N5

WAVES

Practice Exam Questions

Physics
Section 1—Questions

DATA SHEET

Speed of light in materials

Material	*Speed* in $m\,s^{-1}$
Air	$3{\cdot}0 \times 10^8$
Carbon dioxide	$3{\cdot}0 \times 10^8$
Diamond	$1{\cdot}2 \times 10^8$
Glass	$2{\cdot}0 \times 10^8$
Glycerol	$2{\cdot}1 \times 10^8$
Water	$2{\cdot}3 \times 10^8$

Gravitational field strengths

	Gravitational field strength on the surface in $N\,kg^{-1}$
Earth	9·8
Jupiter	23
Mars	3·7
Mercury	3·7
Moon	1·6
Neptune	11
Saturn	9·0
Sun	270
Uranus	8·7
Venus	8·9

Specific latent heat of fusion of materials

Material	*Specific latent heat of fusion* in $J\,kg^{-1}$
Alcohol	$0{\cdot}99 \times 10^5$
Aluminium	$3{\cdot}95 \times 10^5$
Carbon Dioxide	$1{\cdot}80 \times 10^5$
Copper	$2{\cdot}05 \times 10^5$
Iron	$2{\cdot}67 \times 10^5$
Lead	$0{\cdot}25 \times 10^5$
Water	$3{\cdot}34 \times 10^5$

Specific latent heat of vaporisation of materials

Material	*Specific latent heat of vaporisation* in $J\,kg^{-1}$
Alcohol	$11{\cdot}2 \times 10^5$
Carbon Dioxide	$3{\cdot}77 \times 10^5$
Glycerol	$8{\cdot}30 \times 10^5$
Turpentine	$2{\cdot}90 \times 10^5$
Water	$22{\cdot}6 \times 10^5$

Speed of sound in materials

Material	*Speed* in $m\,s^{-1}$
Aluminium	5200
Air	340
Bone	4100
Carbon dioxide	270
Glycerol	1900
Muscle	1600
Steel	5200
Tissue	1500
Water	1500

Specific heat capacity of materials

Material	*Specific heat capacity* in $J\,kg^{-1}\,°C^{-1}$
Alcohol	2350
Aluminium	902
Copper	386
Glass	500
Ice	2100
Iron	480
Lead	128
Oil	2130
Water	4180

Melting and boiling points of materials

Material	*Melting point* in °C	*Boiling point* in °C
Alcohol	−98	65
Aluminium	660	2470
Copper	1077	2567
Glycerol	18	290
Lead	328	1737
Iron	1537	2737

Radiation weighting factors

Type of radiation	*Radiation weighting factor*
alpha	20
beta	1
fast neutrons	10
gamma	1
slow neutrons	3
X-rays	1

8. The period of vibration of a guitar string is 8 ms.

The frequency of the sound produced by the guitar string is

A 0·125 Hz

B 12·5 Hz

C 125 Hz

D 800 Hz

E 8000 Hz.

9. A student makes the following statements about microwaves and radio waves.

I In air, microwaves travel faster than radio waves.

II In air, microwaves have a longer wavelength than radio waves.

III Microwaves and radio waves are both members of the electromagnetic spectrum.

Which of these statements is/are correct?

A I only

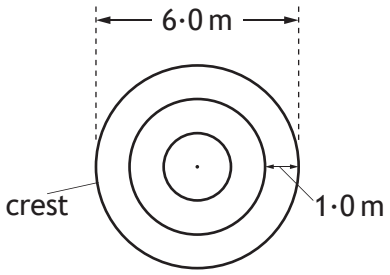
B III only

C I and II only

D I and III only

E II and III only

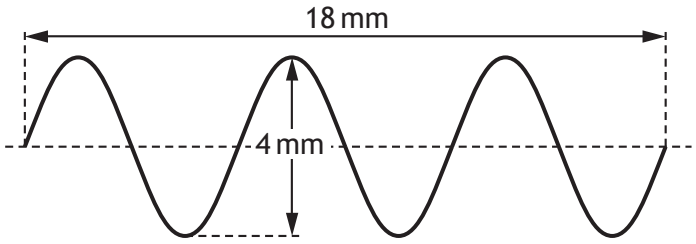
10. The diagram represents the position of the crests of waves 3 seconds after a stone is thrown into a pool of still water.



Which row in the table shows the speed and the frequency of the waves?

	Speed ($m\,s^{-1}$)	*Frequency* (Hz)
A	0·33	3
B	0·33	1
C	1·0	1
D	1·0	3
E	1·0	4

7. The diagram represents a water wave.



The wavelength of the water wave is

A 2 mm
B 3 mm
C 4 mm
D 6 mm
E 18 mm.

8. A student makes the following statements about different types of electromagnetic waves.

I Light waves are transverse waves.
II Radio waves travel at 340 m s^{-1} through air.
III Ultraviolet waves have a longer wavelength than infrared waves.

Which of these statements is/are correct?

A I only
B I and II only
C I and III only
D II and III only
E I, II and III

8. A student makes the following statements about waves.

I Waves transfer energy.

II A wave with a short wavelength diffracts more than a wave with a long wavelength.

III The amplitude of a wave depends on its wavelength.

Which of these statements is/are correct?

A I only

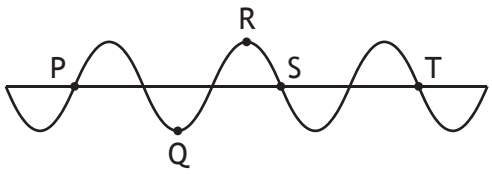
B II only

C III only

D I and II only

E I and III only

9. The diagram represents a wave.



The wavelength of the wave is the horizontal distance between points

A P and Q

B P and S

C Q and R

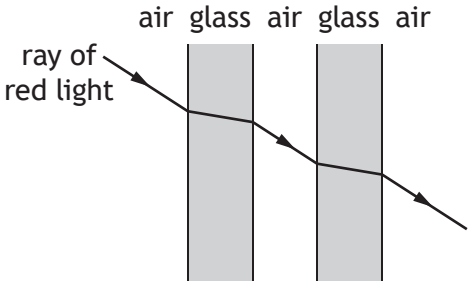
D R and S

E S and T.

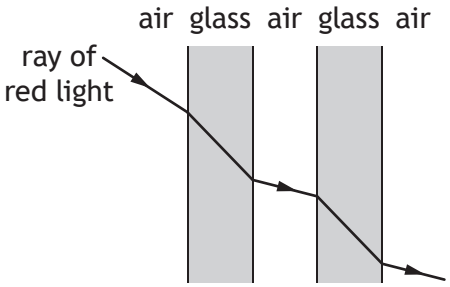
11. A ray of red light passes through a double glazed window.

Which diagram shows the path of the ray as it passes through the window?

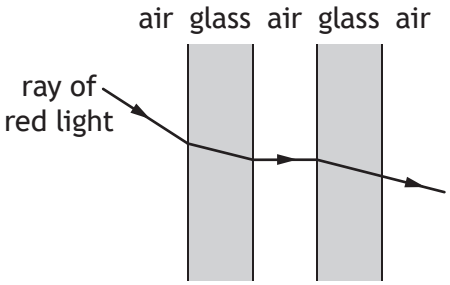
A



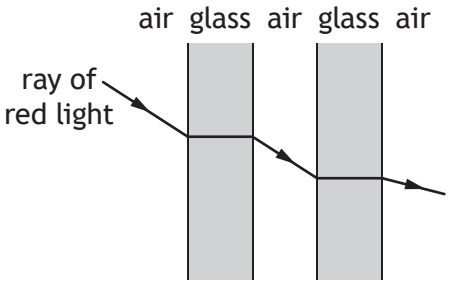
B



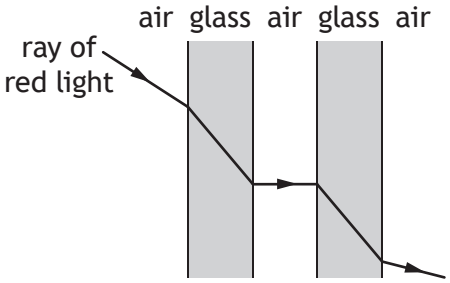
C



D



E



8. A student makes the following statements about waves.

I In a transverse wave, the particles vibrate parallel to the direction of travel of the wave.

II Light waves and water waves are both transverse waves.

III Sound waves are longitudinal waves.

Which of these statements is/are correct?

A I only

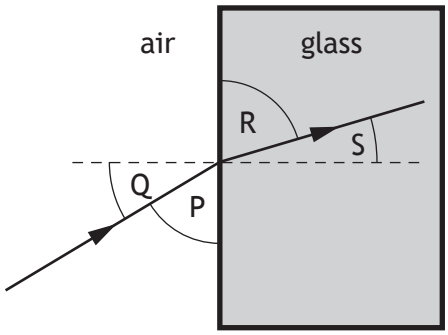
B II only

C III only

D I and II only

E II and III only

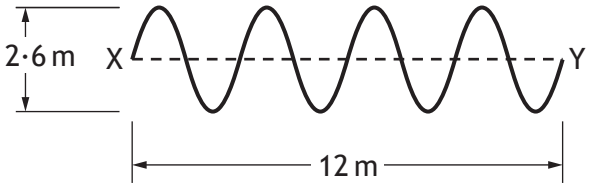
12. The diagram shows the path of a ray of red light as it passes from air into a glass block.



Which row in the table shows the angle of incidence and the angle of refraction?

	Angle of incidence	*Angle of refraction*
A	Q	S
B	S	Q
C	P	R
D	R	P
E	Q	R

9. The diagram represents a wave travelling from X to Y.



The wave travels from X to Y in a time of 0·5 s.

Which row in the table shows the amplitude, wavelength and frequency of this wave?

	Amplitude (m)	*Wavelength* (m)	*Frequency* (Hz)
A	1·3	1·5	2·0
B	2·6	1·5	24
C	1·3	3·0	8·0
D	2·6	3·0	8·0
E	1·3	3·0	24

10. A microwave signal is transmitted by a radar station.

The signal is reflected from an aeroplane.

The aeroplane is at a height of 30 km directly above the radar station.

The time between the signal being transmitted and the reflected signal being received back at the radar station is

A 5×10^{-5} s

B 1×10^{-4} s

C 2×10^{-4} s

D 5×10^{3} s

E 1×10^{4} s.

11. A member of the electromagnetic spectrum has a shorter wavelength than visible light and a lower frequency than X-rays. This type of radiation is

A gamma

B ultraviolet

C infrared

D microwaves

E radio waves.

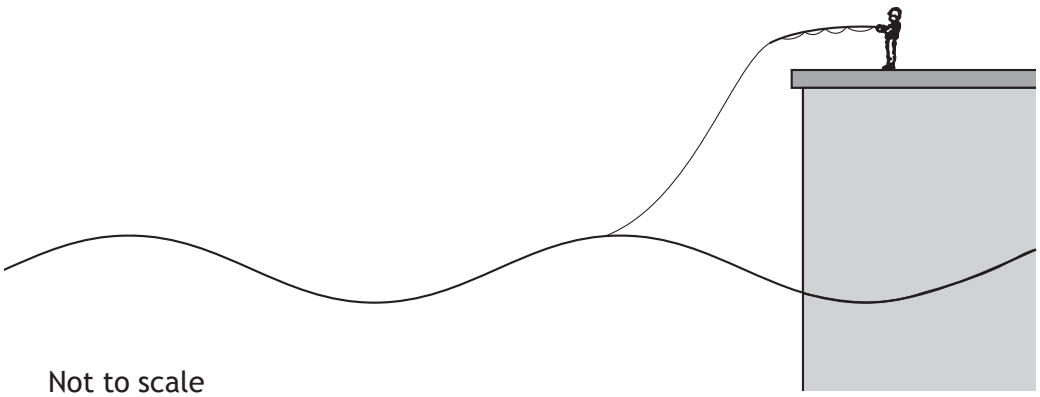
N5

WAVES

Practice Questions

Physics
Section 2

4. A student, fishing from a pier, counts four waves passing the end of the pier in 20 seconds. The student estimates that the wavelength of the waves is 12 m.



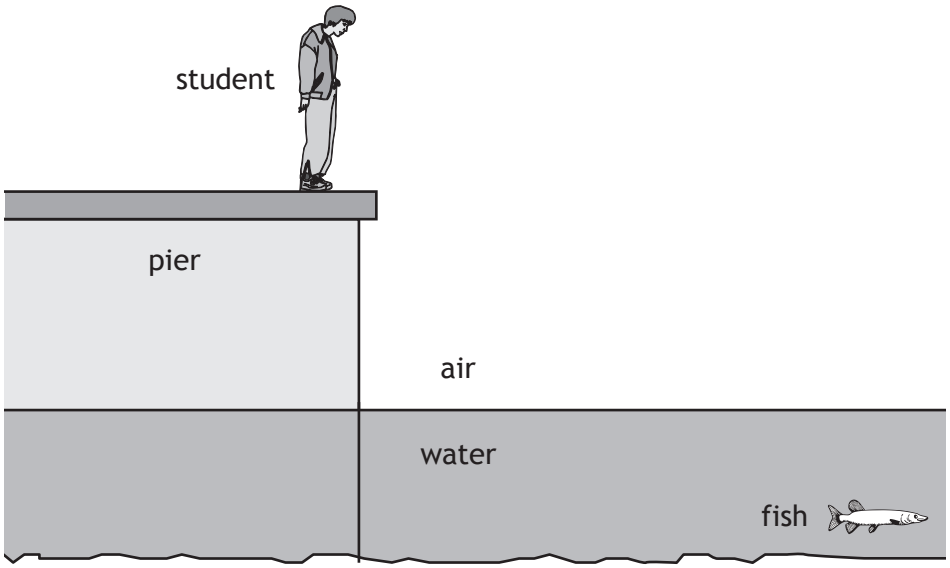
Not to scale

(a) Calculate the speed of the water waves. **4**

Space for working and answer

4. (continued)

(b) When looking down into the calm water behind the pier the student sees a fish.



Complete the diagram to show the path of a ray of light from the fish to the student.

You should include the normal in your diagram. **3**

(An additional diagram, if required, can be found on *Page thirty-one*.)

Total marks 7

5. The UV Index is an international standard measurement of the intensity of ultraviolet radiation from the Sun. Its purpose is to help people to effectively protect themselves from UV rays.

The UV index table is shown.

UV Index	*Description*
0 — 2	Low risk from the Sun's UV rays for the average person
3 — 5	Moderate risk of harm from unprotected Sun exposure
6 — 7	High risk of harm from unprotected Sun exposure
8 — 10	Very high risk of harm from unprotected Sun exposure
11+	Extreme risk of harm from unprotected Sun exposure

The UV index can be calculated using

$$UV\ index = \left[\begin{array}{c} total\ effect\ of \\ UV\ radiation \end{array} \times \begin{array}{c} elevation\ above \\ sea\ level\ adjustment \end{array} \times \begin{array}{c} cloud \\ adjustment \end{array} \right] \div 25$$

The UV index is then rounded to the nearest whole number.

The tables below give information for elevation above sea level and cloud cover.

Elevation above sea level (km)	*Elevation above sea level adjustment*
1	1·06
2	1·12
3	1·18

Cloud cover	*Cloud adjustment*
Clear skies	1·00
Scattered clouds	0·89
Broken clouds	0·73
Overcast skies	0·31

5. (continued)

MARKS | DO NOT WRITE IN THIS MARGIN

(a) At a particular location the total effect of UV radiation is 280.

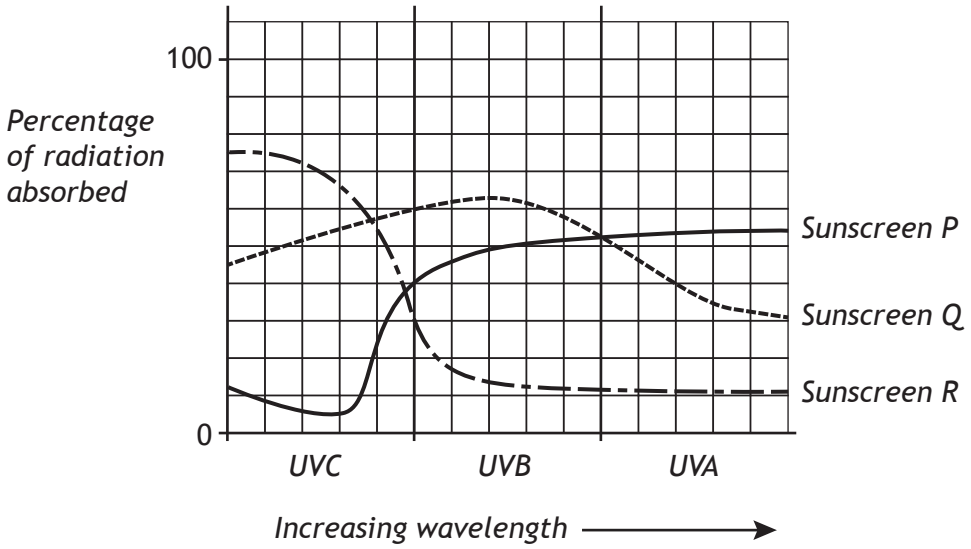
The elevation is 2 km above sea level with overcast skies.

Calculate the UV index value for this location. **2**

Space for working and answer

(b) Applying sunscreen to the skin is one method of protecting people from the Sun's harmful UV rays. UV radiation can be divided into three wavelength ranges, called UVA, UVB and UVC.

A manufacturer carries out some tests on experimental sunscreens P, Q and R to determine how effective they are at absorbing UV radiation. The test results are displayed in the graph.



Using information from the graph, complete the following table. **2**

	UVA	*UVB*	*UVC*
Type of sunscreen that absorbs most of this radiation		Sunscreen Q	
Type of sunscreen that absorbs least of this radiation	Sunscreen R		

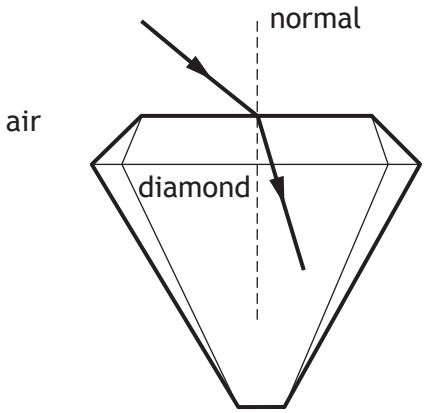
(c) State one useful application of UV radiation. **1**

Total marks 5

5. Diamonds are popular and sought after gemstones.

Light is refracted as it enters and leaves a diamond.

The diagram shows a ray of light entering a diamond.



(a) On the diagram, label the angle of incidence *i* and the angle of refraction *r*. **1**

(b) State what happens to the speed of the light as it enters the diamond. **1**

(c) The optical density of a gemstone is a measure of its ability to refract light.

Gemstones of higher optical density cause more refraction.

A ray of light is directed into a gemstone at an angle of incidence of 45°.

The angle of refraction is then measured.

This is repeated for different gemstones.

Gemstone	*Angle of refraction*
A	24·3°
B	17·0°
C	27·3°
D	19·0°
E	25·5°

Diamond is known to have the highest optical density.

Identify which gemstone is most likely to be diamond. **1**

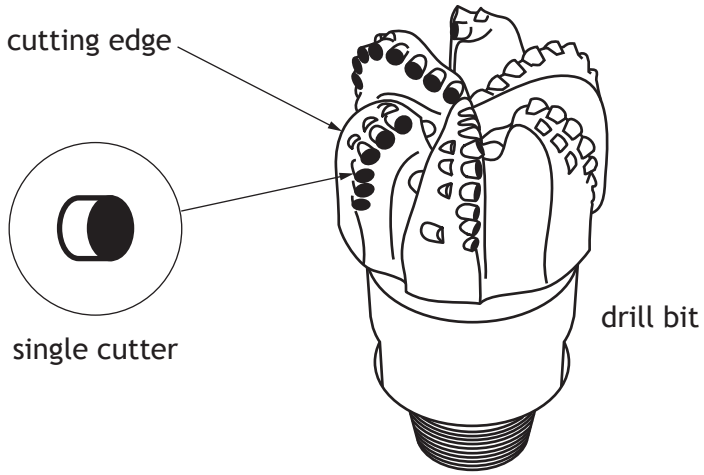
MARKS DO NOT WRITE IN THIS MARGIN

5. (continued)

(d) Diamond is one of the hardest known substances.

Synthetic diamonds are attached to the cutting edges of drill bits for use in the oil industry.

These drill bits are able to cut into rock.



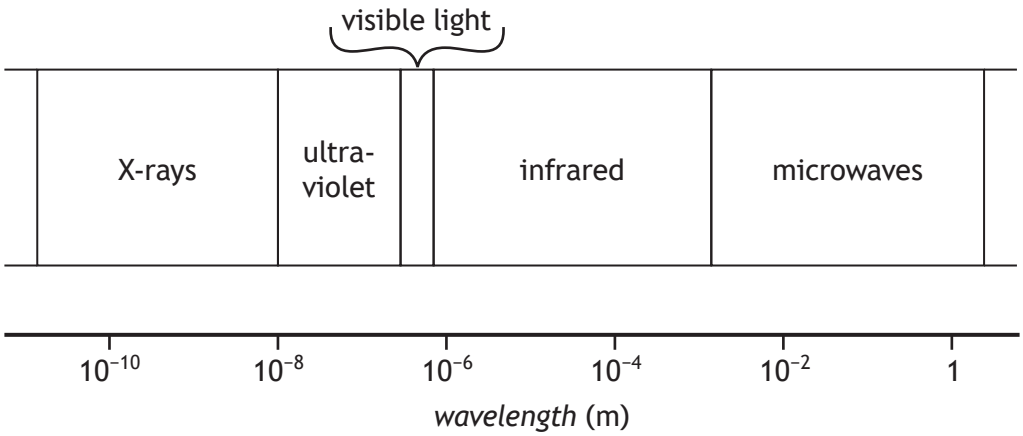
The area of a single cutter in contact with the rock is $1{\cdot}1 \times 10^{-5}\,m^2$.

When drilling, this cutter is designed to exert a maximum force of 61 kN on the rock.

Calculate the maximum pressure that the cutter can exert on the rock. **3**

Space for working and answer

4. The diagram shows some parts of the electromagnetic spectrum in order of increasing wavelength.



(a) State a detector of infrared radiation. **1**

(b) State which radiation in the electromagnetic spectrum has a wavelength shorter than X-rays. **1**

(c) (i) An electromagnetic wave has a frequency of 1·2 GHz.

Show that the wavelength of this wave is 0·25 m. **2**

Space for working and answer

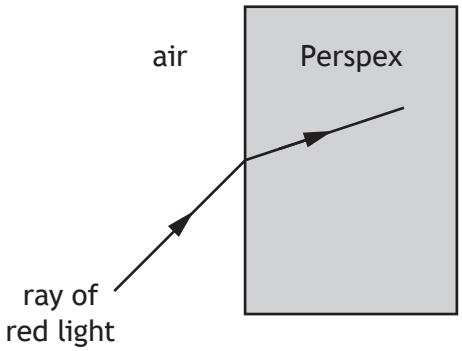
(ii) Identify the part of the spectrum that this wave belongs to. **1**

5. A Physics textbook contains the following statement.

"Electromagnetic waves can be sent out like ripples on a pond."

Using your knowledge of physics, comment on the similarities and/or differences between electromagnetic waves and the ripples on a pond. **3**

6. A student directs a ray of red light into a Perspex block to investigate refraction.



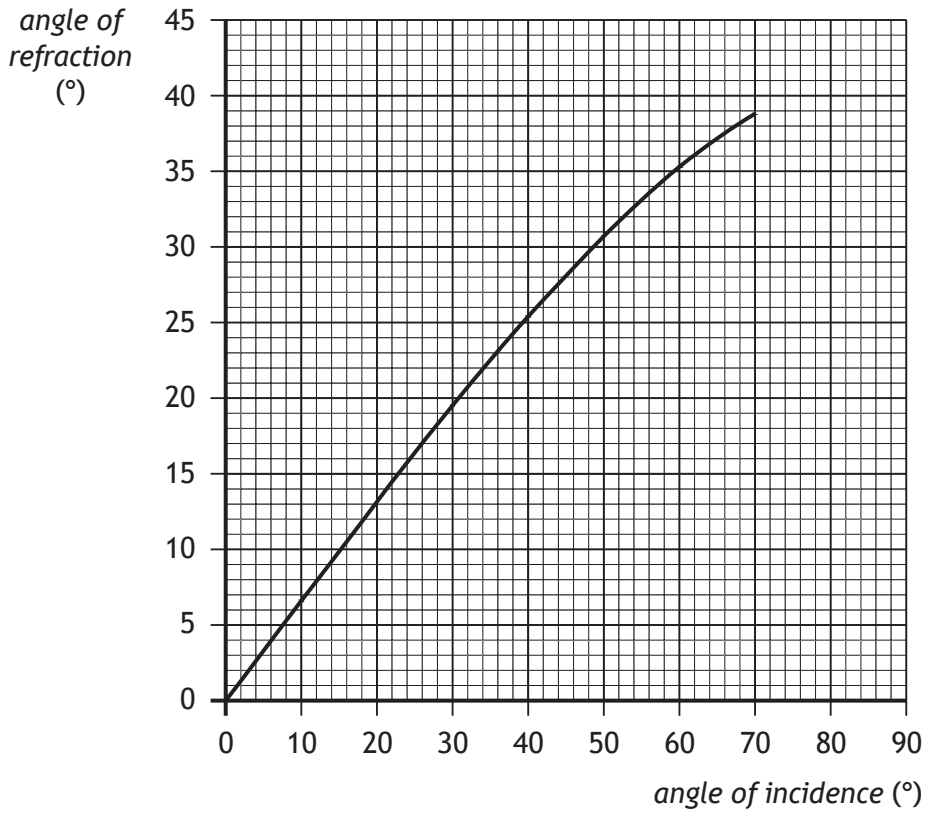
(a) On the diagram, draw and label:

(i) the normal; **1**

(ii) the angle of incidence *i* and the angle of refraction *r*. **1**

(An additional diagram, if required, can be found on *Page 33*)

(b) The student varies the angle of incidence and measures the corresponding angles of refraction. The results are plotted on a graph.



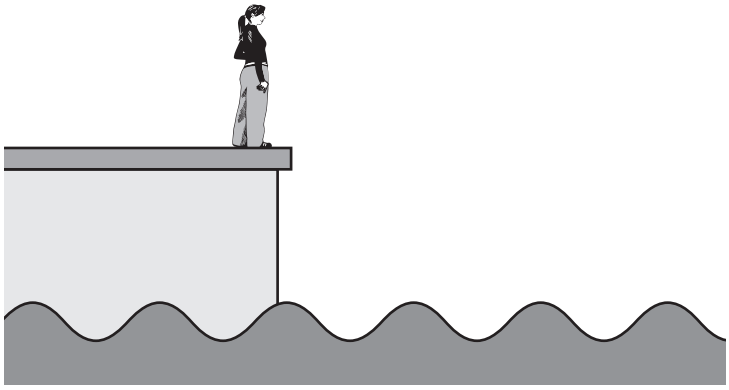
6. (b) (continued)

(i) Determine the angle of refraction when the angle of incidence is 12°. **1**

(ii) Use the graph to predict the angle of refraction the student would obtain for an angle of incidence of 80°. **1**

(c) Suggest why it would be good practice for the student to repeat the investigation a further three or four times. **1**

4. A student observes water waves entering a harbour.



(a) To determine the frequency of the waves, the student measures the time taken for a wave to pass a point at the harbour entrance.

The student measures this time to be 2·5 s

(i) Calculate the frequency of the waves. **3**

Space for working and answer

(ii) Suggest how the accuracy of the frequency determined by the student could be improved. **1**

MARKS

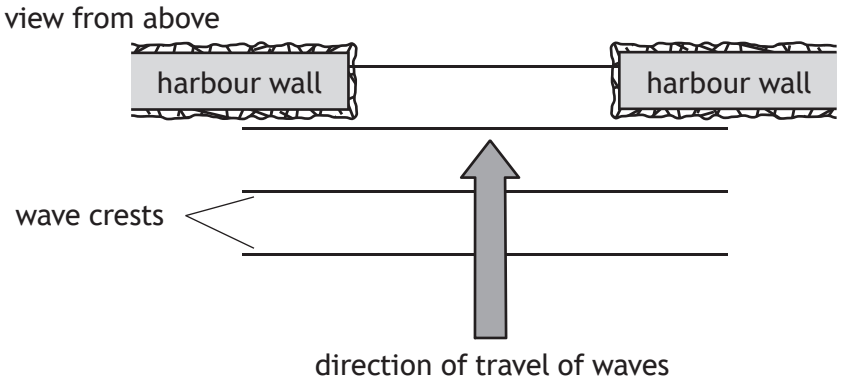
DO NOT WRITE IN THIS MARGIN

(b) The distance between one wave crest and the next crest is 8·0 m.

Calculate the velocity of the waves. **3**

Space for working and answer

(c) Waves travel towards the entrance of the harbour as shown.



Complete the diagram to show the pattern of wave crests inside the harbour. **2**

(An additional diagram, if required, can be found on *Page 28*)

(d) As the waves pass into the harbour the student observes that the amplitude of the waves decreases.

Explain this observation. **1**

N5

Physics
Relationships Sheet

$$E_p = mgh$$

$$E_k = \tfrac{1}{2}mv^2$$

$$Q = It$$

$$V = IR$$

$$R_T = R_1 + R_2 + \ldots$$

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$$

$$V_2 = \left(\frac{R_2}{R_1 + R_2}\right)V_s$$

$$\frac{V_1}{V_2} = \frac{R_1}{R_2}$$

$$P = \frac{E}{t}$$

$$P = IV$$

$$P = I^2R$$

$$P = \frac{V^2}{R}$$

$$E_h = cm\Delta T$$

$$p = \frac{F}{A}$$

$$\frac{pV}{T} = \text{constant}$$

$$p_1V_1 = p_2V_2$$

$$\frac{p_1}{T_1} = \frac{p_2}{T_2}$$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$d = vt$$

$$v = f\lambda$$

$$T = \frac{1}{f}$$

$$A = \frac{N}{t}$$

$$D = \frac{E}{m}$$

$$H = Dw_R$$

$$\dot{H} = \frac{H}{t}$$

$$s = vt$$

$$d = \bar{v}t$$

$$s = \bar{v}t$$

$$a = \frac{v-u}{t}$$

$$W = mg$$

$$F = ma$$

$$E_w = Fd$$

$$E_h = ml$$

Additional Relationships

Circle

circumference $= 2\pi r$

area $= \pi r^2$

Sphere

area $= 4\pi r^2$

volume $= \frac{4}{3}\pi r^3$

Trigonometry

$$\sin\Theta = \frac{\text{opposite}}{\text{hypotenuse}}$$

$$\cos\Theta = \frac{\text{adjacent}}{\text{hypotenuse}}$$

$$\tan\Theta = \frac{\text{opposite}}{\text{adjacent}}$$

$$\sin^2\Theta + \cos^2\Theta = 1$$

Electron Arrangements of Elements

Key

Atomic number
Symbol
Electron arrangement
Name

Group 1 (1)	Group 2 (2)	Transition Elements (3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	Group 3 (13)	Group 4 (14)	Group 5 (15)	Group 6 (16)	Group 7 (17)	Group 0 (18)
1 **H** 1 Hydrogen																	2 **He** 2 Helium
3 **Li** 2,1 Lithium	4 **Be** 2,2 Beryllium											5 **B** 2,3 Boron	6 **C** 2,4 Carbon	7 **N** 2,5 Nitrogen	8 **O** 2,6 Oxygen	9 **F** 2,7 Fluorine	10 **Ne** 2,8 Neon
11 **Na** 2,8,1 Sodium	12 **Mg** 2,8,2 Magnesium											13 **Al** 2,8,3 Aluminium	14 **Si** 2,8,4 Silicon	15 **P** 2,8,5 Phosphorus	16 **S** 2,8,6 Sulfur	17 **Cl** 2,8,7 Chlorine	18 **Ar** 2,8,8 Argon
19 **K** 2,8,8,1 Potassium	20 **Ca** 2,8,8,2 Calcium	21 **Sc** 2,8,9,2 Scandium	22 **Ti** 2,8,10,2 Titanium	23 **V** 2,8,11,2 Vanadium	24 **Cr** 2,8,13,1 Chromium	25 **Mn** 2,8,13,2 Manganese	26 **Fe** 2,8,14,2 Iron	27 **Co** 2,8,15,2 Cobalt	28 **Ni** 2,8,16,2 Nickel	29 **Cu** 2,8,18,1 Copper	30 **Zn** 2,8,18,2 Zinc	31 **Ga** 2,8,18,3 Gallium	32 **Ge** 2,8,18,4 Germanium	33 **As** 2,8,18,5 Arsenic	34 **Se** 2,8,18,6 Selenium	35 **Br** 2,8,18,7 Bromine	36 **Kr** 2,8,18,8 Krypton
37 **Rb** 2,8,18,8,1 Rubidium	38 **Sr** 2,8,18,8,2 Strontium	39 **Y** 2,8,18,9,2 Yttrium	40 **Zr** 2,8,18,10,2 Zirconium	41 **Nb** 2,8,18,12,1 Niobium	42 **Mo** 2,8,18,13,1 Molybdenum	43 **Tc** 2,8,18,13,2 Technetium	44 **Ru** 2,8,18,15,1 Ruthenium	45 **Rh** 2,8,18,16,1 Rhodium	46 **Pd** 2,8,18,18,0 Palladium	47 **Ag** 2,8,18,18,1 Silver	48 **Cd** 2,8,18,18,2 Cadmium	49 **In** 2,8,18,18,3 Indium	50 **Sn** 2,8,18,18,4 Tin	51 **Sb** 2,8,18,18,5 Antimony	52 **Te** 2,8,18,18,6 Tellurium	53 **I** 2,8,18,18,7 Iodine	54 **Xe** 2,8,18,18,8 Xenon
55 **Cs** 2,8,18,18,8,1 Caesium	56 **Ba** 2,8,18,18,8,2 Barium	57 **La** 2,8,18,18,9,2 Lanthanum	72 **Hf** 2,8,18,32,10,2 Hafnium	73 **Ta** 2,8,18,32,11,2 Tantalum	74 **W** 2,8,18,32,12,2 Tungsten	75 **Re** 2,8,18,32,13,2 Rhenium	76 **Os** 2,8,18,32,14,2 Osmium	77 **Ir** 2,8,18,32,15,2 Iridium	78 **Pt** 2,8,18,32,17,1 Platinum	79 **Au** 2,8,18,32,18,1 Gold	80 **Hg** 2,8,18,32,18,2 Mercury	81 **Tl** 2,8,18,32,18,3 Thallium	82 **Pb** 2,8,18,32,18,4 Lead	83 **Bi** 2,8,18,32,18,5 Bismuth	84 **Po** 2,8,18,32,18,6 Polonium	85 **At** 2,8,18,32,18,7 Astatine	86 **Rn** 2,8,18,32,18,8 Radon
87 **Fr** 2,8,18,32,18,8,1 Francium	88 **Ra** 2,8,18,32,18,8,2 Radium	89 **Ac** 2,8,18,32,18,9,2 Actinium	104 **Rf** 2,8,18,32,32,10,2 Rutherfordium	105 **Db** 2,8,18,32,32,11,2 Dubnium	106 **Sg** 2,8,18,32,32,12,2 Seaborgium	107 **Bh** 2,8,18,32,32,13,2 Bohrium	108 **Hs** 2,8,18,32,32,14,2 Hassium	109 **Mt** 2,8,18,32,32,15,2 Meitnerium	110 **Ds** 2,8,18,32,32,17,1 Darmstadtium	111 **Rg** 2,8,18,32,32,18,1 Roentgenium	112 **Cn** 2,8,18,32,32,18,2 Copernicium						

Lanthanides	57 **La** 2,8,18,18,9,2 Lanthanum	58 **Ce** 2,8,18,20,8,2 Cerium	59 **Pr** 2,8,18,21,8,2 Praseodymium	60 **Nd** 2,8,18,22,8,2 Neodymium	61 **Pm** 2,8,18,23,8,2 Promethium	62 **Sm** 2,8,18,24,8,2 Samarium	63 **Eu** 2,8,18,25,8,2 Europium	64 **Gd** 2,8,18,25,9,2 Gadolinium	65 **Tb** 2,8,18,27,8,2 Terbium	66 **Dy** 2,8,18,28,8,2 Dysprosium	67 **Ho** 2,8,18,29,8,2 Holmium	68 **Er** 2,8,18,30,8,2 Erbium	69 **Tm** 2,8,18,31,8,2 Thulium	70 **Yb** 2,8,18,32,8,2 Ytterbium	71 **Lu** 2,8,18,32,9,2 Lutetium
Actinides	89 **Ac** 2,8,18,32,18,9,2 Actinium	90 **Th** 2,8,18,32,18,10,2 Thorium	91 **Pa** 2,8,18,32,20,9,2 Protactinium	92 **U** 2,8,18,32,21,9,2 Uranium	93 **Np** 2,8,18,32,22,9,2 Neptunium	94 **Pu** 2,8,18,32,24,8,2 Plutonium	95 **Am** 2,8,18,32,25,8,2 Americium	96 **Cm** 2,8,18,32,25,9,2 Curium	97 **Bk** 2,8,18,32,27,8,2 Berkelium	98 **Cf** 2,8,18,32,28,8,2 Californium	99 **Es** 2,8,18,32,29,8,2 Einsteinium	100 **Fm** 2,8,18,32,30,8,2 Fermium	101 **Md** 2,8,18,32,31,8,2 Mendelevium	102 **No** 2,8,18,32,32,8,2 Nobelium	103 **Lr** 2,8,18,32,32,9,2 Lawrencium