2 classes worksheet

Math 101, Math Class · Combined Science · AQA

Name | Class | Date

Practice worksheet covering key calculation, graphical, and descriptive skills in forces, waves, electromagnetism, and thermal measurements.

Explainer

This part shows the method. Use it to get started, then try the questions.

Particle model of matter > Internal energy and energy transfers

6.3.2.2 12 Marks Dropped 2 Sep

Identifying Error Types and Calculating Uncertainty

1. Step 1: Identify the error type. If repeated measurements fluctuate unpredictably above and below the true value, the error is a random error (unlike a zero error or systematic error where all values shift in one direction).
2. Step 2: Calculate the range of the data using $\text{range} = \text{maximum value} - \text{minimum value}$. For values $-0.4\ ^\circ\text{C}$ and $+0.6\ ^\circ\text{C}$, $\text{range} = 0.6 - (-0.4) = 1.0\ ^\circ\text{C}$.
3. Step 3: Calculate the uncertainty by halving the range: $\text{uncertainty} = \pm\frac{\text{range}}{2} = \pm\frac{1.0}{2} = \pm 0.5\ ^\circ\text{C}$.

Magnetism and electromagnetism > The motor effect

6.7.2.1 38 Marks Dropped 2 Sep

Explaining the Motor Effect on a Coil

1. Step 1: State the two magnetic fields present: there is an external magnetic field between the magnetic poles, and the electric current in the loop creates its own magnetic field around the wire.
2. Step 2: Identify the current direction in both sides: current flows in opposite directions along side A and side B of the loop.
3. Step 3: Apply Fleming's left-hand rule: because the current directions are opposite, the magnetic forces acting on side A and side B are in opposite directions (one upwards, one downwards), causing the loop to rotate.

Waves > Transverse and longitudinal waves

6.6.1.1 54 Marks Dropped 2 Sep

Explaining Refraction Using Wavefronts

1. Step 1: State how wave speed changes across the boundary: when visible light passes from air into a denser medium (such as glass or a lens), the speed of the light decreases.
2. Step 2: Describe the uneven entry of the wavefront: because the light hits the boundary at an angle, one end of each wavefront enters the medium before the other end.
3. Step 3: Link this to changing direction: the end that enters first slows down first, while the rest of the wavefront continues at the original speed, causing the wave to change direction (refract) towards the normal.

6.5.6.1.2 68 Marks Dropped 2 Sep

Distinguishing Speed, Velocity, and Interaction Pairs

1. Step 1: For an object moving in a circle at a steady pace, the speed (magnitude of velocity) is constant, but velocity is a vector quantity that includes direction. Because the direction of motion continuously changes, the velocity is continuously changing.
2. Step 2: Identify Newton's Third Law pairs: whenever two objects interact, the forces they exert on each other are equal and opposite. The paired force must act between the exact same two interacting objects.
3. Step 3: For example, the Newton's Third Law pair to 'the force of a rope pulling a sled' is 'the force of the sled pulling back on the rope' (not friction or the dogs).

Waves > Transverse and longitudinal waves

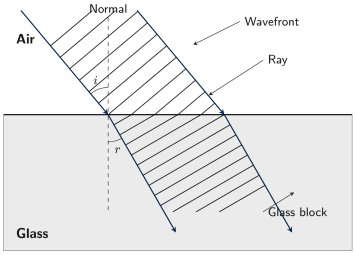
6.6.1.1 54 Marks Dropped 2 Sep

1 **Complete** Fill in the blanks **[3]**

Complete the sentences about wave properties and refraction using words from the box.

In a transverse wave, the oscillations are _____ to the _____.

When a light wavefront enters glass at an angle, the light refracts because the speed of the wave _____, meaning the side of the wavefront entering first slows down before the other side.



perpendicular | parallel | direction of energy transfer | direction of amplitude | decreases | increases

Forces > Speed

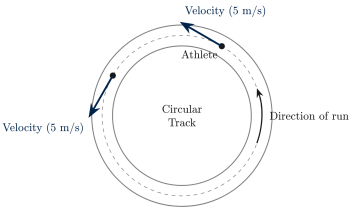
6.5.6.1.2 68 Marks Dropped 2 Sep

2 **Complete** Fill in the blanks **[4]**

An athlete runs around a circular running track at a steady speed of $5\ \mathrm{m/s}$.

The speed of the athlete has a constant _____, but their velocity is continuously changing because their _____ is continuously changing.

According to Newton's Third Law, the pair to the forward force of the athlete's foot pushing backwards on the ground is the force of the _____ pushing forwards on the _____.



Particle model of matter > Internal energy and energy transfers

6.3.2.2 12 Marks Dropped 2 Sep

3 Calculate Your turn **[3]**

A student measures the temperature of boiling water using a digital sensor five times.

The recorded readings are: $99.6\ ^\circ\text{C}$, $100.4\ ^\circ\text{C}$, $99.8\ ^\circ\text{C}$, $100.2\ ^\circ\text{C}$, $100.0\ ^\circ\text{C}$.

(a) Name the type of experimental error shown by these fluctuating readings.

(b) Determine the uncertainty in these measurements.

Magnetism and electromagnetism > The motor effect

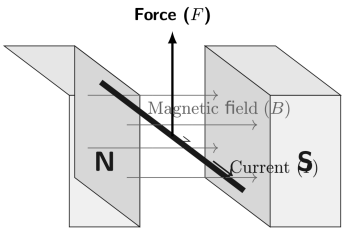
6.7.2.1 38 Marks Dropped 2 Sep

4 Calculate Your turn **[4]**

A straight wire of length $0.080\ \text{m}$ carrying a current of $0.40\ \text{A}$ is placed perpendicular to a uniform magnetic field.

The magnetic force acting on the wire is $3.6\ \text{mN}$.

Calculate the magnetic flux density of the magnetic field. Give the unit.



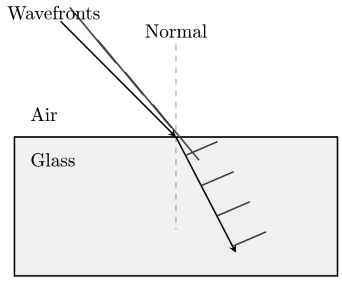
Waves > Transverse and longitudinal waves

6.6.1.1 54 Marks Dropped 2 Sep

5 **Explain** Your turn **[3]**

Figure 1 shows visible light wavefronts in air incident at an angle on the flat boundary of a glass block.

Explain why the light ray changes direction as it enters the glass block.



Magnetism and electromagnetism > The motor effect

6.7.2.1 38 Marks Dropped 2 Sep

6 **Explain** Challenge **[5]**

Figure 2 shows a rectangular coil $ABCD$ positioned on an axle in a uniform magnetic field between a North and South magnetic pole.

When the switch is closed, a current flows through the coil in the direction $A \rightarrow B \rightarrow C \rightarrow D$.

Explain how magnetic forces make the coil rotate, referring to the directions of the current and forces acting on side AB and side CD.

