

**AS Level Physics B (Advancing Physics)**  
**H157/01 Foundations of physics**  
Practice Question Paper

**Date – Morning/Afternoon**

Time allowed: 1 hour 30 minutes



**You must have:**

- the Data, Formulae and Relationships Booklet

**You may use:**

- a scientific calculator



<b>First name</b>										
<b>Last name</b>										
<b>Centre number</b>						<b>Candidate number</b>				

**INSTRUCTIONS**

- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Write your answer to each question in the space provided.
- Additional paper may be used if required but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

**INFORMATION**

- The total mark for this paper is **70**.
- The marks for each question are shown in brackets [ ].
- This document consists of **20** pages.

## SECTION A

You should spend a maximum of 25 minutes on this section.

You should put the letter of the correct answer in the box provided.

Answer **all** the questions.

- 1 Here is a list of combinations of base units of the SI system.  
Which combination gives the correct units of momentum?

- A  $\text{kg m s}^{-1}$   
B  $\text{kg m s}^{-2}$   
C  $\text{kg m}^{-1} \text{s}^{-2}$   
D  $\text{kg m}^{-2} \text{s}^{-2}$

Your answer

[1]

- 2 Here is a list of combinations of base units of the SI system.  
Which combination of units is equivalent to pascal, Pa?

- A  $\text{kg m s}^{-1}$   
B  $\text{kg m s}^{-2}$   
C  $\text{kg m}^{-2} \text{s}^{-2}$   
D  $\text{kg m}^{-1} \text{s}^{-2}$

Your answer

[1]

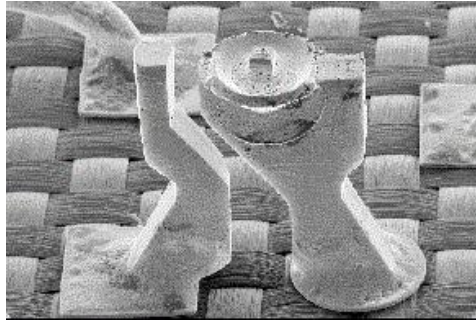
- 3 Polythene, a polymer, is strong and flexible. Which one of the following statements is correct?

- A All polymers are flexible.  
B Polymers do not extend plastically.  
C The bonds in polythene molecules can rotate as the material is stretched.  
D Mobile dislocations weaken polymers.

Your answer

[1]

- 4 The image shown is of an LED and is  $290 \times 195$  pixels. 6 bits per pixel are used for the greyscale levels.



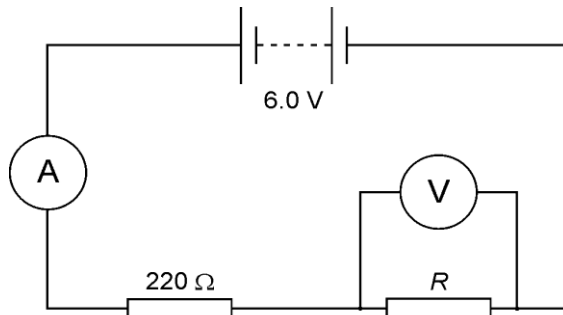
What is the best estimate for the total information in bytes in the uncompressed image?

- A  $2^6$
- B  $4.2 \times 10^4$
- C  $5.7 \times 10^4$
- D  $3.4 \times 10^5$

Your answer

[1]

- 5 An unknown resistor  $R$  and a  $220 \Omega$  resistor are connected to a  $6.0 \text{ V}$  battery of negligible internal resistance as shown.



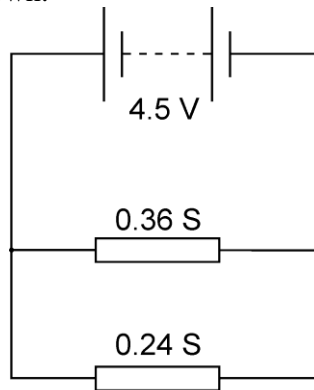
The reading on the voltmeter is  $4.1 \text{ V}$ .  
What should be the reading on the ammeter?

- A  $8.6 \text{ mA}$
- B  $13 \text{ mA}$
- C  $19 \text{ mA}$
- D  $27 \text{ mA}$

Your answer

[1]

- 6 Two conductors of conductances  $0.24 \text{ S}$  and  $0.36 \text{ S}$  are connected in parallel to a  $4.5 \text{ V}$  battery of negligible internal resistance as shown.



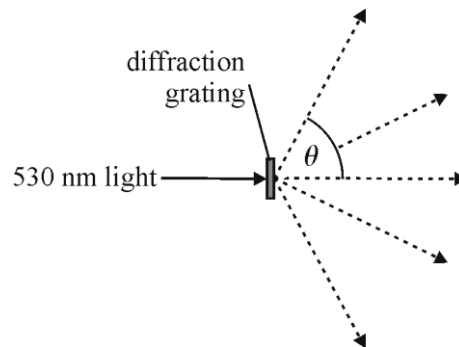
What is the power dissipated in the two conductors?

- A**  $2.9 \text{ W}$   
**B**  $4.9 \text{ W}$   
**C**  $7.3 \text{ W}$   
**D**  $12 \text{ W}$

Your answer

[1]

- 7 A diffraction grating which has  $830 \text{ lines mm}^{-1}$  is illuminated with light of wavelength  $530 \text{ nm}$ .



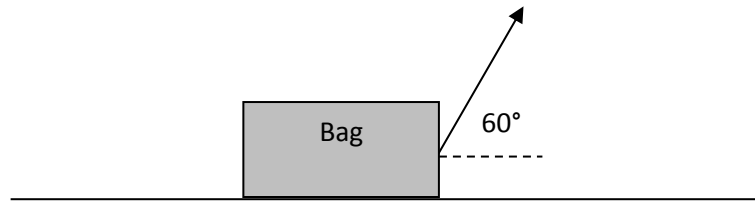
What is the angle  $\theta$  of the second-order diffraction maximum shown, expressed to two significant figures?

- A**  $0.46 \text{ rad}$   
**B**  $1.1 \text{ rad}$   
**C**  $26 \text{ rad}$   
**D**  $62 \text{ rad}$

Your answer

[1]

- 8 A bag weighing 50 N is pulled along the ground with a force of 20 N at an angle of  $60^\circ$  to the horizontal as shown in the diagram.



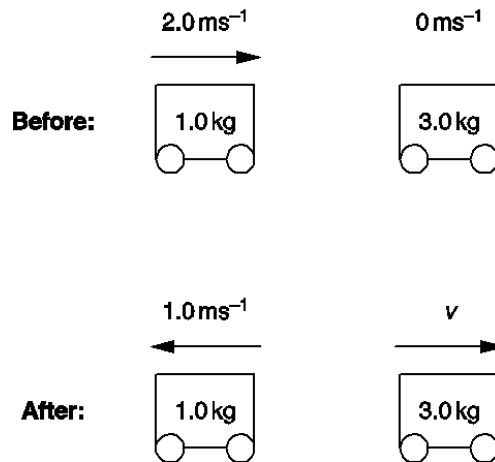
The bag is pulled through a horizontal distance of 6.0 m. How much work has been done pulling the bag?

- A 60 J  
 B 104 J  
 C 120 J  
 D 300 J

Your answer

[1]

- 9 The diagram shows the speed and direction of two trolleys before and after a collision:



What is the velocity,  $v$ , of the 3 kg trolley after the collision?

- A  $0.33 \text{ ms}^{-1}$   
 B  $1.0 \text{ ms}^{-1}$   
 C  $2.3 \text{ ms}^{-1}$   
 D  $3.0 \text{ ms}^{-1}$

Your answer

[1]

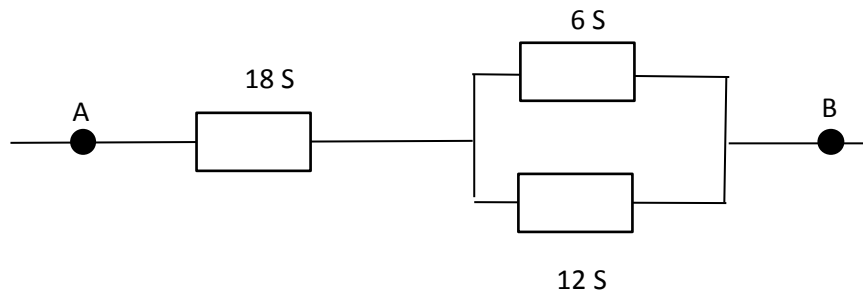
10 Which of these statements correctly describes the properties of a ceramic material?

- A Ceramics are hard, stiff and tough.
- B Ceramics are weak, stiff and ductile.
- C Ceramics are strong, stiff and brittle.
- D Ceramics are strong, flexible and tough.

Your answer

[1]

11 The diagram shows part of an electrical circuit. The conductances of the three components have been labelled.



What is the total conductance between **A** and **B**?

- A 9 S
- B 18 S
- C 22 S
- D 36 S

Your answer

[1]

12 A lamp is placed 0.50 m from a converging lens. The power of the lens is +5.0 D. What is the distance from the lens to the focused image?

- A 0.14 m
- B 0.20 m
- C 0.33 m
- D 0.45 m

Your answer

[1]

**13** A resistor  $R$  dissipates power  $P$  when a p.d.  $V$  is connected across it. How will the power dissipated change when both the resistance and the p.d. are halved?

- A** The power doubles
- B** The power remains the same
- C** The power halves
- D** The power quarters

Your answer

[1]

**14** A battery of e.m.f 6.0 V is connected to a  $4.0 \Omega$  resistor. The p.d. across the terminals of the battery is 5.8 V. What is the internal resistance of the battery?

- A**  $0.03 \Omega$
- B**  $0.05 \Omega$
- C**  $0.14 \Omega$
- D**  $0.16 \Omega$

Your answer

[1]

**15** An elastic spring, of force constant  $k = 200 \text{ N m}^{-1}$ , is extended by 7 cm. What is the energy stored in the spring at this extension?

- A** 0.49 J
- B** 0.98 J
- C** 7.0 J
- D** 14.0 J

Your answer

[1]

- 16** An electron of kinetic energy  $E$  has a de Broglie wavelength  $\lambda$ . What is the de Broglie wavelength of an electron of kinetic energy  $2E$ ?

- A**  $2\lambda$   
**B**  $\sqrt{2}\lambda$   
**C**  $\lambda/\sqrt{2}$   
**D**  $\lambda$

Your answer

[1]

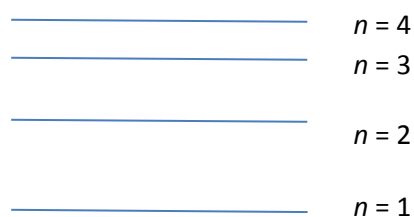
- 17** A wire of length 2.000 m extends to 2.005 m when a 19.6 N weight is hung from it. The diameter of the wire is 0.36 mm. What is the Young modulus of the material of the wire?

- A**  $3.5 \times 10^6$  Pa  
**B**  $1.4 \times 10^7$  Pa  
**C**  $1.9 \times 10^{10}$  Pa  
**D**  $7.7 \times 10^{10}$  Pa

Your answer

[1]

- 18** Figure 18 shows four electron energy levels. Photons are released when an electron drops from one level to another. How many different frequencies of photons can be released from transitions between the energy levels shown?



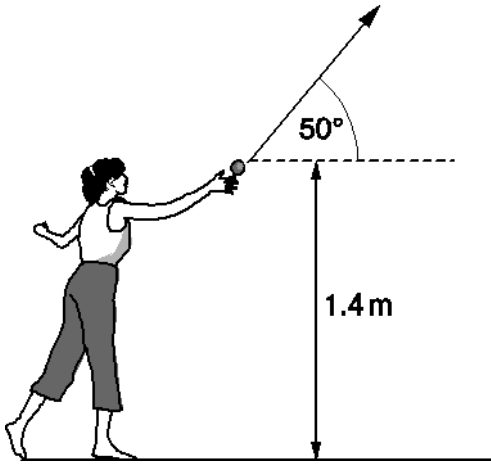
- A** 3  
**B** 4  
**C** 5  
**D** 6

Your answer

[1]



- 19 A ball is thrown at an angle of  $50^\circ$  from a height of 1.4 m with an initial velocity of  $15 \text{ m s}^{-1}$ . What is the maximum height reached by the ball?



- A 3.3 m  
B 4.7 m  
C 6.7 m  
D 8.1 m

Your answer

[1]

- 20 Which of these terms relates to the force per unit area at which a material begins to deform plastically?

- A Breaking stress  
B Breaking strain  
C Yield stress  
D Yield strain

Your answer

[1]

**SECTION B**

Answer **all** the questions.

- 21** The speed of light in a glass block is  $2.0 \times 10^8 \text{ m s}^{-1}$ . Calculate the angle of refraction in the glass for an angle of incidence in air of  $40^\circ$ .

$$c = 3.0 \times 10^8 \text{ m s}^{-1}$$

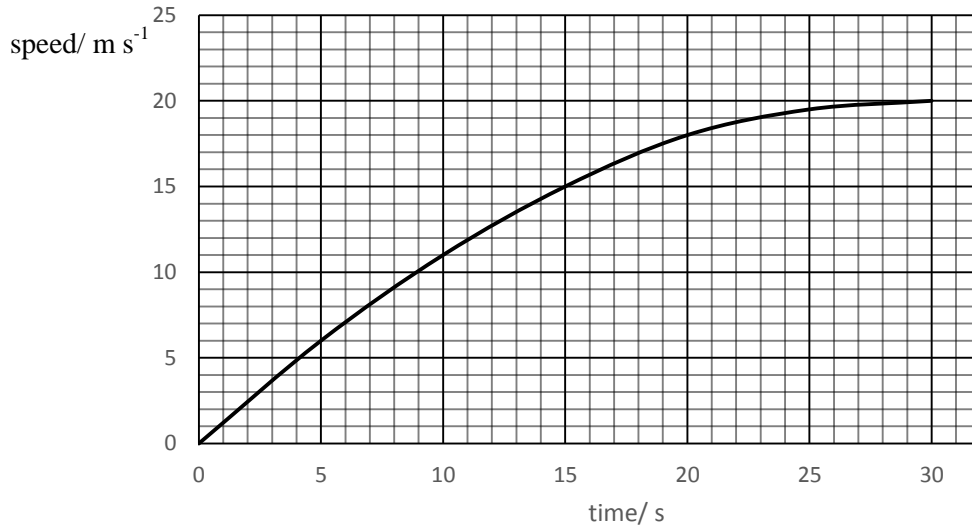
angle of refraction = .....<sup>o</sup> [2]

- 22** A high definition video stream transfers data at  $5 \text{ Mbit s}^{-1}$ .

A film lasts 90 minutes. Calculate the amount of data transferred when this film is streamed in high definition.

data transferred = .....units ..... [2]

23 A car accelerates from rest to a speed of  $20 \text{ m s}^{-1}$  as shown in Fig. 23.



**Fig. 23**

(a) Calculate the average acceleration of the car in the first 30 s of the journey.

acceleration = .....  $\text{m s}^{-2}$  [2]

(b) Use the graph to find the distance travelled by the car in the first 30 s of the journey. Make your method clear.

distance travelled = .....m [2]

- 24 An LDR is used in the light-sensing circuit shown in the Fig. 24.

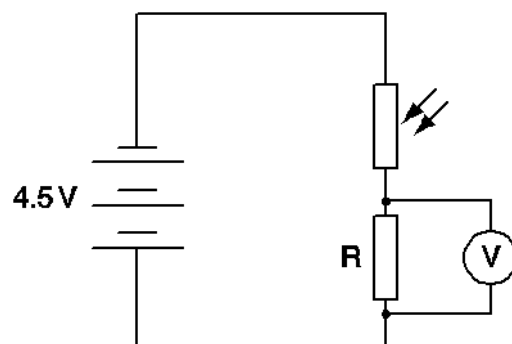


Fig. 24

In bright light conditions, the resistance of the LDR is  $200\ \Omega$ .  
The fixed resistor R has a resistance of  $1000\ \Omega$ . The cells have negligible internal resistance.

- (a) Show that the reading on the high-resistance voltmeter (resistance =  $1\ \text{M}\Omega$ ) in bright light conditions is about 4 V.

[2]

- (b) Explain how the reading on the voltmeter would differ if a voltmeter of resistance  $2000\ \Omega$  was used? Explain your reasoning.

[2]

- 25 The graph in Fig. 25 shows the variation of current in an LED with potential difference across it.

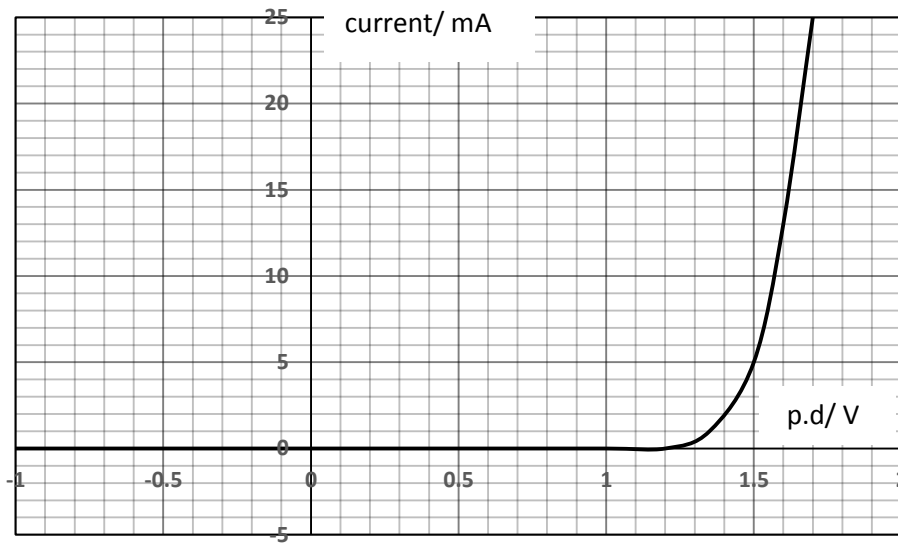


Fig. 25

- (a) Describe the variation of conductance of the diode over the range of p.d. shown on the graph.

[2]

- (b) Calculate the conductance of the diode at a p.d. of 1.5 V.

conductance = ..... S [2]

**26** A motor cyclist maintains a speed of  $25 \text{ m s}^{-1}$  along a level road. The total resistive force acting against the cyclist is 250N.

(a) Calculate the power required to maintain the steady speed against the resistive force.

power = .....W [2]

(b) The kinetic energy of the bike and rider is 50 000 J. The bike has a mass of 90 kg.  
Calculate the mass of the rider.

mass of rider = ..... kg [2]

**SECTION C**

Answer **all** the questions.

**27** An egg of mass 0.055 kg is dropped, with no initial velocity, from a height of 1.5 m. It strikes a hard surface and breaks on first contact with the ground.

**(a)** Calculate the momentum of the egg at the instant it strikes the floor.

momentum = ..... kg m s<sup>-1</sup> [3]

**(b) (i)** The duration of impact with the hard surface is 0.04 s. Calculate the average force on the egg during the impact.

average force = .....N [2]

**(ii)** Experiments suggest that it takes about 25 N to break an egg. Suggest and explain why an egg breaks when dropped from 1.5 m onto a hard surface.

[2]

**(c)** Explain why an egg dropped from the same height onto a soft foam mat does not break on impact.

[3]

**28** This question is about the photoelectric effect.

When electromagnetic radiation of frequency  $4.7 \times 10^{14}$  Hz strikes a particular metal surface, photoelectrons are released with a maximum kinetic energy of 0.18 eV. There is no appreciable time delay between the incident radiation striking the surface and the release of photoelectrons.

The maximum kinetic energy of the photons,  $k.e._{\max}$  is given by Einstein's equation:

$$k.e._{\max} = hf - \phi$$

where  $h$  is the Planck constant and  $f$  is the frequency of the incident radiation. The work function  $\phi$  is the minimum energy required to eject an electron from the metal surface.

(a) (i) State what  $hf$  represents.

[1]

(ii) Calculate the work function of the metal.

= ..... J [2]

(b) The maximum kinetic energy of the ejected electrons is observed to be independent of the intensity of the incident radiation.

(i) Explain what is meant by 'intensity' in the sentence above and explain why the wave model of electromagnetic radiation cannot explain the experimental observations.

[3]

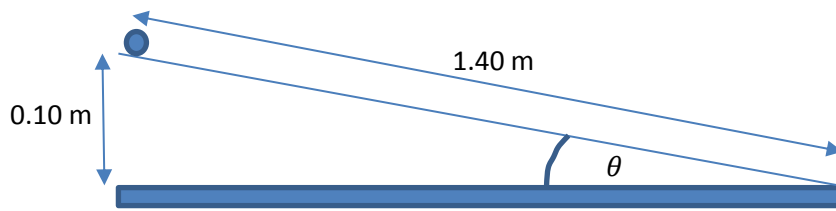


(ii) The number of photoelectrons emitted each second is proportional to the intensity of light. Explain this observation using the photon model of light.

[2]

**29** This question is about measuring the acceleration of a ball rolling down a ramp.

Fig. 29.1 shows the experimental arrangement.

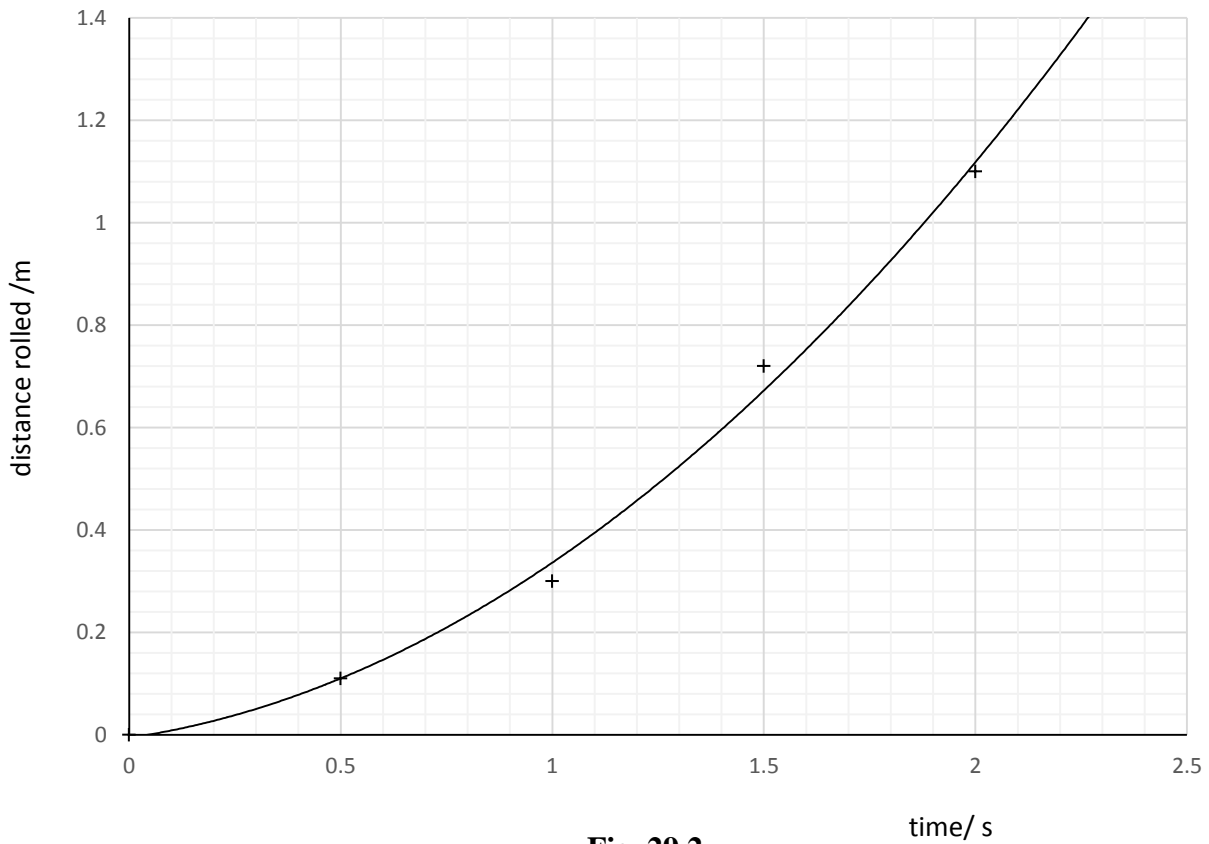


**Fig. 29.1** (not to scale)

(a) Show that the angle  $\theta$  is about  $4^\circ$ .

[1]

(b) Students film the ball rolling down the ramp from rest and obtain the results shown on the graph in Fig. 29.2.



**Fig. 29.2**

From the graph find the velocity of the ball at 1.0 s and 2.0 s. Show your method clearly.  
Use these results to calculate the acceleration of the ball.

velocity at 1.0 s = ..... m s<sup>-1</sup>

velocity at 2.0 s = ..... m s<sup>-1</sup>

acceleration = ..... m s<sup>-2</sup>

[4]

(c) (i) Show that the component of the gravitational field strength,  $g$ , acting parallel to the slope, is about  $0.7 \text{ N kg}^{-1}$ .

[2]

(ii) Use this value to calculate the time taken for the ball to roll 1.4 m down the slope from rest.

time = ..... s

[2]

**(iii)** Compare your value from **c(ii)** to that obtained in the experiment, suggesting reasons for any difference.

[3]

### END OF QUESTION PAPER

---

Copyright Information:

OCR is committed to seeking permission to reproduce all third-party content that it uses in the assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements booklet. This is produced for each series of examinations and is freely available to download from our public website ([www.ocr.org.uk](http://www.ocr.org.uk)) after the live examination series.

If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact the Copyright Team, First Floor, 9 Hills Road, Cambridge CB2 1GE.

OCR is part of the Cambridge Assessment Group; Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.