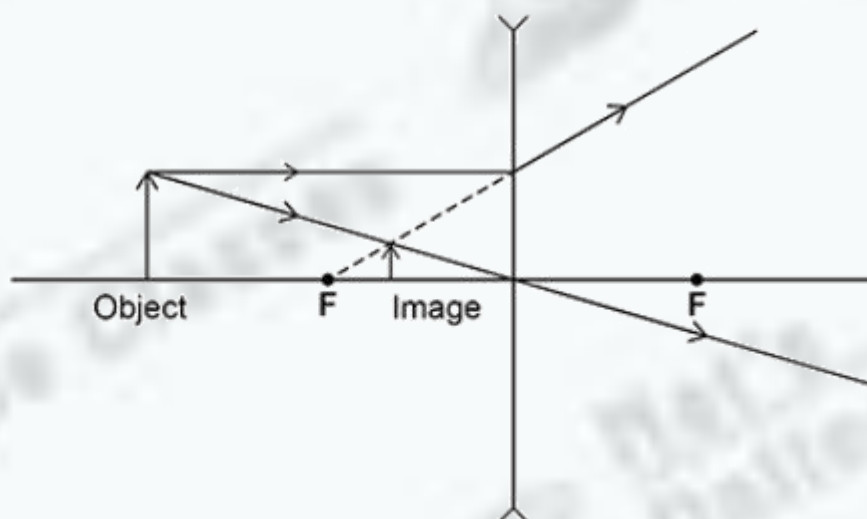## Question: 1

Lenses are used to form images of objects.

(a)   **Figure 1** shows how a concave lens forms an image of an object.

Figure 1

The image of the object in **Figure 1** is upright.

Give **two** other words that describe the image.
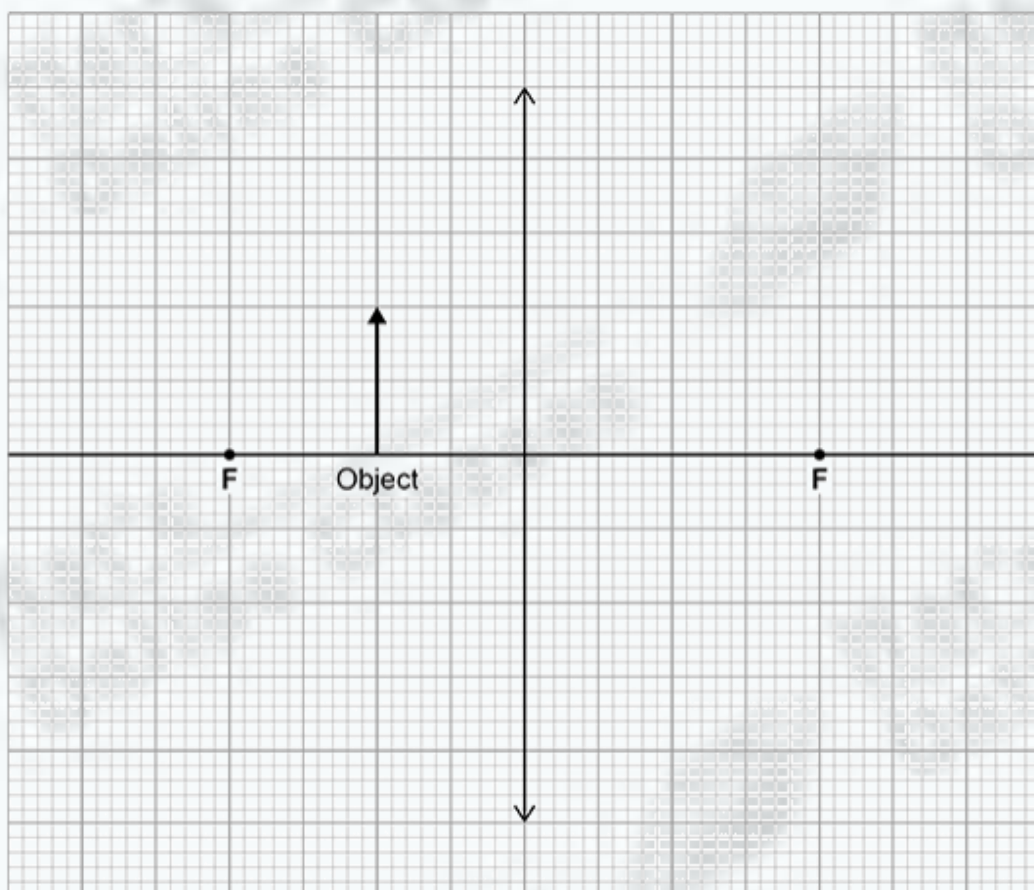
1 _____

2 _____

(1)

(b)   **Figure 2** shows an object near to a **convex** lens.

Complete the ray diagram to show how the image is formed.

Use an arrow to represent the image.
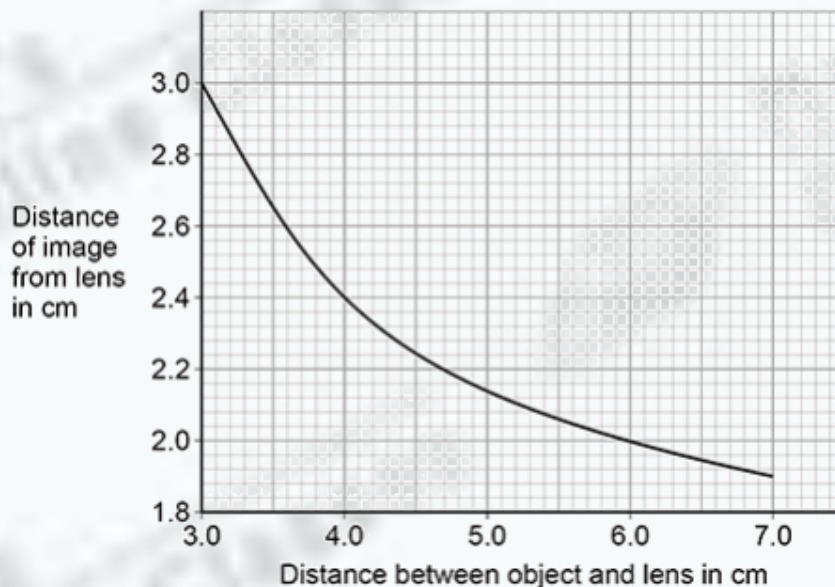
Figure 2

(3)

The position of an image formed by a convex lens varies with the distance between the object and the lens.

Figure 3 shows the results of a student's investigation using a convex lens.

Figure 3

(c) Describe how the distance of the image from the lens decreases as the distance between the object and the lens increases.

_____

(1)

(d) The student measured the distance from the image to the lens four times.

The distance between the object and the lens did not change.

The 4 measurements from the image to the lens were:

 1.9 cm   1.7 cm   2.2 cm   1.4 cm

Calculate the uncertainty in the measurements.
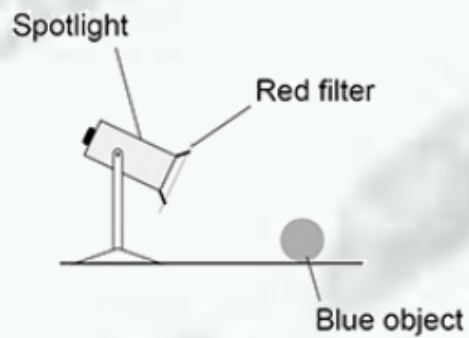
_____

_____

_____

Uncertainty = ± _____ cm

(2)

(e) **Figure 4** shows a spotlight containing a convex lens.

A red filter is placed in front of the spotlight.

The spotlight is directed at a blue object.

Figure 4

Explain why the blue object appears black.

(3)

Mark Scheme

(a) **both** answers correct

        answers may be in either order

  virtual

  diminished

   *allow a description of diminished (eg smaller / reduced)*

    1

(b) any **two** correct lines drawn from the top of the object, passing through the lens and traced backwards

        allow construction lines that are not dashed

        *allow 1 mark for **two** correct lines drawn from the top of the object, passing through the lens BUT not traced backwards*

    2

image drawn in the correct position and with the correct orientation
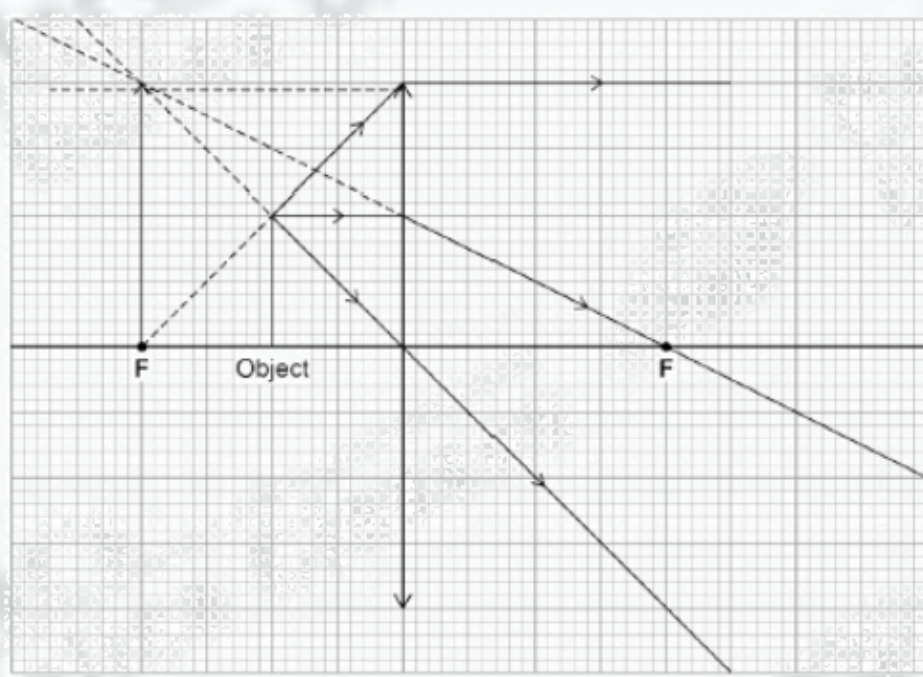
        mark only scores if first two marks score

    1

(c) (increasing the object distance) decreases the image distance more rapidly at small (object) distances / more gradually at larger (object) distances

        *do **not** accept inversely proportional*

    1

(d) $\dfrac{(2.2 - 1.4)}{2}$

                          1

    uncertainty = (±) 0.4 (cm)

        allow

        $\dfrac{1.9 + 1.7 + 2.2 + 1.4}{4} = 1.8$ (1)

        (2.2 – 1.8 =) (±) 0.4 (cm)   (1)

                          1

(e)   only red is transmitted by the filter

                          1

    red is absorbed by the (blue) object

                          1

    (so) no light is reflected by the (blue) object

                          1

Question: 2

Ultraviolet is a type of electromagnetic wave.

(a)   Give **one** use of ultraviolet.

_____

                        (1)

(b)   An ultraviolet wave has a wavelength of 300 nanometres.

Which of the following is equal to 300 nanometres?

Tick (✓) **one** box.

3×10^7 m ☐

3×10^{-7} m ☐

3×10^9 m ☐

3×10^{-9} m ☐

(1)

(c)   The speed of ultraviolet waves is 3×10^8 m/s.

Calculate the frequency of the ultraviolet wave.

Use your answer to part (b)

_____

_____

Frequency = _____ Hz

(3)

(d)　The table below gives the wavelength of an ultraviolet wave and three other electromagnetic waves.

	Ultraviolet	Wave E	Wave F	Wave G
Wavelength in nanometres	300	0.1	600	100 000

Draw **one** line from each wave to the name of the wave.

Wave   Name

Wave E	Infrared

Wave F	Visible light

Wave G	X-rays

(1)

(e)　Electromagnetic waves are transverse.

Some other types of wave are longitudinal.

Describe the difference between transverse and longitudinal waves.

_____

_____

(2)

Mark Scheme

(a)   any **one** from:
- (sun) tan
- energy efficient lamps

       allow
- *(invisible) security coding*
- *detecting forged bank notes*
- *kill microbes*
- *attract insects*
- *sterilise (surgical) equipment*
- *cause the body to produce vitamin D*
- *increasing the growth rate of plants*
- *water purification*

                                                                                        1

(b) 3×10^{-7} m

                                                                                        1

(c) $3.0 \times 10^8 = \text{frequency} \times 3 \times 10^{-7}$

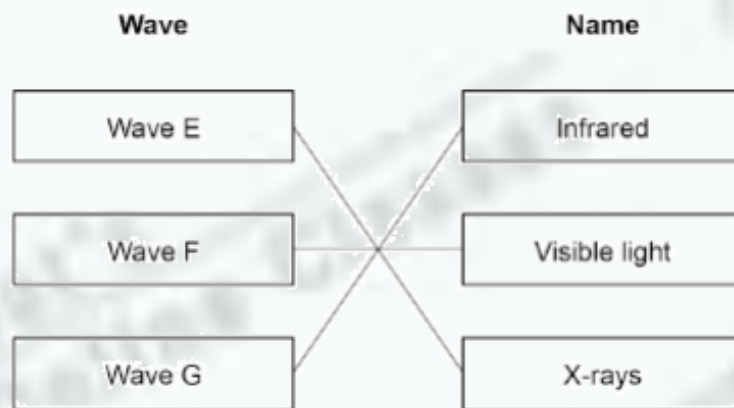   *allow ecf from part (b)*

                                                                                        1

$$\text{frequency} = \frac{3.0 \times 10^8}{3 \times 10^{-7}}$$

                                                                                        1

frequency = 1×10^{15} (Hz)

                                                                                        1

(d)

Wave	Name
Wave E	Infrared
Wave F	Visible light
Wave G	X-rays

Wave E → Visible light, Wave F → Visible light, Wave G → Infrared (crossing lines)

all three lines correct for **1** mark

1

(e) in a transverse wave, the oscillations / vibrations are perpendicular to the direction of energy transfer

allow direction of wave travel for direction of energy transfer

1

in a longitudinal wave, the oscillations / vibrations are parallel to the direction of energy transfer

1