AS Level Physics A
H156/01 Breadth in physics
Practice Question Paper v1.1

Date – Morning/Afternoon
Time allowed: 1 hour 30 minutes

You must have:
- the Data, Formulae and Relationships Booklet

You may use:
- a scientific calculator

First name									
Last name									
Centre number						**Candidate number**				

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 **24** pages.

PRACTICE

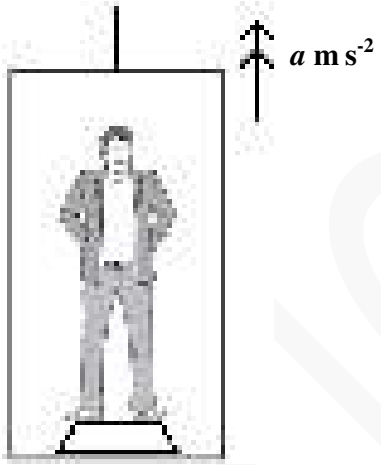
SECTION A

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 A man of mass M is standing on a set of scales in a lift. The lift is accelerating vertically upwards at a constant acceleration a.



The scales show the normal contact force experienced by the man.
What is the reading shown on the scales?

A Mg

B $M(g - a)$

C $M(a + g)$

D $M\frac{a}{g}$

Your answer ☐

[1]

2 The power rating of a toaster is given as 2000 W. Which of the following is **not** an equivalent power rating?

A 2×10^{-9} TW

B 2000 N m s^{-1}

C 2 kJ s^{-1}

D 2000 mJ s^{-1}

Your answer ☐

[1]

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PRACTICE

3 Which of the following statements is true about electromagnetic radiation?

A Radio waves are in the highest energy range of the electromagnetic spectrum.

B Visible light has a range of wavelengths in the order of 450 nm to 700 nm.

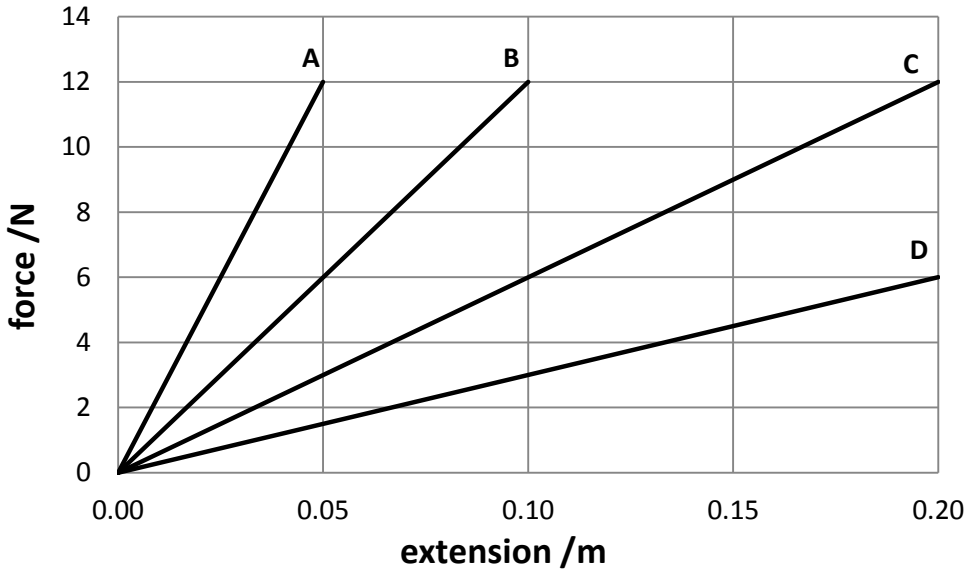
C Ultra-violet waves cannot be plane polarised.

D Gamma rays have a low frequency.

Your answer ☐

[1]

4 The force constant of a spring **X** is 1.2 N cm^{-1}.
The force-extension graphs for four different springs **A, B, C** and **D** are shown below.



Which spring has a force constant equal to half that of spring **X**?

Your answer ☐

[1]

5 Which order of magnitude gives the best estimate for the wavelength in metres of microwave radiation just beyond the infra-red part of the electromagnetic spectrum?

A 10^{3}

B 1

C 10^{-3}

D 10^{-6}

Your answer ☐

[1]

6 A sheet of A4 paper is held horizontal and then dropped from rest from the top of a tall building. It falls towards the ground below, reaching terminal velocity. The same piece of paper is then crumpled into a small ball and then dropped from the same height. It also reaches terminal velocity.
Which of the following will change in the second situation?

A The maximum magnitude of the air resistance.

B The weight of the paper.

C The time taken to reach terminal velocity.

D The initial acceleration when dropped.

Your answer ☐

[1]

7 A copper wire is connected across a cell. The electrons within the copper move.

Which statement is correct about these electrons?

A The electrons drift towards the negative end of the cell.

B The electrons have random speeds because of collisions with many electrons.

C The electrons travel through the copper at the speed of light.

D The electrons collide with vibrating copper ions.

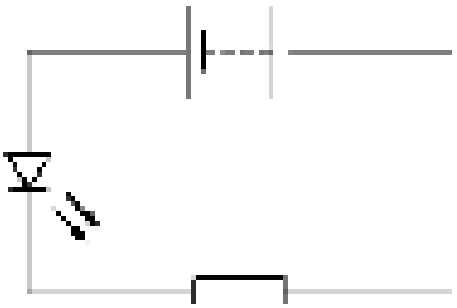
Your answer ☐

[1]

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PRACTICE

8 A light-emitting diode (LED) and a resistor are connected in series to a battery of negligible internal resistance.



The e.m.f. of the battery is 8.0 V. A charge of 10 C passing through the resistor transfers 60 J of energy.
What is the potential difference across the LED?

A 2.0 V

B 6.0 V

C 8.0 V

D 14.0 V

Your answer ☐

[1]

9 The initial temperature T_1 of water in a beaker was 20.1 °C ± 0.2 °C. After the water had been heated for some time, the final temperature T_2 was 27.3 °C ± 0.3 °C. The temperature increase ΔT is given by $\Delta T = T_2 - T_1$

What is the best estimate of the uncertainty in ΔT ?

A ± 0.05 °C

B ± 0.1 °C

C ± 0.25 °C

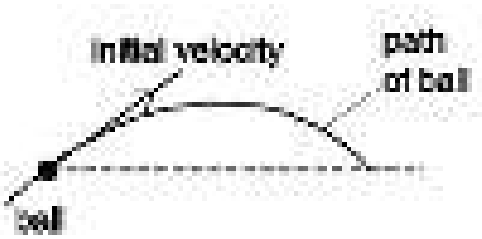
D ± 0.5 °C

Your answer ☐

[1]

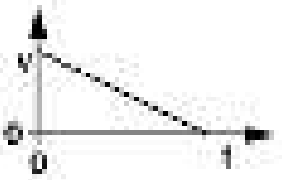
PRACTICE

10 A ball is thrown with an initial velocity at an angle to the horizontal.

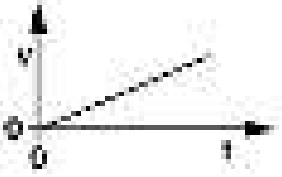


Air resistance has negligible effect on the motion of the ball.
While it is in flight, which graph shows the correct variation of the ball's horizontal velocity v with time t?

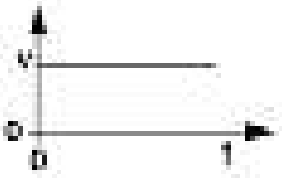
A



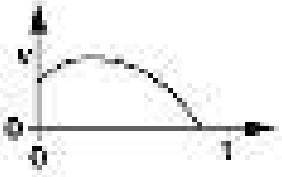
B



C



D

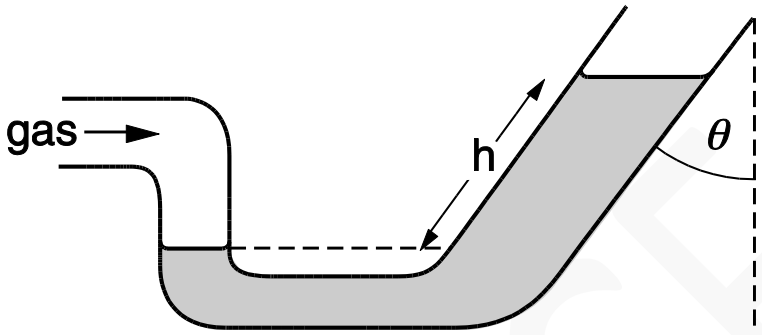


Your answer ☐

[1]

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11 Gas under pressure is forced into a pipe formed into a U shape bend. A liquid of density ρ is pushed up the right hand side so there is a difference h in the height on each side, measured along the side of the tube.
The pipe on the right hand side is inclined at an angle θ to the vertical and it has a cross sectional area double that on the left side.



What is the pressure of the gas in excess of atmospheric pressure?

A $h\rho g$

B $2h\rho g$

C $h\rho g \cos\theta$

D $2h\rho g \cos\theta$

Your answer ☐

[1]

12 A girl standing on a bridge throws a coin upwards with a vertical velocity of 5.0 m s^{-1}. It hits the water below the bridge after 1.5 seconds. Assuming that the effects of air resistance are negligible, what was the initial height of the coin above the water?

A 1.3 m

B 3.5 m

C 7.5 m

D 18.5 m

Your answer ☐

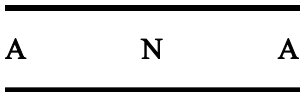
[1]

PRACTICE

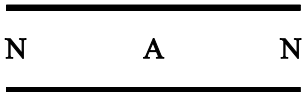
13 Stationary waves are produced in a flute when it is played. When all finger-holes are covered up, the flute can be treated as a pipe open at both ends. A flute is played so that it sounds the next harmonic above the fundamental frequency.

Which diagram correctly shows the node N and antinode A positions for the displacement of air for this harmonic?

A



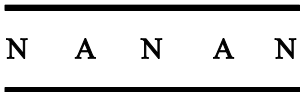
B



C



D



Your answer ☐

[1]

14 A sodium lamp is rated at 40 W.
12% of the power is emitted as yellow light of wavelength 5.9×10^{-7} m.

How many photons of yellow light are emitted per second from this lamp?

A 1.4×10^{19}

B 1.2×10^{20}

C 3.6×10^{27}

D 1.0×10^{40}

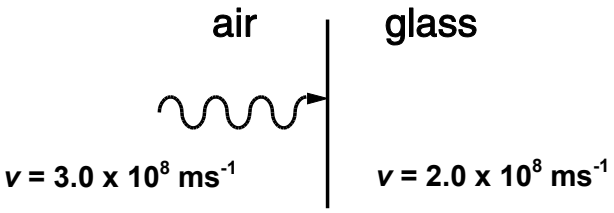
Your answer ☐

[1]

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PRACTICE

15 A beam of monochromatic light passes from air into glass. The speed of the photons in air is 3.0×10^8 m s^{-1} and in glass is 2.0×10^8 m s^{-1}.



Which of the following statements is correct?

A The energy of a photon in glass is 1.5 times the energy of the photon in air.

B The energy of a photon in glass is the same as the energy of the photon in air.

C The energy of a photon in glass is $\frac{2}{3}$ of the energy of the photon in air.

D When the intensity of the monochromatic light beam is halved the energy of each photon of the beam in air is halved.

Your answer ☐

[1]

16 What is the best estimate for the density of steel?

A 10^{-3} g cm^{-3}

B 10^{3} g cm^{-3}

C 1 kg m^{-3}

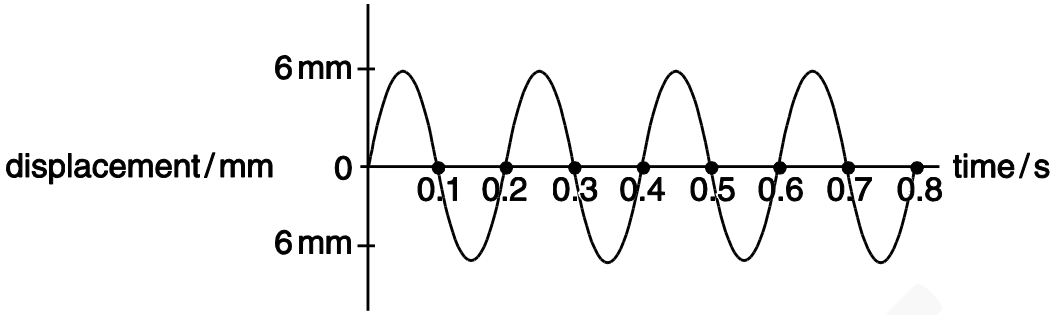
D 10^{3} kg m^{-3}

Your answer ☐

[1]

PRACTICE

17 The graph shows the variation of displacement with time for a progressive wave.



Which of the following statements can be deduced from the graph?

A The frequency of the wave is 5 Hz.

B The graph represents a transverse wave motion.

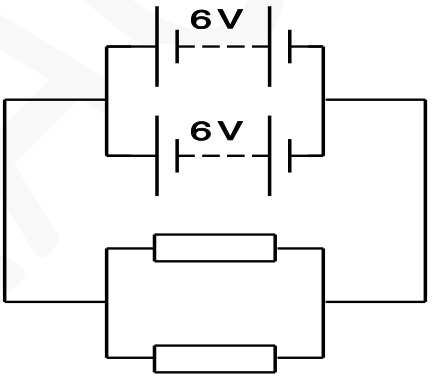
C The amplitude of the wave is 12 mm.

D The wavelength of the wave is 60 m.

Your answer ☐

[1]

18 Two batteries, each of e.m.f. 6.0 V and negligible internal resistance, are joined in parallel. The cells are connected to two identical resistors, joined in parallel.



What is the voltage across each resistor?

A 1.5 V

B 3.0 V

C 6.0 V

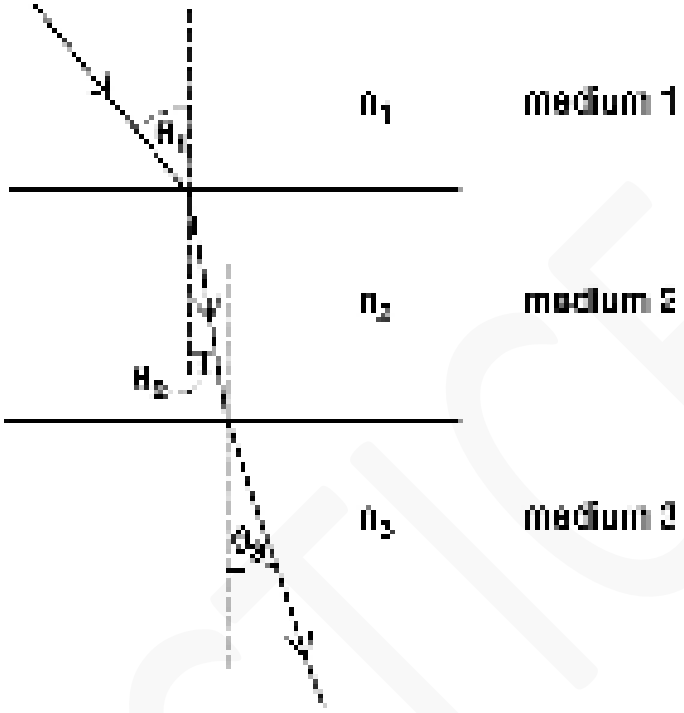
D 12.0 V

Your answer ☐

[1]

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19 A ray of light passes through three media with refractive indices n_1, n_2 and n_3. The speed of light in medium 1 is v_1, in medium 2 is v_2 and in medium 3 is v_3. The angle between the ray and the normal in medium 1 is θ_1, θ_2 in medium 2 and θ_3 in medium 3.



Which of the following statements is/are true?

A The velocity of light in medium 3 is equal to the velocity of light in medium 1

B $v_3 = v_1 \dfrac{\sin\theta_3}{\sin\theta_1}$

C The frequency of light in medium 2 is less than the frequency in medium 1

D $\dfrac{n_2}{n_1} = \dfrac{v_2}{v_1}$

Your answer ☐

[1]

PRACTICE

20 The graph in **Fig. 20.1** below shows the variation of force with extension for a single spring.

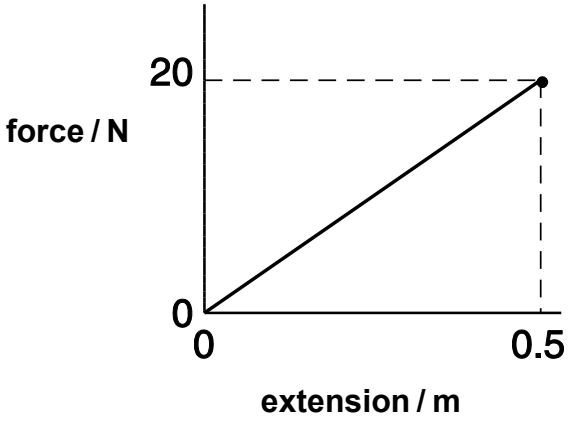


Fig. 20.1

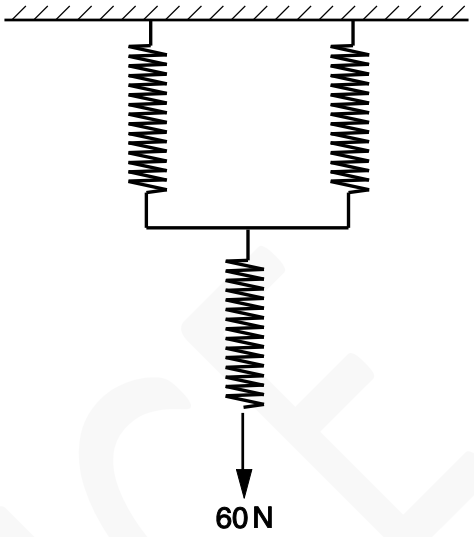


Fig. 20.2

Three of these springs are joined together as shown in **Fig. 20.2** and a force of 60 N applied. What is the distance moved by the 60 N force (to 2 s.f.)?

A 1.5 m

B 2.0 m

C 2.3 m

D 3.0 m

Your answer ☐

[1]

PRACTICE

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SECTION B

Answer **all** the questions.

21 A crane raises a mass of 3000 kg through a height of 12 m in 40 seconds with an efficiency of 60%.

(a) Calculate the total input energy to the crane.

total input energy …….. J **[2]**

(b) The crane cable is made of an alloy. The stress-strain curve for the cable is shown in Fig. 25.

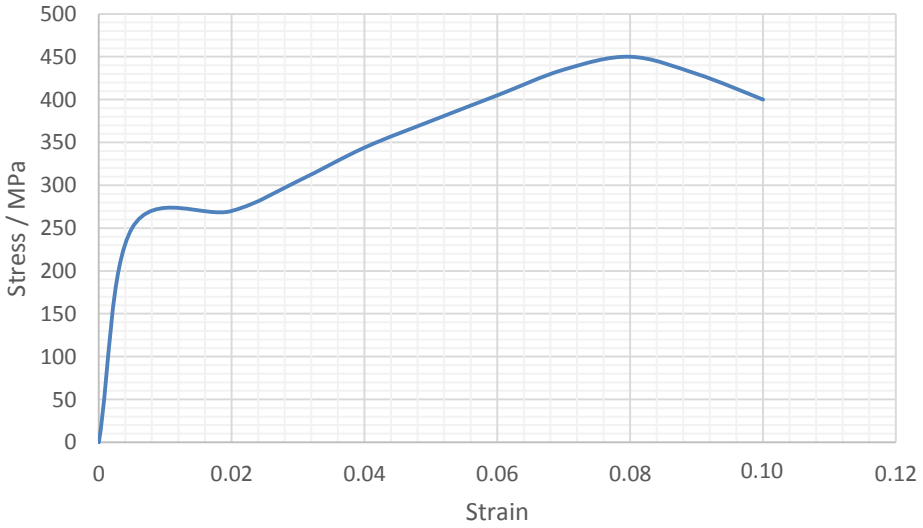


Fig. 25

(i) Use the graph to estimate the stress in the cable at its elastic limit.

stress = ……. MPa **[1]**

(ii) A cable of diameter 0.090 m has a maximum working load allowance of 1.1 x 10^6 N.

By calculating the maximum tensile stress allowed, suggest and explain why the working load allowance is 1.1 x 10^6 N.

[4]

22 A spring of negligible mass and natural length 20 cm has a 0.60 kg mass attached. The mass-spring system oscillates for a short time and then settles in an equilibrium position (Fig. 21).

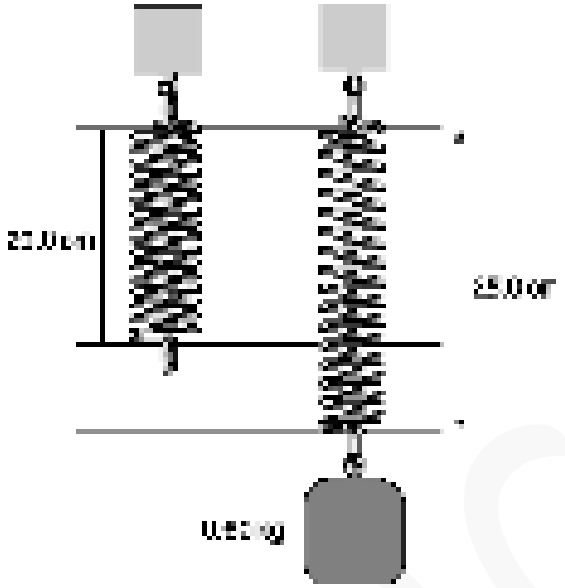


Fig. 21

(a) Calculate the change in gravitational potential energy E_p of the mass when it finally comes to rest in its equilibrium position with length of 25.0 cm.

E_p = ... J **[1]**

(b) Show that the elastic potential energy in the stretched spring in its equilibrium position is 0.15 J.

[2]

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PRACTICE

(c) A student compares the values calculated in **(a)** and **(b)** and concludes that "energy has not been conserved". State the energy transfers that occur as the spring oscillates and comes to rest and explain why the student is wrong.

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..... **[3]**

PRACTICE

23 When a gardener aims water from a hosepipe at the ground, he notices that the water always splashes in many directions. Fig. 22.1 shows the splashes produced by a vertical jet of water hitting the ground.

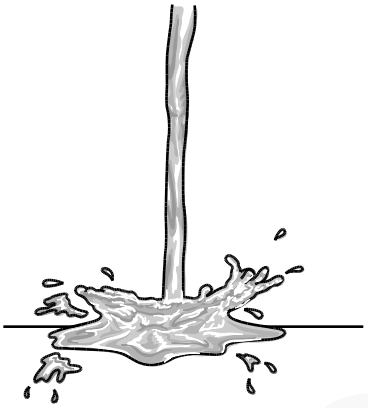


Fig. 22.1

(a) Using ideas about momentum explain why the water splashes in many directions.

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.....

.....

[2]

PRACTICE

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(b) The puddle of water reflects sunlight. A student knows that reflected light is partially polarised. She looks at the reflected light from the puddle of water through a polarising filter, see Fig.22.2.

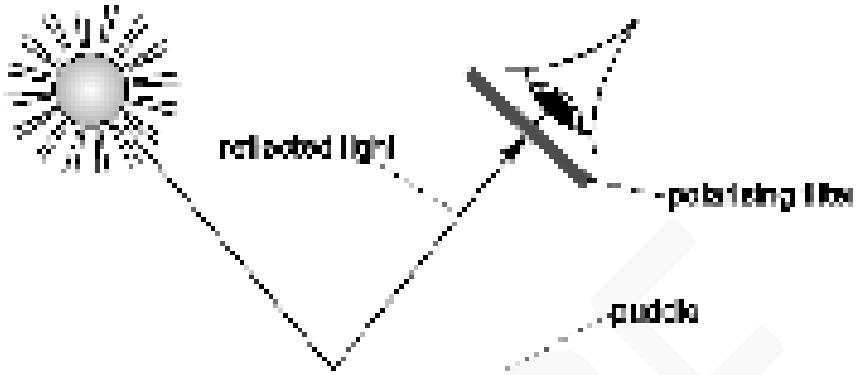


Fig. 22.2

(i) Explain what is meant by the term ***polarised waves***.
You may wish to illustrate your answer with a labelled diagram.

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..... **[2]**

(ii) Describe how the student can use the polarising filter to determine if the reflected light from the puddle is partially polarised. State clearly what she should observe.

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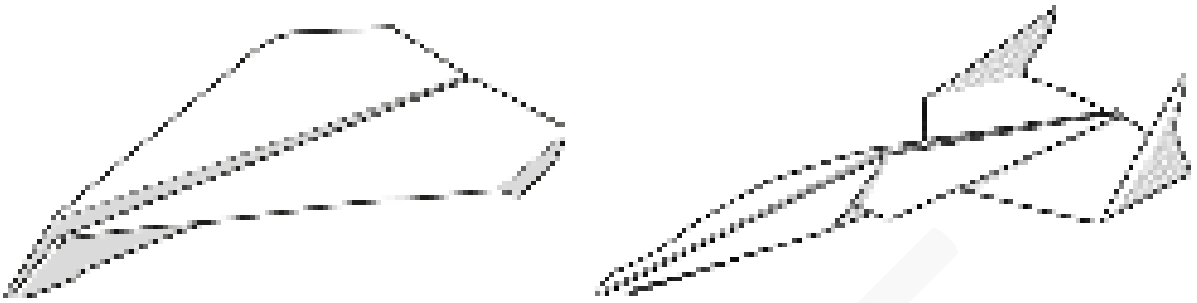
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..... **[3]**

PRACTICE

24 Fig. 23.1 shows two designs for paper aeroplanes made from identical sheets of A4 paper. The condor is slow-moving with a long glide-time, whilst the piranha is designed for speed and accuracy but has a short glide-time.



condor piranha

Fig. 23.1

A student launches each plane horizontally with a velocity of 3.0 m s^{-1} using a catapult. The planes are launched from the same vertical height. This is repeated several times. The time *t* of flight in the air is recorded using a stopwatch. The results are shown in the table of Fig. 23.2.

condor: *t* / s	piranha: *t* / s
3.5	2.0
3.9	1.6
4.2	1.8
3.4	2.2
1.8	2.1

Fig. 23.2

(a) State two ways the student could ensure that this is a fair test.

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.....

.....

..... **[2]**

(b) Using Fig. 23.2, state the minimum and maximum flight times for the **piranha**.

minimum *t* = ... s

maximum *t* = ... s

[1]

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PRACTICE

(c) Using Fig. 23.2, determine the best estimate of the **condor's** flight time. Your answer should include a suitable uncertainty and you should give your values to an appropriate number of significant figures.

flight time = ... ± ..... s **[4]**

(d) The student concludes that the condor has a greater horizontal range than the piranha because the condor's flight time is longer. Explain whether you agree with this conclusion. Use data to support your answer.

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..... **[3]**

PRACTICE

25 Fig. 24 shows a square wafer of semiconductor of length L and thickness t.

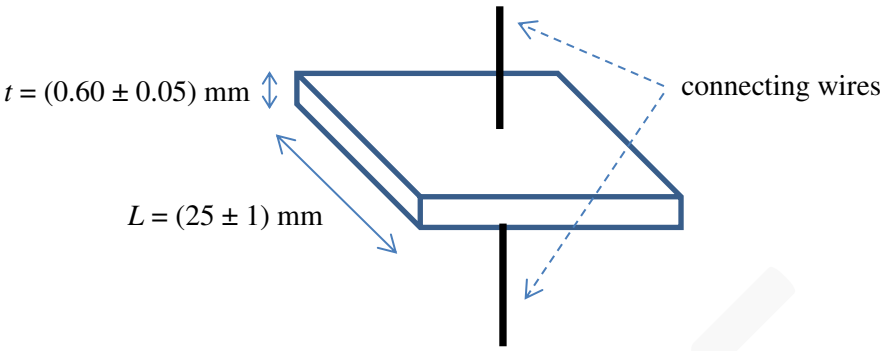


Fig. 24

(a) Suggest how the thickness was determined.

.....

..... [1]

(b) The wafer is connected to a power supply. The current I in the wafer is 32 mA and the potential difference V across the wafer is 0.13 V.

(i) Show that the resistivity ρ of the semiconductor is given by the expression

$$\rho = \frac{VL^2}{It}$$

[2]

(ii) Calculate the resistivity ρ of the semiconductor.

ρ = ... Ω m **[2]**

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PRACTICE

(c) The ammeter reading increases when the circuit in **(b)** remains connected.

Use your knowledge of semiconductors to explain why.

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……

…… **[2]**

PRACTICE

26 A bubble of gas rises upwards through a glass of lemonade. Fig. 26.1 shows a spherical bubble accelerating vertically upwards through the lemonade.

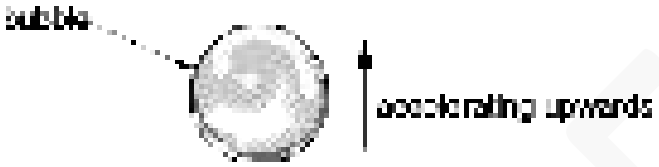


Fig. 26.1

(a) Add arrows to show each force acting on the bubble shortly after it starts to move.

Label each arrow clearly. **[2]**

(b) Fig. 26.2 shows a graph of the vertical velocity of the bubble against time.

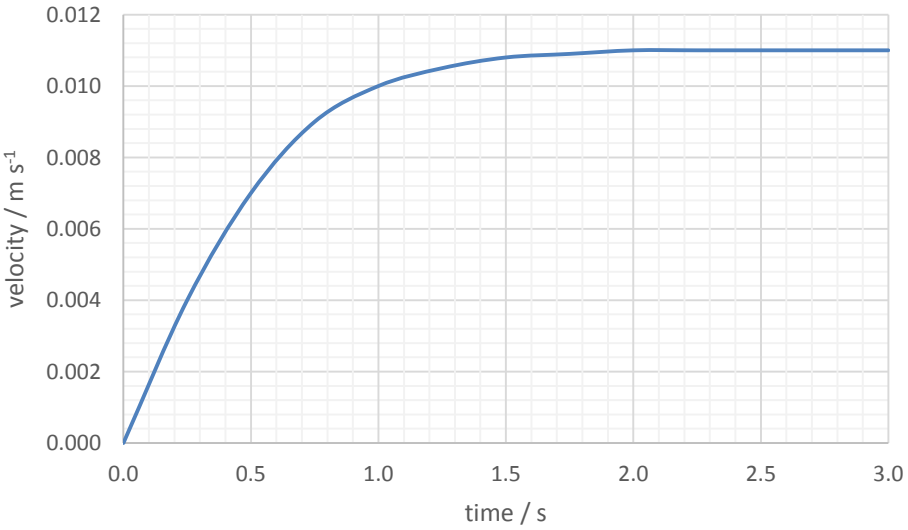


Fig. 26.2

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(i) Use **Fig. 26.2** to describe and explain the motion of the bubble between 0 and 3.0 s.

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……

……

…… **[3]**

(ii) Use **Fig. 26.2** to estimate the **initial** acceleration.

initial acceleration = …… m s^{-2} **[2]**

(iii) Calculate the initial upthrust U on the bubble, given that the mass of the bubble is 6.7×10^{-9} kg.

U = …… N **[2]**

PRACTICE

27 At an open air concert two loudspeakers are placed 5.0 m apart at the front of a stage and are sounding a note of frequency 1200 Hz. A row of seats is 30 m from the stage and parallel to it.

Describe and explain, as precisely as possible, what different people along this row will hear. You must include calculations in your answer. The speed of sound in air is 330 m s^{-1}.

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…… **[4]**

END OF QUESTION PAPER

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