Answers to Examination-style Questions

Chapter 1

1 **(i)** True; **(ii)** true; **(iii)** true; **(iv)** false; **(v)** true; **(vi)** false
2 B
3 *Hint*: see page 6 of the chapter
4 *Hint*: length changes with temperature
5 *Hint*: read page 4 of the chapter and consult the internet

Chapter 2

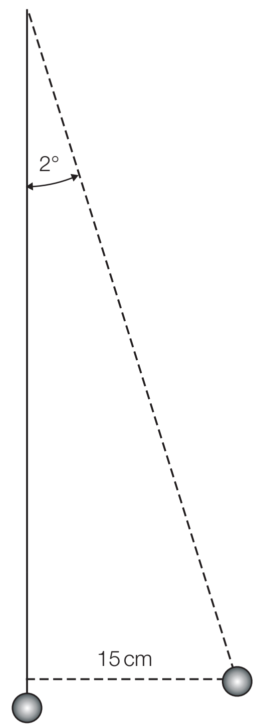
1 **(i)** 1 s
(ii) 0.5 s; +/– 0.25 s
(iii) **(a)** 0.2 s, 0.02 s; **(b)** 0.5 s, 0.05 s; **(c)** 0.7 s, 0.07 s; **(d)** 1.4 s
2 **(i)** 0.1 g
(ii) +/– 0.05 g
(iii) 0.3 g +/– 0.1 g
(iv) *Hint*: read page 19 of the chapter
3 **(i)** Maximum thickness = 1.19 cm; minimum thickness = 1.17 cm
(ii) Thickness = 1.18 cm +/– 0.01 cm
(iii) Thickness = 1.18 cm
4 **(i)** 24.2 m; **(ii)** 40.0 m; **(iii)** 128.2 m; **(iv)** 965 m^2
5 **(i)** **(a)** 641.5–642.5 m; **(b)** 5999.5–6000.5 nm; **(c)** 2999.95–3000.05 K; **(d)** 0.0025–0.0035 J; **(e)** 1.225–1.235 mg
(ii) **(a)** 0.16%; **(b)** 0.017%; **(c)** 0.003%; **(d)** 33% **(e)** 0.8%
(iii) **(a)** 0.003 J; **(b)** 3000.0 K
6 **(i)** 1 mm; **(ii)** 0.33 mm
7 **(i)** **(a)** 0 mg; **(b)** 0.01 g; **(c)** 390 μg; **(d)** 4.5 cm^3; **(e)** 1625 kg; **(f)** 16 km
(ii) Consider the measurement (in your school laboratory) of very small masses, and the distances encountered in marathons
(iii) Decreasing order of precision is (c), (e), (f), (d), (b), (a)

Chapter 3

1 *Hint*: read pages 30–32 of the chapter
2 Remember that your hypothesis is a statement and not a question. So, what is the question? What is the answer? Your plan will consist of what you will do – what steps you will take. Your design will be more detailed. See pages 43–46
3 **(i)** The readings you will take will be the variables in the expression you obtain for the quantity, *g*, which you are setting out to measure. What is the expression for '*g*'?
(ii) This involves your A/I skills. You may need to manipulate the expression for *g* and use the slope of a graph. In obtaining the slope, do not forget the units
(iii) These are difficulties over which you have little control
(iv) *Hint*: consider the variable which has the maximum uncertainty and use this as your guide
4 **(i)** That readings of *v* were taken first with *u* increasing and again with *u* decreasing
(ii) Pay attention to the matter of significance
(iii) Note the hint given about the ranges of values of *u* and *v*
(iv) Read the text on how to join points on a curve on page 34
(v) *Hint*: use the fact that the slope of this graph is 1
(vi) Focal length of the lens = 10.0 cm

Chapter 4

1 C
2 3.4 s; 4.0 s
3 **(i)**



(ii) Length of pendulum = 4.29 m
(iii) $g = 9.8\ m\ s^{-2}$

Chapter 5

1 **(i)** 377 m; **(ii)** 240 m; **(iii)** 7.0 $m\ s^{-1}$; **(iv)** 4.4 $m\ s^{-1}$
2 **(i)** 6.8 N, 19 N; **(ii)** 200 $km\ h^{-1}$, 346 $km\ h^{-1}$ (*Hint*: consider how many operations are involved in each method and then decide which is less subject to error)

3 17 320 N

4 $\cos^{-1}\frac{2}{3} = 48°$ with the bank

5 536 km h^{-1}, 86.2° east of north

Chapter 6

1 **(i)** Force acts along the line joining the centres of the Earth and Moon: **(a)** away from the Earth toward the Moon; **(b)** away from the Moon toward the Earth

(ii) Forces are equal

(iii) Force acts from the centre of the line joining the centres of Earth and Moon. The force caused by the earth acts towards the Earth's centre. The force caused by the Moon acts towards the Moon's centre.

(iv) The force towards the Earth is greater than that acting towards the Moon, since the Earth's mass is larger than the Moon's mass

2 Forces acting on each of the magnets are: **(i)** the tension along the strings (mechanical); **(ii)** the attraction of the other magnet (magnetic); **(iii)** the weight of the magnet (gravitational)

3 **(i)** Read pages 81 and 82

(ii) The gravitational pull on 1 kg of mass on the Moon's surface is $\frac{1}{6}$ of that on the Earth's surface

(iii) 6 kg

Chapter 7

1 **(a)** Non-parallel; **(b)** anti-parallel; **(c)** anti-parallel; **(d)** non-parallel; **(e)** non-parallel; **(f)** parallel

2 **(i)** 1 N; **(ii)** 1 N to the left; **(iii)** 1 N to the right

3 **(i)** 7 N; **(ii)** 6 cm below the 4 N force to the left; **(iii)** the sheet would rotate

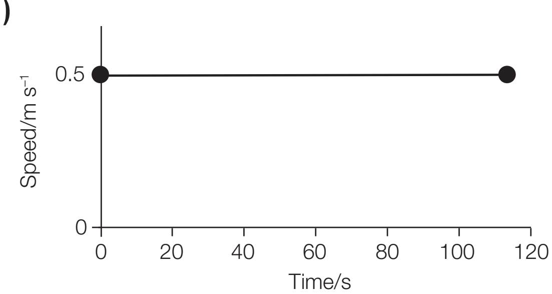
4 **(i)** Consult pages 36–39, and the internet

(ii) Think of a domestic example, e.g. using a kitchen balance, pulling strands …

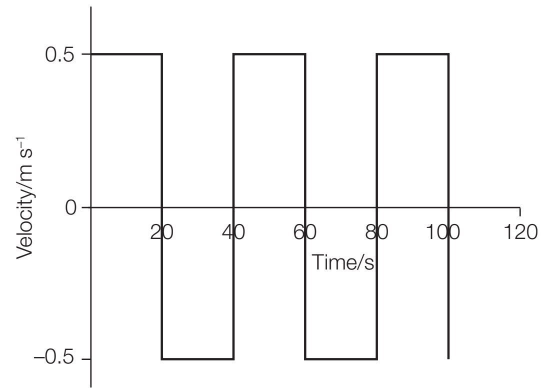
(iii) 43.6 cm

Chapter 8

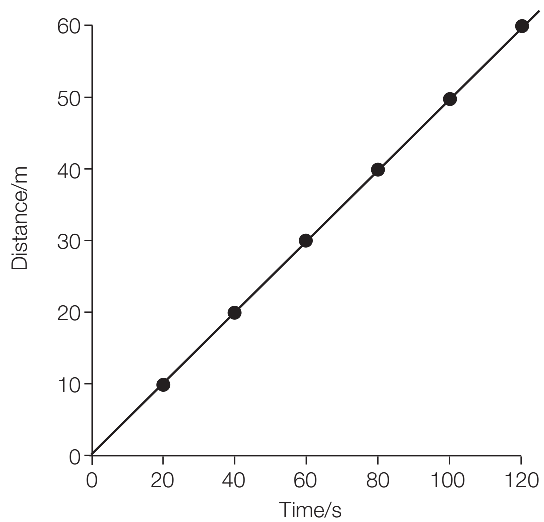
1 **(i)** **(a)**



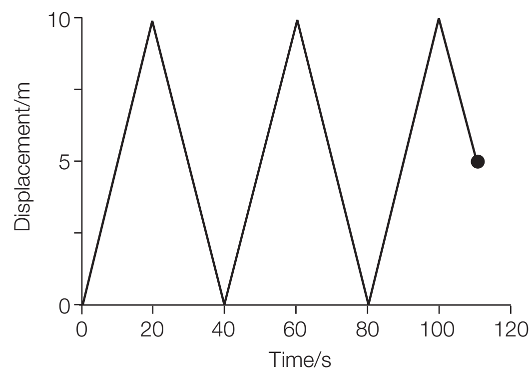
(b)



(c)



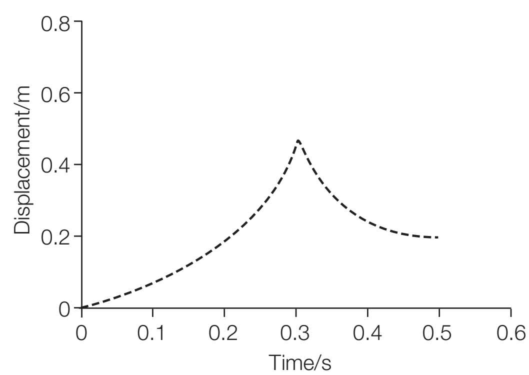
(d)



(ii) 0.045 m s^{-1}

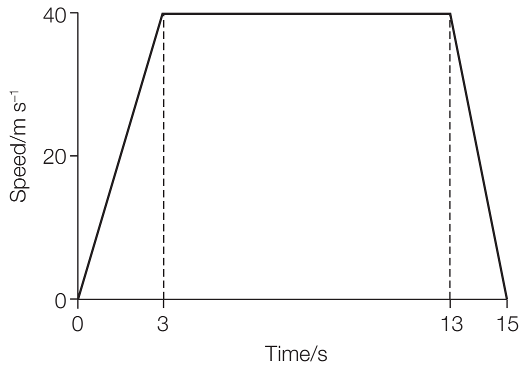
2 **(i)** **(a)** 0.3 s; **(b)** 0.2 s; **(c)** 0.65 m; **(d)** 0.25 m

(ii)



The ball falls from rest for 0.3 s through 0.45 m and then rebounds to a height of 2 m with an initial velocity of 2 m s^{-1}

3 **(i)** **(a)**



(b) 500 m; **(c)** 33.3 m s^{-1}

(ii) 8.9 m s^{-2}

4 **(i)** **(a)** 8.9 m s^{-1}; **(b)** 445 kg m s^{-1}; **(c)** 890 N; **(d)** 17.8 m s^{-2}

(ii) *Hint*: recall that the force that brings the boy to rest will depend on the time he takes to come to rest

5 **(i)** *Hint*: use Newton's third law and the effect of friction on the motion of the chair **(ii)** *Hint*: same as at **(i)**

(iii) *Hint*: consider frictional force between the person and the mango skin and that between the mango skin and the pavement. Now use Newton's first and second laws

6 **(i)** *Hint*: consider carefully the mechanism of paddling and then apply Newton's third law to the paddle and the water

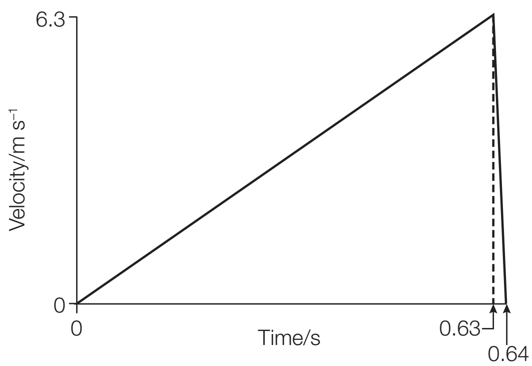
(ii) *Hint*: use the frictional force between the rope and the tree and then Newton's second law to the climber

(iii) *Hint*: use Newton's second law about the rate of change of momentum

7 **(i)** **(a)** 0.63 s; **(b)** 6.3 m s^{-1}

(ii) **(a)** 630 N; **(b)** 3.2 cm

(iii)



8 *Hint*: See the answer to question 4**(ii)**

Chapter 9

1 The missing words are: capacity; work; force; force; application; parallel; same direction; force; kinetic; kinetic; work done; parallel

2 **(i)** Ball in case (a); **(ii)** 9.4 J

3 **(i)** 0.90 m s^{-1}; **(ii)** 1800 N; **(iii)** 81 000 J; **(iv)** 67 500 J; **(v)** 14.9 kW; **(vi)** 29.7 kW

4 **(i)** 240 kJ; **(ii)** 8 kW

(iii) *Hint*: consider frictional forces and the distance covered by the lift as against that covered by the moving staircase

5 **(i)** 60 kg m s^{-1}; **(ii)** 60 N; **(iii)** 42 J; **(iv)** 4.2 kW; **(v)** 6000 m s^{-1}; **(vi)** 70 cm

Chapter 10

1 **(i)** 136 Pa; consult the internet for the name of the scientist and his contribution to science; **(ii)** 0.74

2 **(i)** 0.19 N cm^{-2}; **(ii)** 1900 Pa

3 710 kPa

4 **(i)** If there is an air bubble in the water, a pressure will be exerted by the air in this bubble. This pressure will be transmitted down to the plastic sheet and give rise to a downward force on the sheet. The total downward force on the sheet (which will include the weight of the water) will exceed the upward force on the sheet and the sheet will fall

(ii) *Hint*: consider the role played by pressure in the sinking of a vehicle into soft ground

(iii) *Hint*: consider the additional pressure obtained in using a downward force on a very narrow (sharp) knife blade

(iv) *Hint*: the pain experienced on the shoulders will depend on the pressure acting downward on the shoulders. Consider how this pressure could be made as small as possible

5 **(i)** *Hint*: apply Pascal's law to the two columns of the different liquids above the common junction; **(ii)** 0.86 g cm^{-3}

6 *Hint*: apply Pascal's law to the two liquid columns above the mercury menisci

7 **(i)** The pressures due to the columns are each equal to the atmospheric above the liquid meniscus in each beaker

(ii) The atmosphere

(iii) The individual liquids

(iv) Pressure due to liquid A + p = pressure due to liquid B + p, where p = pressure due to the air left in the U-tube

(v) $h_A \rho_A g = h_B \rho_B g$

(vi) Ratio of the densities of liquids A and B = $\frac{h_B}{h_A}$

Chapter 11

1 C

2 C

3 B

4 A

5 **(i)** B expands more than A

(ii) **(a)** The flow stops because the circuit is broken when the strip moves away from C; **(b)** the flow resumes since B contracts more than A, causing the strip to curve towards, and make contact with, C

(iii) Down – so that the strip on cooling takes a longer time to make contact with C

(iv) Thermostat

6 Solid: fixed volume, fixed shape

Liquid: slightly larger than in solid, making density less than solid; vibrations and random motion (translations); fixed volume, takes shape of container

Gas: no fixed shape; fills any volume into which it is put; volume depends on pressure; very compressible

Chapter 12

1 B

2 B

3 B

4 **(i)** Clinical thermometer; **(ii)** 37.8°C

(iii) A – capillary bore; B – stem; C – constriction; D – thermometric fluid; E – bulb

(iv) To enable the thermometer to retain its highest reading

(v) So that heat can get very quickly to the thermometric fluid

5 **(i)** Fahrenheit; Kelvin

(ii) A 40°C; B –273°C; C 212°F; E –459°F; F 373 K; G 313 K; H 0 K

6 **(i)** Pouring – water evaporates (molecules escapes from the liquid surface) as the liquid is poured, taking latent heat from the liquid, and thus cooling it

(ii) Blowing – removes the rather energetic molecules as the leave the surface of the liquid; the average kinetic energy of the remaining molecules, and hence the temperature of the liquid, drops

Chapter 13

1 D

2 D

3 C

4 B

5 B (*Note*: do not confuse heat capacity with specific heat capacity. The concepts and the units are different; see text)

6 C

7 C

8 B

9 B

10 When the trains are brought to a sudden stop, the huge kinetic energy of the moving train becomes zero. This energy is converted to thermal energy which gives rise to heat enough to start fires on the train

11 **(i)** See text (e.g. figure 13.7)

(ii) By using a rheostat in series with the heating coil and adjusting it as needed to keep the current steady

(iii) **(a)** 5250 J; **(b)** 8.75 W; **(c)** some of the heat supplied escapes from the water into the surrounding environment

12 **(i)** **(a)** Sunshine contains ‘caloric’ which is absorbed by the bar, causing the temperature to rise; **(b)** the heat energy (electromagnetic wave energy) interacts with the molecules causing molecules of the bar to vibrate faster, resulting in a rise in temperature

(ii) Each time a fixed amount of potential energy was lost by the falling weight, a fixed temperature rise was obtained, confirming that a fixed quantity of heat (energy) must have given rise to the increase in temperature

Chapter 14

1 C

2 A

3 C

4 B

5 D

6 D

7 A

8 **(i)** Conduction – metal pipes containing liquid refrigerant conduct heat from food to the refrigerant; the heat is used for changing the liquid refrigerant to vapour

Convection – cold air from the freezer descends into the refrigerator cabin, and hot air from the refrigerator cabin rises to the freezer and becomes cooled

Radiation – heat taken from the food by the refrigerant is radiated from the refrigerator by black fins located at the back of the refrigerator

(ii) **(a)** \$40.50; **(b)** 4 320 000 J

(iii) If the back is placed too close to the wall, as the wall warms up due to the heat radiated by the black fins, the wall itself will radiate heat back into the fins. A distance of about 10 cm between the wall and the fins will allow heat to escape upwards by convection, so that the wall will not get as hot

9 **(i)** 3000 W

(ii) **(a)** 300 W; **(b)** 33%

(iii) **(a)** A ceiling which traps and seals air will reduce heat entry by conduction; **(b)** double glazing of windows (trapping air between two sheets of glass) will also help reduce heat gain by conduction

10 **(i)** Walls and roof

(ii) Walls – using materials that are poor conductors (e.g. hollow tiles with air pockets) will help reduce heat loss by conduction; walls painted white will help reduce heat loss by radiation

Roof – using roofing poor conducting material will help reduce heat loss by conduction; roofing of a light or shiny colour will help reduce heat loss by radiation

Chapter 15

1 C

2 B

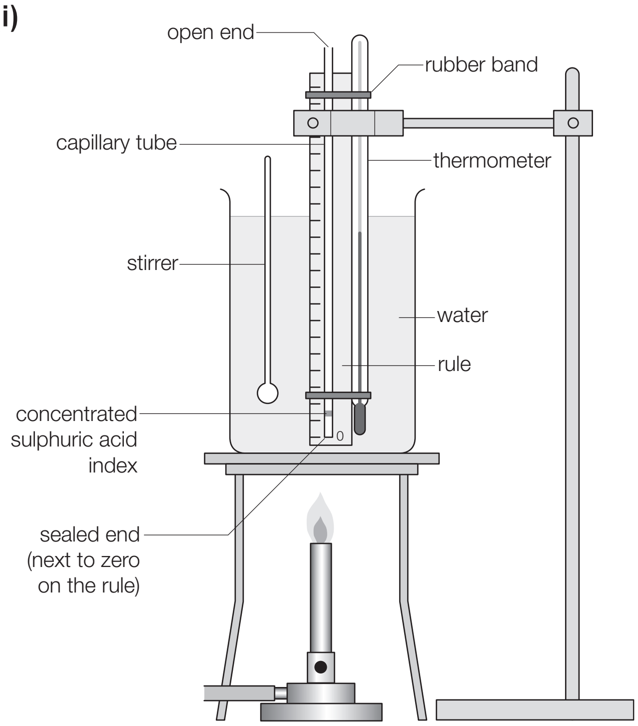
3 C

4 D

5 **(i)** and **(ii)** see text

6 1.3 m^3

7 **(i)**

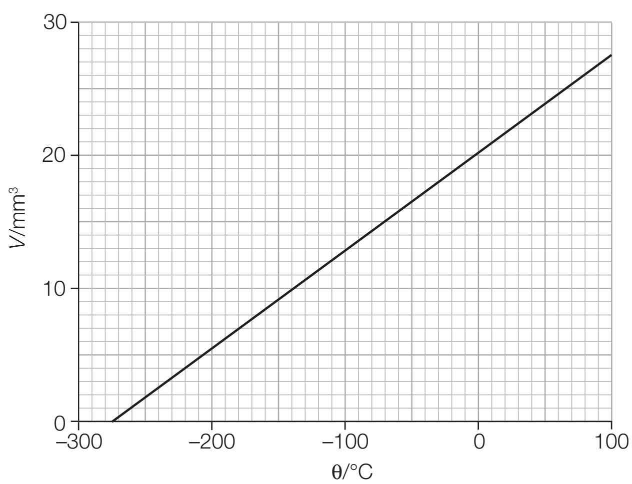


(ii) By leaving the capillary bore open to the atmosphere (whose pressure is assumed to be constant for the duration of the experiment)

(iii) **(a)** Stirrer; **(b)** to ensure that the water is mixed so that its temperature is uniform throughout

(iv) For a constant cross-section area, *A*, volume, *V*, is directly proportional to height, *h*, since $V = Ah$

(v) **(a)**



(b) $V \approx 20.0$ mm^3; $\theta \approx -275$°C

(vi) gradient = 0.073 mm^3/°C

(vii) Atmospheric pressure might have changed during the experiment. The sensitivity (smallest division) of the thermometer and ruler limits the accuracy of the experimental values

8 3.9 litres

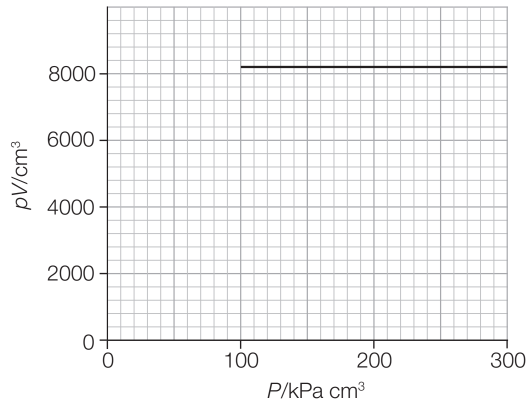
9 **(i)** See text

(ii) **(a)** There must be a fixed mass of gas; the temperature must be constant

(b) Gas is sealed by oil in a tube closed at the top; gas is pressurised and oil level is observed to check for leaks of either gas or oil. Volumes are read a few minutes after pressure has been changed, to allow the apparatus to remain at (constant) room temperature

(c) A plastic shield

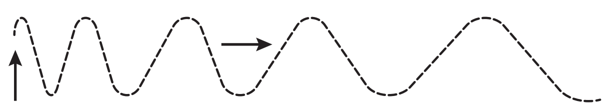
(iii) **(a)**



(b) Allowing for experimental errors, the graph is in agreement with Boyle's law since *PV* is approximately constant (at about 8000 kPa cm^3) on the graph

Chapter 16

1



2 Transverse waves since, when the palm moves forward, the water in contact with it will be piled upwards and when the hand moves backward the water level will fall

3 The ball will move up and down in the water, since it will follow the movement of the waves produced when the stone falls in the water. It will not, therefore, move forward. The ball will only move forward if a force is applied to it from behind

4 *Hint*: consider carefully what an oscillation is (see page 245) and decide whether the movement of the coconut tree fits the description of an oscillation

5 *Hint*: as for question 4

Chapter 17

1 **(i)** 0.2 s; **(ii)** 2 cm; **(iii)** 10; **(iv)** zero; **(v)** 2 s

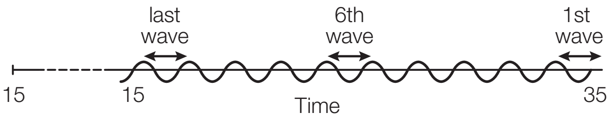
2 **(i)** **(a)** B, D; **(b)** A, C; D, F

(ii) **(a)** $\frac{1}{4}\lambda$; **(b)** $\left(\frac{5}{4}\right)\lambda$; **(c)** 1λ; **(d)** $\left(\frac{5}{4}\right)\lambda$

(iii) **(a)** $\frac{1}{8}$ s; **(b)** $\frac{1}{4}$ s; **(c)** $\frac{7}{8}$ s

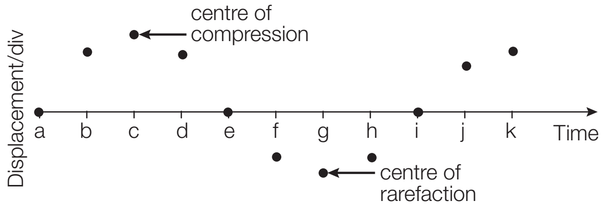
(iv) $\left(\frac{5}{8}\right)\lambda$

3



4 **(i)** Longitudinal wave

(ii)



(iii) Amplitude at 'c' = 1 cm, at 'g' = 0.8 cm, at 'k' = 0.8 cm; wavelength = 8 cm

Chapter 18

1 Yes. Since the molecules of air at high pressure are closer together than the molecules of air at a low pressure, the inter-molecular forces which control the expansion and contraction will be larger. The air will therefore be more elastic (springy) and it will transmit sound faster

2 **(i)** He should join the speakers by a straight line and then draw another straight line perpendicular to this line some distance away from the line of the speakers and in front of the speakers

(ii) He should now walk along this perpendicular and if he finds that there are places where the sound is intense and other places where the sound is very faint or absent altogether as he walks along it, he would know that he has achieved interference. The waxing and waning of the sound should alternate

(iii) No. For the reason, consider whether all the sound waves will give constructive interference or destructive interference at the same places. Now explain why the answer is as stated

3 **(i)** A vertical line whose mid-point is the (0,0) point on the CRO screen.

(ii) A line similar to the line at (i), but half the length

(iii) The line at (i) will get shorter and shorter remaining above the time axis, until, at a certain point, its length will become zero. It will then increase in length once again, but in the opposite direction and, at a certain point, again begin to decrease to 0. This pattern of increasing and decreasing in length, in opposite directions about the time axis, will continue right up to the point Y. This increase and decrease in length should take place at roughly equal intervals

(iv) A vertical line will be seen at all points along XY. This line will straddle the time axis and be of about the same length throughout

4 **(i)** Wavelength = 0.3 mm

(ii) New wavelength = 30 mm

(iii) Since diffraction increases with wavelength and high-frequency sound is of much smaller wavelength than low-frequency sound, it is much less subject to diffraction inside the body tissues. The images obtained with ultrasound are therefore sharper than they would be with lower frequency sound

Chapter 19

1 **(i)** A spectrum is a range of electromagnetic waves of continuously increasing (or decreasing) wavelength

(ii) Because the forces which produce the waves are electrical and magnetic in nature

(iii) **(c)** are ultra-violet rays; **(d)** are visible (or light) rays; **(e)** are infra-red (or heat) rays

(iv) Frequency = 500 kHz

(v)

(vi) With the eye, light-meter, etc.

(vii) By using a high temperature source, e.g., a flame or an oven

(viii) Band (f)

2

	Sound waves	Light waves
Are transverse waves	✗	✓
Can travel in a vacuum	✗	✓
Energy is carried by particles only	✓	✗
Can be absorbed by matter	✓	✓
Can undergo refraction	✓	✓
Can show interference	✓	✓
Obey the laws of reflection and refraction	✓	✓

3 Yes. By waving the charged comb to and fro, you are causing the charges on the comb to be accelerated (see page 288)

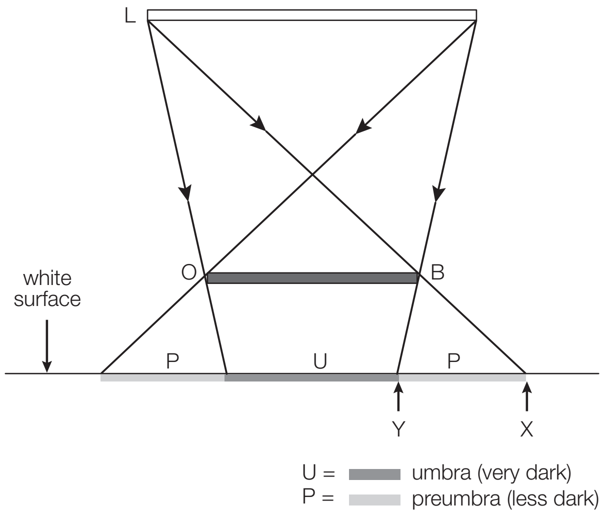
4 5.5×10^{14} Hz

Chapter 20

1 If it goes past a sharp edge in a narrow slit or if it passes through a very fine pin hole

2 See pages 249 and 250

3

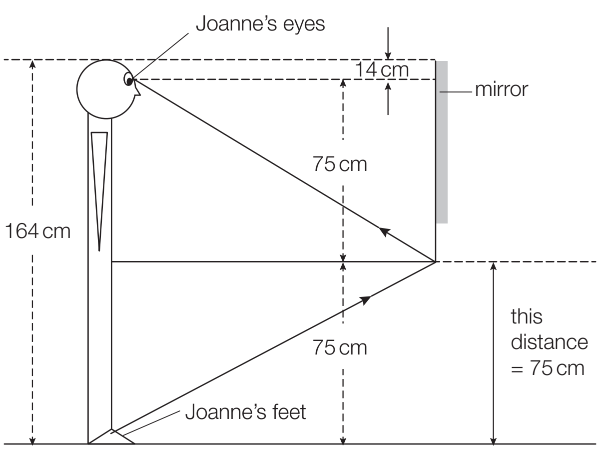


4 Fluorescent lamps are generally much larger than incandescent bulbs. Since point sources produce no penumbra and since the larger the light source the larger the penumbra, it follows that fluorescent lamps with their larger size will produce a larger penumbra than light bulbs. Since penumbras are lighter shadows than umbras, then the shadows produced by fluorescent lamps will be less dark than those produced by incandescent bulbs

Chapter 21

1 The words and phrases are: virtual; upright; the same distance away from; virtual; diverge; cannot

2 See the figure below and use the laws of reflection



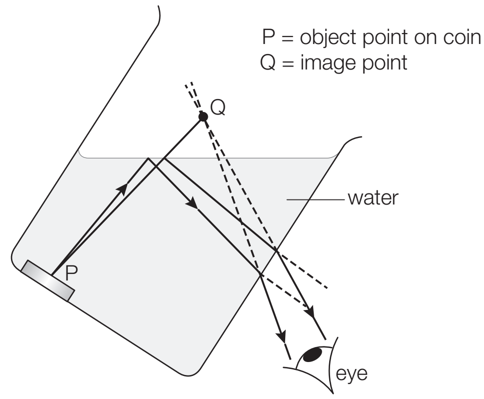
Chapter 22

1 **(i)** **(a)** B; **(b)** B; **(c)** D
(ii) A and C; B and D

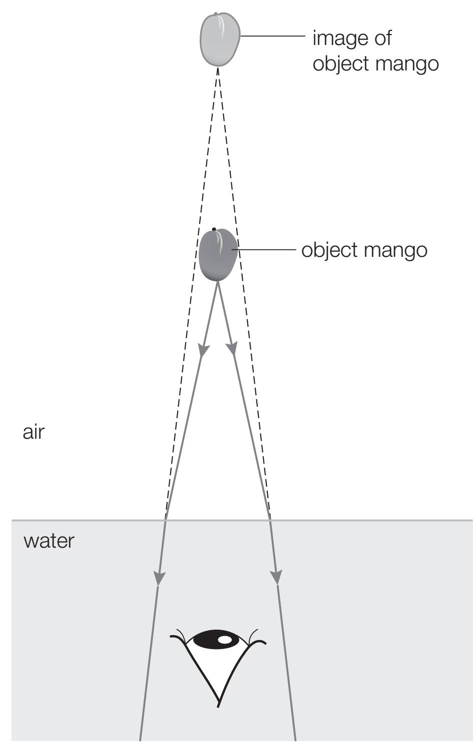
2 **(i)** **(a)** f, h, j; **(b)** none; **(c)** f, h, j
(ii) 4 images; the image due to the ray labelled 'a'
(iii) The image due to the ray labelled 'a'
(iv) Because dispersion occurs only with refraction and not with reflection. Since rays f, h and j are all suffering refraction out of the glass they are all liable to be dispersed on entering the air

3 **(i)** The order is **(c)**, **(b)**, **(a)**
(ii) The critical angles are: **(a)** 69.8°; **(b)** 66.2°; 60.4°

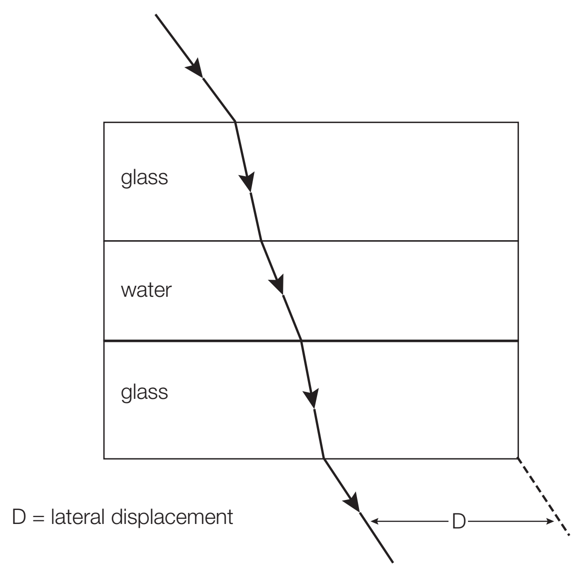
4 **(i)**



(ii)



5 **(i)** **(a)** They will be parallel; **(b)** they will be parallel
(ii) *Hint*: read page 327 for a clue to the answer
(iii) and **(iv)**



6 **(i)** Blue; **(ii)** blue; **(iii)** black; **(iv)** black

Chapter 23

1 **(i)** *Hint*: read pages 353 and 354

(ii) **(a)** The lamp bulb provides light to the film. This light will allow light and dark features of the object to be clearly identified. The slide contains the object to be projected. The lens will produce the magnified image of the object. The screen is used in order to allow the image to be observed

(b) Placing the slide just outside the focus of the lens would cause the image to be:

- real, and
- magnified

If the slide were placed:

1 within the focus, there would be no image on the screen, since the image would be virtual

2 too far outside the focus, the image would become too small (diminished), although it would remain real

(iii) To obtain an image on a more distant screen, the slide must be moved nearer to the focus, but be kept outside the focus'. In this case the image would be larger, but the brightness would not be as good

(iv) 'Twice inverted' means that the image is inverted about a horizontal axis and also a vertical axis

2 Object distance should be 12 cm

Chapter 24

1 B

2 C

3 D

4 **(i)** *Either* the paper was uncharged *or* had a charge that was opposite to that on the charged rod

(ii) The paper acquires the same sign of charge as the rod upon contact with the rod and is repelled since like charges repel

5 **(i)** Electrons; **(ii)** towards B; **(iii)** +2 C on each

6 **(i)** A – negative; B – positive

(ii) Electrons are attracted from B towards A by the positively charged rod (since both A and B are made of metal and therefore have 'free' electrons)

(iii) Induction (since the charging rod does not actually touch the metal spheres)

Chapter 25

1 B

2 B

3 D

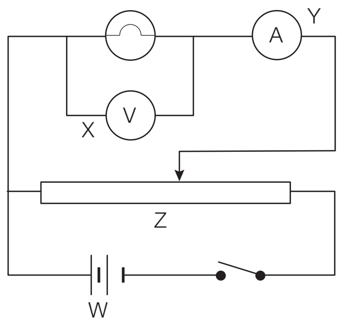
4 B

5 C

6 C

7 C

8 **(i)**



(ii) W – battery; X – voltmeter; Y – ammeter; Z – rheostat

(iii) Potential divider

(iv) 4.0 Ω

(v) Lamp gets brighter because a greater voltage is supplied due to a greater faction of the rheostat wire being connected from the positive terminal of the battery to P

9 **(i)** W – switch; X – light-emitting diode (LED); Y – fixed resistor

(ii) To limit the current through the LED so that it does not burn up

(iii) 10.4 V

(iv) 520 Ω

Chapter 26

1 B

2 A

3 B

4 D

5 B

6 C

7 At B

8 **(i)** **(a)** In series; **(b)** in parallel

(ii) **(a)** 0.50 A; **(b)** 1.5 A; **(c)** 1.0 A

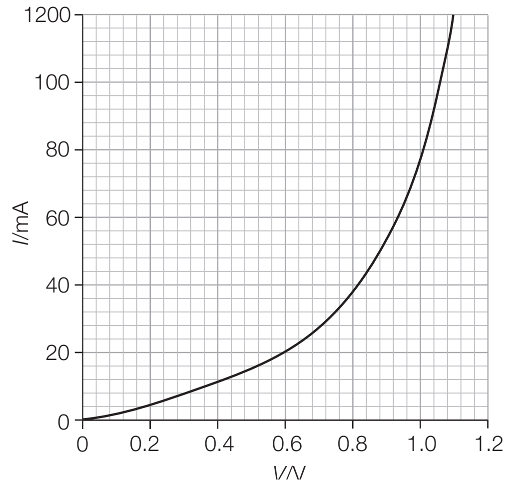
(iii) **(a)** 240 Ω; **(b)** 60 W

(iv) 3 A (The maximum current required is 1.5 A. A fuse of 3 A will allow for minor fluctuations in the current, but will 'blow' and disable the circuit if, for some reason, the current is greater than 3 A. Excessive currents can cause wires to overheat and even result in fires)

(v) All lamps in X and Z remain lighted; all lamps in Y go out

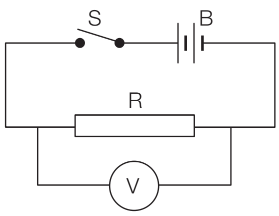
9 **(i)** **(a)** Switch; **(b)** rheostat

(ii) **(a)**



(b) A semiconductor diode; **(c)** up to 1.0 V

10 **(i)**



(ii) The reading on the ammeter will drop by half

Chapter 27

1 B

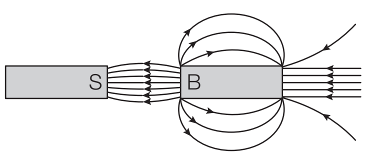
2 C

3 **(i)** C; **(ii)** B

4 **(i)** B; **(ii)** C; **(iii)** B

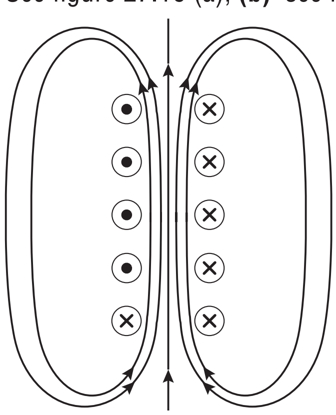
5 **(i)** Place the compass horizontally and away from magnetic fields. Allow it to settle in the Earth's magnetic field. **(a)** The end which points roughly towards the north is the N-pole; **(b)** the pole of the bar magnet that repels the other pole (S-pole) of the compass is an S-pole

(ii)

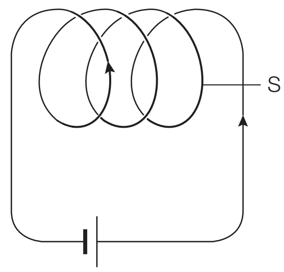


6 **(a)** See figure 27.16 (a); **(b)** see figure 27.17 (b)

(c)



7 **(i)** and **(ii)**



(iii) Use large current, soft iron core, large number of turns

(iv) See section on 'Uses of electromagnets' (page 424)

(v) The alternating current produces an alternating magnetic field which causes the ordered domains in the magnet to become randomly rearranged, resulting in a net magnetisation that is practically zero in the material, especially if, during this process, the material is laid in an east–west position

Chapter 28

1 C

2 A

3 C

4 **(i)** Upward; **(ii)** brush

(iii) To reverse the current every half cycle so that the coil would spin in one direction only

(iv) D.C. motor

(v) Hoisting of objects; spinning of CDs in portable CD players

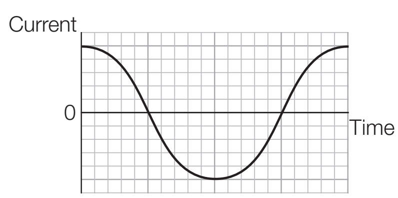
(vi) Moving coil ammeter

5 27.5 V

6 0.33 A

7 **(i)** From A to B

(ii)



(iii) Brush

(iv) Electromagnetic induction

(v) To generate a.c. electricity

8 See section 'Practical transformers' (page 445)

9 The 'pick-up' has a coil and a soft iron core. (The steel string is magnetic and when it vibrates next to the coil, it induces a varying current in the coil of the pick-up)

Chapter 29

1 A

2 A

3 A

4 B

5 A

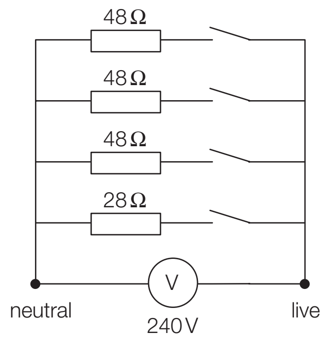
6 B

7 B

8 B

9 $4.87

10 **(i)**



(ii) 6000 W

11 **(i)** Transformer

(ii) **(a)** 160 A; **(b)** 20 A

(iii) At high transmission voltages, the current, *I*, along the lines is small. Power lost along the lines is therefore greatly reduced, since power loss is equal to I^2R for lines of resistance, *R*

12 In a ring circuit, the current reaches its outlet along two paths (wires). Hence less current is used in each wire to an outlet. This allows more power to be delivered safely to the outlet along the same wires than if a simple parallel circuit is used (see section 'Ring circuits', page 459)

13 **(i)** A primary cell cannot be recharged; a secondary cell can

(ii) **(a)** The amount of chemicals making up the cell – more chemicals, longer life

(b) The elements of which the electrodes are made (different pairs of elements give rise to different voltages)

(c) The internal resistance of the cell

14 **(i)** See figure 29.12 and section 'Lighting circuits' (page 458)

(ii) Single-pole, double-throw (SPDT)

15 **(i)** Advantage – can deliver very large currents required to operate the starter motor of a car

Disadvantage – lead is toxic and therefore disposal poses environmental problems (also the acid is corrosive and can affect materials or persons if spilt on them)

(ii) Advantages – can provide moderately large currents to operate toys; rechargeable

Disadvantages – cadmium is toxic; batteries can explode if shorted

Chapter 30

1 A

2 A

3 C

4 A

5 D

6 C

7 B

8 D

9 B

10 **(i)** Y-input

(ii) **(a)** 8 cm (assuming each square on the screen is 1 cm × 1 cm); **(b)** 10 ms

(iii) 100 Hz

(iv) 3.3 m

11 **(i)** **(a)** Y-shift; **(b)** focus

(ii) **(a)** Alternating; **(b)** 8 V

(iii) Time base

(iv) Similar shape, but twice the size vertically and crossing the horizontal axis at the same points

Chapter 31

1 D

2 A

3 A

4 D

5 C

6 **(i)** Y. The orientation of the diode is such that current will easily pass through the diode to Y on its way to 0 V. (The buzzer has a higher resistance than the wire and therefore most of the current will pass through the wire from Y and very little through the buzzer)

(ii) Resistor. To limit the current through the diode and thus to protect the diode from excessive heating

(iii) 300 Ω

7 **(i)**

A	B	C	Y_1	Y_2	Y_3
0	0	0	1	1	1
0	1	0	1	1	1
0	0	1	1	0	1
0	1	1	1	0	1
1	0	0	1	1	1
1	1	0	0	1	1
1	0	1	1	0	1
1	1	1	0	0	0

(ii) All combinations except the last row: A–1, B–1, and C–1

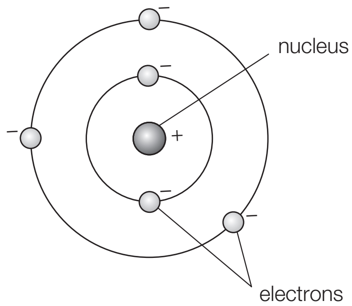
(iii) If any of three circuits with outputs to A, B, and C are not working (i.e. a logic output of 0), a warning light (Y_3) goes on. Thus the logic circuit can be used to monitor if any of three circuits is/are not functioning

Chapter 32

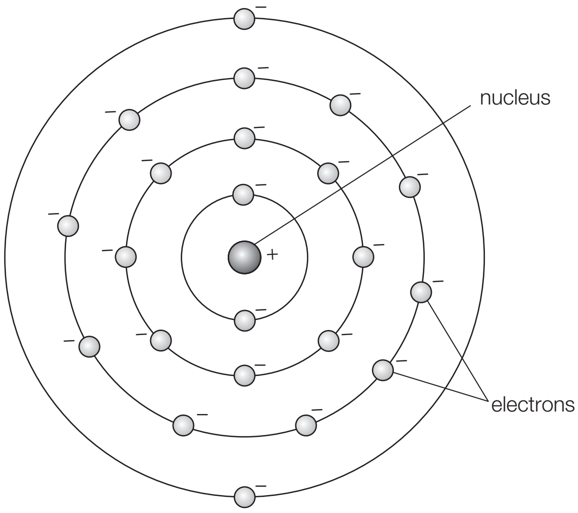
1 **(i)** John Dalton; **(ii)** Sir Joseph J. Thomson; **(iii)** Ernest Rutherford; **(iv)** Niels Bohr

2 2, 8, 18 (using the formula $2n^2$)

3



atom with 5 electrons



atom with 22 electrons

Note: although the 3rd shell can accommodate up to 18 electrons ($2n^2$), for an atom with 22 electrons, 12 outermost electrons are not in the 3rd shell. There are 10 electrons in the 3rd shell and 2 in the 4th shell. Chapter 33 addresses this discrepancy.

4 Bohr assumed that electrons moved in circular, 'allowed' orbits around the nucleus without losing energy

5 The model worked fairly well for the hydrogen atom but not for atoms of other elements (see section 'Success and failure of the Bohr model', page 502)

6 The electron is treated as having wave properties rather than particle properties only. Also, the position of an electron within an atom is treated on the basis of probability – electrons are located in 'orbitals' rather than orbits' (see section 'A wave model of the atom', page 504)

7 B

8 C

9 10^{-10} m

11 Yes. The pattern of spectral lines in Y matches exactly the pattern of lines in X

Chapter 33

1 A

2 C

3 B

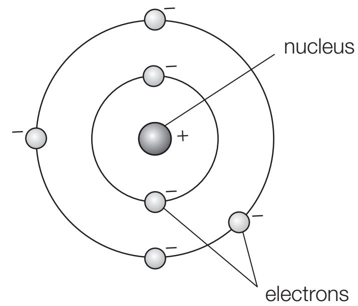
4 7.5×10^{12} electrons

5 **(i)** **(a)** P; **(b)** Ca; **(c)** Cr

(ii) Ca (or Be)

(iii) Period III Group IV; 2, 8, 4

(iv)



nitrogen atom

6 **(i)** It is believed that within the nucleus, neutrons, although neutral, exert a very large force that overcomes the force of repulsion between the protons, thus preventing the protons from flying apart

(ii) A proton and an electron have the same magnitude of charge but the charges are opposite in sign. An atom is normally neutral, electrically, since it has equal numbers of protons and electrons

(iii) Lithium is very reactive since its atom has only 1 outermost electron, which can easily be dislodged. Neon is not reactive since its outermost shell has a full complement of electrons (8), which is a very stable configuration

7 Protons and neutrons

8 **(i)** For elements with atomic number less than 30, an equal number of protons and neutrons results in stability of the nucleus (see also section 'Stability of the nucleus')

(ii) An atom tends to achieve a stable state when its outermost shell contains the maximum allowable number of electrons (see also section 'Stable energy states among the orbiting electrons')

Chapter 34

1 A

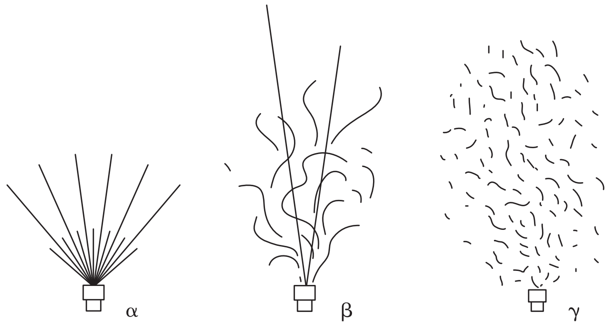
2 A

3 **(i)** **(a)** To cool the alcohol vapour to supersaturation

(b) To form a vapour so that when radiation produces ionisation in the atoms of the vapour, the ions attract other vapour molecules, which coalesce to form traces of visible droplets (see section 'The cloud chamber', page 518)

(c) The strong light illuminates the droplets and the black face plate provides a dark background against which the illuminated droplets can be easily seen

(ii)



4 **(i)** A – gamma; B – alpha; C – beta

(ii) **(a)** Alpha radiation is not suitable since it is easily stopped by aluminium sheeting

(b) Beta. Beta radiation will penetrate aluminium sheeting, and the intensity of beta radiation passing through the sheeting is quite sensitive to the thickness of aluminium sheeting

(iii) **(a)** $^{14}_{6}C \rightarrow ^{14}_{7}N + ^{0}_{-1}e$; **(b)** $^{226}_{88}Ra \rightarrow ^{222}_{86}Rn + ^{4}_{2}He + ^{0}_{0}\lambda$

5 **(i)** Reduces by 2; **(ii)** increases by 1; **(iii)** stays the same

Properties	α	β	λ
charge	+2e	–e	0
nature	helium nuclei	electrons	electro-magnetic waves
affected by magnetic field	yes	yes	no
approximate range in aluminium	0.1 mm	3 cm	indefinite
degree of ionisation produced	very strong	fairly strong	weak

Chapter 35

1 A

2 A

3 A (A fairly long half-life isotope is needed and the radiation from the isotope must be fairly intense. Cobalt–60 fits these criteria)

4 D

5 D

6 D

7 **(i)** The time taken for half a sample of radioactive nuclei to decay

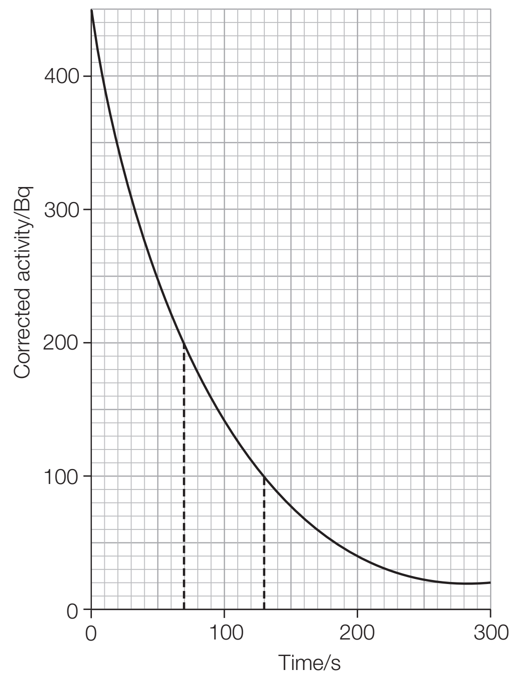
(ii) No. Because radioactivity is a random process, so it is not possible to predict when the last nuclei will decay. Half life is just an average measure of time for decay

(iii) Radon–220 is continuously being produced from the decay of thorium–232, which has a half-life of 1.4×10^{10} year.

8 **(i)** Because background radiation is always present and the instrument gives a reading of the total radiation incident on the detector

(ii) 245, 135, 40, 35, 12

(iii)



65 s (400–200 Bq)

65 s (200–100 Bq)

(iv) This is because radioactivity is a random process and it is only the average activity that is being used in the experiment

9 **(i)** Cobalt–60. A fairly long half-life is needed and the radiation must be able to penetrate steel. Only cobalt–60 from the list fits these two criteria

(ii) A Geiger–Müller tube

Chapter 36

1 C

2 A

3 A

4 B

5 **(i)** $^{235}_{92}U + ^{1}_{0}n \rightarrow ^{144}_{56}Ba + ^{90}_{36}Y + 2^{1}_{0}n$ + energy

(ii) Nuclear fission

(iii) Krypton (Kr)

(iv) **(a)** 2 neutrons are produced in each fission. These can initiate further fission in other uranium nuclei, hence a chain reaction becomes possible

(b) Some mass 'lost' during the reaction gets converted to energy (according to the equation $E = \Delta mc^2$)

6 **(i)** **(a)** To control the reaction by absorbing excess neutrons (which could initiate undesirable fission that results in overheating)

(b) To slow down neutrons so that they can be captured by uranium nuclei

(c) Contain uranium–235 which, upon fission, produces energy

(d) To remove the heat produced by fission from the reactor chamber

(e) To pass the heat from the hot gas coming from the reactor on to water in order to convert the water into steam

(f) The steam causes the turbine to spin (the spinning turbine is attached to a generator which produces electricity)

(ii) See sections ‘ Points in favour of using nuclear power’ and ‘Points against the use of nuclear power’ (page 545)

(iii) The cold gas would no longer be available to cool the nuclear reactor; overheating will occur and there is possibility of a ‘meltdown’ (structures melt under the intense heat) or even an explosion

7 (i) Advantage – the sea is huge and thus can dilute the concentration of the radioactive materials being dumped

Disadvantage – the sea has water currents which can spread the radioactive materials worldwide

(ii) Advantage – the thick layer of earth can serve as a radioactive shield

Disadvantage – ground water can be polluted with the materials if leakage occurs; earthquakes can result in redistribution of the radioactive materials, creating further pollution to the environment and hazards to health

(iii) Advantage – space is vast, hence the effects would be diluted as far as Earth is concerned

Disadvantage – radioactive pollution will now be sent into space and might land on planets, and even on spaceships

8 4.0×10^{-12} J