Write your name here

Surname	Other names

Pearson Edexcel Level 3 GCE

Centre Number	Candidate Number

Physics

Advanced Subsidiary
Paper 2: Core Physics II

Sample Assessment Materials for first teaching September 2015
Time: 1 hour 30 minutes

Paper Reference
8PH0/02

You may need the Formulae Sheet, a calculator, protractor and a ruler.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions in Sections A and B.
- Answer the questions in the spaces provided – *there may be more space than you need.*

Information

- The total mark for this paper is 80.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*
- You may use a scientific calculator.
- In questions marked with an *****, marks will be awarded for your ability to structure your answer logically showing how the points that you make are related or follow on from each other where appropriate.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.
- You are advised to show your working in calculations including units where appropriate.

Turn over ▶

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SECTION A

Answer ALL questions.

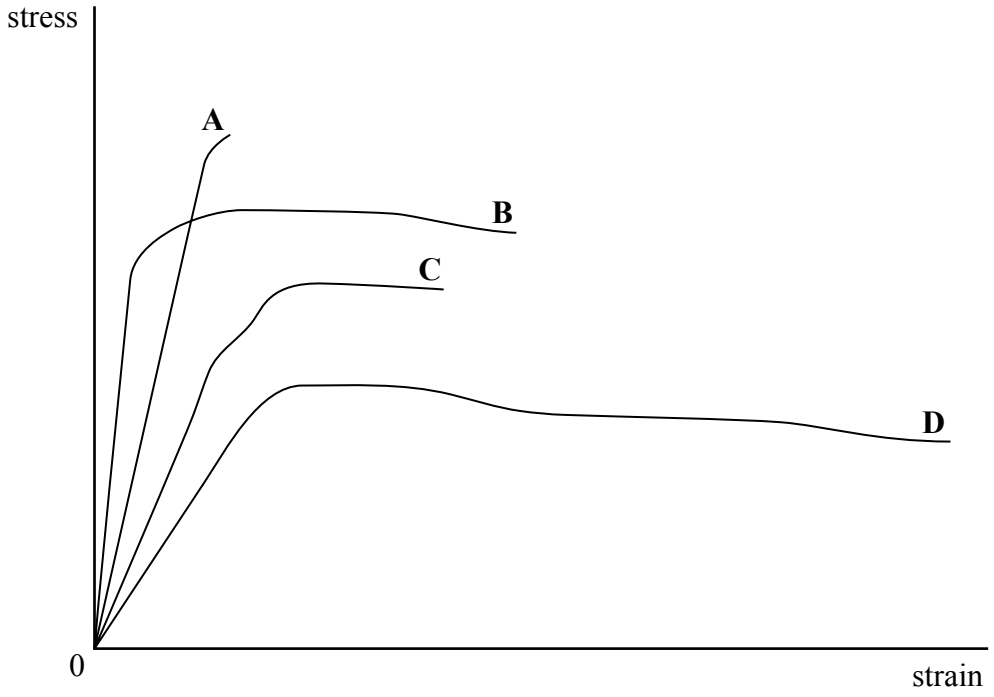
All multiple choice questions must be answered with a cross ☒ in the box for the correct answer from A to D. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 Which of the following would increase the amount of detail (resolution) in an ultrasound scan?

- ☒ **A** faster wave speed
- ☒ **B** larger wavelength
- ☒ **C** lower frequency
- ☒ **D** shorter pulses

(Total for Question 1 = 1 mark)

2



Which of the materials represented in the graph has the largest value of the Young Modulus?

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for Question 2 = 1 mark)

3 Light passes between medium X and medium Y.

Speed of light in X = 2.00×10^8 m s^{-1}

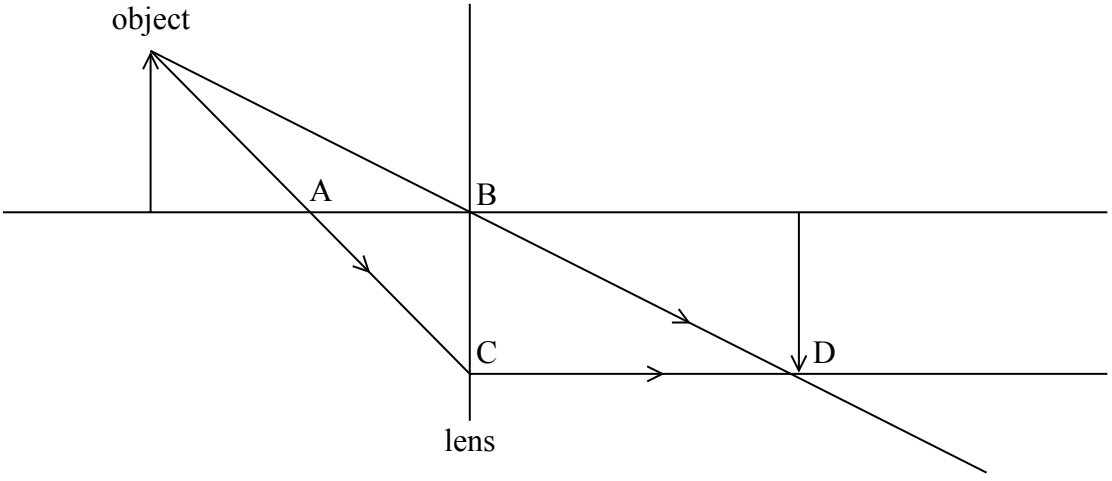
Speed of light in Y = 2.25×10^8 m s^{-1}

Which line of the table correctly shows what happens to the frequency and wavelength of the light as light passes from medium X to medium Y?

	Frequency	Wavelength
☒ **A**	decreases	increases
☒ **B**	increases	decreases
☒ **C**	unchanged	increases
☒ **D**	unchanged	decreases

(Total for Question 3 = 1 mark)

4 The diagram shows how an image is formed by an object that is placed a small distance from a thin converging lens.



Which of the labels A, B, C or D represents the focal point of the lens?

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(Total for Question 4 = 1 mark)

5 The viscosity of fluids varies with temperature.

Which line of the table correctly shows the change in viscosity with increasing temperature?

	Oil	Dry air
☒ **A**	decreases	decreases
☒ **B**	decreases	increases
☒ **C**	increases	decreases
☒ **D**	increases	increases

(Total for Question 5 = 1 mark)

6 In everyday life the effect of diffraction is more significant for sound than for light.

This is because

☒ **A** light has a much shorter wavelength than sound.

☒ **B** light is a transverse wave but sound is a longitudinal wave.

☒ **C** light is an electromagnetic wave but sound is a mechanical wave.

☒ **D** the speed of light in air is much higher than the speed of sound.

(Total for Question 6 = 1 mark)

7 Two waves have the same amplitude and are travelling in the same medium.

The two waves can produce a standing wave if they

☒ **A** have different frequencies and travel in opposite directions.

☒ **B** have different frequencies and travel in the same direction.

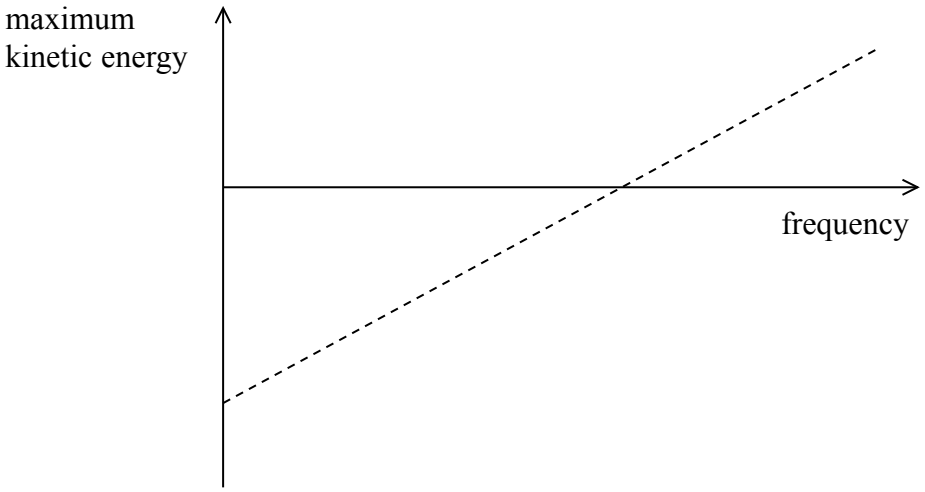
☒ **C** have the same frequency and travel in opposite directions.

☒ **D** have the same frequency and travel in the same direction.

(Total for Question 7 = 1 mark)

8 In an investigation of the photoelectric effect, a metal plate is illuminated with light of different frequencies.

The graph shows the maximum kinetic energy of emitted electrons at different frequencies.



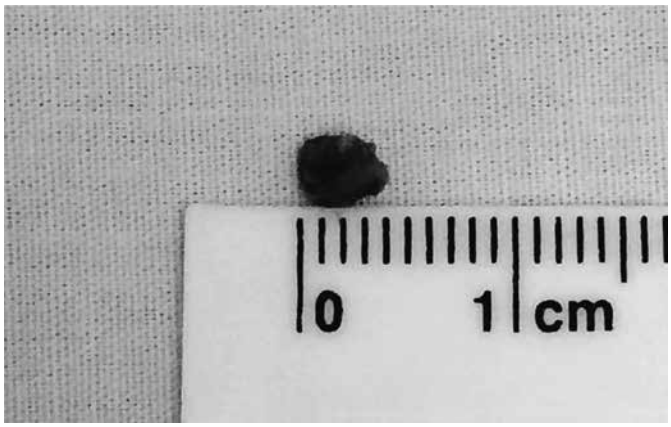
Which line of the table correctly shows the values given by the graph?

		***x* intercept**	**negative *y* intercept**
☒	**A**	Planck constant	work function
☒	**B**	threshold frequency	Planck constant
☒	**C**	threshold frequency	work function
☒	**D**	work function	threshold frequency

(Total for Question 8 = 1 mark)

9 Kidney stones can form from the deposit of minerals in a human kidney.

The photograph shows a kidney stone that has been removed from a hospital patient.



This kidney stone was detected using pulses of ultrasound.
The ultrasound used to detect this kidney stone had a frequency of 2.5 MHz.

Justify whether this was a suitable frequency for detecting this kidney stone.

Speed of sound in body tissue = 1500 m s^{-1}

(Total for Question 9 = 4 marks)

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TURN OVER FOR QUESTION 10

10 (a) Electromagnetic radiation can be polarised.

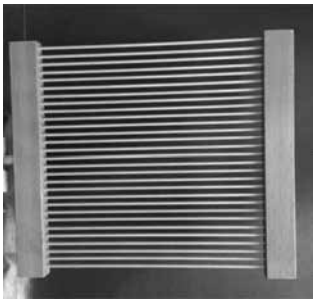
Describe what happens during the polarisation of an electromagnetic wave.

(3)

(b) The photograph shows a filter for microwave radiation.

The filter is placed between a microwave source and a detector, which detects a strong signal.

When the filter is rotated by 90° about a horizontal axis to the position shown below, the detected signal falls from a maximum to zero.



Explain this observation.

(3)

(Total for Question 10 = 6 marks)

11 A student carries out an experiment to determine the viscosity of a liquid. To do this, she takes measurements to determine the terminal velocity of a solid sphere falling through the liquid.

The data needed for such an experiment is:

weight of sphere = 4.8×10^{-3} N
radius of sphere = 2.5×10^{-3} m
volume of sphere = 6.5×10^{-8} m^3
density of liquid = 1300 kg m^{-3}

(a) Show that the upthrust on the sphere is about 8×10^{-4} N.

(3)

(b) The student calculates that the terminal velocity is 4.6×10^{-3} m s^{-1}.

Use this value to calculate the viscosity of the liquid in kg m^{-1} s^{-1}.

(3)

Viscosity = ... kg m^{-1} s^{-1}

(Total for Question 11 = 6 marks)

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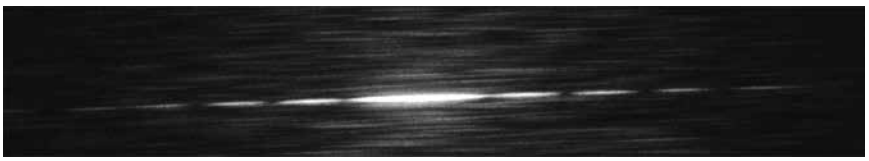
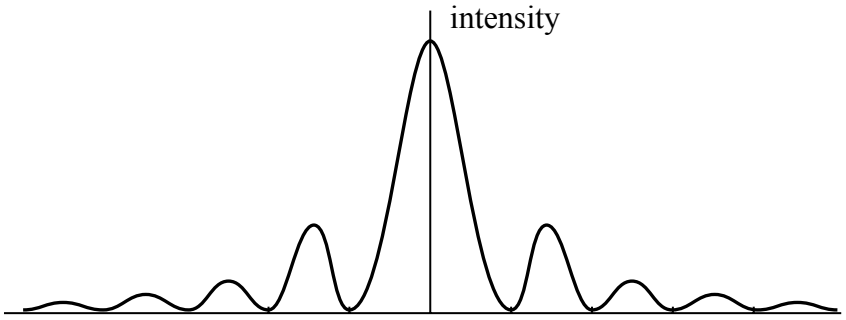
TURN OVER FOR QUESTION 12

12 A student obtains the following diffraction pattern on a wall by shining a red laser beam through a single narrow slit.

The corresponding graph of intensity against position is shown below.





(a) Explain how the diffraction pattern is created.

(3)

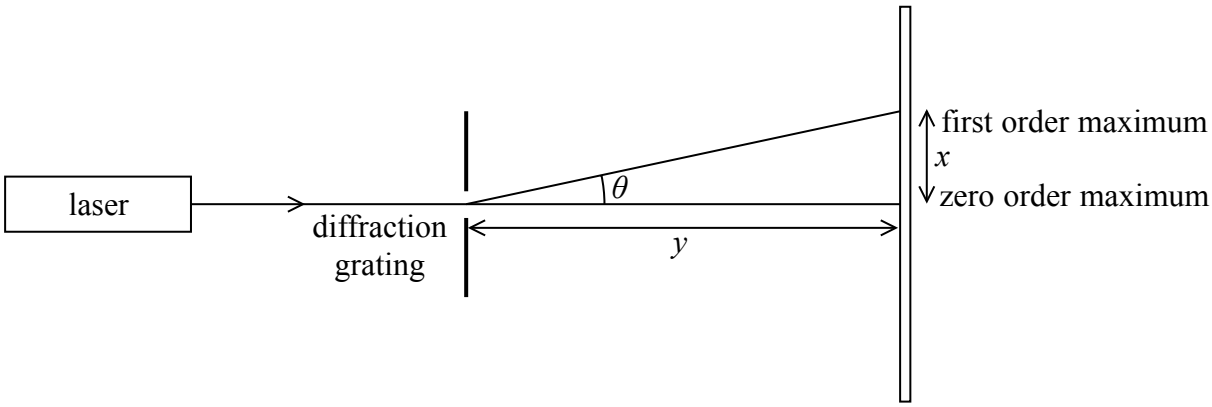
(b) Explain how the pattern would differ if green laser light were used instead of red laser light.

(3)

(c) A student replaces the single slit with a diffraction grating and obtains the pattern shown in the photograph.

The photograph shows the zero order maximum and the first and second orders on either side.

The student takes measurements to determine the grating spacing.



The student measures x, the distance between the zero order maximum and the first order maximum, and y, the distance between the slit and the screen.

x = 23 cm
y = 1.5 m
Number of lines per millimetre = 300

Calculate the wavelength of light from the laser.

(3)

Wavelength = ...

(Total for Question 12 = 9 marks)

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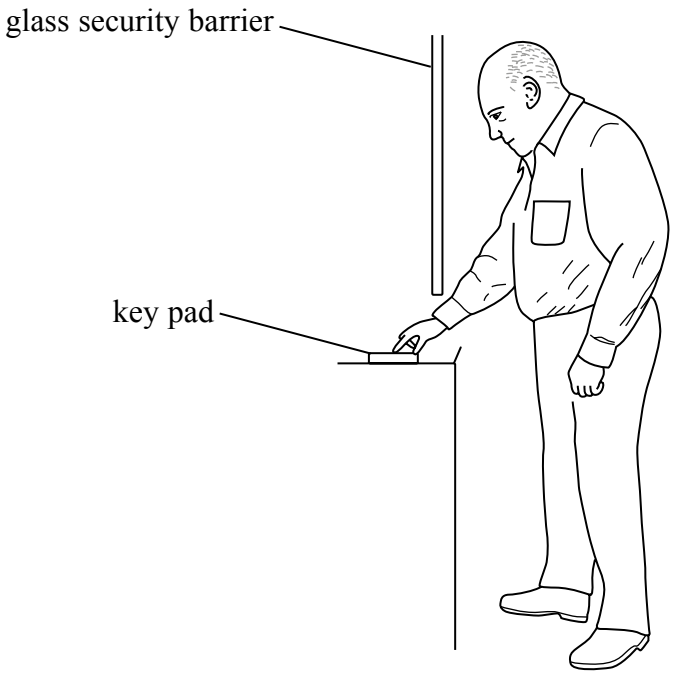
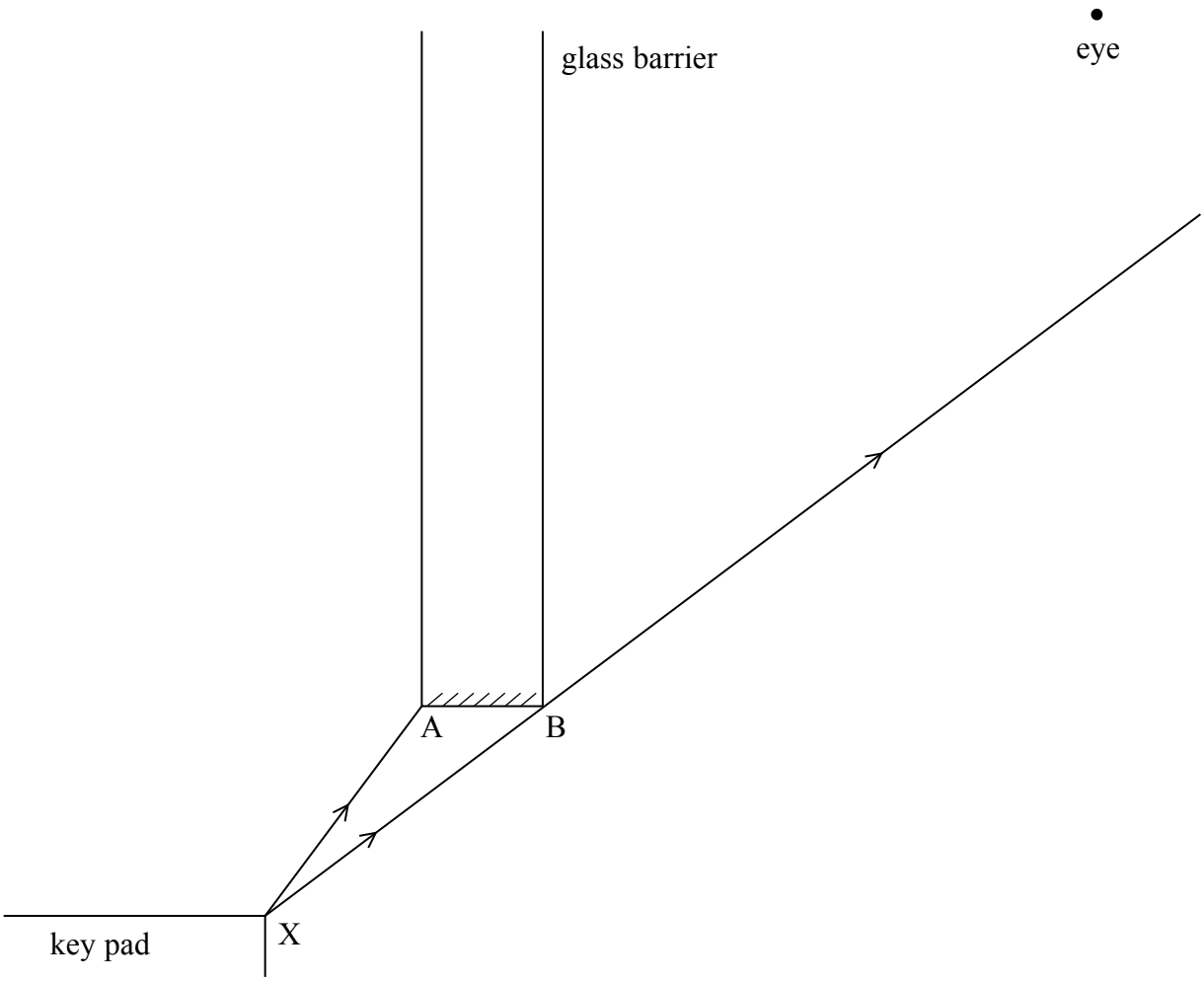
13 A motorist pays for petrol at a filling station using a bank card for which a personal identification number must be entered on a key pad.

There is a thick sheet of glass between the cashier and the motorist, with a gap at the bottom to give access to the key pad.



When standing as shown in the diagram, refraction of light through the glass means that the motorist is unable to see the key pad without moving his head to see under the glass.

QUESTION 13 CONTINUES ON NEXT PAGE



(a) The diagram shows rays from the key pad. The light travelling initially along the path XA, which then passes through the glass, does not reach the motorist's eye. Assume no light passes through the surface AB.

(i) Measure the angle of incidence for the ray travelling along XA and calculate the angle of refraction in the glass.

refractive index of glass = 1.5

(3)

(ii) Add to the diagram to show that light travelling initially along the path XA does not reach the eye of the motorist.

(1)

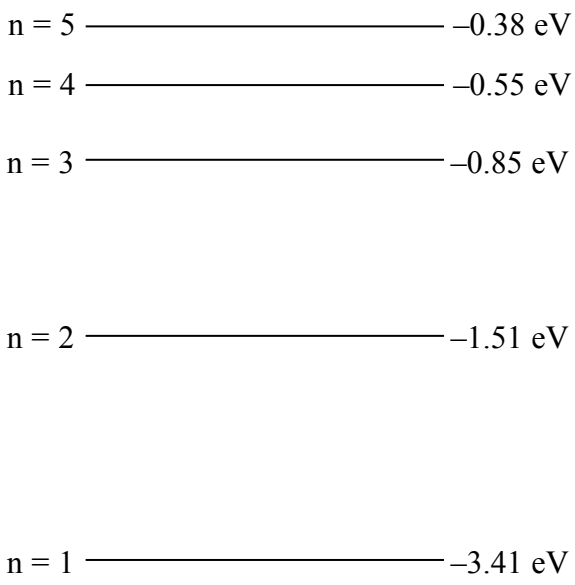
*(b) The refractive index of glass may be determined by measuring angles of incidence and angles of refraction for light passing into a glass block.

Explain how the choice of the width of the ray of light and the range of the angles of incidence can ensure the accuracy of the result.

(6)

(Total for Question 13 = 10 marks)

14 The diagram represents some of the energy levels for an atom.



(a) Calculate the lowest frequency of light that would be absorbed by an electron with energy –0.85 eV in the atom shown.

(3)

Frequency = ...

(b) When the light from a star is dispersed to form a spectrum, dark lines are seen at a number of frequencies. This is known as an absorption spectrum and is caused by the presence of certain elements in the star.

Explain how the absorption spectrum is created.

(3)

(Total for Question 14 = 6 marks)

15 The photograph shows a child's nature observation kit used for observing small creatures such as flies.

The lid has a built-in lens and an additional optional lens to allow the magnification to be increased.

The photographs below show the appearance of a fly using no lens, a single lens and two lenses respectively.

(a) A student reads that the power of a combination of lenses is equal to the sum of the powers of the individual lenses.

$$\text{power}_{\text{combination}} = \text{power}_{\text{lens1}} + \text{power}_{\text{lens2}}$$

The student investigates this relationship using the lenses in the observation kit.

The student records the method and measurements as shown below.

Method

Set up a bulb on one side of the laboratory.
Hold the lens near the opposite wall and vary the distance from the wall until a clear image of the bulb is seen on the wall.
With the other hand, use a ruler to measure the distance of the lens from the clear image formed.
This is the focal length.

Results

Lens	Focal length/cm
Lens in the lid	12
Optional lens	17.5
Combination of both lenses	7

The distance between the light and the opposite wall was 6 m.

(i) Explain **one** way of improving the value obtained for the focal length of the lens.

(2)

(ii) Determine whether the data from this experiment supports the conclusion

$$\text{power}_{\text{combination}} = \text{power}_{\text{lens1}} + \text{power}_{\text{lens2}}$$

Support your answer with a calculation.

(4)

(b) The distance of an object from the combined lenses is 5.0 cm.

Calculate the magnification of the lens.

Focal length = 7.0 cm.

(3)

Magnification = ...

(Total for Question 15 = 9 marks)

TOTAL FOR SECTION A = 58 MARKS

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SECTION B

Answer ALL questions.

16 Read the following press release and then answer the questions that follow.

"Lockheed Martin Demonstrates Weapons Grade High Power Fiber Laser

BOTHELL, Wash., Jan. 28, 2014 – Lockheed Martin has demonstrated a 30-kilowatt electric fiber laser, the highest power ever documented while retaining beam quality and electrical efficiency.

The internally funded research and development program culminated in this demonstration, which was achieved by combining many fiber lasers into a single, near-perfect quality beam of light – all while using approximately 50 percent less electricity than alternative solid-state laser technologies. The unique process, called Spectral Beam Combining, sends beams from multiple fiber laser modules, each with a unique wavelength, into a combiner that forms a single, powerful, high quality beam."

(Source: Lockheed Martin Demonstrates Weapons Grade High Power Fiber Laser Wash Bothell, Jan 28, 2014)

Traditional solid state lasers convert about 20% of electrical input energy to light output.

(a) The high power laser uses Spectral Beam Combining involving several beams with different wavelengths instead of a system using coherent beams.

Explain how combining coherent beams could lead to zero intensity in some parts of the combined beam.

(3)

(b) A student uses a laser pointer to measure the internal resistance of a cell.
The laser uses a battery of three small cells.
The student obtains the following results:

Laser switched off	
Potential difference across cells	4.1 V
Current in cells	0 mA
Laser switched on	
Potential difference across cells	3.7 V
Current in cells	14 mA

(i) Calculate the internal resistance of the battery of cells.

(2)

.....

.....

.....

Internal resistance = ...

(ii) The student notices that the manufacturer of the laser pointer claims it is as efficient as industrial lasers. At a distance of several metres the laser pointer produces a circular spot of diameter 6 mm and intensity 140 W m^{-2}.

Max power output < 5mW

Use this data and the data in the passage to evaluate the manufacturer's claim.

(5)

(Total for Question 16 = 10 marks)

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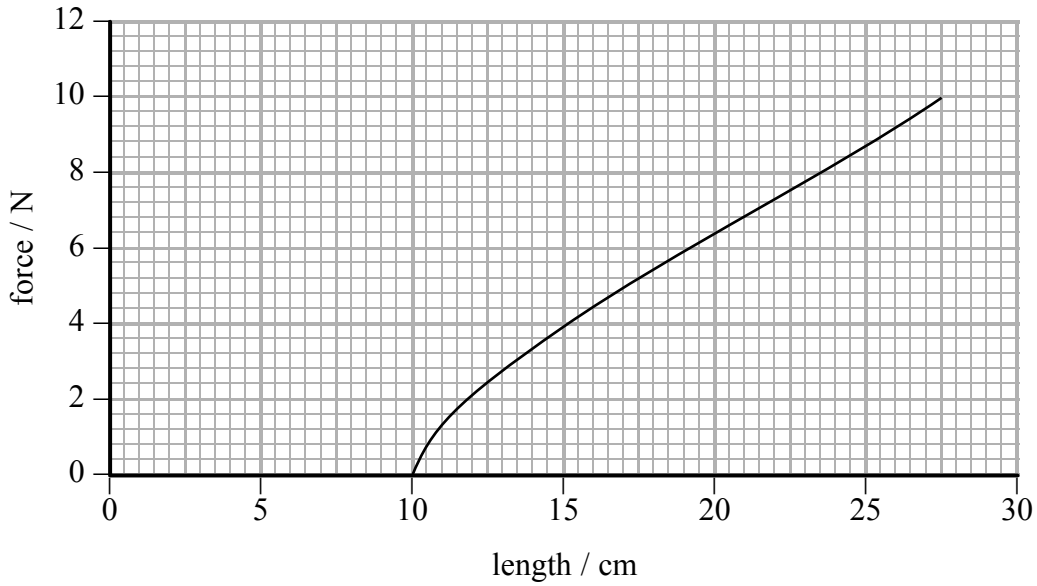
17 The photograph shows a toy that fires rubber bands.

A student investigates the properties of one of the rubber bands and obtains the following graph.



(a) The student wants to determine the mass of one of the rubber bands. He places five rubber bands on a balance and obtains a reading of 2 g. He divides the reading on the balance by five to determine the mass of one rubber band.

Explain how he could improve his result.

(3)

(b) The rubber band is stretched by 17.4 cm when it is placed on the toy.

Show that the work done on the rubber band is about 1 J.

(3)

(c) Calculate the maximum possible value for the initial velocity of the rubber band as it is fired from the toy. Assume the mass of a rubber band is 0.4 g.

(2)

Maximum initial velocity = ...

(d) The student thinks the calculated value of maximum velocity is too high because the band does not travel as far as expected.

Explain how the student could determine the initial velocity with the use of a video camera and why light gates would not be suitable.

(4)

(Total for Question 17 = 12 marks)

TOTAL FOR SECTION B = 22 MARKS
TOTAL FOR PAPER = 80 MARKS

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