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PAGE DESIGN PORTFOLIO

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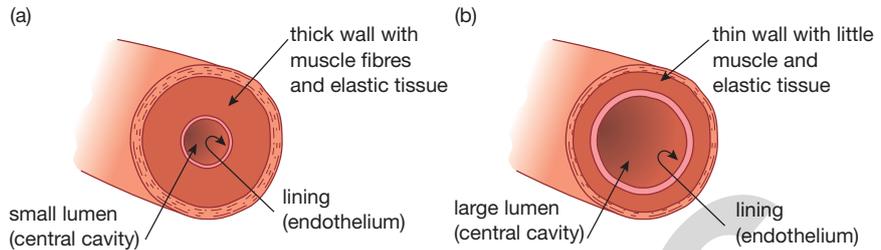
EXTENSION WORK

Arterioles are small arteries. They carry blood into organs from arteries. Their structure is similar to the larger arteries, but they have a larger proportion of muscle fibres in their walls. They are also supplied with nerve endings in their walls and so can be made to dilate (become wider) or constrict (become narrower) to allow more or less blood into the organ.

If *all* the arterioles constrict, it is harder for blood to pass through them – there is more resistance. This increases blood pressure. Prolonged stress can cause arterioles to constrict and so increase blood pressure.

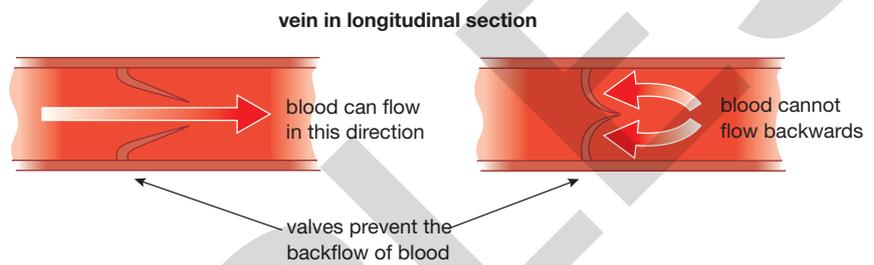
KEY POINT

All arteries carry oxygenated blood (blood containing a lot of oxygen) except the pulmonary artery and the umbilical artery of an unborn baby. All veins carry deoxygenated blood (blood containing less oxygen) except the pulmonary vein and umbilical vein.



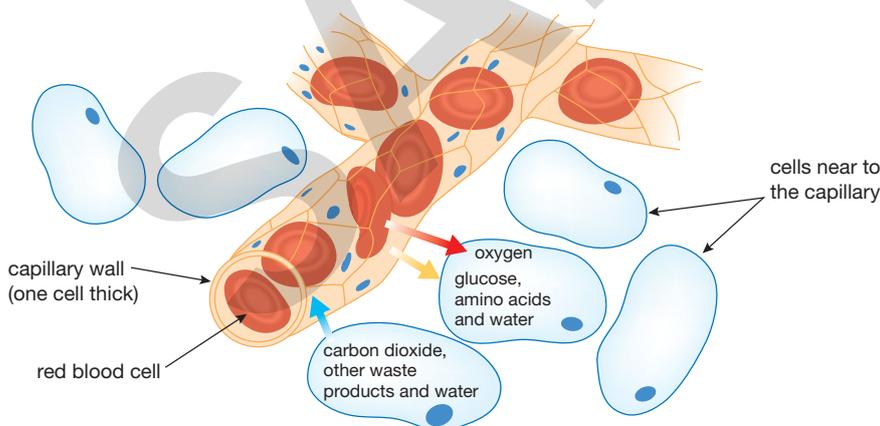
▲ Figure 5.9 The structure of (a) an artery and (b) a vein as seen in cross section.

Veins also have **semilunar** (half-moon shaped) **valves**, which prevent the backflow of blood. The action of these valves is explained in Figure 5.10.

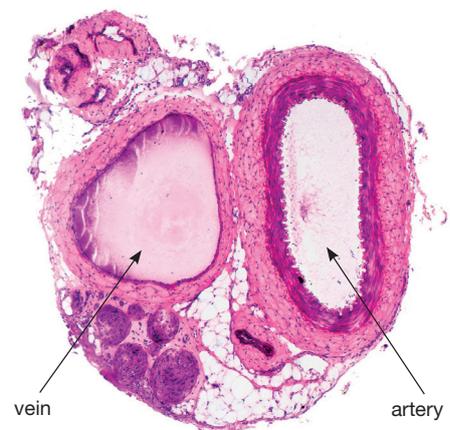


▲ Figure 5.10 The action of semilunar valves in veins

Capillaries carry blood through organs, bringing the blood close to every cell in the organ. Substances are transferred between the blood in the capillary and the cells. To do this, capillaries must be small enough to ‘fit’ between cells, and allow materials to pass through their walls easily. Figure 5.11 shows the structure of a capillary and how exchange of substances takes place between the capillary and nearby cells. The walls of capillaries are one cell thick, providing a short distance for diffusion of materials into and out of the blood. Red blood cells just fit through the tiny diameter of capillaries, so they are close to the capillary wall. This means that there is a short distance for oxygen to diffuse. Figure 5.12 shows a photograph of a cross-section through an artery and a vein.



▲ Figure 5.11 How capillaries exchange materials with cells



▲ Figure 5.12 The lumen of the artery is the same size as the lumen of the vein – but note the difference in the thickness of the walls of these two vessels.

Activity ?

Working individually, find out the latest base interest rate set by the Bank of England. Find out what the rate was 6 months ago. Has the base rate gone up or down? How do you think this might affect businesses in your local area?

Now, in small groups, discuss and compare your findings.

Link it up

You will learn more about the effect of the economy on the way in which businesses trade overseas in Topic 2.1 *Growing the business*.

Checkpoint

Now it is time to review your understanding of the economy and business so far.

Strengthen

- S1** Describe one way in which businesses are affected when unemployment levels are low.
- S2** What are the benefits to a business selling luxury cars of having high levels of consumer income? Explain why this is the case.
- S3** Describe how an increase in inflation can have an impact on businesses.

Challenge

- C1** Research the impact on a business of negative inflation.
- C2** Discuss the statement: 'low interest rates are always good for businesses'. Do you agree or disagree? Justify your opinion.

Government taxation

Taxation is the collection or payment of **taxes**. Individuals and businesses pay taxes to the government to fund public services such as hospitals, schools and colleges, and the police. There are different types of tax in the UK, as shown in Table 1.5.10.

Key term

Tax: a proportion of an individual's income or a business's profits that must be paid to the government.

Government tax	Description
Income tax	Individuals pay income tax from their wages. The percentage of their wages that they pay as tax depends on how much they earn.
National Insurance	Individuals pay this insurance to cover their state pensions and other benefits. Employers also pay a National Insurance contribution on behalf of their employees. As with income tax, the amount depends on how much the employee earns.
Value added tax (VAT)	Individuals pay VAT when they buy goods and services, as VAT is added on to the price of those products and services. VAT is also paid by businesses when they buy from their suppliers.
Corporation tax	Businesses pay corporation tax on any profits that they make.
Council tax	Individuals pay council tax to pay for services that are provided in their local community.
Business rates	Businesses pay business rates to pay for services that are provided for them locally.
Excise duties	Individuals pay these extra taxes when they buy certain products, such as cigarettes or alcohol, because excise duties are added to the price of these products.
Other taxes	Several other taxes are paid by individuals and businesses, such as the carrier bag levy.

Table 1.5.10 The different types of tax collected by the UK government

THINKING BIGGER

HYDROGEN REVOLUTION

Like many car manufacturers, Toyota is looking to build a lead in the next generation of hydrogen-powered cars. On sale since 2015 is the new Toyota Mirai: '... the nearest thing yet to an ultimate eco-car'. The following extract from the car manufacturer's blog explains how they work.

HOW DOES TOYOTA'S FUEL CELL VEHICLE WORK?



fig A The Toyota Mirai fuel cell car came second in the What Car? 2015 Reader Award.

The revolution starts here... The countdown to the launch of Toyota's advanced new fuel cell vehicle has finally begun.

On sale in 2015, the Toyota Mirai has been described as the nearest thing yet to the ultimate eco-car, and a key step in finding a solution to energy demands and emissions issues associated with traditional petrol and diesel engines.

But Toyota's new fuel cell vehicle is much more than the realisation of cutting-edge science theory.

How do fuel cell vehicles actually work?

A fuel cell converts fuel into electricity by forcing it to react with oxygen.

Hydrogen is the most common fuel used in today's fuel cells, but almost any hydrocarbon, including gas and alcohol, can be used. Fuel cells require a constant supply of fuel and oxygen to sustain the electricity generating reaction.

It's worth pointing out that the idea of fuel cells is nothing new; in fact, the first examples were designed in the mid-1800s. However, it took more than 100 years for the idea to get off the ground – literally, as NASA refined their use for the Apollo Moon project.

This environmentally friendly and highly energy-efficient process of generating electricity in a fuel cell produces no tailpipe emissions, but lots of pure water – great news, if you are running one inside a spaceship. Back on Earth the same qualities make fuel cell vehicles ideal for achieving sustainable mobility, which is why Toyota has been striving to make this technology widely available as soon as possible.

That understood, it is now necessary to explain the functions of the two primary components used in a fuel cell vehicle.

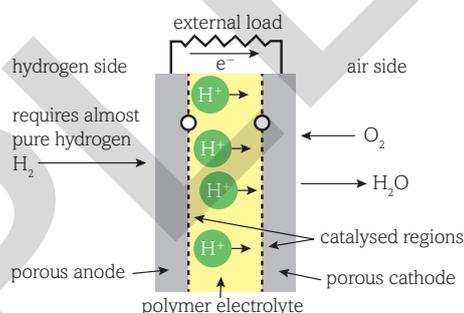


fig B How a fuel cell makes electricity.

Fuel cell

The fuel cell generates electricity through a chemical reaction between hydrogen and oxygen. This is achieved by supplying hydrogen to the negative anode of the fuel cell and ambient air to the positive cathode.

A fuel cell consists of individual cells within a membrane electrode assembly (MEA) sandwiched between separators. The MEA consists of a polymer electrolyte membrane with positive and negative catalyst layers on either side. Each cell yields less than one volt of electricity, so several hundred cells are connected in series to increase the voltage. This combined body of cells is called a stack, which is commonly referred to as a fuel cell unit.

Though it is possible to use other elements in a fuel cell, the advantage of hydrogen is its high energy efficiency. Since electricity can be produced directly from hydrogen without combustion, it is possible to convert 83% of the energy within a hydrogen molecule into electricity. This is more than double the energy efficiency of a petrol-powered engine.

High-pressure hydrogen tank

Hydrogen is stored in two high-pressure (70 MPa) tanks. The innermost layer features a polyamide resin liner that has high strength and superb resistance to hydrogen permeation. This is necessary because the diameter of hydrogen molecules is the smallest known to science and tend to escape through inferior materials.

Further use of optimal materials has increased tank capacity (historically, most FCVs have needed four separate tanks to improve capacity and therefore cruising range) and reduced weight. This can be seen in the winding angle, tension, volume and wall thickness of the carbon fibre used in the outer shell.

Where else will I encounter these themes?

Book 1

11

12

13

YOU ARE HERE

There are two methods for booking (recording) level readings to enable the reduced levels of points to be found:

- ▶ the height of the plane of collimation (HPC) method
- ▶ the rise and fall method.

The HPC method

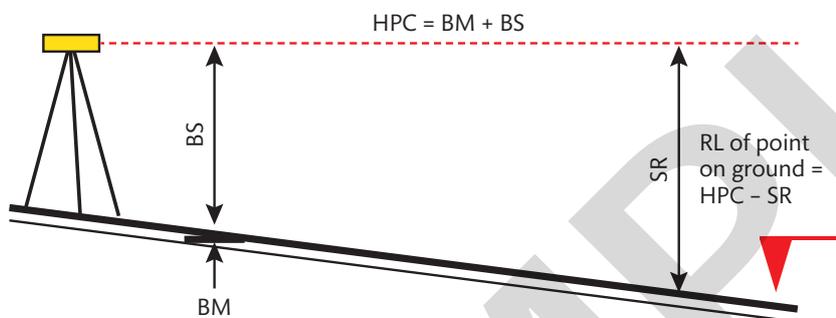
This uses the horizontal line of sight through the level instrument as a reference for all the individual staff readings.

$$\text{Height of plane of collimation (HPC)} = \text{Given bench mark height (BM)} + \text{Backsight reading (BS)}$$

Once the HPC is found, the reduced levels (RL) of the ground can then be found:

$$\text{Reduced level of ground (RL)} = \text{Height of plane of collimation (HPC)} - \text{Any staff reading (SR)}$$

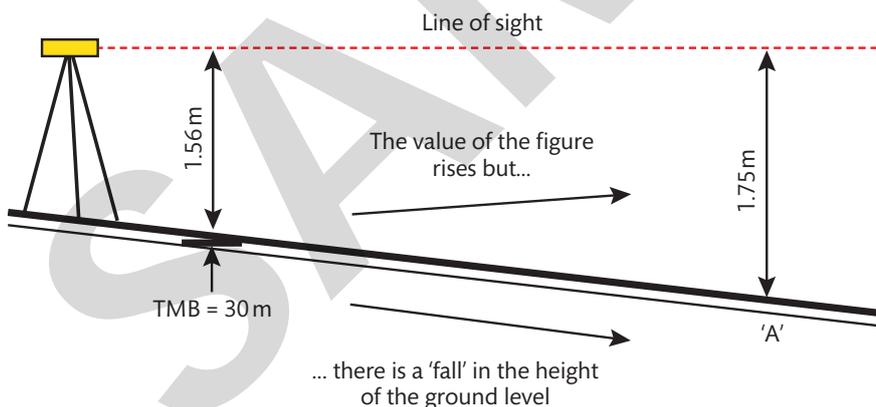
This is as shown in Figure 6.6(a).



▶ **Figure 6.6(a):** The HPC method

The rise and fall method

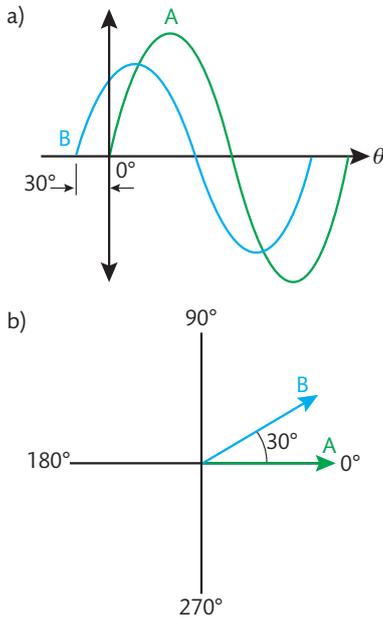
This method does not use the height of collimation but instead compares the difference in height between adjacent staff readings. In Figure 6.6(b), the staff reading at the TBM is 1.56 m and the next staff reading at point A on the ground is 1.75 m.



▶ **Figure 6.6(b):** The rise and fall method

The difference between these two readings is found by subtracting the second reading from the first reading, i.e. $1.56\text{ m} - 1.75\text{ m} = -0.19\text{ m}$. Because it is a negative value, it is a 'fall'.

If the TBM is at a known height of, say, 30 m, then the reduced level of point A is $30\text{ m} - 0.19\text{ m} = 29.81\text{ m}$. This can be seen from looking at the staff readings compared



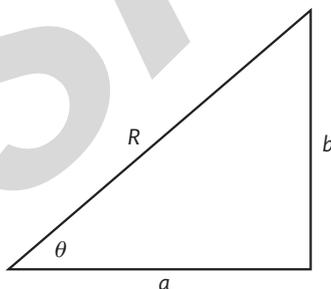
► **Figure 8.9** (a) Wave B is a phase-shifted version of the sine wave A. (b) The corresponding phasor B makes an angle of 30° with phasor A

In **Figure 8.9** the phasor B leads the phasor A by 30°, or $\frac{\pi}{6}$ radians. We know the equation for A is $y = R \sin(\omega t)$. The equation for B is $y = R \sin(\omega t + \frac{\pi}{6})$.

A phasor can be written in a number of ways. The most common forms are the following:

- **polar** notation – where the **magnitude** (also called the **modulus**) R and the **phase angle** (also called the **argument**) θ are together expressed as $R \angle \theta$
- **rectangular** (or **Cartesian**) notation – where the phasor is resolved into horizontal (a) and vertical (b) components to give $a + jb$.

Figure 8.10 shows how to convert between these two forms of notation.



► **Figure 8.10** Conversion between polar and rectangular forms of representing a phasor

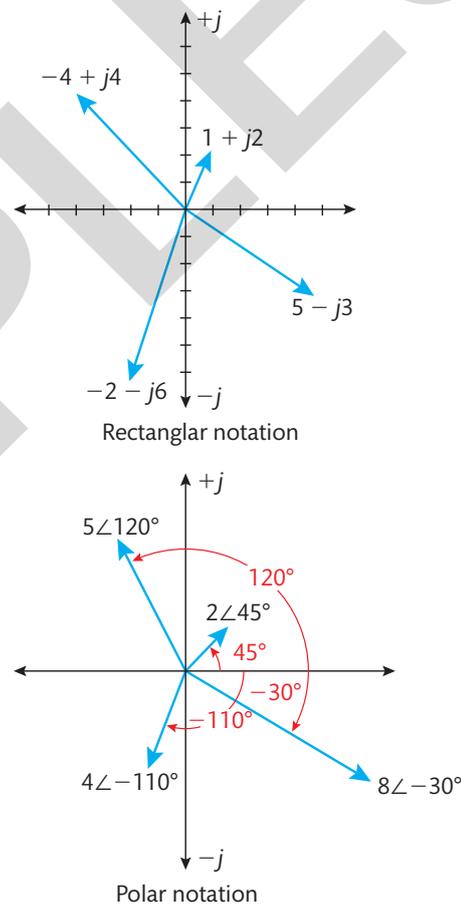
In particular, a phasor with rectangular form $a + jb$ has

- modulus $|a + jb| = \sqrt{a^2 + b^2}$
- argument $\arg(a + jb) = \tan^{-1}(\frac{b}{a})$.

The complex number system lets you add, subtract, multiply and divide phasor quantities that have both magnitude and angle (see the section on complex number arithmetic below).

Numbers on the complex plane

If you plot complex numbers on a set of perpendicular axes (the complex plane), you get an **Argand diagram** (see **Figure 8.11**).



► **Figure 8.11** Two examples of Argand diagrams

The j operator is associated with the vertical component of the phasor. It represents an anti-clockwise phase shift of 90° or $\frac{\pi}{2}$ rad. A j shift followed by another j shift gives j^2 , which is equivalent to a 180° phase shift. This corresponds to the wave being inverted, or multiplied by -1 . Therefore j satisfies the equation $j^2 = -1$.

Skills boost

2 How do I structure my analysis?

Every point you make in an analysis should be supported with evidence from the text and analytical comment. However, following a rigid structure – such as writing in point-evidence-explanation (PEE) paragraphs – can limit the range and depth of your analysis.

Read the sentences below. They are taken from one paragraph of a student's analysis of the extract.

- A. The writer begins the extract with a dramatic incident, taken out of chronological order to engage the reader's interest immediately.
- B. The narrator hears "the bawling of an air horn" and describes how a "big truck... shot past us... its trailer shimmying wildly."
- C. When we next see the truck, it has "smashed through the guardrails" of the road and "fallen hundreds of feet through empty space."
- D. The personification of the truck lying "on its back" suggests the 'death' of the truck and the almost certain death of its driver, adding to the reader's sense of shock.
- E. The writer summarises the impact of the incident in the short, emphatic sentence: "Nobody spoke."

- 1 Think about the function of each of the sentences above. Some may have more than one function.
 - a Write P beside any of the sentences that makes a **point**.
 - b Write Q beside any of the sentences that includes a **quotation**.
 - c Write A beside any of the sentences that **analyses** the text.
- 2
 - a Which of the sentences would you include in a paragraph of analysis focusing on the truck accident? Tick them.
 - b How would you sequence the sentences you have ticked? Number them in your order.
 - c How would you summarise the structure of the paragraph you have sequenced? Use 'point', 'quotation' and 'analysis' in your summary.

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COMMUNIQUER À L'ÉCRIT

Situation de communication



Objectifs

- ◆ Rédiger un texte simple et cohérent pour sensibiliser l'entourage à des sujets d'intérêt commun
- ◆ Communiquer par écrit sur des sujets d'intérêt commun

Activités

- 1 Par petits groupes, rédigez, dans le cadre d'une campagne de sensibilisation, l'affiche publicitaire de votre entreprise concernant les principes et les comportements à adopter au sein du lieu de travail en faveur du développement durable. Utilisez les tournures impersonnelles pour formuler vos recommandations.
- 2 Rédigez, en petits groupes, un questionnaire destiné à vos collègues pour sonder leur perception et leur engagement en matière de développement durable, aussi bien dans le travail qu'en famille. Vous opterez pour des questions fermées (réponse par oui ou non) ou pour des QCM (questions à choix multiples).
- 3 Choisissez dans les journaux une information relative à l'environnement écologique et rédigez des phrases sur les modèles syntaxiques suivants :
 - a « La question s'est posée : _____ ? Pour résoudre ce problème, _____ ... »
 - b « La seule issue (solution) serait _____ ... »
 - c « Ce sont les _____ qui _____ ... »

Had a go Nearly there Nailed it!

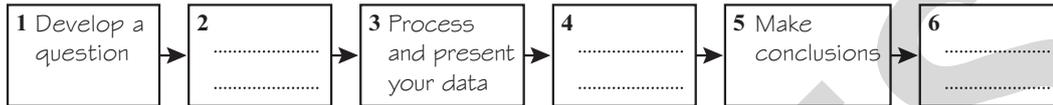
Fieldwork:
rivers

Formulating enquiry questions

This section is about Rivers fieldwork. For Coastal fieldwork, see page 98.

Guided

- 1 Identify the stages in the enquiry process by completing boxes 2, 4 and 6 in the diagram below. (3 marks)



- 2 Study **Figure 1**.

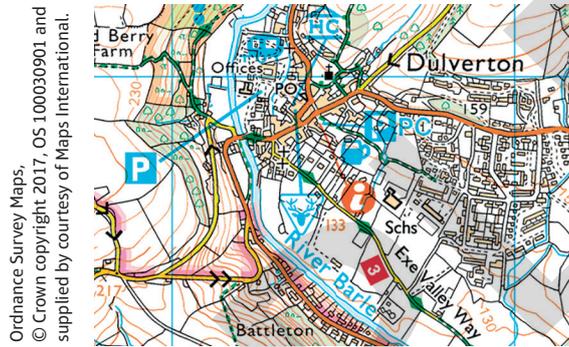


Figure 1 Ordnance Survey map 1:25 000 of Dulverton, Somerset

A group of students intend to carry out fieldwork at a number of sites along the River Barle (**Figure 1**).

- (a) Suggest an enquiry question based on river channel processes that they might investigate. (1 mark)
-

- (b) Suggest **one** reason why the River Barle is a suitable location to investigate your chosen enquiry question. (2 marks)
-
-

Look carefully at the map.

- 3 (a) State **one** geography theory or concept that might be investigated as part of this fieldwork. (1 mark)
-

- (b) Explain why the theory or concept named in (a) is relevant to this investigation. (4 marks)
-
-
-

- 4 Study **Figure 1**. Name **one** man-made feature that might affect this fieldwork investigation. (1 mark)
-

Had a look Nearly there Nailed it!
UNIT 1
Learning aim A

Growth and physiological change

The term **growth** describes an increase in height and weight. Growth continues until **EARLY ADULTHOOD**. The term **physiological change** describes the physical changes that take place throughout the life stages.

Key changes



1 Infancy/early childhood

Children grow rapidly and develop many physical skills.

2 Adolescent

The body continues to develop. There may be **GROWTH SPURTS**. Bodies will change as they reach **SEXUAL MATURITY**.

3 Young adult

The body has reached **PHYSICAL MATURITY**.

4 Older adult

The **AGEING PROCESS** begins in middle adulthood.

Worked example

Ben is 15 years old. In the last year he has grown rapidly and is now 175 cm tall. Ben is fit and active, and he is the fastest sprinter in his year group at school.

1 At what life stage will Ben reach his full height? (1 mark)

- A Early adulthood
 B Infancy
 C Adolescence
 D Middle adulthood

2 At what life stage will Ben begin the ageing process? (1 mark)

Ben will begin the ageing process when he reaches the middle adulthood life stage.

Key terms

GROWTH SPURTS: periods of fast growth

SEXUAL MATURITY: when an individual's reproductive organs are fully matured

PHYSICAL MATURITY: when an individual reaches their full height and the peak of physical fitness

AGEING PROCESS: by about 65, individuals will have lost some strength and muscle tone

In this answer you are only expected to identify the life stages. You don't need to identify specific ages.

Now try this

Give **one** example of physical growth and **one** example of a physiological change.

(2 marks)

Had a look Nearly there Nailed it!

**The struggle
for power,
1924–28**

Stalin leads the USSR

After Lenin's death in 1924, there was a struggle for power among the senior communists to become leader of the Soviet Union. Just before he died, Lenin had written a 'testament' criticising all the other senior communists, but each of the main rivals had different strengths and weaknesses.

Stalin

Ideology: Believed in 'Socialism in One Country': that the USSR could become a socialist state on its own.

- 👍 Position as General Secretary: power to appoint supporters to key party jobs.
- 👍 Appearance of moderation: no extreme views, always respectful to rivals. Kept private opinions to himself.
- 👎 Lenin's testament criticised his rudeness and lust for power.
- 👎 Seen as boring, unlike many key rivals.



Trotsky

Ideology: Believed in 'Permanent Revolution': that communism needed revolutions to spread from country to country. Believed in rapid industrialisation rather than NEP.

- 👍 Brilliant speaker.
- 👍 Lenin's close comrade through the revolution and Civil War.
- 👍 His organisation and leadership key to Red victory in Civil War.
- 👎 Arrogant and bossy.
- 👎 Menshevik until 1917, unlike the others, who were longstanding Bolsheviks.
- 👎 Lack of supporters outside the military.



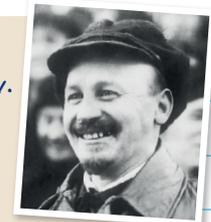
Zinoviev and Kamenev

- 👍 Worked closely together, strengthened them both.
- 👍 Zinoviev was party boss in Petrograd, Kamenev in Moscow.
- 👍 Worked closely with Stalin to run the party and weaken Trotsky after Lenin's death.
- 👎 The only two senior Bolsheviks to oppose Lenin's plan to seize power in October 1917.
- 👎 Power was limited to Petrograd and Moscow, while Stalin controlled the party.



Bukharin

- 👍 Very popular within the party.
- 👍 Excellent writer and theorist: editor of *Pravda* (party newspaper).
- 👎 Argued strongly against Treaty of Brest-Litovsk, which was later used against him.
- 👎 The main supporter of NEP, which many Bolsheviks viewed as capitalist.



Key steps to Stalin as leader

Stalin made sure that he took the lead role at Lenin's funeral, which Trotsky was too ill to attend.

Stalin then worked with Kamenev and Zinoviev (with Bukharin's support) to undermine Trotsky. But when Kamenev and Zinoviev then opposed Bukharin, Stalin criticised them for trying to split the party.

Economic difficulties in 1927–28 put pressure on NEP, which Bukharin supported. Stalin switched to arguing for rapid industrialisation and the collectivisation of agriculture. Stalin won the party's support and Bukharin lost his influence.

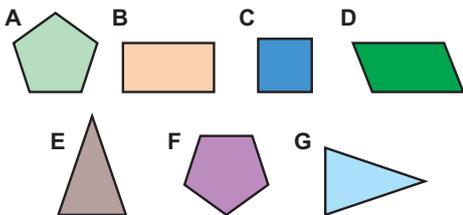
Now try this

Explain how Stalin used his position as General Secretary of the Communist Party to get rid of his rivals for power.

6 ANGLES

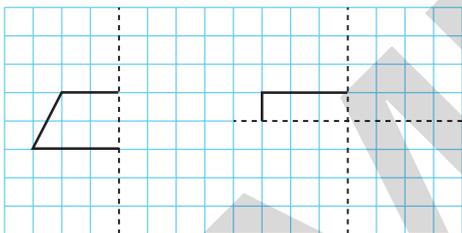
6.1 Properties of shapes

- 1 Write down the letters of two pairs of shapes that are congruent.

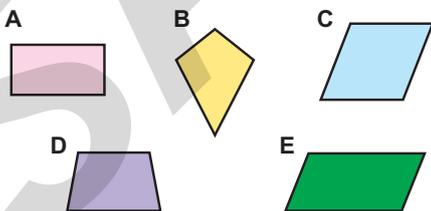


Q1 hint Congruent shapes are exactly the same size and shape, so if you cut them out, one shape fits on top of the other exactly. It does not matter if you turn them over or turn them round.

- 2 These parts of shapes are drawn on a centimetre square grid. The dotted lines are lines of symmetry.



- a Copy and complete the diagrams.
 b Name each shape and measure and label all its angles.
- 3 Which of these shapes have
 a equal length diagonals
 b two pairs of equal sides
 c only one pair of parallel sides?



- 4 **R** Name each quadrilateral being described.
 a I have two pairs of parallel sides and my opposite angles are equal.

- b I have four equal sides and my diagonals are not the same length.
 c I have two pairs of equal sides and one pair of equal angles.
 d My diagonals are the same length and bisect at 90° .

- 5 **P** Draw a coordinate grid with axes labelled from -5 to 5 .

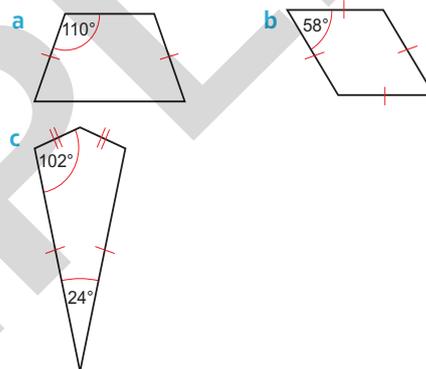
Plot these points.

$A(-1, 0)$, $B(1, -1)$, $C(1, 5)$

Write down the coordinates of a point that would make

- a a kite
 b a parallelogram
 c an isosceles trapezium.

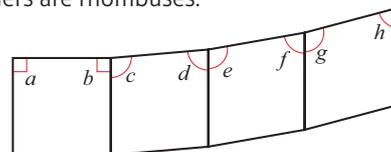
- 6 Work out the sizes of the missing angles in each quadrilateral.



- 7 **R** Charlie is an architect.

He draws a design for a path.

The left-hand section is a square and the others are rhombuses.



Charlie uses these rules in his design.

- Angle c is 5% bigger than angle a , rounded to the nearest degree.
- Angle e is 5% bigger than angle c , rounded to the nearest degree.
- Angle g is 5% bigger than angle e , rounded to the nearest degree.

Work out the sizes of the angles a to h .

a $f(x) = 3 \times \frac{x^{\frac{3}{2}}}{\frac{3}{2}} + c = 2x^{\frac{3}{2}} + c$

b $f'(x) = 3 = 3x^0$
 So $f(x) = 3 \times \frac{x^1}{1} + c = 3x + c$

Remember $3 \div \frac{3}{2} = 3 \times \frac{2}{3} = 2$
 Simplify your answer.

$x^0 = 1$, so 3 can be written as $3x^0$.

You can integrate a function in the form kx^n by integrating x^n and multiplying the integral by k .

- If $\frac{dy}{dx} = kx^n$, then $y = \frac{k}{n+1}x^{n+1} + c, n \neq -1$.
- Using function notation, if $f'(x) = kx^n$, then $f(x) = \frac{k}{n+1}x^{n+1} + c, n \neq -1$.
- When integrating polynomials, apply the rule of integration separately to each term.

Watch out You don't need to multiply the constant term (c) by k .

Example 3

Given $\frac{dy}{dx} = 6x + 2x^{-3} - 3x^{\frac{1}{2}}$, find y .

$y = \frac{6x^2}{2} + \frac{2}{-2}x^{-2} - \frac{3}{\frac{3}{2}}x^{\frac{3}{2}} + c$
 $= 3x^2 - x^{-2} - 2x^{\frac{3}{2}} + c$

Apply the rule of integration to each term of the expression and add c .
 Now simplify each term and remember to add c .

Exercise 13A

- Find an expression for y when $\frac{dy}{dx}$ is the following:

a x^5	b $10x^4$	c $-x^{-2}$	d $-4x^{-3}$	e $x^{\frac{2}{3}}$	f $4x^{\frac{1}{2}}$
g $-2x^6$	h $x^{-\frac{1}{2}}$	i $5x^{-\frac{3}{2}}$	j $6x^{\frac{1}{3}}$	k $36x^{11}$	l $-14x^{-8}$
m $-3x^{-\frac{2}{3}}$	n -5	o $6x$	p $2x^{-0.4}$		
- Find y when $\frac{dy}{dx}$ is given by the following expressions. In each case simplify your answer.

a $x^3 - \frac{3}{2}x^{-\frac{1}{2}} - 6x^{-2}$	b $4x^3 + x^{-\frac{2}{3}} - x^{-2}$	c $4 - 12x^{-4} + 2x^{-\frac{1}{2}}$
d $5x^{\frac{2}{3}} - 10x^4 + x^{-3}$	e $-\frac{4}{3}x^{-\frac{4}{3}} - 3 + 8x$	f $5x^4 - x^{-\frac{3}{2}} - 12x^{-5}$
- Find $f(x)$ when $f'(x)$ is given by the following expressions. In each case simplify your answer.

a $12x + \frac{3}{2}x^{-\frac{3}{2}} + 5$	b $6x^5 + 6x^{-7} - \frac{1}{6}x^{-\frac{7}{6}}$	c $\frac{1}{2}x^{-\frac{1}{2}} - \frac{1}{2}x^{-\frac{3}{2}}$
d $10x^4 + 8x^{-3}$	e $2x^{-\frac{1}{3}} + 4x^{-\frac{5}{3}}$	f $9x^2 + 4x^{-3} + \frac{1}{4}x^{-\frac{1}{2}}$

- (E/P)** 4 Find y given that $\frac{dy}{dx} = (2x + 3)^2$. (4 marks)

Problem-solving
 Start by expanding the brackets.

that for red light. Since $\sin c = 1/n$, we see that the critical angle for blue light is *less* than for red light.

Total internal reflection may also occur when light in glass ($n_g = 1.51$, say) is incident on a boundary with water ($n_w = 1.33$). Applying 'n sin i is a constant' to the critical case, Figure 2.12 we have

$$n_g \sin C = n_w \sin 90^\circ$$

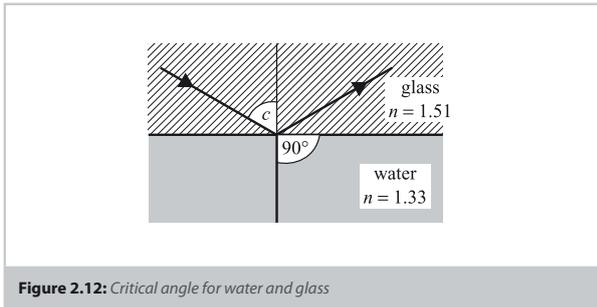


Figure 2.12: Critical angle for water and glass

where c is the critical angle. As $\sin 90^\circ = 1$

$$n_g \sin c = n_w$$

$$\therefore \sin c = \frac{n_w}{n_g} = \frac{1.33}{1.51} = 0.88$$

So $\therefore c = 63^\circ$ (approximately)

So if the angle of incidence in the glass exceeds 63° , **total internal reflection** occurs.

Note that total internal reflection can occur only when light travels from one medium to another with a *smaller* refractive index, which is optically less dense. It cannot occur when light travels from one medium to another optically denser, for example from air to glass, or from water to glass. In this case a refracted ray is always obtained.

d) Practical application of total internal reflection

Total internal reflection of radio waves

When radio waves are sent skywards by a transmitter they are progressively refracted away from the normal as they enter the ionosphere.

At some height, they undergo total internal reflection with the parallel layers and they can be received (detected) by a receiver on the other side of the earth figure 2.13)

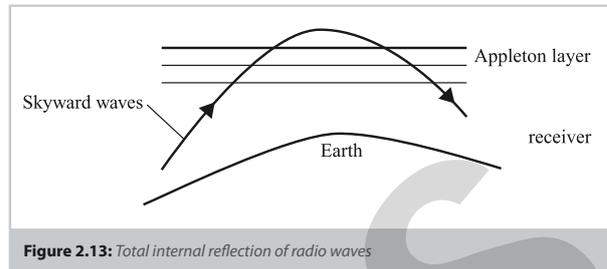


Figure 2.13: Total internal reflection of radio waves

Optical fibres

An optical fibre is a thin strand comprising two different types of glass. There is a central core with high refractive index and the coating with low optical density.

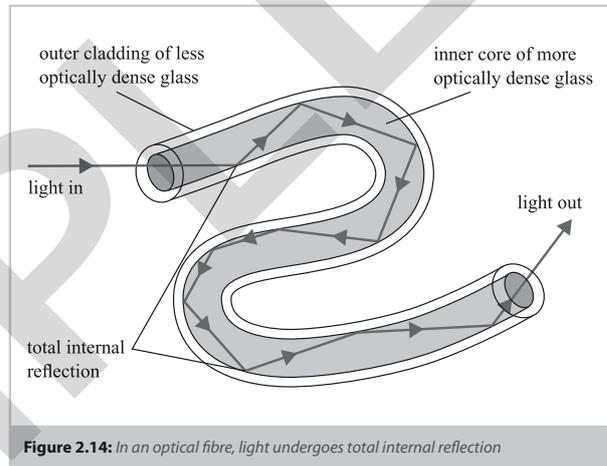


Figure 2.14: In an optical fibre, light undergoes total internal reflection

So light entering the core strikes the boundary of the glasses at an angle greater than the critical angle and consequently it undergoes total internal reflection (Figure 2.14).

In medicine they are used in endoscopes to see the inside of the body. Here, large numbers of these strands are fixed together to form a bundle so that sufficient light can be carried by them to enable the objects to be seen through them.

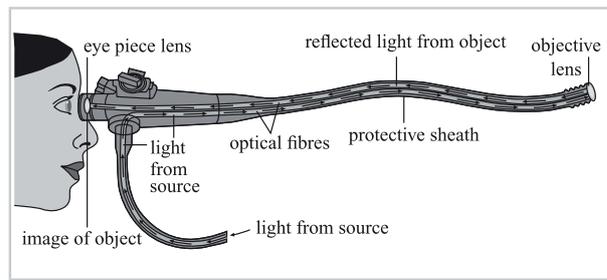


Figure 2.15: Optical fibres are used in endoscopes

THINK ▶ FUTURE



Mohammed Khan

Strength and conditioning coach

I've been working as a strength and conditioning coach in professional basketball for two years. During this time, I have encountered so many different athletes for whom I've had to produce individualised training programmes, either for sport performance or injury rehabilitation purposes.

When I completed my BTEC Level 3 Sport, I went to university and completed a course in Performance Conditioning, then completed my UK Strength and Conditioning Association accreditation. This complemented my existing basketball coaching qualifications and playing experience so I'm happy that I have the subject-specific knowledge as well as an understanding of the sport. This gives me solid background knowledge when I carry out research.

Having an understanding of the sport you work in is essential for effective work as a strength and conditioning coach. So is the ability to develop and maintain effective working relationships with different individuals. In doing so, you are more likely to be able to get to know your players which is really useful when it comes to trying to get them to agree to try things like new training methods you have researched.

It is also important to keep up with developments when it comes to researching new strength and conditioning methods as they are regularly advancing, and if you don't know what the best methods are, you can't offer the best quality of service and support to your clients. This is important as the safety and well-being of your players is always your main concern when you are working in sport, even more important than their levels of performance. So having them train and perform in the way they should be doing is more likely to mean they will stay safe and well.

Focusing on your skills

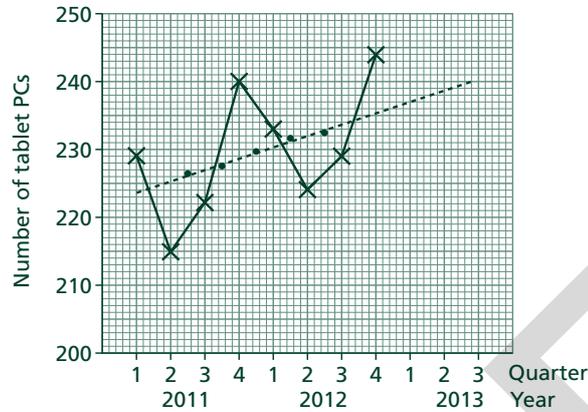
Conducting research with athletes

Research is important for the continued development of sports teams and athletes as it helps to develop knowledge, understanding and skills. You should think about the following points.

- Before completing any research with a client, make sure that you have their consent.
- Make sure that you provide them with a clear information sheet so that they know exactly what will be required of them.
- Make sure that you have a good depth of knowledge, understanding and skills across each of the main approaches to research.
- Remember, there is no one best approach to research, only approaches that are best suited to answering research questions.

Guided

- 4 The time-series graph gives information about the number of tablet PCs sold by a shop in each quarter from 2011 to 2012. The diagram also shows the four-point moving averages and the trend line.



- a Find an estimate of the seasonal variation for Quarter 2 in 2011.

2011 Quarter 2 actual value - trend value = 215 - 225 =

- b Find an estimate of the seasonal variation for Quarter 2 in 2012.

2012 Quarter 2 actual value - trend value = 224 - =

- c Find an estimate of the mean seasonal variation for Quarter 2.

Mean seasonal variation for Quarter 2 = $\frac{..... +}{2}$ =

Hint
Use your answers to parts a and b.

You should know
Exam questions include the use of mean seasonal variation to make predictions. This will be covered in Section 4.3.

Practice

- 5 The time-series graph shows the number of people at a holiday resort in each quarter from 2011 to 2012.

- a Find an estimate of the seasonal variation for Quarter 1 in 2011.

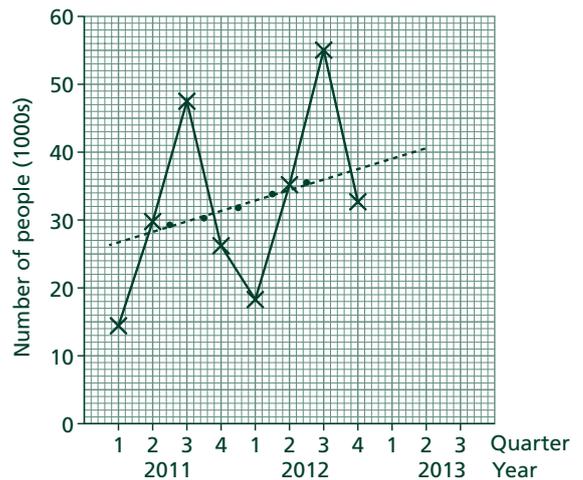
.....

- b Find an estimate of the seasonal variation for Quarter 1 in 2012.

.....

- c Find an estimate of the mean seasonal variation for Quarter 1.

.....



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