Exam-style questions Section 1 p43

Q1 b)
Q2 a)
Q3 c)
Q4 b)
Q5 d)
Q6 c)
Q7 d)
Q8 c)
Q9 a)
Q10 b)

Q11 a) You can show weight (down), upthrust (up) or drag (backwards) [2].

b) i) Average speed = $\frac{1500 \text{ m}}{1200 \text{ s}}$

= 1.25 m/s [1]

ii) Average speed = $\frac{51\,500 \text{ m}}{6800 \text{ s}}$ [1]

= 7.6 m/s [1]

You have to add up the total distances and total times

iii) The athlete ran at a constant speed (about 7 m/s) until a distance of 4 400 m. Then she slowed until a distance of 6 000 m. She then picked up speed again, but slowed a little at the end.[3]

Q12 a) Student's graph using data from table [1 mark for suitable axes, 1 mark for correct data plotting, 1 mark for best fit line/curve]

b) i) 67.5 km

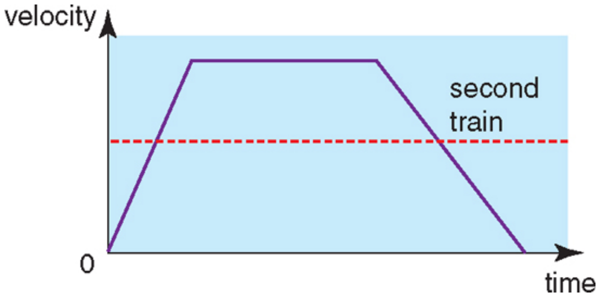
ii) 2 h 20 m

c) Average speed = distance moved/time taken [1]

Q13 a) The velocity is decreasing. [1]

b) The area A + B + C [1]

c)



[2]

Q14 a) i) $F > B$. There is an unbalanced forwards force to accelerate it. [1]

ii) $F = ma$ [1]

iii) $a = \frac{F}{m}$ [1]

$= \frac{15\,000 \text{ N}}{12\,500 \text{ kg}}$ [1]

$= 1.2$ m/s^2 [1]

b) i) For example, alertness of driver [1]

ii) For example, worn tyres and/or brakes increase the braking distance [1]

Q15 a) Stopping distance = thinking distance + braking distance [1]

b) i) The thinking distance is proportional to the speed [1]

ii) The braking distance increases more rapidly as the speed increases [1]

c) 32 m [1]

d) For safety you should use the longest stopping distance, not the average [1]

e) i) No change as the driver will still take the same time to react [2]

ii) This increases as there is little grip for the tyres. [2]

Q16 a) $a = \dfrac{v-u}{t}$

$= \dfrac{78}{60}$

$= 1.3$ m/s^2

b) The acceleration = $\dfrac{\text{resultant force}}{\text{mass}}$

The forwards force stays constant, but as the plane goes faster, air resistance increases. Therefore the resultant force decreases and consequently the acceleration.

Q17 a) acceleration $= \dfrac{\text{change in speed}}{\text{mass}}$ [1]

$= \dfrac{120}{180}$ [1]

$= 0.67$ m/s^2 [1]

b) d = average speed × time [1]

= 120 m/s × 60 s [1]

= 7200 m [1]

c) Distance = area under AB + area under BC + area under CD [1]

$= \dfrac{1}{2} \times 120 \times 180 + 7200 + \dfrac{1}{2} \times 120 \times 202$ [1]

= 10 800 + 7200 + 1220 [1]

= 30 120 m or 30.12 km [1]

It is difficult to measure the times accurately off the graph so any distance from 29–31 km is good.

d) d = average speed × time

$t = \dfrac{\text{distance}}{\text{average speed}}$ [1]

$= \dfrac{9\ 289\ 000 \text{ m}}{120 \text{ m/s}}$ [1]

= 77 408 s = 21.5 hours [1]

Q18 a) To avoid any anomalous results and to average out errors. [1]

b) The reaction time is likely to be cancelled out by the time delay in stopping the watch. [1]

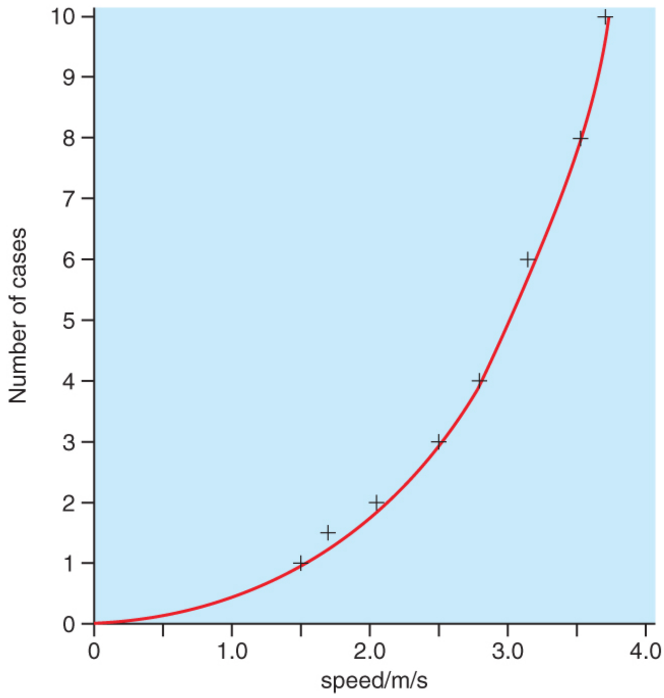
A more accurate watch would improve the accuracy, because all the measurements show a reliable pattern e.g. 1.4, 1.4, 1.4 for 4 cake cases. [1]

c) i) Average time of fall column added to table and completed by student (see table below) [2]

ii) Average speed of fall column added to table and completed by student (see table below) [2]

Number of cake cases	Time of fall/ s (average)	Speed of fall/ m/s (average)
1	2.63	1.52
1.5	2.23	1.79
2	1.97	2.03
3	1.60	2.50
4	1.40	2.86
6	1.27	3.16
8	1.13	3.53
10	1.07	3.75

d)



There do not appear to be any anomalous results as all the points lie close to the smooth curve.
[1 mark for suitable axes, 2 marks for correct data points, 1 mark for suitable smooth curve of best fit, 1 mark for comment on any anomalous points]

e) i) 2.25 m/s [1]

ii) 3.35 m/s [1]

f) g) See page 19 [2 marks for f) and 2 marks for g)]

h) The drag force increases with speed. [1] As the number of cases is increased the weight increases, but this is balanced by the drag. [1]

i) No. [1]
Because he has forgotten that the larger cases also have a larger mass.[1]

19 a) i) The length of the card. [1]

ii) This makes sure that the gliders move at a constant speed through the experiment. [1]

b) i) A vector quantity has a direction as well as a magnitude. [1]

ii) momentum = 2.4 kg × 0.6 m/s [1]
= 1.44 kg m/s [1]

iii) zero as it is stationary [1]

c) i) 1.44 kg m/s [1]

ii) 1.44 = m × 0.4 [1]
m = 3.6 kg so mass of Q = 3.6 kg – 2.4 kg = 1.2 kg [1]

iii) Change of momentum of $p = m(v_2 - v_1)$ [1]
= 1.2 kg × 0.4 m/s
= 0.48 kg m/s [1]

iv) $\text{force} = \dfrac{\text{change in momentum}}{\text{time}}$ [1]

$= \dfrac{0.48\text{kg m/s}}{0.05\text{ s}}$ [1]

= 9.6 N [1]

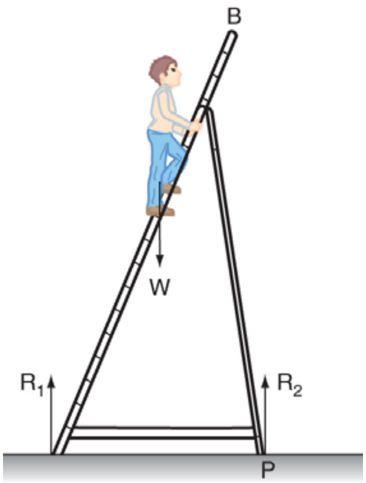
v) 9.6 N, but in the opposite direction [1]

Q 20 a) Turning moment of the container about P = force × perpendicular distance [1]
= 25 000 × 16 [1] = 400 000 Nm [1]

b) To counterbalance the container by providing a turning moment clockwise. [1]

c) Clockwise turning moments equal the anti-clockwise turning moments [1]
So 25 000 × 16 = W × 4, [1]
so weight of concrete blocks needed = 100 000 N [1]

Q 21 The man's weight acts through his centre of gravity as shown.[1]
The weight is balanced by two reaction forces. [1]
The ladder only becomes unstable if the man climbs very high (position B), so that his weight could then tip the ladder about point P. [1]



Q 22 a) Leaning out provides a larger turning moment, [1]
which helps balance the large turning moment produced by the wind in the sail. [1]

b) Turning moment is force × perpendicular distance [1]
so 750 × 0.7 [1] = 525 Nm [1]

c) Leaning out further produces a larger turning moment, [1]
to balance the increased moment from the stronger wind. [1]

Exam-style questions Section 2 p86

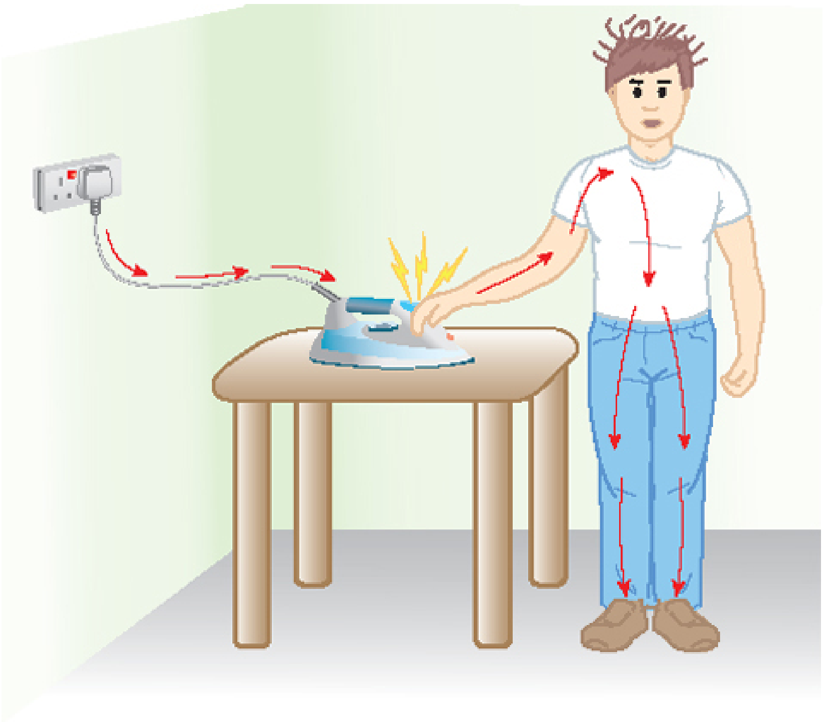
Q1 B
Q2 C
Q3 B
Q4 D
Q5 A
Q6 C
Q7 B
Q8 D
Q9 A
Q10 C

Q11 a) Neutral, [1]
fuse, [1]
cord-grip [1]

b) The live wire carries a dangerous voltage. [1]
So the fuse is put here so that, if it blows, the dangerous wire is disconnected so that you cannot get a shock from a faulty electrical device. [1]

c) Connect the fuse; [1] get the flex under the cord-grip; [1]
rewire the neutral wire [1]
and the earth wire to remove the bare copper wire. [1]

Q12 a)



[1]

b) The high voltage of the iron would cause a large current to flow through the earth wire [1]
rather than to the metal casing then the person, so they would not have received a shock. [1]

c) $I = \frac{V}{R}$ [1]

$= \frac{230}{46\ 000}$ [1]

= 0.005 A or 5 mA [1]

Q13 a) So that each device can be switched on and off separately. [1]
Each device is designed to work off 230 V. [1]

b) Current = 0.5 A + 0.1 A + 0.3 A + 0.1 A
= 1 A [1]
$P = I \times V$ [1]
$= 1 \times 230$
= 230 W [1]

c) Total current = 14 A. [1]
This will blow the fuse. [1]

d) To ensure that current from the socket is less than 13 A. [1]

e) This avoids getting a shock. [1]
If the live wire touches the metal case, a large current would flow. [1]

f) It has a plastic case. [1]
The wire is already insulated, but if it becomes disconnected, the plastic case is a second insulator which stops you getting a shock. [1]

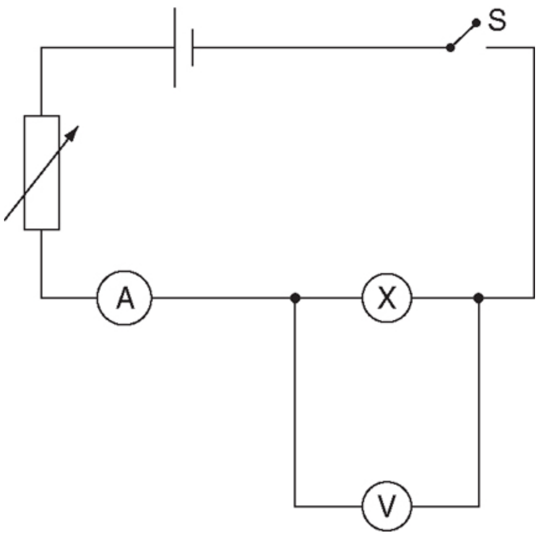
Q14 a) A_3 = 0.4 A [1]
A_4 = 0.6 A [1]

b) *R* is larger than 25 Ω, [1]
because the current flowing through it is less than 0.4 A. [1]

c) $V = IR$ [1]
$= 0.4 \times 25$ [1]
= 10 V [1]

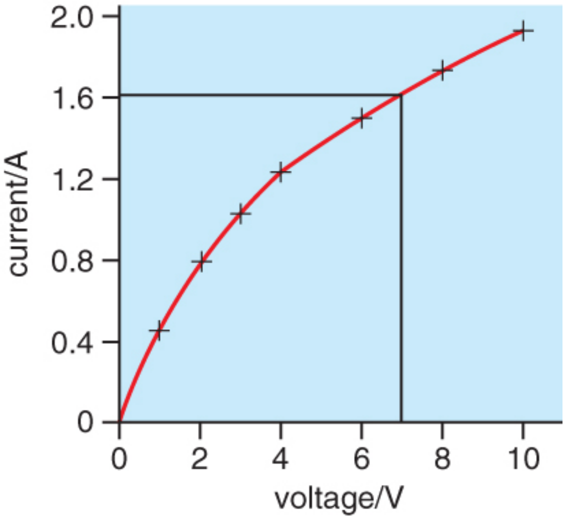
d) 10 V [1]

Q15 a)



[3]

b) i)



[1 mark choice of axes and labelling axes, 2 marks for plotting, 1 mark for the curve of best fit]

ii) 1.62 or 1.63 A [1]

iii) $R = \frac{V}{I}$ [1]

$= \frac{2}{0.8}$

$= 2.5\ \Omega$ [1]

$R = \frac{V}{I}$

$= \frac{6}{1.5}$

$= 4.0\ \Omega$ [1]

iv) The lamp gets hotter as the current increases, [1]
so the resistance increases. [1] (Increased atomic vibrations impede the movement of electrons).

v) $P = I \times V$ [1]
$= 1.9 \times 10$ [1]
$= 19$ W [1]

Q16 a) $A_1 = 1.1$ A [1];
$A_2 = 0.9$ A [1];
$A_3 = 1.1$ A [1]

b) $R = \frac{V}{I}$ [1]

$= \frac{12}{0.2}$ [1]

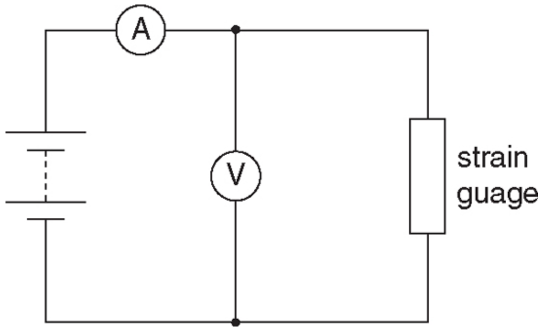
$= 60\ \Omega$ [1]

c) $P = I \times V$ [1]
$= 0.6 \times 12$ [1]
$= 7.2$ W [1]

Q17 a) It rises sharply to a maximum value in the first 0.2 s. [1]
Then reaches a steady value after 0.7 s. [1]

b) i) 4.7 A [1]
ii) 2.0 A [1]
c) At the start the lamp is cold so the resistance is low; so a large current flows. [1]
The current heats the lamp so its resistance rises and the current falls. [1]
d) The lamp dissipates 24 W of power [1]
when it is supplied from a 12 V power supply. [1]

Q18 a)



[1]

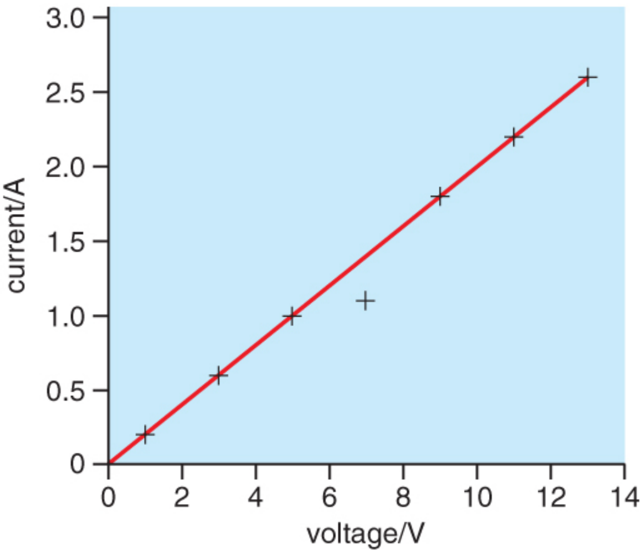
b) $R = \frac{V}{I}$ [1]

$= \frac{6}{0.03}$ [1]

$= 200\ \Omega$ [1]

c) The wire becomes longer and thinner. A longer wire has greater resistance; a thinner wire has greater resistance. [1]
d) The current decreases. [1]

Q19 a) $V = IR$ [1]
b) i) [1]
ii)



[1 mark for choosing the scale, 1 mark for labelling axes, 2 marks for plotting the points, 1 mark for the line of best fit]
iii) Point 7 V 1.14 mA [1]
iv) Not on line of best fit [1]
v) $R = \frac{V}{I}$

$= \frac{11}{0.0022}$ [1]

$= 5\,000\ \Omega$ or $5\ k\Omega$ [1]

c) i) LDR (light dependent resistor) [1]

ii) current [1]
and voltage [1]

iii) The experiment lasts 24 hours, [1]
so she might need some sleep. [1]

iv) *y*-axis is resistance / Ω [1];
x-axis is time / h [1]

Q20 a) i) Electrons are transferred to the rod [1]
from the cloth rubbing the rod. [1]

ii) Refer to Figure 9.7 on page 77. [4]

b) The student's hair and head all get a negative charge. The hair is repelled from the head so it stands up [1];
each hair is also repelled from the other strands of hair, so it all spreads out [1].
Like charges repel. [1]

Q21 Soot particles become negatively charged when they touch the grid. [1]
They are then repelled from the grid [1]
and attracted to the positive collecting plates. [1]
The soot sticks to the plate and is removed later. [1]

Q22 a) The paint drops spread out because they repel each other, [1]
and they are attracted towards the car which is negatively charged. [1]

b) The car must attract the drops. [1]
By being negatively charged, drops are attracted to all parts of the car. [1]

Q23 a) Electrons in the tree are repelled away from the cloud, [1]
so it is left positively charged. [1]

b) i) $I = \frac{Q}{t}$ [1]

$= \frac{15}{0.04}$ [1]

$= 375$ A [1]

ii) $E = QV$ [1]

$= 15 \times 800\,000$ kV[1]

$= 12\,000$ MJ [1]

Exam-style questions Section 3 p121

Q1 D
Q2 C
Q3 C
Q4 B
Q5 C
Q6 B
Q7 C
Q8 A
Q9 C
Q10 A

Q11 a) Sound is a longitudinal wave. [1]
This is made up of a series of compressions and expansions, [1]
which move backwards and forwards along the direction in which the wave travels. [1]

b) i) These are measured to the nearest 0.01 s. [1]

$$\text{Average speed} = \frac{\text{distance}}{\text{time}}$$ [1]

c) i) Andrew 0.45 s [1];
Kefe 0.5 s [1]

ii) $v = 150/0.45$
$= 330$ m/s [1]
$v = 150/0.5$
$= 300$ m/s [1]

d) Points to consider: Andrew's answer is more accurate; [1]
Andrew's measurements were more precise than Kefe's; [1]
Andrew is correct to some extent – he reacted as he saw the clash of cymbals and again when he heard them, [1]
but he could anticipate the start as he saw them moving; [1]
Kefe's is not the best possible result – he is over 10% out from the accepted value. [1]

Q12 a) Refraction is a change of direction of a light ray caused by a change of speed as it enters glass or water from air. [1]

b) See Figure 5.3. [1 mark for correctly labelled angle of incidence, 1 mark for correctly labelled angle of refraction]

c) i) $$n = \frac{\sin i}{\sin r}$$ [1]

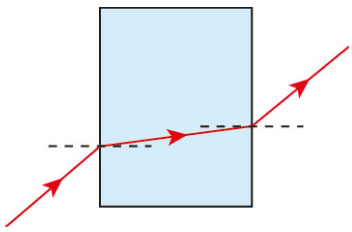
ii) The student should set up the ray box to direct a light ray towards the block of glass, as in the diagram.
The student should mark the ray's position as it enters and leaves the block with pins, and also mark the position of the block by drawing round it in pencil. (These two rays are labelled AB and CD in Figure 5.3.)
The student should then remove the block and draw in the refracted ray path as it goes through the block (line BC in Figure 5.3).
The normal should be marked in for the incident ray.

The student should then measure angle *i* and angle *r* with a protractor, then calculate the refractive index using $n = \frac{\sin i}{\sin r}$ then repeating the process with different angles of incidence several times for each angle. If the student plots a graph of sin *i* against sin *r*, the gradient is *n*. [6 marks in total: up to 3 marks for for describing the set-up and drawings and up to 3 marks for explaining that $n = \frac{\sin i}{\sin r}$ and identifying *i* and *r*. A good diagram helps earn marks both for the calculation and experimental design.]

Q13 a) The image in a plane mirror is virtual.[1]
The angle of incidence equals the angle of reflection. [1]
b) i) (1) is the normal [1];
(2) is the mirror [1].
ii) *r* is the angle to the right of the normal. [1]
(*i* is the angle to the left of the normal)

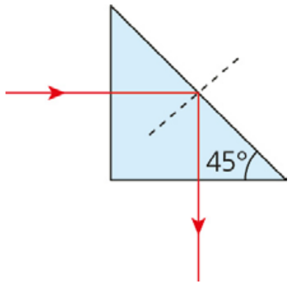
Q14 a) i) The normal [1]
ii) *e* [1]
iii) angle of refraction [1]
iv) $n = \frac{\sin i}{\sin r}$ [1]
v) The ray carries on in a straight line. [1]
vi) Because the ray goes along the normal. [1]

b) i)



[1 mark for air-glass refraction towards normal, 1 mark for ray through glass block, 1 mark for glass-air refraction away from normal]

ii)



[1 mark for ray continuing straight into prism, 1 mark for internal reflection at sloping edge]

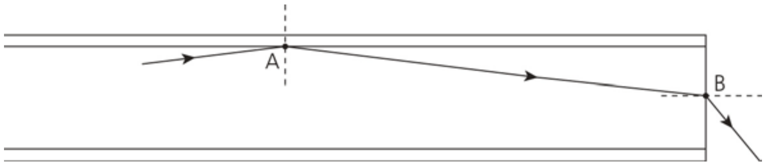
Q15 a) A is visible light; B is X-rays [1]
b) infra-red [1]
c) microwaves [1]
d) gamma rays [1]

e) For example (there are others):

i) Bright light can damage your eyes. [1]
Wear sunglasses to reduce the glare. [1]

ii) Ultraviolet can cause skin cancer. [1]
Keep out of the sun; wear a hat and sunblock. [1]

Q16 a) i) ii)



[1 mark for path of light ray between A and B; 1 mark for glass-air refraction away from normal; 1 mark for exit light ray]

b) i) The angle of incidence is greater than the critical angle. [1]

ii) The angle of incidence is less than the critical angle. [1]

Q17 a) i) You should show angle of incidence *i* to the left of the normal [1] and angle of reflection *r* to the right of the normal. [1]

ii)

- Draw round the block, mark its position. [1]
- Draw in the normal, incident ray and reflected ray. [1]
- Remove the block and extend the rays and normal to meet.
- Measure *i* and *r* with a protractor. [1]

iii) $i = r$ [1]

b) i) critical angle [1]

ii) $n = \frac{1}{\sin c}$ [1]

$n = \frac{1}{\sin 42}$ [1]

$= \frac{1}{0.06691}$

$= 1.49$ [1]

Q18 a) i) Pete has a louder voice because the amplitude of the vibrations picked up by the microphone is larger.

ii) Annie has a higher pitch because the frequency (number of waves per second) is higher.

b) $2.4 \times 0.5 = 1.2$ V

c) i) $T = 2 \times 2$ ms

$= 4$ ms

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

$= \frac{1}{0.004}$

$= 250$ Hz

Q19 When a source of waves is moving relative to an observer (or receiver) there is an apparent change of frequency and wavelength. For example, when a fire engine moves towards us, the pitch of the siren appears higher. The movement causes the wavelengths to be squashed (and so shortened).

[You could add a diagram such as Figure 2.7]

Exam-style questions Section 4 p154

Q1 B
Q2 D
Q3 B
Q4 C
Q5 C
Q6 B
Q7 C
Q8 D
Q9 D
Q10 A

Q11
a) Draft excluders – e.g. a rug to block the bottom of the door [1]
b) Double glazing [1]
c) Cavity wall insulation [1]
d) Loft insulation [1]
e) B, C, A The black surface absorbs radiation the best; the shiny metal surface absorbs heat least well.

Q12
a) Gravitational PE = mgh [1]
$= 30 \times 10 \times 5.8$ [1]
$= 1740$ J [1]

b) Energy per minute $= 5 \times 1740$ J [1]
$= 8700$ J [1]
Energy per second = 145 J/s [1]

c) $$\text{efficiency} = \frac{\text{useful power}}{\text{power input}}$$

$$\text{power input} = \frac{\text{useful power}}{\text{efficiency}} \text{ [1]}$$

$$= \frac{145}{0.2} \text{ [1]}$$

= 725 W [1]

Q13
a) $$\text{Increase in KE} = \frac{1}{2}mv_2^{\ 2} - \frac{1}{2}mv_1^{\ 2} \text{ [1]}$$

$$= \frac{1}{2} \times 1500 \times 25^2 - \frac{1}{2} \times 1500 \times 15^2 \text{ [1]}$$

= 300 000 J (300KJ) [1]

b) The kinetic energy is proportional to v^2

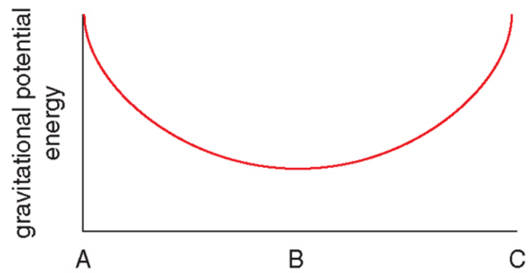
Q14
a) $$\text{KE} = \frac{1}{2}mv^2$$

$$10\ 830 = \frac{1}{2}60v^2 \text{ [1]}$$

$v^2 = 361$ [1]

$v = 19$ m/s [1]

b)



[1 mark for axes, 2 marks for smooth curve, 1 mark only for straight lines from A to B]

c) 10830 = mgh [1]

= 60 × 10 × h [1]

h = 10830/600

= 18 m [1]

Q15 a) Energy from the chemical store in your muscles is transferred to the ball's gravitational potential and kinetic stores.

b) Energy from the fuel's chemical store is transferred to the car's kinetic store and the thermal store of the surroundings. Then energy is transferred to the brake's thermal store.

c) Energy in the firework's chemical store is transferred to the firework's gravitational potential and kinetic stores. Then energy is transferred to the thermal store of the surroundings.

Q16 a) Thermal energy cannot pass through a vacuum by conduction or convection. [2]

b) Thermal energy cannot be lost by convection or evaporation as the stopper blocks the opening and is an insulator. [2]

c) The inner silver surfaces reflect heat back into the flask. [1]

The outer silver surfaces are poor emitters of radiation. [1]

Q17 Answers are in the text.

Q18 a) i) Black is a good absorber of radiation. [1]

ii) Copper conducts the heat quickly into the water. [1]

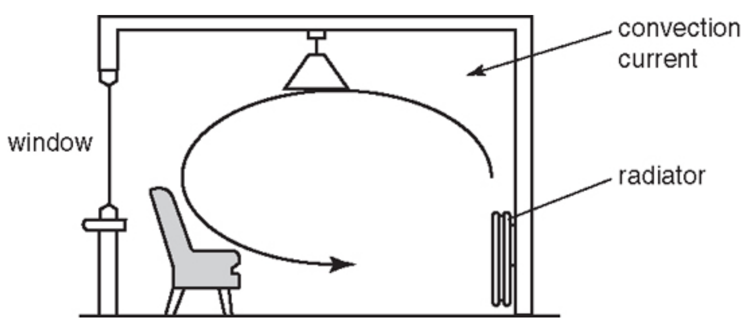
b) Advantage: once installed the energy is free; it is green energy. [1]

Disadvantage: there will be less heat on cold cloudy days, and at night. [1]

c) Hot water is less dense than cold water and rises to the top. [1]

Hot water goes to the radiator; cold water is pumped to the panel for heating. [1]

d)



[1]

The radiator heats the room by convection. Hot less dense air rises on the right; cold denser air falls on the left. Also some conduction and radiation [1]

e) Answers are in the text.

Q19 Some stored kinetic energy is transferred to the potential energy store as the train goes up the small hill. [1]
Then as the train sets off, the stored potential energy is transferred back into the kinetic energy store [1], which helps move the train. [1]

Q20 a) $W = F \times d$ [1]
$= 600 \text{ N} \times 300 \text{ m}$ [1]
$= 180\,000 \text{ J}$ (180 KJ) [1]

b) $P = \frac{W}{t}$ [1]
$= \frac{18\,000}{900}$ [1]
$= 200 \text{ W}$ [1]

c) 1 croissant produces 20% of 400 kJ useful energy; this is 80 kJ. [1]
Jacques needs 180/80 = 2¼ croissants [1]
He probably deserves 3. [1]

d) 80% of the energy ends up generating heat and making Jacques hot. [1]

Exam-style questions Section 5 p183

Q1 A
Q2 D
Q3 C
Q4 B
Q5 C
Q6 B
Q7 D
Q8 C
Q9 C
Q10 A

Q11 a) $\text{density} = \frac{\text{mass}}{\text{volume}}$ [1]

b)

- Put water in the cylinder – measure volume (V_1) [1]
- Measure the mass of 10 marbles using the balance (m) [1]
- Put the marbles in the cylinder – measure volume of water and marbles (V_2) [1]
- Convert m to kg; convert ($V_2 - V_1$) to m^3 (or g and cm^3). [1]
- Calculate density using : density = $m / (V_2 - V_1)$ [1]

Q12 The ether evaporates. [1]
When a liquid evaporates, energy has been supplied to it. [1]
This energy is removed from the hand so it feels cooler. [1]

Q13 a) 373 K [1]
b) Molecules in steam are further apart than molecules in water – steam is a gas. [1]
c) They move rapidly [1]
and hit the walls of the kettle [1]
d) $p_1V_1 = p_2V_2$ [1]
$100\text{ kPa} \times V_1 = 135\text{ kPa} \times 520\text{ cm}^3$ [1]
$V_1 = (135/100) \times 520\text{ cm}^3$
$= 702\text{ cm}^3$ [1]
e) The pressure rises as the molecules move faster when the gas heats up. [1]

Q14 a) 40^{o} C

b) $\Delta Q = mc\Delta t$

$48\,000 = 2 \times c \times 40$
$c = \frac{48\,000}{80}$
$= 600\text{ J/kg }^{o}\text{C}$

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

$c = \frac{48\,000}{10 \times 60}$

$= 80\text{ W}$

Q15 a) 54° C

b) The energy supplied is used to break bonds and increase the internal (or potential) energy of the molecules. The wax changes state.

c) i) The specific heat capacity of a material is the energy required to raise the temperature of 1 kg of the substance by 1° C.

ii) The temperature of the solid rises more quickly than the liquid (of the same mass) for the same energy supplied. Therefore its specific heat capacity is less.

Q16 a) i) $P = h\rho g$

$= 25 \times 1000 \times 10$ [1]

$= 250\,000\ \text{N/m}^2 = 250$ kPa [1]

ii) 350 kPa [1]

b) i) $P_1V_1 = P_2V_2$

$350 \times 5 = 100 \times V_2$ [1]

$V_2 = 3.5 \times 5$

$= 17.5$ l [1]

ii) If they did not breathe out, at the surface, the pressure inside the lungs would be 350 kPa and outside 100 kPa. [1]

This pressure difference would damage the lung. [1]

Q17 a) 400 K [1]

b) i) $P_1V_1 = P_2V_2$ [1]

$P_1 \times \frac{1}{20} = 120\ \text{kPa} \times 1$

$P_1 = 120 \times 20$ kPa

$= 2400$ kPa [1]

ii) $\frac{P_1}{P_2} = \frac{T_1}{T_2}$

$P_1 = \frac{1000}{400} \times P_2$ [1]

$= 2.5 \times 2400$ kPa

$= 6000$ kPa or 6 MPa [1]

Q18 a) The molecules move faster at higher temperatures. [1]

So the molecules hit the cylinder walls faster and more often. [1]

b) i) 1200°C = 1473 K; 20°C = 293 K [1]

$\frac{P_1}{P_2} = \frac{T_1}{T_2}$ [1]

$$P_1 = \frac{T_1}{T_2} \times P_2$$

$$= \frac{1473}{293} \times 300 \text{ kPa [1]}$$

$$= 1508 \text{ kPa}$$

ii) This pressure might cause the cylinder to explode. [1]

Q19 a) The molecules move quickly and hit the walls of the container. [1]
There are billions of collisions each second. [1]

b) $P_1V_1 = P_2V_2$ [1]
$10^7 \times 0.1 = 1.2 \times 10^5 \times V_2$
$V_2 = (10^7 \times 0.1)/1.2 \times 10^5$ [1]
$= 8.33 \text{ m}^3$ [1]

c) $8.33 = n \times 1.0 \times 10^{-2}$ [1]
$n = 833$ balloons [1]

Exam-style questions Section 6 p213

Q1 C
Q2 C
Q3 C
Q4 A
Q5 C
Q6 A
Q7 C
Q8 D
Q9a) C
b) B

Q10 a) A larger current [1]
strong magnets [1]
b) Reverse the current [1]
reverse the magnetic field [1]
c) When the current is parallel to the field. [1]

Q11 a) The wheel turns a magnet inside the dynamo.[1]
This magnet rotates near to a coil. [1]
The changing magnetic field induces a voltage in the coil. [1]
b) The magnetic field changes faster. [1]
This induces a larger voltage. [1]
c) There must be a changing magnetic field to induce voltage. [1]

Q12 a) Increase the primary voltage. [1]
Decrease the number of turns in the primary coil. [1]
Increase the number of turns in the secondary. [1]
b) For a voltage to be induced in the secondary coil there must be a changing magnetic field in it. [1]
A changing current in the primary coil produces a changing magnetic field [1]
which is linked with an iron core to the secondary coil. [1]
c) A step-up transformer turns the transmitted power into a high voltage and lower current supply. [1]
The power wasted as heat in the lines is calculated using the formula: $P = I^2R$. [1]
So less power is wasted when the current is low. [1]
A step-down transformer then turns the supply into a low voltage supply (230 V) which can be used safely in homes. [1]

d) i) $\frac{V_S}{V_P} = \frac{N_S}{N_P}$ [1]

$\frac{400}{25} = \frac{48\ 000}{N_P}$

Np = 3000 [1]

ii) $I_p = \frac{50\ 000\ 000}{25\ 000}$ [1]

= 2000 A [1]

iii) $V_p \times I_p = V_s \times I_s$

$25\ 000 \times 2000 = 400\ 000 \times I_s$ [1]

= 125 A [1]

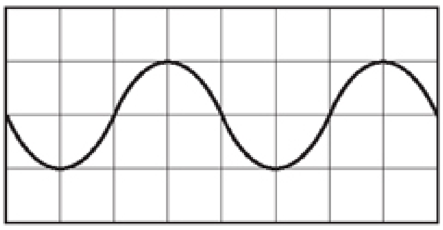
Q13 a) i) There is a changing magnetic field which induces a current. [1]
ii) It changes direction. [1]
iii) Move the magnet faster; use a stronger magnet; use a coil with more turns. [3]
b) The meter only detects a current when there is a changing magnetic field in the coil. [1]
This happens when the current is turned on and off. [1]
An a.c. supply is like that; the current is always changing direction. [1]

Q14 a) The changing magnetic field induces a current. [1]
b) Because the magnet changes direction in the coil as it vibrates up and down. [1]
c) It is moving quickly. [1]
d) It is at the top or bottom of its movement and it is stationary. [1]
e) More turns of wire; [1] stronger magnet. [1]

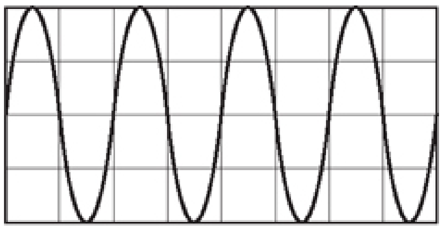
Q15 a) To the right. [1]
b) i) Less [1]
ii) More [1]
iii) The wire moves to the left. [1]
c) A motor; an ammeter. [1]

Q16 a) i) The wire moves to the right [1]
ii) The wire jumps upwards [1]
b) i) A moving magnet produces a changing magnetic field, [1]
which induces a voltage in the coil. [1]
ii) Because first a north pole approaches one side of the coil, then a south pole.
As the field changes direction so does the voltage. [1]
c) i) [1] ii) [2] iii) [2]

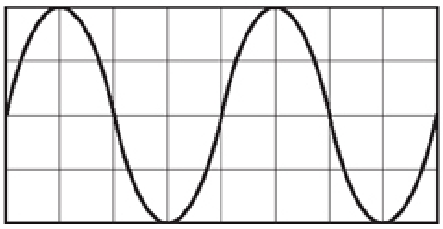
(i)



(iii)



(ii)



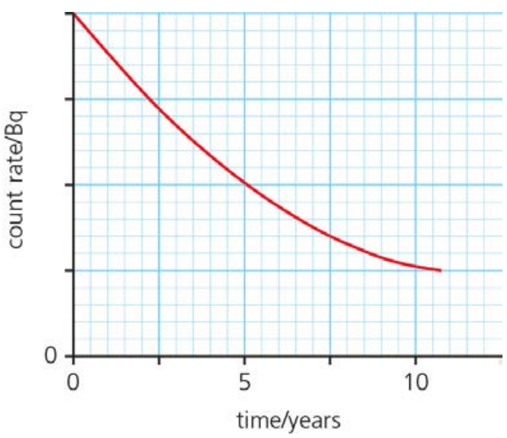
d) Iron increases the strength of the magnetic field through the coil. [1]

Exam-style questions Section 7 p234

Q1 A
Q2 C
Q3 D
Q4 D
Q5 C
Q6 B
Q7 A
Q8 B
Q 9 A
Q10 C

Q11 a) Proton mass 1 [1]
Electron charge –1 [1]
b) i) p = 11, e = 11, n = 12 [2]
ii) It has an extra neutron [1]
iii) A radioisotope is an isotope (type of nucleus) which is radioactive. [1]
iv) $^{24}_{11}\text{Na} \rightarrow\, ^{24}_{12}\text{Mg} +\, ^{0}_{-1}\text{e}$ [2]
v) Sodium [1]
c) i) Geiger-Müller tube [1]
ii) Cancer [1]

Q12 a) Technetium-99. [1]
It has a short half-life, which allows a small dose to be delivered in a short time. The advantage of the short half-life is that the emissions occur quickly, so they can be detected and measured. [1]
b)



[1 mark for the two axes. 1 mark for half-life of 5 years. 1 mark for the curve.]

Q13 a) 136 neutrons [1]
b) i) Atomic number – number of protons [1]
ii) Mass number – number of protons and neutrons. [1]
c) i) Alpha [1]
ii) The proton number changes. The proton number determines the atom. [1]

Q14 a) 5700 or 5800 years [1]
b) 300 counts per day = 12.5 counts per hour. [1]
From the graph, [1] this corresponds to an age of 2000 years. [1]

c) i) There has been too little decay to make it easy to notice the difference. [1]
ii) There is likely to be too little carbon-14 to make an accurate measurement. [1]

Q15 a) Caesium-137 has 3 more neutrons than caesium-134. [1]
b) Beta radiation (fast-moving) electrons. [1]
Gamma radiation (short wavelength) electromagnetic waves. [1]
c) 5 half-lives – 40 days[1]
d) Caesium-137. [1]
This is because its half-life is 30 years. [1] The other two isotopes will have decayed – though they were more active and dangerous just after the accident.

Q16 a) i) There is a film which is sensitive to the radiations. [1]
The film is covered to prevent exposure to light. [1]
ii) The aluminium foil stops beta and alpha particles reaching the film, so the area below that will just be detecting γ-rays. [1]
The area without the foil could detect α and β particles. [1]
b) Radiation can be dangerous to us, causing cancer if we are exposed to too much. [1]
If a worker has been exposed to a dangerous dose, they must stop working in a radiation zone. [1]

Q17 a) Radioactive decay is random. [1]
You expect a certain fraction of nuclei to decay in a given time, but it cannot be predicted. [1]
b) The sample of radioactive material has decayed. [1]
The count is now due to background radiation. [1]
c) 3 minutes. [2]
(You need to remember to take away the background count. So the initial count due to the gas is 120 – 10 = 110. So, after one half-life the starting count has dropped by 55 to 65.)

Q18 a) i) Fission. [1]
ii) Draw a diagram such as Figure 8.3. [1]
The two neutrons emitted from this reaction can be captured by the other nuclei to trigger further fissions. [1]
This is a chain reaction which keeps going, and can generate energy for electricity production. [1]
iii) It increases by 1 $^{235}_{92}U + ^{1}_{0}n \rightarrow ^{236}_{92}U$ [1]

b) The boron control rods absorb the neutrons. [1]
This closes down the chain reaction, [1]
because neutrons produced by one fuel rod trigger a fission reaction in a neighbouring fuel rod. [1]

Q19 There is a background count of about 8. So none of the radiation passes through 2.0 mm thickness of aluminium. This tells us there are no gamma rays.
520 – 328 = 192 of the count is stopped by paper. This tells us that there are some alpha particles.
The rest of the count is due to beta particles which pass through paper and are stopped by thick aluminium (about 320 of the count).

Exam-style questions Section 8 p271

Q1 C
Q2 B
Q3 A
Q4 A
Q5 D
Q6 B
Q7 A
Q8 B
Q9 D
Q10 D

Q11 a) A main sequence star fuses hydrogen nuclei to form helium nuclei.

b) The Milky Way is a galaxy containing billions of stars. Our Sun is in the Milky Way.

c) A supernova is a very large star at the end of its life. It explodes emitting vast amounts of energy.

d) A neutron star is a very dense star made out of neutrons only.

Q12 a) A cold cloud of gas (nebula) condenses under the pull of gravity.

As the cloud condenses it heats up. A protostar is formed. Eventually the star gets so hot that fusion starts. Now a star is born.

b) Hydrogen fuses to form helium. So the amount of hydrogen decreases.

c) Once hydrogen stops fusing to form helium, the core of the star cools. The pressure in the centre of the star drops, so the star collapses. The collapse causes further rapid heating, so that the star explodes as a supernova. The centre of the star can be left either as a black hole or a neutron star.

Q13 a) Inside a supernova

b) The supernova produces so much energy that small nuclei fuse to form elements heavier than iron.

c) Our solar system is younger than many stars.

Q14 a) Main sequence stars: sun A, D, or F;
red dwarf B; red giant E; white dwarf C.

b) A, D and F are brighter than the Sun. When stars are bright they have low absolute magnitudes.

c) F is closer to the Earth than star A. F is close enough for it to outshine A.

d) G is hotter. Green stars are always hotter than yellow stars.

Q15 a) i) A

ii) B

b) i) An ellipse.

ii) The comet (B) speeds up as it moves towards the Sun.

iii) Gravity.

Q16 a) i) 296 N

ii) 880 N

b) The radius, density or mass of the planet.

Q17 a) $v = \frac{2\pi r}{T}$

$= \frac{2\pi \times 384\ 000\ 000}{27.3 \times 24 \times 3600}$

= 1020 m/s (3sf)

b) $v = \frac{2\pi r}{T}$

$7500 = \frac{2\pi \times 6\ 500\ 000}{T}$

$T = \frac{2\pi \times 6\ 500\ 000}{7500}$

= 5450 s (3 sf) or 1.5 h

Q18 a) 1 mark for choice of scale
1 mark for labelling axes
2 marks for plotting the points
1 mark for the straight line

b) The graph shows the speed of the galaxies is proportional to their distance away.

This suggests all the galaxies were in the same place a long time ago. This supports the Big Bang Theory.

c) From the graph:

G 1200×10^{18} km
H 2400×10^{18} km

d) v = 60 000 000 m/s

= 6×10^7 m/s

$$\frac{v}{c} = \frac{6\times10^7}{3\times10^8}$$

= 0.2

$$\frac{\Delta\lambda}{\lambda} = 0.2$$

So $\Delta\lambda$ = 0.2 × 580 nm

= 116 nm

Q19 Refer to the text

Label axes for (i) luminosity	1
(ii) temperature	1
Main sequence	1
Giant branch	1
Dwarf branch	1
Sun position	1

Marks given for reasonable accuracy.