Physics: Momentum, Heat and Pressure

%	I can …	Prove it!

70%+

I can …

1.6 Predict how the distance for a vehicle to make an emergency stop varies over a range of speeds (triple only)
1.10 Interpret graphs relating speed to stopping distance (triple only)
1.11 Estimate the forces involved in the deceleration of road vehicles (triple only)
2.3 Complete calculations about the collision of two objects using the momentum equation (triple only)
2.4 Combine F = m a and a = Δv/Δt to give the equation F = mΔv/Δt to show force = the rate of change of momentum (triple only)
2.5 Explain safety features with reference to momentum (air bags, seat belts, gym crash mats, cycle helmets and cushioned playground surfaces) (triple only)
6.1 Explain what a 'perfect black body' is (triple only)
6.2 Describe the factors that affect the intensity and wavelength of infrared emissions (triple only)
6.3 Describe the rates of radiation emission for an object and apply this to the Earth (triple only)
6.4 Draw and interpret diagrams to explain how radiation effects the temperature of the Earth (global warming) (triple only)
7.8 Use and rearrange pV=constant (triple only)

Prove it!

1. Suggest a stopping distance for a car travelling at
   a) 10m/s (around town)
   b) 30m/s (on a motorway)
2. Estimate the braking force required to stop
   a) A 1200kg car travelling at 20m/s with braking distance 40m.
   b) A 8000kg lorry travelling at 30m/s with braking distance 60m.
3. A railway truck of mass 800 kg moving with a constant velocity of 5 m/s, collides and couples with another railway truck of mass 650 kg which is stationary. Calculate the common velocity (v) with which the coupled trucks move off after the collision.
4. Show how to derive an equation linking change in momentum with force by using two other equations.
5. Explain using an equation and sentences how crash mats, cycle helmets and air bags, reduce the impact of a crash.
6. Explain what a black body is.
7. Fill in the gaps. As the temperature of an object increases, the ____________ of all radiation wavelengths increases, but the intensity of __________ wavelengths increases the most as these are higher energy. This means that a hot object may glow a ______ colour, or if it is even hotter it will glow _______.
8. Explain why the temperature of the ground increases on a sunny day using ideas about absorption and emission of infrared radiation.
9. If the temperature of the ground is constant over an hour, what does that say about the amount of radiation that is absorbed and emitted.
10. Suggest four factors that affect the temperature of the Earth (overall, so excluding weather and climate factors).
11. A sample of gas is at atmospheric pressure (100 000 Pa) and has volume 50cm^3
    a. Determine the new pressure if the volume is halved.
    b. Determine the new pressure if the volume is doubled.
    c. Determine the new pressure if the volume is decreased to 35cm^3.
    d. Determine the new volume if the pressure is reduced to 78 000 Pa.

60%

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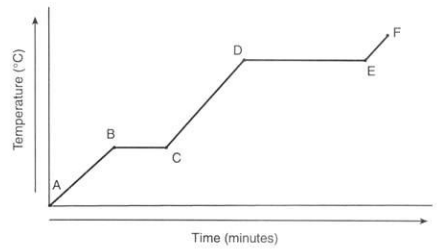
1.7 Explain the energy transfers when a vehicle brakes
1.8 Link braking force, deceleration and stopping distances
1.9 Explain the dangers caused by large decelerations
4.1 Describe how mass is conserved during changes of state
4.7 Interpret heating and cooling graphs that include changes of state
5.5 Distinguish between specific heat capacity and specific latent heat
7.1 Describe the motion of particles in a gas and relate this to pressure, kinetic energy and temperature
7.2 Explain the relationship between temperature and pressure of a gas at constant volume
7.5 Explain how 'doing work' (transferring energy) on a gas effect the internal energy and temperature e.g. using a bicycle pump (triple only)
7.6 Explain gas contraction and expansion (triple only)
7.7 Use the particle model to explain the effect of change in pressure or volume on a gas (at a fixed temperature) (triple only)
7.10 Calculate differences in pressure at different depths in liquids (triple only)
7.11 Explain what causes upthrust (triple only)
7.12 Describe factors which influence floating and sinking (triple only)

Prove it!

1. Explain the energy transfers when a car decelerates through braking.
2. Suggest two dangers caused by large accelerations.
3. What is the law of conservation of mass in state changes? Give an example.
4. Draw out and annotate this heating curve to explain what is happening at each stage.



5. Explain the difference between specific heat capacity and specific latent heat.
6. Compare how the particles in a gas move with how the particles in a liquid move. Include the words pressure, kinetic energy and temperature.
7. Describe what happens to the pressure of a gas if the temperature is increased (assuming a fixed volume).
8. Explain how and why pumping air into a bicycle tyre changes the temperature of the air in the tyre.
9. Describe how volume and pressure change when a gas
   A) expands
   B) contracts
10. Describe the relationship between volume and pressure, at a fixed temperature.
11. A diver descends from a depth of 10m to a depth of 25m. The density of water is 1000kg/m^3. Work on the increase in pressure.
12. An Olympic diver jumps in from a diving board. Explain what causes the upthrust she experiences when she heads through the water.
13. Complete this sentence: The size of the upthrust force is always equal to…
14. Will these materials (in the table) float or sink in water? The density of water is 1g/cm^3.

SUBSTANCE	DENSITY (G/CM)
AIR	0.0013
WOOD (OAK)	0.85
WATER	1.00
ICE	0.93
ALUMINUM	2.7
LEAD	11.3
GOLD	19.3
ETHANOL (alcohol)	0.94
METHANOL (fuel)	0.79

50%

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2.2 Explain conservation of 'momentum'
3.1 Use and rearrange ρ =m/v
3.4 Required practical: Determine the densities of regular and irregular solid objects and liquids
4.4 Explain the effect of heating on the energy within a system and calculate energy change during a state change.
5.1 Explain the differences between 'heat' and 'temperature' and link to latent heat.
5.3 Use and rearrange equations for calculating specific heat capacity
5.4 (Required Practical) Describe the practical used to investigate the specific heat capacity of a given object.
4.6 Explain and calculate 'specific latent heat' using the E=mL
7.9 Use and rearrange p= F/A and p = h ρ g (pressure due to a column of liquid) and explain this relationship in words (triple only)

Prove it!

1. What is the law of conservation of momentum?
2. Calculate the density of the materials in the table:

Substance	Volume in cm^3	Mass in g	Density in g/cm^3
Gasoline	5	3.5	
Milk	10	10.3	
Gold	8	154.4	
Aluminum	12	32.4	
Water (at 4°C)	14	14	
Water (at 20°C)	16	15.968	
Ice (at 0°C)	20	18.4	

3. Explain how to calculate the density of
   a) A regular shaped cylinder.
   b) An irregular shaped piece of modelling clay.
4. How does the energy within a system change when you are heating it.
5. The specific latent heat of fusion of ice is 0.336 MJ/kg. Calculate the energy required for turn 50cm^3 of water into ice.
6. The specific latent heat of fusion of copper is 207kJ/kg. Calculate the energy required for turn 100kg of liquid copper into solid.
7. Explain why temperatures remain constant during state changes. Use the words latent heat in your answer.
8. How much energy is needed to increase the temperature of 500 g of lead from 20ºC to 45ºC? The specific heat capacity of lead is 128 J/kg ºC.
9. Explain a method for calculating the specific heat capacity of a block of aluminium metal.
10. If the density of water is 1000kg/m^3, what is the pressure due to the water at the bottom of a swimming pool 2m deep?
11. Describe how the pressure in a plunge pool will be different at the top and bottom of the pool.

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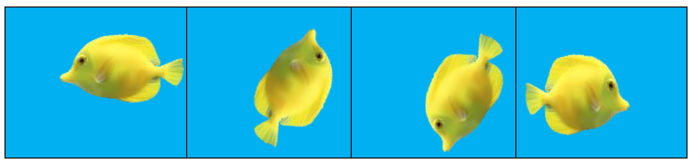
40%

1.3 Describe factors that effect a drivers reaction time
1.4 Explain methods used to measure human's reaction times
1.5 Describe factors affecting 'braking distance'
3.3 Link the arrangement of atoms and molecules to different densities of the states
5.2 Define and calculate specific heat capacity
4.5 Describe 'latent heat' of a material including specific latent heat of fusion and specific latent heat of vaporisation
7.3 Use and rearrange p = F / A (triple only)
7.4 Define 'fluid' and describe the direction of force caused by fluid pressure (triple only)
7.13 Describe what the 'atmosphere' is and explain how density changes with altitude (triple only)
7.14 Explain what causes atmospheric pressure and how this changes with height/altitude (triple only)

1. List three factors that increase the thinking distance of a car.
2. List two factors that decrease the thinking distance of a car.
3. Explain how the age of the driver might affect the thinking distance of a car.
4. Describe two ways to measure someone's reaction time.
5. Suggest four factors that would affect the braking distance of a car and describe how they would change the braking distance.
6. Put these in order from low density to high density. Explain your answer using ideas about particles: *plastic, water, oxygen.*
7. What is the definition of specific heat capacity?
8. What is the equation for calculating specific heat capacity and what are the units for specific heat capacity?
9. Calculate the specific heat capacity of a material with mass 10kg that is heated with 60000J and its temperature raises by 3°C.
10. Calculate the specific heat capacities for the materials in the table.
11. Define specific latent heat and explain what latent heat of vaporisation and latent heat of fusion are.

Substance	Energy (J)	Temperature change after 10 mins (°C)	Mass (kg)	Specific Heat capacity
water	30000	7	1	a)
brine (salt water)	30000	10	1	b)
paraffin	30000	13	1	c)
aluminium	30000	33	1	d)
iron	30000	60	1	e)
copper	30000	75	1	f)

12. A football player is tackled by another player and lands with the combined weight of both players on his knee. If the combined weight of the players is 2400 N and the player's knee measures 0.1 m by 0.1 m, how much pressure is exerted on the turf when the player lands on his knee?
13. A forestry worker accidentally strikes a pipe with the end of a pickaxe while trying to dig a hole. If the pickaxe strikes with a force of 2000 N and the end of the pickaxe measures 0.02 m by 0.01 m, how much pressure is exerted on the pipe by the pickaxe?
14. A skateboarder lands on all four wheels after riding a railing. If the skateboarder has a weight of 900 N and the area on the bottom of a single wheel is 0.0001 m^2, what pressure does the skateboard put on the ground?
15. Describe what a fluid is.
16. Draw arrows to show the direction of the pressure caused by the water on the fish in these diagrams. The fish are swimming forward in all pictures.



17. Define atmosphere and explain how atmospheric pressure changes with altitude.

20%

1.1 Define 'stopping distance', 'thinking distance' and 'braking distance'
1.2 Recall typical values for reaction times
2.1 Define 'momentum' using p = m v
3.2 Draw simple diagrams to model the difference between solids, liquids and gases
4.2 Explain why changes of state are physical changes
4.3 Define internal energy

1. Write definitions for stopping distance, braking distance and thinking distance.
2. Explain how to calculate stopping distance from thinking distance and braking distance.
3. What is the range of typical human reaction times?
4. Define momentum using the equation.
5. Draw diagrams to show the particles in solids, liquids and gases.
6. Are changes of state physical or chemical changes? Explain your answer.
7. What is the definition of internal energy?

Key Terms

Stopping distance   Braking distance   Thinking Distance   Momentum   Conservation   Collision   Density
States of Matter   Particle Model   Changes of State   Heat   Temperature   Specific Heat Capacity
Heating and Cooling Curves   Latent Heat   Specific Latent Heat   Black body   Pressure
Force   Upthrust   Floating   Sinking   Atmosphere   Atmospheric Pressure