

Forces – An Introduction

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A **force** is a **vector** quantity.
What does this mean?

1

Forces – An Introduction

A **vector** quantity, such as force, has a **direction** as well as a **magnitude**.

1

Forces in Action

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The **moment of a force** about a **pivot** is given by $M = Fd$.
Describe fully what d represents.

2

Forces in Action

d is the **perpendicular distance** from the **pivot** to the line of action of the **force**.

2

Pressure and Pressure Differences

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A liquid is under a constant **pressure**.
The larger the area of surface on which the pressure acts, the larger the force on that surface. True or false?

3

Pressure and Pressure Differences

True.

$$p = \frac{F}{A}$$

$$\text{so } F = pA.$$

For a particular pressure, p , the force F is **proportional** to the area A .

3

Forces and Motion

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What is a typical **speed** for a person walking?
Choose from:
2.5 m/s 1.5 m/s 0.5 m/s

4

Forces and Motion

A typical **speed** for a person walking is **1.5 m/s**.
2.5 m/s would be running.
0.5 m/s would be very slow walking.

4

Forces and Acceleration

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Which equation is used to summarise **Newton's Second Law**?

5

Forces and Acceleration

We can use this equation to summarise **Newton's Second Law**:

$$\text{force} = \text{mass} \times \text{acceleration}$$

5

What can you say about the **forces** on an object that is falling at its **terminal velocity**?

6

The **resistive force** acting upwards equals the **weight** acting downwards. The forces are **balanced** and there is no **resultant force** on the object.

6

List factors that will **increase** the **braking distance** of a vehicle.

7

Factors that **increase** the **braking distance** include: higher vehicle speed; ice, snow or water on the road; poorly functioning brakes; worn tyres; incorrectly inflated tyres.

7

In the equation $E_e = \frac{1}{2} ke^2$ for calculating the **elastic potential energy** stored in a stretched spring, what does k represent and what is its **unit**?

8

k is the **spring constant** of the spring, which is a measure of its stiffness:
force applied to spring = $k \times$ extension
The **unit** of k is N/m.

8

Complete this sentence correctly.
On a very cold day, a hut with thin metal walls will cool down very quickly because of the metal's ...
... **low thermal conductivity**
... **high thermal conductivity**

9

On a very cold day, a hut with thin metal walls will cool down very quickly because of the metal's **high thermal conductivity**.
The higher the thermal conductivity of a material, the higher the **rate of energy transfer** by **conduction** through the material.

9

What is the relationship between wave **speed**, wave **frequency** and **wavelength**?

10

wave speed = frequency \times wavelength

10

Reflection, Refraction and Sound

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Light travels across a boundary from a material of high **refractive index** into air. Describe its change of direction.

11

Reflection, Refraction and Sound

The light changes direction (is **refracted**) **away from the normal** (the perpendicular to the boundary) – unless the light is travelling perpendicular to the boundary, in which case it will continue straight.

11

Waves for Detection and Exploration

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One type of **seismic wave** is a **transverse** wave that cannot travel through a liquid. Another type of seismic wave is a **longitudinal** wave that travels much faster.

Give the names of each of these types of seismic wave.

12

Waves for Detection and Exploration

S-waves (secondary seismic waves) are **transverse** and cannot travel through a liquid.

P-waves (primary seismic waves) are **longitudinal** and travel much faster than S-waves.

12

The Electromagnetic Spectrum

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Which type of electromagnetic radiation correctly fills the gap in these sentences?

In an **energy efficient** lamp, waves are produced by the gas inside when an electric current passes. These waves are absorbed by the coating on the lamp, which then gives off **visible light**.

13

The Electromagnetic Spectrum

Ultraviolet (UV)

13

Lenses

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Describe the difference between a **convex** lens and a **concave** lens.

14

Lenses

A **convex** lens is thicker in the middle than at the edges. Parallel rays of light **converge** to the **principal focus** after passing through a convex lens. A **concave** lens is thicker at the edges than in the middle. Parallel rays of light spread out (**diverge**) after passing through a concave lens, so that they appear to have come from the **principal focus** on the side of the lens from which they came.

14

Light and Black Body Radiation

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When we study emission and absorption of radiation, what is meant by a perfect **black body**?

15

Light and Black Body Radiation

A perfect **black body** absorbs all of the radiation incident on it. It does not reflect or transmit any of the radiation.

15

What is the equation relating the **potential difference** across, the **current** through and the **resistance** of a component in a circuit?

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Potential difference
= **current** × **resistance**

16

State the behaviour of an **LDR** in a circuit when the light intensity falling on it **decreases**.

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17

An **LDR** is a light-dependent resistor. Its electrical **resistance** **increases** when the light intensity **decreases**.

17

State the equation for calculating the electrical **power** P of a device of resistance R , when the current through it is I , and state the **unit** of power.

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Power $P = I^2 R$
The **unit** of power is the **watt**, W (equivalent to J/s).

18

State the colours of the wires in the cable of a domestic appliance: the **live** wire, the **neutral** wire and the **earth** wire.

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19

Live wire: brown
Neutral wire: blue
Earth wire: green and yellow (stripes)

19

True or false?
If all of the electrical energy supplied to an efficient kettle is used to heat the water, this equation determines the change in temperature of the water, $\Delta\theta$. $IVt = mc\Delta\theta$

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20

True.
The electrical energy supplied to the kettle is **power** × **time** = IVt .
The rise in temperature of the water $\Delta\theta$ depends on the mass m and the **specific heat capacity** c of the water. Energy change of water = $mc\Delta\theta$.

20

What is meant by an **electric field**?

21

An **electric field** is a region around an **electrically charged** object in which another electrically charged object will experience a **force**.

21

Which of these sentence endings makes the statement correct?

A **magnetic material** brought close to a magnet ...
... is always attracted to the N pole of the magnet.
... is attracted to the nearest pole of the magnet.

22

A **magnetic material** brought close to a magnet is attracted to the **nearest pole** of the magnet. The strong **magnetic field** near **either** magnet pole makes the nearby magnetic material an **induced magnet** and this **always causes attraction**.

22

List the factors that affect the size of the force on a **current-carrying conductor** in a **magnetic field**.

23

The **magnetic flux density**, the size of the **current** and the length of the conductor that is in (and perpendicular to) the magnetic field.

23

What is an **alternator** and how does it work?

24

An **alternator** is an electromagnetic device that generates an **alternating current**. A magnet rotates close to a coil of wire. The changing magnetic field through the coil **induces** an **alternating potential difference** between its ends and so generates an alternating current in its circuit.

24

What is the difference between the **specific heat capacity** and the **specific latent heat** of a material?

25

Specific heat capacity is the energy needed to raise the temperature of 1 kg of the material by 1 °C, with no change of state.
Specific latent heat is the energy needed to change the state of 1 kg of the material, with no change in temperature.

25

Choose the correct word to complete this sentence.

Isotopes of an element contain the same number of ...
... **neutrons** ... **protons**

26

Isotopes of an element contain the same number of **protons**.

They have **different** numbers of **neutrons**.

26

Complete the gaps in the sentences. Choose from:

greater smaller
more less

Beta radiation has a ... **ionising power** than **alpha radiation** and so is ... **penetrating** and has a ... **range** in air.

A beta source a few metres away from you is therefore likely to be ... dangerous than an alpha source at that distance.

27

Beta radiation has a **smaller ionising power** than **alpha radiation** and so is **more penetrating** and has a **greater range** in air.

A beta source a few metres away from you is therefore likely to be **more** dangerous than an alpha source at that distance.

27

State **two** definitions of radioactive **half-life**.

28

1. The **half-life** is the (average) time taken for half of the radioactive nuclei in a sample to **decay**.
2. The **half-life** is the time taken for the **activity** (or count rate) of a radioactive sample to fall to half its original value.

28

How does a **chain reaction** start during nuclear **fission**?

29

During **fission**, a large nucleus splits into two smaller ones and two or three **neutrons** are emitted with kinetic energy. Fission can be initiated by a large nucleus absorbing a neutron. So the neutrons emitted from the first fission can go on to cause fission of two or three other nuclei, and so the process continues and escalates.

29

What is meant by a **main sequence** star?

30

A **main sequence** star is in the stable part of its lifecycle. There is **equilibrium** (a balance) between the inward **gravitational collapse** of the star and the outward expansion of the star due to energy from **fusion** of hydrogen in the star's core.

30

How does **red-shift** provide evidence supporting the **Big Bang theory**?

Light from all distant **galaxies** shows **red-shift** – an increase in wavelength – which tells us they are all moving away from us. More distant galaxies have greater red-shift, which means they are moving away with greater speed. This agrees with the **Big Bang theory**, which proposes that the universe began from a very small, hot and dense region.