

# OCR B Physics A Level

## 3.1.1 - Imaging and Signalling

### Flashcards

This work by [PMT Education](https://www.pmt.education) is licensed under [CC BY-NC-ND 4.0](https://creativecommons.org/licenses/by-nc-nd/4.0/)



What is meant by the term 'real image'?



What is meant by the term 'real image'?

A real image is one that can be projected onto a screen.



In the wave model of light, what can be said about the direction of the wave's motion and its wavefronts?



In the wave model of light, what can be said about the direction of the wave's motion and its wavefronts?

The wave fronts lie perpendicular to the direction of the wave's motion.



# What are plane wave fronts?



## What are plane wave fronts?

Wave fronts that are parallel to each other and don't appear to have any curvature.



What condition is required for a wave to have plane wave fronts?





What condition is required for a wave to have plane wave fronts?

The wave should come from a very distant source:

- Curvature =  $1/\text{radius}$
- As the radius tends to infinity, the curvature approaches zero.



# How does a converging lens affect wavefronts of light?



How does a converging lens affect wavefronts of light?

The lens adds a curvature of  $1/f$  to the wavefronts of light.



State the Lensmaker's Equation.



State the Lensmaker's Equation.

$$1/v = 1/u + 1/f$$

Where  $v$  = image distance

$u$  = object distance

$f$  = focal distance



What expression is used to calculate the power of a lens?



What expression is used to calculate the power of a lens?

$$Power = 1/f$$



What unit is used for the power of a lens?





What unit is used for the power of a lens?

Dioptries, D



# Why are object distance values negative?



# Why are object distance values negative?

Object distance is measured in the opposite direction to the image and focal distances, which are both positive values.



State the equations for linear magnification.



State the equations for linear magnification

$$\text{Linear Magnification} = \frac{\text{Image Height}}{\text{Object Height}}$$

$$\text{Linear Magnification} = \frac{\text{Image Distance}}{\text{Object Distance}}$$



What do modern cameras use instead of film to store images?



What do modern cameras use instead of film to store images?

Charged Coupled Devices (CCDs).



# What is a CCD?





## What is a CCD?

A charge coupled device is a screen covered with pixels that store charge when light is incident on them.



# What is a binary system?



## What is a binary system?

A system that can only take two possible values, such as on or off.



What expression can be used to calculate the number of alternatives produced by a given number of bits?



What expression can be used to calculate the number of alternatives produced by a given number of bits?

$$N = 2^b$$

Where  $N$  is the number of alternatives,  
 $b$  is the number of bits



What expression can be used to calculate the number of bits required for a given number of values?



What expression can be used to calculate the number of bits required for a given number of values?

$$b = \log_2 N$$

Where  $N$  is the number of alternatives,  
 $b$  is the number of bits



# What is meant by the resolution of an image?





What is meant by the resolution of an image?

The resolution of an image is the smallest distance between which two points can be distinguished.



What equation is used to calculate resolution?



What equation is used to calculate resolution?

$$\text{Resolution} = \frac{\text{Width of Image}}{\text{Number of Pixels}}$$



What are the **four** main ways of processing an image?



What are the **four** main ways of processing an image?

1. Removal of Noise
2. Edge Detection
3. Increasing Contrast
4. Changing Brightness



Explain the process of noise removal.



Explain the process of noise removal.

- The value of each pixel is replaced by the mean of the 8 pixels immediately surrounding it.
- This removes random disturbances and produces a smoother image.



Explain the process of edge detection.





Explain the process of edge detection.

- The average value of the 8 pixels around a given pixel, is subtracted from that pixel.
- This removes areas of uniform colour and produces clear outlines.



Explain the process of increasing image contrast.



Explain the process of increasing image contrast.

- Multiply each pixel value by a fixed number, so the image spreads across all available values.
- This will make the image more vivid.



Explain the process of increasing image brightness.



Explain the process of increasing image brightness.

- Add a fixed number to each pixel's value.
  - This will brighten the image.



Explain the difference between analogue and digital signals.



Explain the difference between analogue and digital signals.

Analogue signals can continuously vary between values whereas digital signals can only take discrete values.



What process can be used to convert analogue signals into digital signals?





What process can be used to convert analogue signals into digital signals?

Sampling can be used to convert an analogue signal into a digital signal.



What does the process of sampling  
involve?



What does the process of sampling involve?

Sampling involves taking frequent measurements of analogue signals, and then rounding them to the nearest value/quantisation level.



What problem can arise when carrying out sampling?



What problem can arise when carrying out sampling?

Sampling can produce quantisation errors, which is where there is a difference between the actual level and the quantisation level.



State a positive and a negative of analogue signals.



State a positive and a negative of analogue signals.

- Positive: More detailed than digital signals.
- Negative: They cannot be easily amplified due to noise.



State **four** advantages of digital signals.





State **four** advantages of digital signals.

1. They are noise resistant.
2. They are easy to send, store and receive.
3. Their transmission is faster.
4. They can be easily compressed.



State **two** disadvantages of digital signals.



State **two** disadvantages of digital signals.

1. They can have a lack of detail.
2. They are easily scrambled.



What equation can be used to calculate the maximum number of useful quantisation levels?



What equation can be used to calculate the maximum number of useful quantisation levels?

$$\textit{Maximum number of quantisation levels} = \frac{\textit{total noisy signal variation}}{\textit{noise variation}}$$



State an equation linking the number of quantisation levels used and the image resolution.



State an equation linking the number of quantisation levels used and the image resolution.

$$\text{Resolution} = \frac{\text{p.d range of signals}}{\text{number of quantisation levels}}$$



What is the condition for the minimum sampling rate that can be used when converting an analogue signal to a digital one?





What is the condition for the minimum sampling rate that can be used when converting an analogue signal to a digital one?

The minimum sampling rate must be at least twice the highest frequency in the signal.



What can occur if the sampling rate is too low?



What can occur if the sampling rate is too low?

- Aliasing can occur.
- A low frequency signal may be produced from a high frequency signal due to it being sampled too infrequently.



# What is bit rate?



## What is bit rate?

Bit rate is the rate of information transmission.



State the equation used to calculate bit rate.



State the equation used to calculate bit rate.

*Bit rate = samples per second x bits per sample*



# What is the relationship between bits and bytes?





# What is the relationship between bits and bytes?

A byte is a string of 8 bits.

