Year 7

Physics Friend

Forces

ANSWERS

What is a force

Page 4 questions:

1. Define what a force is and give two examples.

Answer: A force is a push or a pull. Examples: gravity pulling objects down, a person pushing a trolley.

2. What is the unit of force, and what instrument is used to measure it?

Answer: Unit: Newton (N). Instrument: Newtonmeter.

3. Explain the difference between a vector and a scalar quantity. Give an example of each.

Answer: A vector has both magnitude and direction (e.g., force). A scalar has only magnitude (e.g., temperature).

4. Why might it be misleading to say that two objects are "touching" when they interact?

Answer: Because at atomic level, objects repel each other before actual contact; so "touching" is not literal.

5. Gravity is a non-contact force. Explain how it can still affect objects millions of kilometres apart.

Answer: Every object with mass in the Universe attracts every other object with mass. The gravitational force gets weaker the further the objects are apart, but never reduces to zero.

Speed, Velocity and Acceleration

Page 5 questions:

1. A cyclist travels 200 m in 40 s. What is their speed?

Answer: Speed = distance ÷ time = 200 m ÷ 40 s = 5 m/s.

2. How is velocity different from speed?

Answer: Velocity is speed with direction; speed is scalar, velocity is vector.

3. List three situations in which an object might be accelerating.

Answer: Speeding up, slowing down, changing direction.

4. A car travels in a circle at a constant speed. Is it accelerating? Explain your answer using the definition of acceleration.

Answer: Yes, because acceleration means change in velocity and velocity if a vector so it includes direction. Therefore, changing direction is accelerating.

5. Why is acceleration considered a vector? Can an object accelerate without speeding up?

Answer: Because it has direction, and yes—e.g., changing direction and slowing down are also forms of acceleration.

Balanced and Unbalanced Forces

Page 8 questions:

1. What is meant by a balanced force?

Answer: Forces that are equal in size and opposite in direction, cancel out.

2. What is the resultant force on an object with 6N pulling left and 4N pulling right?

Answer: Resultant = 6N left – 4N right = 2N left.

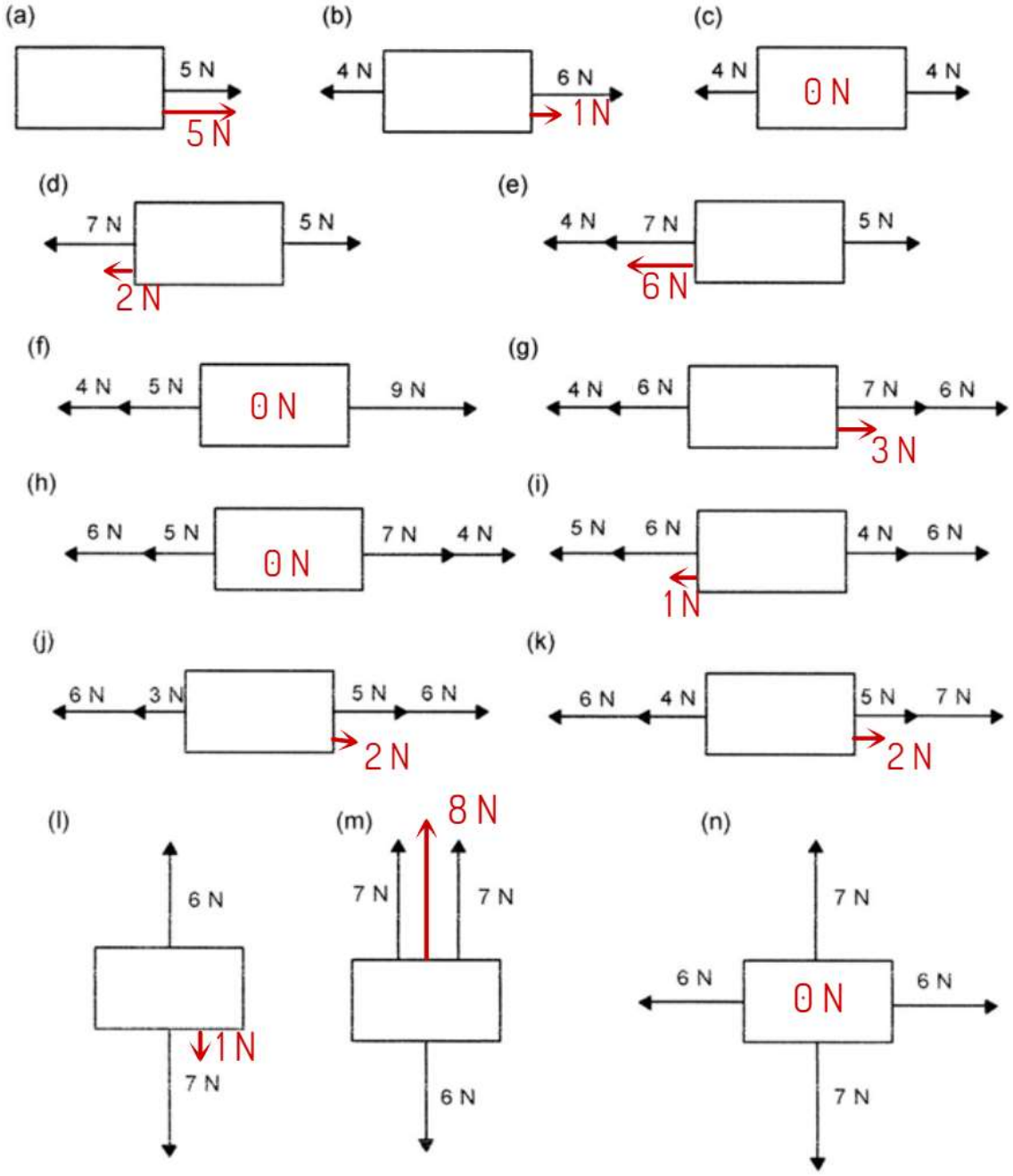
3. State Newton's First Law and explain what it means for a moving object.

Answer: An object will stay at rest or move at constant velocity unless acted on by a force.

4. A rocket in space continues moving without its engines firing. Use Newton's 1st Law to explain why.

Answer: No friction or air resistance in space, so it continues at constant velocity.

5. In each of the examples below, decide whether the forces are balanced or unbalanced. If they are unbalanced, determine the size and direction of the resultant force.



Mass and Weight

Page 8 questions:

1. What is the formula to calculate weight from mass?

Answer: Weight = mass × gravitational field strength (W = m × g).

2. Calculate the weight of a 12 kg object on Earth (g = 10 N/kg).

Answer: W = 12 kg × 10 N/kg = 120 N.

3. Why does your weight change on different planets but your mass stays the same?

Answer: Mass is constant because it depends on the amount of matter in an object; weight depends on the gravitational field strength in the place where an object is.

4. A student weighs 700 N on Earth. What would their weight be on the Moon where g = 1.6 N/kg?

Answer: Mass = weight ÷ g = 700 N ÷ 10 N/kg = 70 kg → On Moon: 70 kg × 1.6 N/kg = 112 N.

5. Why do astronauts on the International Space Station appear weightless, even though gravity is still acting on them?

Springs

Page 9 questions:

1. A spring is 20cm long when a load of 10N is hanging from it, and 30cm long when a load of 20N is hanging from it. Draw diagrams and work out the length of the spring when a) there is no load on it b) there is a load of 5N on it.

Answer: No load: 20 cm – (30 cm – 20 cm)/1N = 10 cm. b) 5N = 5 cm extension → 15 cm total.

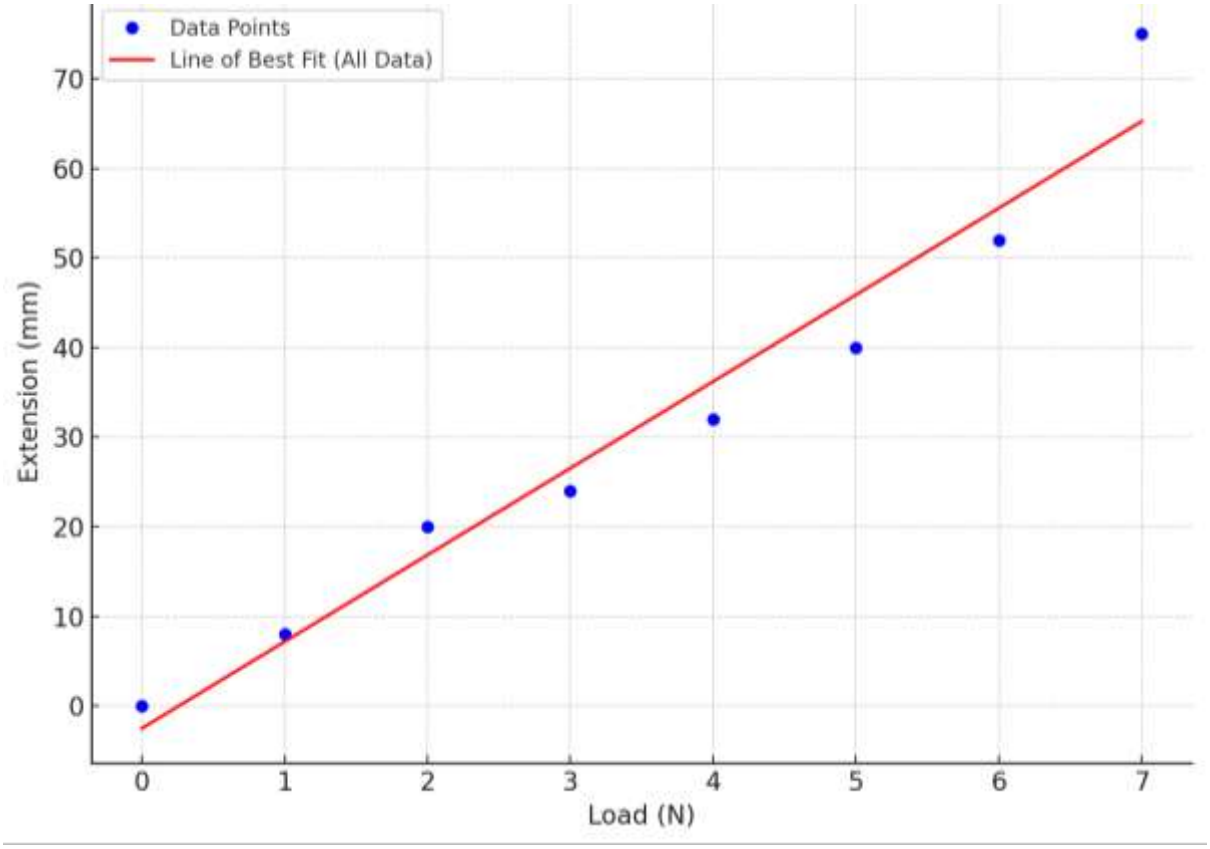
2. What is the length of the spring when unstretched? This is called its natural length.

Answer: 50 mm

3. Complete the table of extension values.

Load (N)	0	1	2	3	4	5	6	7
Length (mm)	50	58	70	74	82	90	102	125
Extension (mm)	0	8	20	24	32	40	52	75

4. Plot a graph of extension (y-axis) against load (x-axis).



5. One of the results does not fit the pattern of the rest of the data (an anomaly). Which is it? What do you think it should be?

Answer: 3N appears to be an anomaly; estimate it should be ~76 mm.

6. Mark the elastic limit on your graph.

Answer: Mark at 6N

7. What load would give an extension of 30mm?

Answer: Estimate from graph, ~3.5N.

8. What would be the spring length for a load of 4.5N?

Answer: Estimate from graph, ~90 mm.

9. Find out the meanings of the following words: a) elastic b) rigid c) hardness d) ductile e) malleable.

Answer: Returns to shape once force is removed, b) Resists deformation, c) Resists scratching, d) Can be stretched into a wire, e) Can be hammered into shape.

Friction

Page 11 questions:

1. What is friction and when is it useful?

Answer: Friction opposes motion. Useful: brakes.

2. Give two ways in which friction can be reduced.

Answer: Lubricants, smooth surfaces.

3. Why does rubbing your hands together produce heat?

Answer: Microscopic bumps resist motion—creates heat.

4. Explain how friction acts at a microscopic level between two surfaces.

Answer: Surfaces are rough, their bumps interlock and resist sliding.

5. Below is a list of places where friction occurs. Decide in each case whether the friction is useful or unwanted.

Answer: Useful: Brakes, shoelaces, shoes and floor. Unwanted: Bike gears (oil), air resistance (streamlined design), water resistance (streamlined shape)

Density

Page 14 questions:

1. What is the formula for density?

Answer: Density = mass ÷ volume ($\rho = m \div V$).

2. A block has a mass of 250 g and a volume of 50 cm^3. What is its density?

Answer: Density = 250 ÷ 50 = 5 g/cm^3.

3. Describe how you would find the volume of an irregular object.

Answer: Use a Eureka can to measure displaced water.

4. Why is steel heavier than feathers even though both can have the same mass?

Answer: Because density compares equal volumes—not total mass.

5. A rock has a mass of 3.6 kg and displaces 1.2 litres of water when fully submerged. What is the density of the rock in g/cm³?

Answer: Volume = 1200 cm³; mass = 3600 g; density = 3600 ÷ 1200 = 3 g/cm³.

Floating and upthrust

Page 16 questions:

1. What patterns do you notice in your results?

Answer: Objects seem lighter in water due to upthrust.

2. Can you suggest reasons for these observations?

Answer: Water exerts an upward force that opposes weight.

3. Would the readings on the newtonmeter be the same, more or less, if the object was immersed in cooking oil rather than in water?

Answer: Less, because oil is less dense than water.

4. The Dead Sea is very salty. How does this affect the ability of people to float in it?

Answer: Salt increases water density → more upthrust → easier to float.

5. What are Plimsoll lines and why were they added to ships?

Answer: They indicate safe loading limits and were added for safety.

Revision questions

Page 17

1. What type of force is air resistance: contact or non-contact?

Answer: Contact.

2. A force causes a change in motion or shape. Name two everyday examples of this happening.

Answer: Kicking a ball (motion), squashing a sponge (shape).

3. What does the length of an arrow represent in a force diagram?

Answer: The size of the force.

4. Which unit do we use for mass, and which for force?

Answer: Mass = kg, Force = N.

5. A snail moves 0.6 m in 30 seconds. What is its speed in m/s?

Answer: Speed = 0.6 ÷ 30 = 0.02 m/s.

6. Which physical quantity must always be stated with a direction: speed or velocity?

Answer: Velocity.

7. What do we mean by the term "resultant force"?

Answer: The overall force acting on an object **or** a single force which could replace all of the forces acting on the object and have the same effect

8. If an object is moving at a constant speed in a straight line, what can we say about the forces acting on it?

Answer: Forces are balanced/Resultant force is zero.

9. Describe what would happen to a moving object if all forces acting on it suddenly became balanced.

Answer: It would continue at constant velocity.

10. Write the equation used to calculate weight and define each variable.

Answer: $W = m \times g$; W = weight (N), m = mass (kg), g = field strength (N/kg).

11. An object on Earth weighs 120 N. What is its mass?

Answer: $m = 120 \div 10 = 12$ kg.

12. A student travels to a planet where g = 5 N/kg. If their mass is 50 kg, what is their weight on that planet?

Answer: $W = 50 \times 5 = 250$ N.

13. Why should you not add more than 8N to a spring during an experiment?

Answer: It could stretch beyond its elastic limit.

14. What is meant by a spring behaving "elastically"?

Answer: Returns to its original shape when the forces are removed from it.

15. When drawing a graph of force versus extension, what does a straight line through the origin tell us?

Answer: The object obeys Hooke's Law.

16. Describe what a lubricant does and give one example of where it might be used.

Answer: Reduces friction; e.g., oil in engines.

17. Explain how you could measure the density of a liquid in a school lab.

Answer: Weigh 100 cm^3 of liquid, then divide mass by volume.

18. Why do objects with lower density than water float?

Answer: Lower density means the object can displace a volume of water with the same weight as itself, so the upthrust balances the weight of the object.

19. A steel cube sinks in water but a hollow steel boat floats. Explain why.

Answer: The hollow boat has a lower average density, which is less than the density of water.

20. Why is the upthrust on a block greater in salt water than in fresh water?

Answer: Salt water is denser, so the block displaces a greater weight of water → more upthrust.