SAMPLE: PHYSICS

5. Draw graphs of displacement/time and displacement/distance (or position) for progressive waves (no transposition).

A progressive wave is one that has a periodic source of disturbance, whilst a pulse is caused from a single disturbance.

Displacement/time graphs and displacement/distance graphs of waves both have sinusoidal shapes. However, they should not be confused to be the same since different measurements are taken from the two types of graphs. Examples are shown in Diagrams 1.1.5.1 and 1.1.5.2.

Diagram 1.1.5.1:

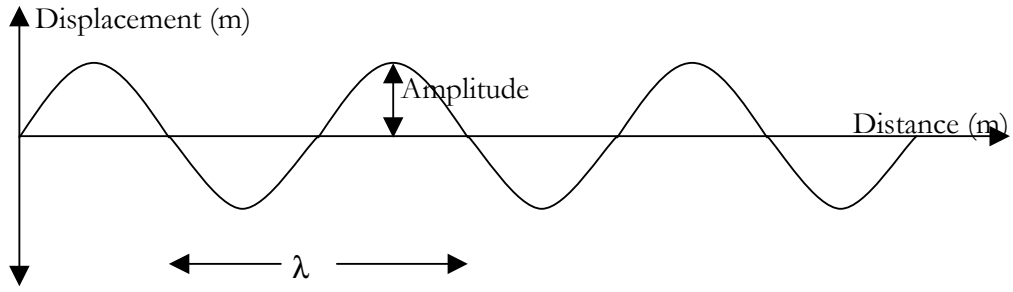
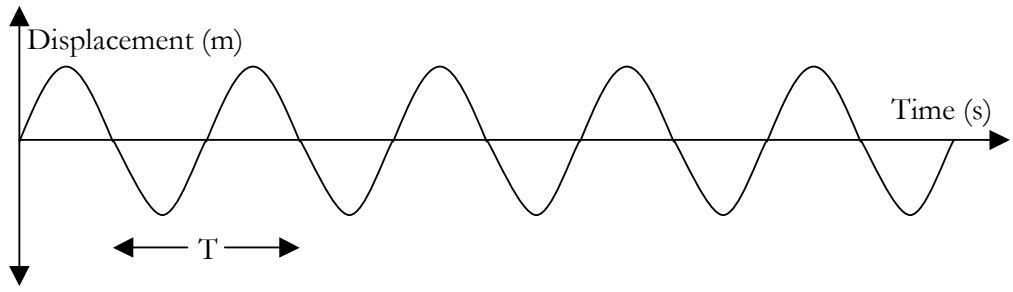


Diagram 1.1.5.2:

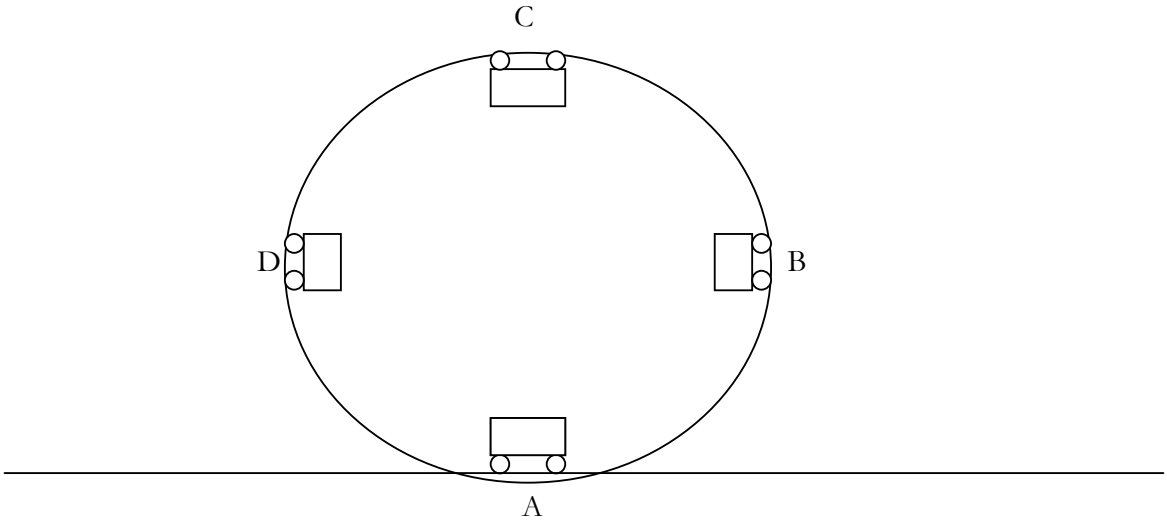


8. Analyse the forces acting when an object undergoes circular motion in a vertical plane.

Example:

Remembering that centripetal force can be the resultant of the sum of two or more forces, state the direction that the forces below are acting in each of the four positions of the rollercoaster. The rollercoaster travels at a constant speed throughout the loop.

1. The weight force of the rollercoaster.
2. The reaction force of the rollercoaster tracks.



Answer:

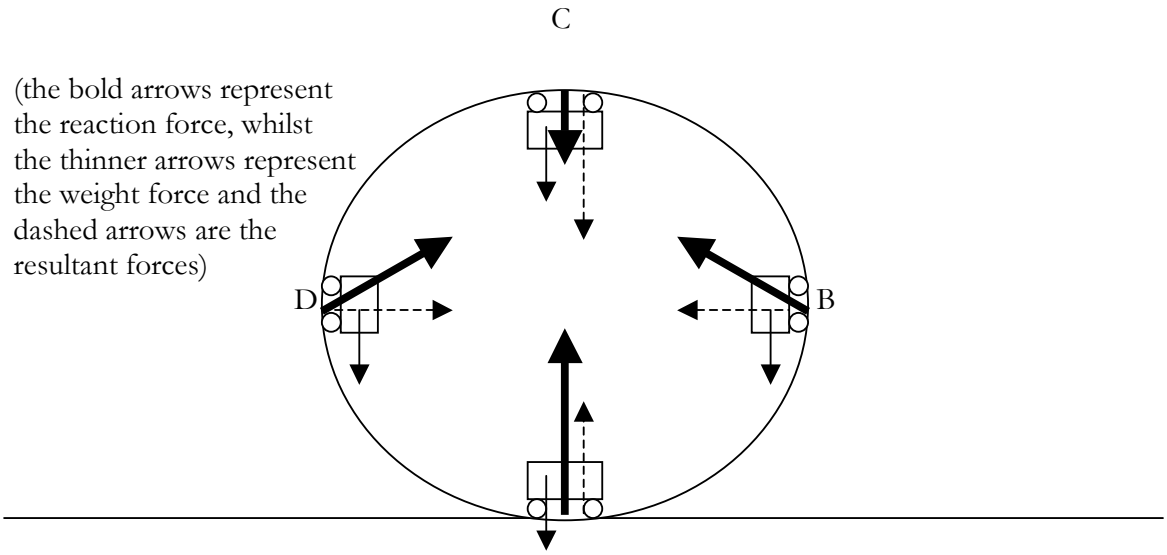
In all of the cases shown, the direction of the weight force is directly downwards. It is only the direction of the reaction force of the rollercoaster tracks that changes. The direction of the reaction force is determined by the fact that the vector sum of the reaction and weight forces must be directed towards the middle of the circle made out by the rollercoaster track. The direction of the resultant force must be toward the middle of the circle to maintain the circular motion of the roller coaster.

A. In this case the reaction force is directed vertically upwards.
B. Because the weight force is directed downwards, the reaction force must have a vertical component equal to this weight force as well as a horizontal component. The vector

sum of the weight and the reaction forces will thus be directed towards the middle of the circle (the vertical components cancel each other out). The direction of the reaction force will be up and to the left.

C. The reaction force here will be directed downwards. Its magnitude will be less than that of the reaction force in position A because in this case the weight force is acting in the same direction. (Remember that since the speed is constant, the centripetal force is constant).

D. This is the reverse case of position C. The reaction force will be directed up and to the right.



(the bold arrows represent the reaction force, whilst the thinner arrows represent the weight force and the dashed arrows are the resultant forces)

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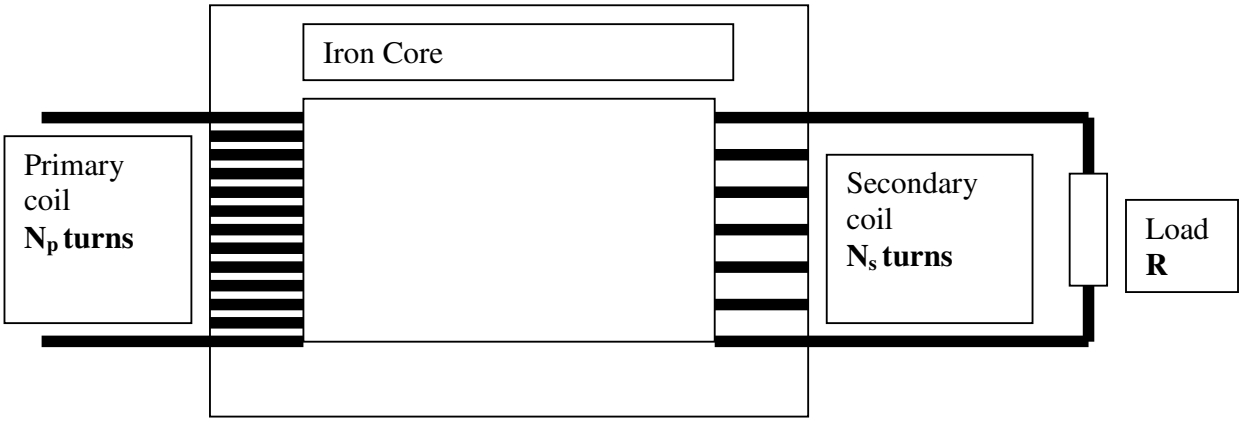
A step-down transformer:



A step up transformer is used to increase the voltage and is used particularly for transmitting electricity at high voltages along the lines. A step down transformer is used to decrease the voltage in order for use in homes.

It is important to note the means by which electromagnetic (EM) induction is achieved in order to understand the principle of the transformer.

In order to obtain an EMF in a coil there must be either a change in field strength or a change in the area of the coil. The principle used for transformers is the change in field strength as the current in the electromagnet near the coils fluctuates.

Explanation of action of a transformer:

The applied AC voltage across the primary coil causes a changing current $\mathbf{I_p}$ in the primary. This produces a changing flux in the iron core. The changing flux of the core will then pass through the secondary coil and thus induces a voltage in the secondary coil. Also, energy or power is not created or destroyed, rather the current ratio between the primary and secondary changes to balance the voltage ratio which is determined by the ratio of the turns of the primary and secondary coils.

It is important to note that transformers only operate with AC because there needs to be a changing flux to induce EMF in the secondary coils.

Turns ratio formula:

$$\frac{V_s}{V_p} = \frac{N_s}{N_p}$$

Electric transmission:

It is important to note the formula : $\mathbf{P_{loss} = V_d\ I = RI^2}$

That is to say that the power lost = the voltage drop x current. Since V=IR,

Power lost also = RI^2

Electricity is therefore best transmitted at high voltages. This is in order to reduce the losses due to resistance. This is because when power is transmitted at high voltages, the current along the lines decreases due to a "trade-off" between voltage and current as P= IV. As current decreases, the power lost is decreased considerably.

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- END OF PHYSICS SAMPLE -