CHECK THE ANSWER ON THE ANSWER LINE **If answer = 2.5 (m/s^2) award 3 marks**	**3**		**ALLOW ECF from 15aii**
(acceleration) = force ÷ mass ✓ = 2000 ÷ 800 ✓ = 2.5 (m/s^2) ✓		1.2 2.1 2.1	**ALLOW** correct symbol equation e.g (a =) F ÷ m **IGNORE** triangle style equations

Q6.a(2018)

FIRST CHECK THE ANSWER ON THE ANSWER LINE **If answer = 0.05 (J) award 3 marks**	**3**		
(work done) = force x distance ✓		1.2	**ALLOW** correct symbol equation e.g. (w) = fxd **IGNORE** triangle style equations
0.05 x 1(.0) ✓ = 0.05 (J) ✓		2.1 2.1	

Q6.b(2018)

FIRST CHECK THE ANSWER ON THE ANSWER LINE **If answer = 0.01 W award 4 marks**	**4**		**ALLOW ECF from 16ai** e.g.1 W if answer to 16ai is 5 (J) ✓✓✓✓ 4 W if answer to 16ai is 20 (J) ✓✓✓✓
(power) = work done ÷ time ✓		1.2	**ALLOW** correct symbol equation e.g. (p) =w/t **IGNORE** triangle style equations
0.05 ÷ 5 ✓ = 0.01 ✓		2.1 2.1	**ALLOW** 0.01 with no units or incorrect units ✓✓✓
W / watts ✓		1.1	Unit mark is independent **ALLOW** J/s

Q6.c(2018)

3 (V)

Q6.d(2018)

FIRST CHECK THE ANSWER ON THE ANSWER LINE **If answer = 0.5 (A) award 3 marks**	**3**		**ALLOW ECF from 16bi**
(current) = potential difference ÷ resistance ✓		1.2	**ALLOW** correct symbol equation e.g. (I) =V/R **IGNORE** triangle style equations
3 ÷ 6.0 ✓ = 0.5 (A) ✓		2.1 2.1	

Q6.e(2018)

add mass (to the toy car) ✓			**ALLOW** add weight (to the toy car)
add a resistor (to the electrical circuit to reduce current)✓			**IGNORE just** reduce current **ALLOW specific** changes to the motor e.g. use a lower current motor / use less powerful motor **IGNORE** just reduce voltage to motor / increase the resistance of the motor

Q7.(2019)

B

Q8.a(2019)

FIRST CHECK THE ANSWER ON ANSWER LINE **If answer = 1.5 (N) award 2 marks** 25 × 0.06 ✓ = 1.5 (N) ✓	**2**

Q8.b(2019)

pull of spring / tension / AW ✓	**2**	**2×1.1**	**ALLOW** force of spring
(pull of) gravity / pull of earth / weight / AW ✓			**ALLOW** gravitational (force) / force of gravity / force due to gravity

Q8.c(2019)

there is a resultant force / weight ✓	**2**	**2×1.1**	**ALLOW** (there is a downwards force but) no upwards force / downwards force > upwards force **ALLOW** correct idea of unbalanced forces
So the object accelerates (down) ✓			

Q8.d(2019)

Force of mass on bench / AW ✓ Contact force ✓	**2**

Q9.a(2019)

Force due to gravity / AW	**1**	**1.1**	**ALLOW** the force/pull of gravity on an object **ALLOW** W = m x g or W = m x a or in words

Q9.b(2019)

Recall W = m × g ✓	**3**	**1.2**	**ALLOW** F=ma
100g = 0.1kg ✓		**1.2**	
W (= 0.1 × 10) = 1N ✓		**2.1**	**ALLOW** use of g = 9.8 to give 0.98 (N)

Q9.c(2019)

Lubricate (wheels/surface) ✓	**1**	**3.3b**	**ALLOW** incline surface **ALLOW** make surface/wheels smooth(er) **ALLOW** use an air track **ALLOW** decrease mass / weight of trolley

Q9.d(2019)

FIRST CHECK THE ANSWER ON ANSWER LINE **If answer = 3.75 (m / s^2) award 3 marks** correct rearrangement of letters/words **OR** $1^2 – 0.5^2 = 2 × a × 0.1$ **OR** $1^2 – 0.5^2 = 0.75$✓ Rearrangement: $a = 1^2 – 0.5^2 / 2 \times 0.1$ **OR** $1^2 – 0.5^2 / 0.2$ **OR** 0.75 / 0.2 ✓ a = 3.75 (m / s^2) ✓	**3**	**3 x 2.1**	**ALLOW U** and **V** transposed for -3.75 m./s^2

Q9.e(2019)

FIRST CHECK THE ANSWER ON ANSWER LINE **If answer = 0.72 (J) award 3 marks** Recall (KE =) ½ × m × v^2 ✓ ½ × 1 × $(1.2)^2$ ✓ (KE =) 0.72 (J) ✓	**3**

Q9.f(2019)

(No) because line of best fit does not pass through origin / (0,0) (AW)	**1**	**3.2b**	**ALLOW** quantitative description of direct proportionality using data from the graph

Q10.(2020)

C

Q11.(2020)

A

Q12.(2020)

Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. **Level 3 (5–6 marks)** Describes the properties of **A** and **B** using knowledge of elastic and plastic deformation. **AND** Describes the properties of **A** and **B** using knowledge of Hooke's Law. **AND** Describes how the graphs show different stiffness of **A** and **B**. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Describes the properties of **A** and **B** using knowledge of elastic and plastic deformation. **AND** Describes the properties of **A** and **B** using knowledge of Hooke's Law. **OR** Describes the properties of **A** and **B** using knowledge of elastic and plastic deformation. **AND** Describes how the graphs show different stiffness of **A** and **B**. **OR**	**6**	**4 × 1.2** **2 × 3.2b**	**AO3.2b Analyses information and ideas to draw conclusions about properties of each spring** • **A** is stiffer / higher spring constant / doesn't extend/stretch as much (for the same force) • as more force needed for same extension • **B** is more flexible / less stiff / lower spring constant / extends/stretches more (for the same force) • as less force needed for same extension **AO1.2 Demonstrates knowledge of linear and non-linear relationships between force and extension.** • As force increases, extension increases • Linear relationship (between F and x) for **A** • F proportional to x for **A** • F proportional to x for **B** at the start / up to elastic limit / up to limit of proportionality • Non-linear relationship for **B** • **A** obeys Hooke's law • **B** obeys Hooke's law at the start / up to elastic limit / limit of proportionality • **B** doesn't obey Hooke's law at the end / after the elastic limit / after limit of proportionality **AO1.2 Demonstrates knowledge of elastic and plastic deformation** • **A** shows elastic behaviour • **A** has the same shape / not overstretched (when force removed) • **B** shows plastic behaviour • **B** has a different shape / overstretched (when force is removed)

Describes the properties of **A** and **B** using knowledge of Hooke's Law. **AND** Describes how the graphs show different stiffness of **A** and **B**. *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** Describes the properties of **A** and **B** using knowledge of elastic and plastic deformation. **OR** Describes the properties of **A** and **B** using knowledge of Hooke's Law. **OR** Describes how the graphs show different stiffness of **A** and **B.** *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** *No response or no response worthy of credit.*

Q13.(2021)

D ✓

Q14.(2021)

D ✓

Q15.a(2021)

Vertical arrow 5 cm long pointing upwards ✓	**1**	**2.2**	Judge 5 cm by eye **IGNORE** label

Q15.b(2021)

Contact ✓	**1**

Q15.c(2021)

Forces Unbalanced Speed ✓✓	**2**	**2 × 1.1**	All 3 correct = ✓✓ Any 2 correct = ✓

Q15.d(2021)

FIRST CHECK THE ANSWER ON ANSWER LINE **If answer = 160 (N) award 2 marks** (Force =) 0.4 × 400 ✓ (Force =) 160 (N) ✓	**2**

Q15.e(2021)

There is more than 1 force acting on the ball ✓ Force from foot **AND** force from wall on ball ✓	**2**	**2 × 2.1**	**ALLOW** there are forces (acting) on the ball

Q16.a(2021)

FIRST CHECK THE ANSWER ON ANSWER LINE **If answer = 81 (J) award 2 marks** (W =) 45 × 1.8 ✓ (W =) 81 (J) ✓	**2**

Q16.b(2021)

FIRST CHECK THE ANSWER ON ANSWER LINE **If answer = 300 W award 3 marks** (P =) 1500 / 5 ✓ (P =) 300 ✓ W / watts ✓	**3**	**2 × 2.1** **1.2**	**ALLOW** J/s

Q17.a(2021)

FIRST CHECK THE ANSWER ON ANSWER LINE **If answer = 2 (N) award 3 marks** Conversion: 200 g = 0.2 kg ✓ (Force =) 0.2 × 10 ✓ (Force =) 2 (N) ✓	**3**	**1.2** **2 × 2.1**	**ALLOW** use of 9.8(1) to give an answer of 1.96 (N) for 3 marks **ALLOW** 2 marks for 2000 (N) (unit conversion missed)

Q17.b(2021)

FIRST CHECK THE ANSWER ON ANSWER LINE **If answer = 20 (N / m) award 3 marks** Rearrangement: (k =) F ÷ x ✓ (k =) 4.91 ÷ 0.25 or 19.6 ✓ (k =) 20 (N / m) ✓	**3**	**1.2** **2 × 2.1**	**ALLOW** candidate's answer to the nearest whole number for 1 mark

Q17.c(2021)

Mean = ((20+18+20+19)/4 =) 19 (N / m) ✓	**1**	**1.2**	**ALLOW** 19.25

Q17.d(2021)

Plot a graph of force against extension / AW ✓ Gradient = spring constant ✓	**2**

Q18.(2022)

C ✓

Q19.(2022)

B ✓

Q20.(2022)

A ✓

Q21.a(2022)

Any two from:	**2**	**2 × 3.1b**	
Springs connected in series ✓			**ALLOW** connected in line / one after the other
Each spring will stretch (due to the force) ✓			**ALLOW** all/more springs stretched
(Idea that) total extension is the sum of each spring's extension ✓			
(Idea of) extra springs (themselves) add more weight/mass/force ✓			

Q21.b(2022)

Ruler / (metre) rule ✓	**1**	**1.1b**	**ALLOW** measuring tape

Q21.c(2022)

The number/amount of springs (connected) / AW ✓	**1**	**3.3a**	**ALLOW** add more springs

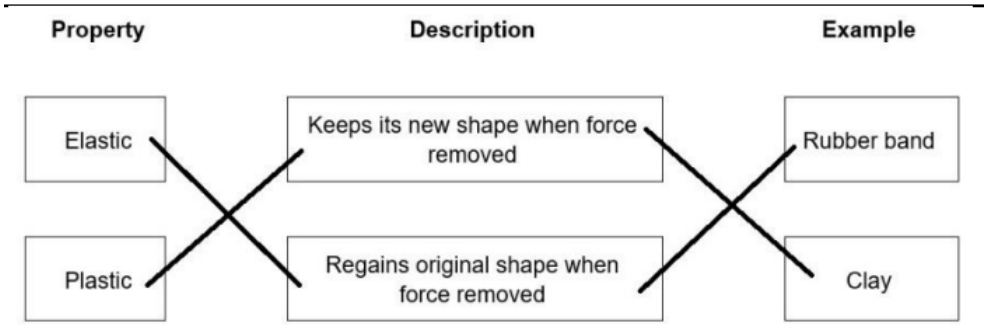
Q21.d(2022)

The extension/stretch (of the spring) ✓	**1**	**3.3a**	**ALLOW** original length **and** extended/stretched length **IGNORE** just length of spring

Q21.e(2022)

The type of spring / (amount of) mass/weight/load/force (added) ✓	**1**	**3.3a**	**ALLOW** (mass) hanger **ALLOW** same spring constant **IGNORE** the spring(s)

Q22.a(2022)



Property and Description correctly matched x 2 ✓
Description and Example correctly matched x 2 ✓

Q22.b(2022)

Child **C** ✓

Q22.c(2022)

0.15 (kg) ✓	**1**	**1.2**	**ALLOW** any correct standard form, e.g. 150 x 10^{-3} (kg)

Q22.d(2022)

FIRST CHECK THE ANSWER ON ANSWER LINE **If answer = 3.5 (N) award 2 marks** Weight = 0.35 × 10 ✓ Weight = 3.5 (N) ✓	**2**	**2 × 2.1**	**ALLOW** 3.5 x 10^{n} multiplied by 10, e.g. 350 x 10 for 1 mark

Q22.e(2022)

100 (g) ✓

Q22.f(2022)

(100 g has) the smallest mass for the same force ✓	**1**	**1.1**	**ALLOW** correct reference to a = F ÷ m, e.g acceleration is inversely proportional to the mass if the force is constant **ALLOW** smaller (size) so less air resistance **ALLOW** all three correct calculations of acceleration

Q23.(2023)

A

Q24.(2023)

B

Q25.(2023)

D

Q26.(2024)

C

Q27.(2024)

B

Q28.(2024)

C

Q29.(2024)

D

Q30.a(2024)

First check the answer on the answer line **If answer = 30 000 (J) award 3 marks**	**3**		
(W =) Fs selected ✓		**1.2**	**ALLOW** (W=) F x d / (work=) force x distance **ALLOW** 600 x 0.20 for 1 mark
(W =) 600 × 0.20 × 250 ✓		**2.1**	**ALLOW** 120 for 2 marks
(W =) 30 000 (J) ✓		**2.1**	

Q30.b(2024)

First check the answer on the answer line **If answer = 0.15 (kW) award 3 marks**	**3**		
(P =) 36 000 ÷ 240 ✓		**2.1**	
(P =) 150 (W) ✓		**2.1**	
(P =) 0.15 (kW) ✓		**1.2**	**ALLOW** 1.5 x 10^{-1} (kW) **ALLOW** incorrect answer given in W correctly converted to kW e.g. 30 converted to 0.03 **ALLOW** 1.5 x 10^{n} as the final answer for 2 marks

Q30.c(2024)

Any three from: Measure height (of step) using a metre rule / tape measure / ruler ✓ Count number of steps ✓ Measure weight using a (weighing) scales / balance ✓ Measure time using a stopwatch ✓	**3**	**3 × 3.3a**	**ALLOW** stairs for steps throughout **IGNORE** measure height/distance using a trundle wheel **ALLOW** (use a set) amount of steps / see how many steps **ALLOW** measure weight using a newton meter / measure mass using scales/balance and multiply by g/10 **ALLOW** measure time using a timer / stop clock If no other marks scored: **ALLOW** two different pieces of equipment to measure two different quantities for 1 mark e.g. use a metre rule and a stopwatch

Q30.d(2024)

	Yes	**No**		**1**
Precise	✓			
Repeatable	✓		✓	

Q30.e(2024)

Precise because results are close together / small range ✓ Repeatable because (same person) repeats the experiment/the method/the investigation/using same equipment giving similar results ✓	**2**	**2 × 3.2a**	**ALLOW** results are similar / every test comes out roughly the same / low range / range of 3 **ALLOW** correct descriptions of precise **and** repeatable without linking to terms precise or repeatable for 1 mark e.g. the results have a small range because the same person repeats the investigation