THE VISUAL PERCEPTION SYSTEM

To feel, smell, see, hear or know where we are in relation to our environment involves both sensory and perceptual activity. Actually, we have seven different perceptual systems (including the kinaesthetic and vestibular system in addition to those already referred to above).

The perceptual system studied in detail in VCE Psychology is **the visual perception system which is defined as the complete network of physiological structures involved in vision: The eyes, photoreceptors, optic or neural pathway and visual cortex**.

We are surrounded by external physical energy sources. Generally receptor neurons (sensory neurons) only respond to one type of physical energy. The ears respond to mechanical energy in the form of sound waves, and smell to chemical energy. In vision sensory neurons in the eyes respond to a portion of electromagnetic radiation or light energy known as the visible spectrum of light.

Finding meaning in external stimuli involves six interdependent and sequential types of processing which occurs in two stages: **Visual sensation and visual perception**.

Visual sensation refers to the **reception and transduction** of electromagnetic energy by the photoreceptors, and the **transmission** of electrochemical energy to the brain.

Visual perception refers to the **selection, organisation and interpretation** of visual sensation into meaningful visual perceptions of objects in the physical world. (P528)

QUESTION 1
The relationship between the process of visual sensation and visual perception is best described as:

A Two separate and distinct processes.
B Two aspects of the same process.
C Two separate but interactive processes.
D One extended process.

QUESTION 2
Visual perception is:

A The transduction of electromagnetic energy into electrochemical energy.
B The transmission of electromagnetic energy to the primary visual cortex.
C The detection or awareness of the presence of light energy.
D The selection, organisation and interpretation of visual sensations.

QUESTION 3
Define the term visual perception system.

_____

_____

_____

_____

RESPONSE TO LIGHT (P174-175)

They eye responds to light waves or **electromagnetic radiation**. Light waves are measured in nanometres. A nanometre is one billionth of a metre. The eyes respond to restricted wavelengths of light which range between **380 nanometres (perceived as violet**) – **760 nanometres (perceived as red)**. This is termed the visible spectrum.

Always use the term electromagnetic energy not light when responding to examination questions (light energy is acceptable but never just light).

Light waves also vary in their length and height (or amplitude). The length of a light wave determines the colour perceived. The height of a light wave determines its intensity or how brightly it is perceived.

Short wavelength – bluish in colour

Long wavelength – reddish in colour

High amplitude – bright or intense colours

Low amplitude – dull colours

THE CONCEPT OF THRESHOLDS

The term threshold refers to the ability to detect a stimulus or changes in a stimulus.

The absolute threshold (for vision) refers to the **minimum amount of energy** necessary for a (visual) stimulus to be perceived on average 50% of the time. (P177)
(For vision it is a candle flame seen from approx. 50 kilometres under ideal viewing conditions).

The differential threshold (or just noticeable difference) **is the smallest detectable change in the intensity of energy** between two (visual) stimuli by (the eye) or sensory receptors on average 50% of the time. (P177)

Weber's Law states the amount of change needed to produce a just noticeable difference **is a constant proportion of the original stimulus intensity**. For example, if a sound of 2 decibels required a 2-decibel change for a difference to be noticed, then a 100-decibel sound would need a 100-decibel change if any difference in loudness was to be noticed.

Note: Thresholds can be measured for all the senses – hearing, taste, smell, touch etc.

QUESTION 4

(a) **Explain** the difference between the absolute threshold for vision and the differential threshold for vision.

_____

_____

_____

_____

_____

_____

(b) **Provide** an example to illustrate each of the thresholds.

Absolute threshold:

_____

_____

_____

_____

Differential threshold:

_____

_____

_____

_____

QUESTION 5

Karl was camping in the desert on a cloudy and moonless night. It was completely dark. In the early hours of the morning Karl noticed that he could suddenly detect some light where before he could not. This is an example of:

A The absolute threshold for vision.
B The differential threshold for vision.
C The just noticeable difference.
D The just noticeable change.

HOW DOES THE EYE WORK?

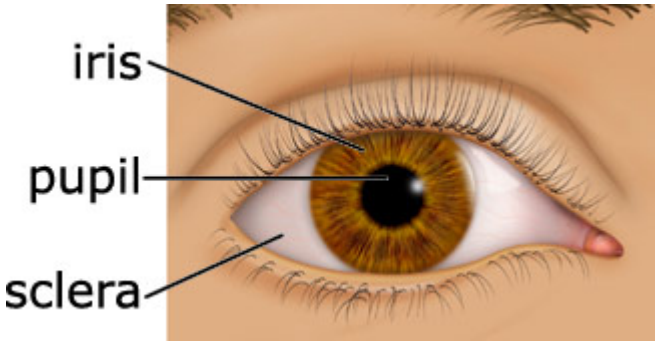
The Path of Light Moves:

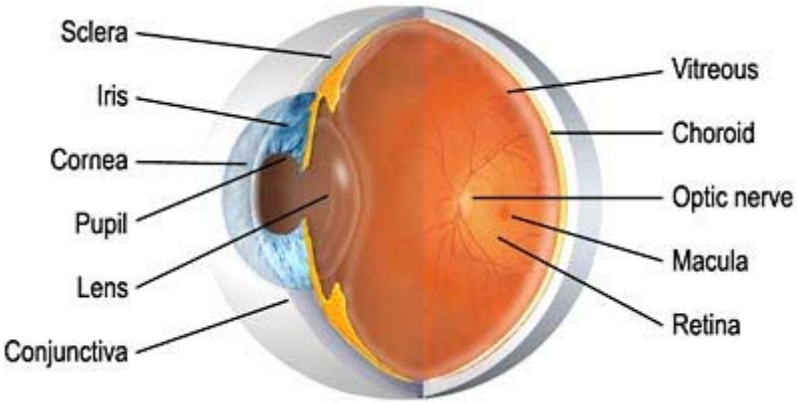
Through the cornea ➔ through pupil (surrounded by iris) ➔ through lens ➔

Through vitreous humour ➔ to retina (containing the photoreceptors: rods and cones) ➔

to optic nerve (which crosses at the optic chiasm) ➔ to final destination in the primary visual cortex at the base of the occipital lobes of the cerebral cortex.

Diagram of the eye:





Source: www.stlukeseye.com/anatomy The website of St Luke's Cataract & Laser Institute, Florida. USA. Image downloaded 22/4/07.

RODS AND CONES

RODS **125 million each retina.**	**CONES** **6.5 million each retina.**
Rods function best in low levels of light.	**Cones function best in daylight and in high levels of light.**
Pure rod vision is **black and white**, and shades of grey. (Although rods don't allow the perception of colour they are activated by light in the blue end of the spectrum).	Cones provide **colour vision.**
Rods provide a **low** level of visual acuity. (clarity)	Cones provide a **high** level of visual acuity (clarity). (Fovea is a tiny cup-shaped area at centre of retina with the greatest concentration of cones).
Rods are responsible for **peripheral vision** (rods found about 20 degrees from centre of retina).	Cones are responsible for **central vision.**
Concentrated in the outer reaches of the retina.	Concentrated in the centre of the retina.
Respond best to shorter wavelengths.	Respond to all wavelengths but respond best to longer wavelengths.

Note:

Rods are also sensitive to movement.

To see an object in low light conditions, look to one side of it so the image will be focused on the rods, which will operate in the dim light conditions.

Refer to Pages 175-176.

QUESTION 6
Describe the role of photoreceptors in the process of visual sensation and perception.

_____

_____

_____

_____

QUESTION 7
Identify two ways in which the function of rods differs to that of cones.

_____

_____

_____

_____

IDENTIFY THE PARTS OF THE EYE

Fill in each gap below – Refer pages 172-173

The _____ is a transparent convex shaped covering which functions to protect the eye, and acts to focus the light onto the retina at the back of the eye.

The_____ is the coloured ring of muscle which expands or contracts to cause alterations in the size of the pupil, determining how much light gains entry to the eye.

The _____ is the opening which admits light entering the eye. It dilates or contracts as necessary.

The _____ is the **major** focussing mechanism of the eye. It adjusts it shape when the viewing distance changes. It elongates and stretches to focus on distant objects, and bulges and shortens to focus on closer objects. This process is known as _____

At the _____the rods and cones receive and absorb light. They are responsible for _____so it can be transmitted to the visual cortex as neural messages in the form of electrochemical energy for further brain processing, and the final stage of perception, interpretation.

_____are found mainly at the centre of the retina. They are responsible for sight in daylight and under high levels of lighting conditions, colour vision, and visual acuity – they do not operate in dim lighting conditions.

_____ function best in low levels of light, and are used for vision in dark conditions and peripheral vision. They are most dense 15 – 20 degrees from the fovea.

The _____ is the where the nerve fibres are bunched together and leave the eye so there are no photoreceptors there to detect the presence of light.

Nerve fibres bundled together form the two _____ which transport information from the retina to the brain.

As the _____ is the area of the retina with the highest concentration of cones, it is area of the retina responsible for the _____level of visual acuity or clarity.

Rods and cones change _____ energy into _____ energy.
.
As they are more sensitive to light and function in low levels of light _____ have a lower _____threshold than _____have.

In order to view an object in the night sky it would be best to view an object by looking _____ _____ so that it is focused on the _____at the _____ of the retina.

THE INTERACTIVE NATURE OF THE PROCESSES OF THE RETINA AND BRAIN IN VISUAL PERCEPTION

Finding meaning in external stimuli involves **six interactive, interdependent, sequential and progressive** processes which occur continually in the visual system: **Reception, transduction, transmission, selection, organisation and interpretation.**

Even though each process can be distinguished as being different to the rest, in reality they are related to the others and visual perception is not likely to occur in the absence of any one of them.

Try to visualise what is happening at the level of the photoreceptors and along the optic nerves etc. as you read each explanation and then write it out later in the space below. (P182-190)

(i) **RECEPTION** is the process whereby photoreceptors detect the presence of electromagnetic radiation when an image of a visual stimulus is cast onto the retina. (P182)

_____

_____

(ii) **TRANSDUCTION** is the process whereby photoreceptors convert electromagnetic energy into electrochemical energy. (P183)

_____

_____

(iii) **TRANSMISSION** involves sending and receiving information from neuron to neuron along the optic pathway to the visual cortex. (P183)

_____

_____

(iv) **SELECTION** involves discriminating between various features of the stimulus in terms of different wavelengths of light, colour, or lines of a particular direction, length or angle etc. (P187)

(It is like a sorting/analysing process conducted by specialised neurons which respond only to certain features of the visual stimulus. It begins during when the photoreceptors detect the presence of light and is continued by highly specialised **feature-detector cells** in the visual cortex.)

_____

_____

(v) **ORGANISATION** occurs as the elements of the incoming stimulus are reassembled in a meaningful way. (P190)

_____

_____

(vi) **INTERPRETATION occurs when the sensory information is given meaning and identified.** (It is guided by mental processes and psychological factors like our prior experience and context). (P190)

_____

_____

QUESTION 8
The process of reception in visual perception involves the stimulation of photoreceptors located in the _____. The _____ are the most numerous of these photoreceptors and they are located in the _____ of the retina.

A Lens, cones, outer parts.
B Retina, rods, outer parts.
C Pupil, cones, central part.
D Retina, rods, central part.

QUESTION 9
Which of the following statements about the passage of light rays through the eye to the retina is **correct**?

A Light rays from the top of an object being viewed are bent to fall at the top of the retina.
B Light rays from the left side of an object are bent to the right side of the retina.
C Light rays from the bottom of an object being viewed are bent to fall at the top of the retina.
D Images focused onto the retina are right-side-up.

QUESTION 10
The term 'left visual field' means:

A The image that is focussed onto the left of the retina.
B The left half of the entire area that is visible.
C The left side of the eye.
D The left side of the retina.

QUESTION 11
Electrochemical energy is:

A Also known as light energy.
B Also known as electromagnetic energy.
C A form of energy that involves the movement of chemical charges from one neuron to the next.
D A form of energy that involves the movement of electrical charges from one neuron to the next.

QUESTION 12
Transduction occurs only after a photochemical reaction takes place within the photoreceptors. Select the best explanation of this process from the list below:

A Photopigments within rods and cones are broken down into other chemicals andtransmitted to the brain.
B Photopigments within photoreceptors are bleached before being transmitted to the brain.
C A chemical change involving the bleaching of photopigments within photoreceptorsoccurs starting the transduction process.
D A chemical change involving the conversion of electromagnetic energy to electrochemical energy occurs allowing transduction to proceed.

QUESTION 13
Transduction involves:

A The conversion of electromagnetic energy to light energy.
B The conversion of electromagnetic energy to electrochemical energy.
C The conversion of electrochemical energy to light energy.
D The conversion of electrochemical energy to electromagnetic energy.

QUESTION 14
Photoreceptors transmit neural impulses to the brain via:

A Bipolar cells and ganglion cells.
B Rods and cones.
C The optic chiasm.
D Neural pathways.

QUESTION 15
Which of the following statements about the optic nerve is **incorrect?**

A The optic nerve transmits visual information to the primary visual cortex in the occipital lobe.

B The optic nerve consists of around one million axons or nerve fibres.

C The optic nerve consists of ganglion cells and bipolar cells.

D The optic nerve fibres that originate from the right side of the retina transmit information to the right visual cortex.

QUESTION 16
Part of the selection process in visual perception involves:

A The selective response by the photoreceptors to a narrow range of wavelengths.
B The selective response by the cones to a narrow range of wavelengths.
C The selective response by the rods to a narrow range of wavelengths.
D All of the above.

QUESTION 17
Selection occurs in:

A The visual cortex.
B The photoreceptors.
C The photoreceptors and in the visual cortex.
D The eye and the brain.

QUESTION 18
Explain why interpretation in visual perception is dependent upon the process of organisation.

QUESTION 19
Which of the following statements about organization in visual perception is **incorrect**?

A Organisation is dependent both on visual perception principles and subjective factors like prior experience.

B Organisation involves the reassembling of elements or features of a visual stimulus into a meaningful shape using grouping principles.

C Organisation is the detection and coding of particular features of a stimulus such as size, colour and movement.

D Organisation takes place in the brain.

TASK

Draw a very simple diagram of the visual system in the space below. Have your diagram extend from the eyes, to the optic nerves which exit from the backs of both eyes, to the brain. Then label where each stage in visual sensation and visual perception occurs. For example, at the retina you would draw photoreceptors and label reception, transduction, and the beginning of transmission (where information exits from the back of the eye at the beginning of the optic nerve) because these processes occur at the level of the photoreceptors and the eye.

VISUAL PERCEPTION PRINCIPLES

GROUP ONE – GESTALT PRINCIPLES

Figure-ground organisation is where we distinguish 'figure' from 'ground' (background). Figure has contour and meaning; while ground is without form and contour, is meaningless and appears as behind the figure (P198). (**Be aware** that camouflage deliberately makes separation of figure-ground difficult because it blends similar patterns in the figure and the background making it difficult to discern a contour.)

For Example: _____

_____

_____

Proximity (or nearness) is where stimuli that are **near each other** tend to be grouped together and **perceived as a whole**, separate and different to stimuli further away. (P202)

For Example:_____

_____

_____

Similarity is where stimuli **similar in size, shape, colour or texture** are perceived as belonging together, **grouped to form a meaningful whole**. (P201)

For Example: _____

_____

_____

Closure refers to our strong tendency to mentally **complete an incomplete** figure so it is perceived as a **meaningful and complete form or whole**. (P200)

For Example: _____

_____

QUESTION 20
What is the name of a special figure which allows figure **or** ground to be perceived as valid alternatives?

_____

_____

QUESTION 21
In figure-ground organisation the contour always belongs to the _____.

QUESTION 22
When viewing a portrait we tend to focus on the image of the person which we see as standing out against the background. This is an example of _____ known as _____.

A A depth cue, similarity.
B A Gestalt principle, similarity.
C A depth cue, figure ground organisation.
D A Gestalt principle, figure ground organisation.

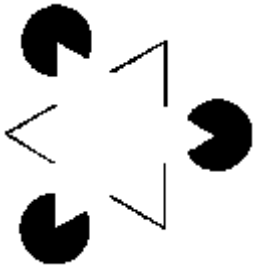
QUESTION 23
Pietro was employed as a security guard at the football and was stationed at the top of the main stand which gave him a good view of the entire stadium. When looking out at the crowd he was able to see groups of people all wearing the same colours and therefore perceived these as belonging together as supporters of a particular team. This tendency to perceive the spectators as groups of supporters rather than individuals is an example of the Gestalt principle of:

A Proximity.
B Similarity.
C Closure.
D Interposition.

QUESTION 24
Pietro was also able to see two groups of players huddled together at each end of the oval. He assumed that the members of each group belonged to a particular team. This tendency to perceive the players as a team rather than individuals is an example of the Gestalt principle of:

A Proximity.
B Similarity.
C Closure.
D Interposition.

QUESTION 25
Pietro noticed the shape below on one of the billboards and perceived this incomplete figure as a star. This tendency to mentally close in the gaps in the figure to form a complete image is an example of the Gestalt principle of:



(Fultz)

A Similarity.
B Closure.
C Interposition.
D Proximity.

GROUP 2 – DEPTH PRINCIPLES

	Monocular Depth Cues	Binocular Depth Cues
Internal Cues	Accommodation.	Retinal disparity. Convergence.
Pictorial Cues **(external – and all monocular)**	Interposition. Linear perspective. Texture gradient. Relative size. Height in the visual field.	

Depth perception is the ability to see three-dimensional space and accurately judge distance, using perceptual cues from the environment (external) or from within the body (internal). Depth cues that operate on internal information are primary depth cues while those that rely on external information are secondary depth cues.

The visual cliff provides evidence that depth perception is partly learned and partly innate (4 months in humans).

Adults perceive depth cues which can be **monocular cues** (only require the use of one eye) or **binocular cues** (only operating when two eyes are used); and **internal cues** (from within the body) or **external cues** (from the environment).

Accommodation (monocular cue) involves adjustment in the shape of the lens in response to different viewing distances in order to focus an image of an object of view on the retina. Information about movement in the ciliary muscles and the shape of the lens provides the brain with information enabling it to assess the depth and/or distance of an object from the viewer. The lens elongates to focus on distant objects, and bulges to focus on closer objects (P208). It enables continual focus on objects which are moving, even those moving very quickly. (P208)

Convergence (a binocular cue) operates when the eyes **turn (not move)** inwards to keep an object of view focused close to the fovea. The brain is able to judge that the greater the tension on the muscles **turning** the eyes, the closer the object is to the viewer. It will only work as a depth cue if the object of view is within a distance of 6 - 7 metres. (P206)

Retinal disparity (a binocular cue) occurs when the eyes, which are 6 - 7 cm apart, present separate images of the world to the brain which compares them and merges them into a three-dimensional perception. There is **greater** difference (disparity) between the two retinal images of objects viewed at closer ranges, and **less** difference between the two retinal images of objects viewed from a distance. (P204)

(**Note:** Remember the numbers 6 & 7 when discussing binocular depth cues. Convergence occurs within a distance of 6 – 7 metres, retinal disparity is due to the 6 – 7 cm gap between the eyes.)

QUESTION 26
Provide an example of a primary depth cue and a secondary depth cue.

Primary _____

Secondary _____

QUESTION 27
Explain, using specific examples, the difference between a monocular and a binocular depth cue.

Monocular
_____
_____

Example
_____
_____

Binocular
_____
_____

Example
_____
_____

QUESTION 28
Oscar is a keen cricketer and particularly enjoys batting. When batting he keeps his eye on the ball and is able to tell from internal cues when the ball is close enough for him to hit it.

(a) **Identify** the depth cue that Oscar is using in this situation.

_____

_____

_____

(b) **Describe** how this process occurs.

_____

_____

_____

(c) **Explain** how this provides information about depth and distance.

_____

_____

_____

QUESTION 29
Retinal disparity occurs when an object we are viewing is:

A More than ten metres from the viewer.
B Less than ten metres from the viewer.
C Approximately six metres from the viewer.
D Approximately six centimetres from the viewer.

QUESTION 30
The monocular depth cue of accommodation occurs due to the action of which anatomical feature?

A The retina.
B The lens.
C The cornea.
D The pupil.

PICTORIAL DEPTH CUES

(EXTERNAL AND ALL MONOCULAR)

Relative size refers to the inclination to perceive the object producing the larger retinal image as closest to us, and the smaller object as more distant. **Is only effective as a depth cue when two or more similar sized and familiar objects can be compared**. (P214)

For Example: _____

_____

_____

Interposition or overlap occurs when one object obscures part of another. The partially obscured object is perceived as more distant than the one obscuring it. (P212)

For Example: _____

_____

_____

Texture gradient: Refers to changes in texture which occur on surfaces as they move into the distance. Clear, fine detail diminishes with distance. (P213)

For Example: _____

_____

_____

Linear perspective refers to the appearance of depth caused by the **seeming convergence** of parallel lines as they move into the distance. (P211)

For Example: _____

_____

_____

Height in the visual field refers to the perception that objects **close to the horizon** are more distant than those further away from it. Objects on ground **below** horizon get **higher** in visual field and appear smaller as they move toward horizon; while objects in sky **above** horizon get **lower** in visual field and appear smaller as they move toward the horizon. (P214)

For Example: _____

_____

_____

QUESTION 31
In the space below draw a picture to illustrate the five pictorial depth cues studied in Unit 3. (Rough sketch is OK).

QUESTION 32
How would you use relative size to convey depth in a painting?

_____

_____

_____

_____

QUESTION 33
Under what condition/s will relative size fail to operate as a depth cue?

_____

_____

QUESTION 34
How is the pictorial depth cue texture gradient used to imply depth?

_____

_____

_____

_____

QUESTION 35
In a painting of a herd of cows in a field, a cow that is drawn in the foreground and partially obscuring another will be perceived as being closer to the viewer. This is an example of:

A Height in the visual field.
B Interposition.
C Texture gradient.
D Relative size.

QUESTION 36
Using the above example, cows drawn closer to the horizon will be perceived as being further away than cows drawn further from the horizon. This is an example of:

A Height in the visual field.
B Interposition.
C Texture gradient.
D Relative size.