

PAST PAPER QUESTIONS

I.G.C.S.E. PHYSICS (Extended)

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Chapter 1 Measurements

1. W09

Fig 1.1 shows part of a measuring instrument.

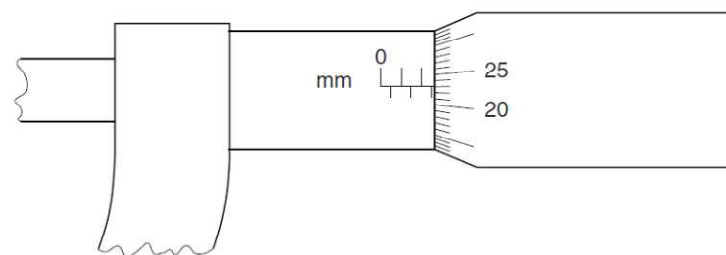


Fig. 1.1

(a) State the name of this instrument.

..... [1]

(b) Record the reading shown in Fig. 1.1.

..... [1]

(c) Describe how you would find the thickness of a sheet of paper used in a magazine.

.....

 [3]

[Total: 5]

2.

(b) A student used a suitable measuring cylinder and a spring balance to find the density of a sample of the stone.

(i) Describe how the measuring cylinder is used, and state the readings that are taken.

.....

(ii) Describe how the spring balance is used, and state the reading that is taken.

.....

(iii) Write down an equation from which the density of the stone is calculated.

.....

(iv) The student then wishes to find the density of cork. Suggest how the apparatus and the method would need to be changed.

.....

[6]

3.

The list below gives the approximate densities of various metals.

gold	19 g/cm ³
lead	11 g/cm ³
copper	9 g/cm ³
iron	8 g/cm ³

At an antiques market, a collector buys what is advertised as a small ancient gold statue. When the collector tests it in the laboratory, he finds its mass is 600g and its volume is 65 cm³.

(a) In the space below, describe how the volume of the statue could be measured. You may draw diagrams if you wish.

[3]

(b) Use the figures given above to decide whether the statue was really made of gold. Show your working.

Was the statue made of gold? (Tick one box.)

yes	<input type="checkbox"/>
no	<input type="checkbox"/>

[3]

[Total: 6]

4.

(a) State what is meant by the terms

(i) *weight*, [1]

(ii) *density*, [1]

(b) A student is given a spring balance that has a scale in newtons. The student is told that the acceleration of free-fall is 10 m/s².

(i) Describe how the student could find the mass of an irregular solid object. [2]

(ii) Describe how the student could go on to find the density of the object. [2]

5.

A scientist needs to find the density of a sample of rock whilst down a mine. He has only a spring balance, a measuring cylinder, some water and some thread.

(a) In the space below, draw two labelled diagrams, one to show the spring balance being used and the other to show the measuring cylinder being used with a suitable rock sample. [2]

(b) The spring balance is calibrated in newtons. State how the mass of the rock sample may be found from the reading of the spring balance. [1]

(c) State the readings that would be taken from the measuring cylinder. [1]

(d) State how the volume of the rock would be found from the readings. [1]

(e) State in words the formula that would be used to find the density of the sample.
density = [1]

Chapter 2 Speed, velocity and acceleration

1. S11

In a laboratory, an experiment is carried out to measure the acceleration of a trolley on a horizontal table, when pulled by a horizontal force.



Fig. 1.1

The measurements are repeated for a series of different forces, with the results shown in the table below.

force / N	4.0	6.0	10.0	14.0
acceleration / m/s ²	0.50	0.85	1.55	2.25

(a) On Fig. 1.2, plot these points and draw the best straight line for your points. [2]

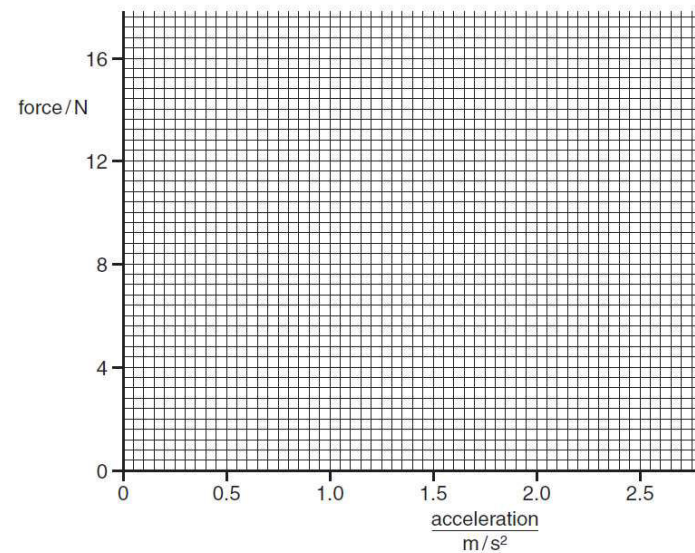


Fig. 1.2

- (b) The graph shows that below a certain force there is no acceleration.
- (i) Find the value of this force.[1]
- (ii) A force smaller than that in (b)(i) is applied to the stationary trolley. Suggest what happens to the trolley, if anything.
.....[1]
- (c) Show that the gradient of your graph is about 5.7.

gradient =[1]

- (d) (i) State the equation that links resultant force F , mass m and acceleration a .
.....[1]
- (ii) Use your gradient from (c) to find the mass of the trolley.
mass =[2]

(e) On Fig. 1.3, sketch a speed/time graph for a trolley with constant acceleration.

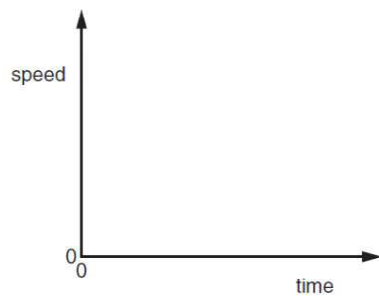


Fig. 1.3

[1]

[Total: 9]

- (b) Calculate the distance between the start of the town and the end of the town.
distance = [3]
- (c) Calculate the acceleration of the car between C and D.
- acceleration = [3]

(d) State how the graph shows that the deceleration of the car has the same numerical value as its acceleration.
.....
..... [1]

[Total: 8]

2. S10

1 Fig. 1.1 shows the speed/time graph for a car travelling along a straight road.

The graph shows how the speed of the car changes as the car passes through a small town.

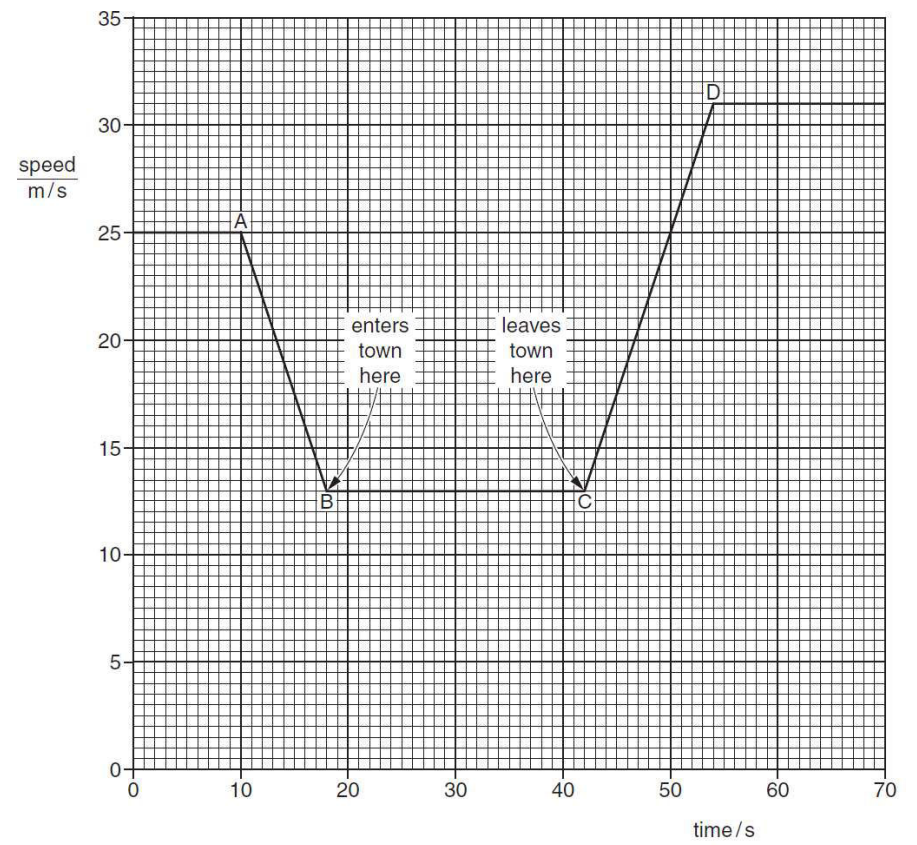


Fig. 1.1

- (a) Describe what happens to the speed of the car
- (i) between A and B, [1]
- (ii) between B and C, [1]
- (iii) between C and D, [1]

3. S08

Fig. 1.1 shows the speed-time graphs for two falling balls.

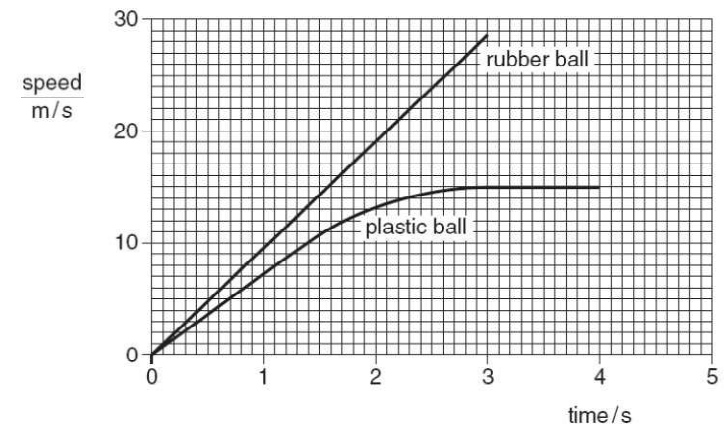


Fig. 1.1

Both balls fall from the same height above the ground.

- (a) Use the graphs to find
- (i) the average acceleration of the falling rubber ball during the first 3.0s,
acceleration = [2]
- (ii) the distance fallen by the rubber ball during the first 3.0s,
distance = [2]
- (iii) the terminal velocity of the plastic ball.
terminal velocity = [1]

4.

Fig. 1.1 shows a model car moving clockwise around a horizontal circular track.

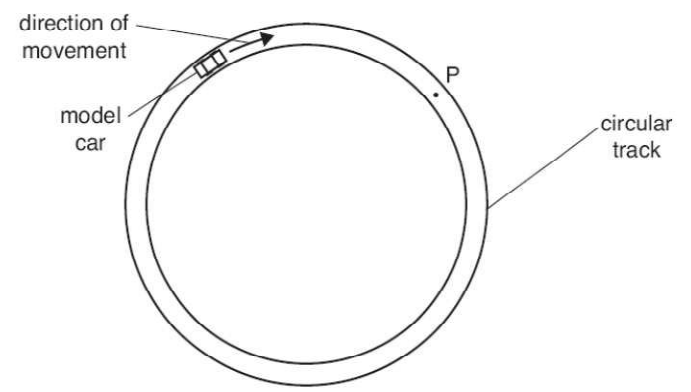


Fig. 1.1

- (a) A force acts on the car to keep it moving in a circle.
 - (i) Draw an arrow on Fig. 1.1 to show the direction of this force. [1]
 - (ii) The speed of the car increases. State what happens to the magnitude of this force. [1]
- (b) (i) The car travels too quickly and leaves the track at P. On Fig. 1.1, draw an arrow to show the direction of travel after it has left the track. [1]
- (ii) In terms of the forces acting on the car, suggest why it left the track at P. [2]

(c) The car, starting from rest, completes one lap of the track in 10s. Its motion is shown graphically in Fig. 1.2.

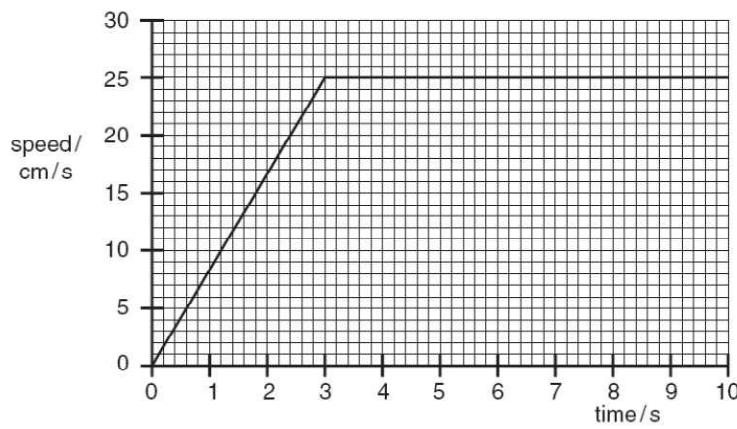


Fig. 1.2

- (i) Describe the motion between 3.0s and 10.0s after the car has started. [1]
- (ii) Use Fig. 1.2 to calculate the circumference of the track. [2]
- (iii) Calculate the increase in speed per second during the time 0 to 3.0s. [2]

[Total: 10]

5.

A bus travels from one bus stop to the next. The journey has three distinct parts. Stated in order they are
 uniform acceleration from rest for 8.0s,
 uniform speed for 12s,
 non-uniform deceleration for 5.0s.
 Fig. 1.1 shows only the deceleration of the bus.

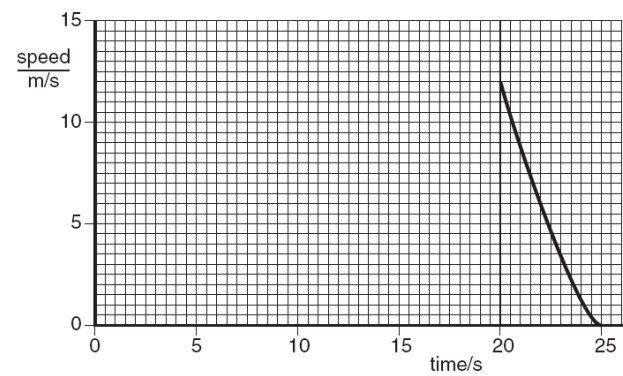


Fig. 1.1

- (a) On Fig. 1.1, complete the graph to show the first two parts of the journey. [3]
- (b) Calculate the acceleration of the bus 4.0s after leaving the first bus stop. [2]
- (c) Use the graph to estimate the distance the bus travels between 20s and 25s. [2]
- (d) On leaving the second bus stop, the uniform acceleration of the bus is 1.2 m/s^2 . The mass of the bus and passengers is 4000 kg. Calculate the accelerating force that acts on the bus. [2]
- (e) The acceleration of the bus from the second bus stop is less than that from the first bus stop. Suggest two reasons for this. [2]

Chapter 3 Force and moment

1. W09

A student investigated the stretching of a spring by hanging various weights from it and measuring the corresponding extensions. The results are shown below.

weight/N	0	1	2	3	4	5
extension/mm	0	21	40	51	82	103

(a) On Fig. 3.1, plot the points from these results. Do not draw a line through the points yet. [2]

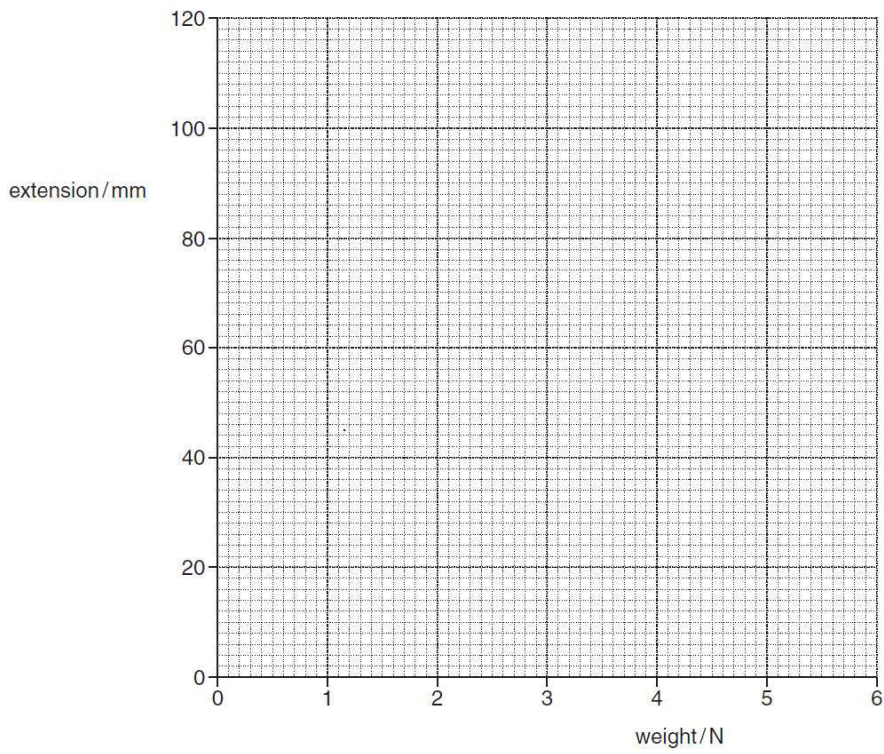


Fig. 3.1

(b) The student appears to have made an error in recording one of the results.

Which result is this?

..... [1]

(c) Ignoring the incorrect result, draw the best straight line through the remaining points. [1]

(d) State and explain whether this spring is obeying Hooke's Law.

.....

 [2]

(e) Describe how the graph might be shaped if the student continued to add several more weights to the spring.

.....

 [1]

(f) The student estimates that if he hangs a 45N load on the spring, the extension will be 920 mm.

Explain why this estimate may be unrealistic.

.....

 [1]

[Total: 8]

2.

Fig. 1.1 shows apparatus that may be used to compare the strengths of two springs of the same size, but made from different materials.

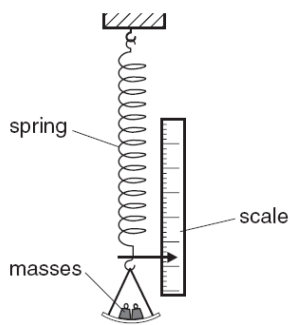


Fig. 1.1

(a) (i) Explain how the masses produce a force to stretch the spring.

.....

(ii) Explain why this force, like all forces, is a vector quantity.

.....

[2]

(b) Fig. 1.2 shows the graphs obtained when the two springs are stretched.

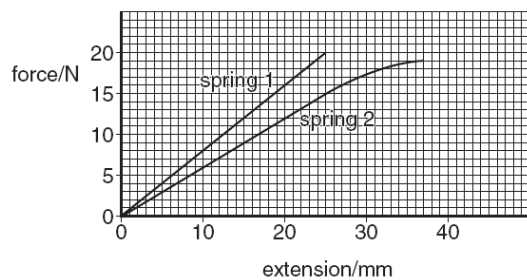


Fig. 1.2

(i) State which spring is more difficult to extend. Quote values from the graphs to support your answer.

.....

(ii) On the graph of spring 2, mark a point P at the limit of proportionality. Explain your choice of point P.

.....

(iii) Use the graphs to find the difference in the extensions of the two springs when a force of 15 N is applied to each one.

difference in extensions =

[6]

3. (a) A spring of original length 3.0cm is extended to a total length of 5.0cm by a force of 8.0N.
Assuming the limit of proportionality of the spring has not been reached, calculate the force needed to extend it to a total length of 6.0cm.

force = [3]

- (b) Fig. 3.1 shows the arrangement for an experiment on moments.

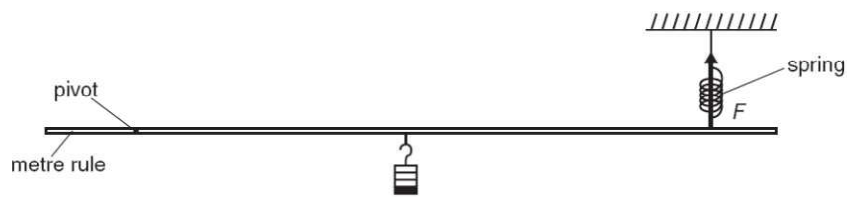


Fig. 3.1

The spring exerts a force F on the metre rule.

- (i) On Fig. 3.1, mark another quantity which must be measured to find the moment of the force F . [1]
(ii) State how the moment of the force F is calculated.

..... [1]
..... [1]

[Total: 5]

5. A student sets up the apparatus shown in Fig. 2.1 in order to find the resultant of the two tensions T_1 and T_2 acting at P. When the tensions T_1 , T_2 and T_3 are balanced, the angles between T_1 and the vertical and T_2 and the vertical are as marked on Fig. 2.1.

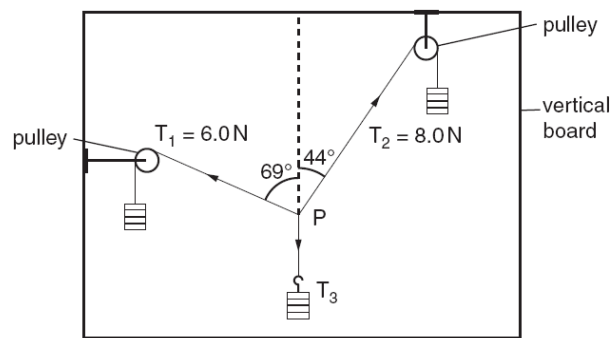


Fig. 2.1

In the space below, draw a scale diagram of the forces T_1 and T_2 . Use the diagram to find the resultant of the two forces.

State

- (a) the scale used, scale =
(b) the value of the resultant, value =
(c) the direction of the resultant, direction =

[6]

4. Fig. 2.1 shows a steam safety valve. When the pressure gets too high, the steam lifts the weight W and allows steam to escape.

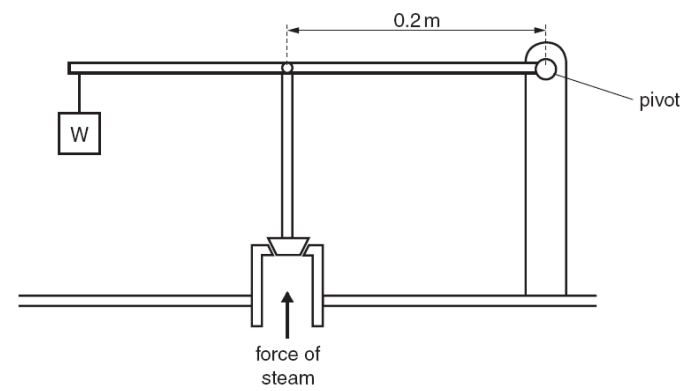


Fig. 2.1

- (a) Explain, in terms of moments of forces, how the valve works.

..... [2]

- (b) The moment of weight W about the pivot is 12Nm. The perpendicular distance of the line of action of the force of the steam on the valve from the pivot is 0.2m.

The area of the piston is 0.0003m².

Calculate

- (i) the minimum steam force needed for the steam to escape,

force = [2]

- (ii) the minimum steam pressure for the steam to escape.

pressure = [2]

[Total: 6]

Chapter 4 Energy, work and power

1. S09

A farmer uses an electric pump to raise water from a river in order to fill the irrigation channels that keep the soil in his fields moist.

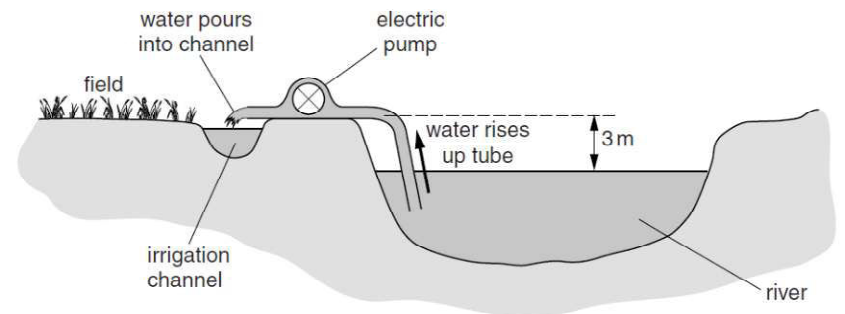


Fig. 5.1

Every minute, the pump raises 12 kg of water through a vertical height of 3m.

- (a) Calculate the increase in the gravitational potential energy of 12 kg of water when it is raised 3m.

increase in gravitational potential energy = [3]

- (b) Calculate the useful power output of the pump as it raises the water.

power = [3]

[Total: 6]

2. W10

Fig. 5.1 shows a model cable-car system. It is driven by an electric motor coupled to a gear system.

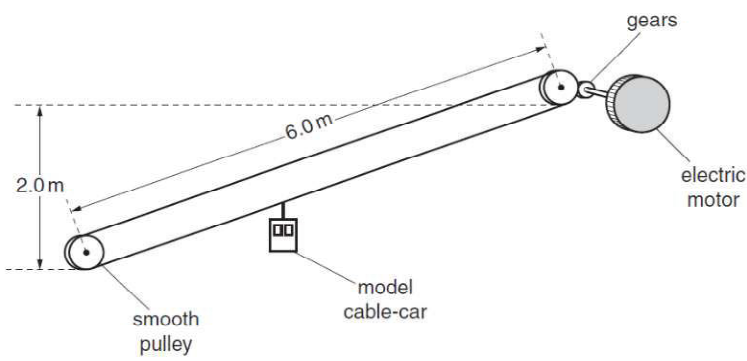


Fig. 5.1

The model cable-car has a mass of 5.0 kg and is lifted from the bottom pulley to the top pulley in 40 s. It stops automatically at the top.

(a) Calculate

(i) the average speed of the cable-car,

average speed = [2]

(ii) the gravitational potential energy gained by the cable-car,

gravitational potential energy gained = [2]

3. S10

A car of mass 900 kg is travelling at a steady speed of 30 m/s against a resistive force of 2000 N, as illustrated in Fig. 2.1.

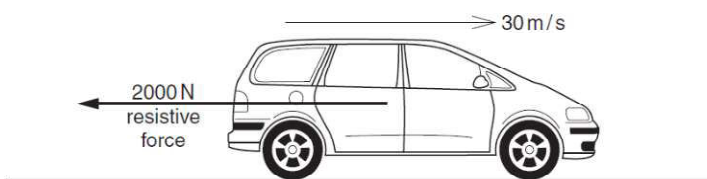


Fig. 2.1

(a) Calculate the kinetic energy of the car.

kinetic energy = [2]

(b) Calculate the energy used in 1.0 s against the resistive force.

energy = [2]

(c) What is the minimum power that the car engine has to deliver to the wheels?

minimum power = [1]

(iii) the useful output power of the driving mechanism.

power = [2]

(b) How would the electrical power input to the motor compare with your answer to (a)(iii)?

..... [1]

[Total: 7]

(d) What form of energy is in the fuel, used by the engine to drive the car?

..... [1]

(e) State why the energy in the fuel is converted at a greater rate than you have calculated in (c).

..... [1]

[Total: 7]

4.

5. S08

A wind turbine has blades, which sweep out an area of diameter 25m.

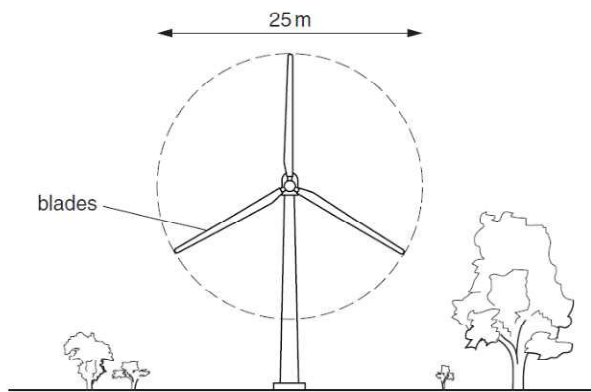


Fig. 5.1

(a) The wind is blowing directly towards the wind turbine at a speed of 12 m/s. At this wind speed, 7500 kg of air passes every second through the circular area swept out by the blades.

(i) Calculate the kinetic energy of the air travelling at 12 m/s, which passes through the circular area in 1 second.

kinetic energy = [3]

(ii) The turbine converts 10% of the kinetic energy of the wind to electrical energy.

Calculate the electrical power output of the turbine. State any equation that you use.

power = [3]

(b) On another day, the wind speed is half that in (a).

(i) Calculate the mass of air passing through the circular area per second on this day.

mass = [1]

(ii) Calculate the power output of the wind turbine on the second day as a fraction of that on the first day.

fraction = [3]

[Total: 10]

Chapter 5 Pressure

1. S09

(a) A man squeezes a pin between his thumb and finger, as shown in Fig. 6.1.

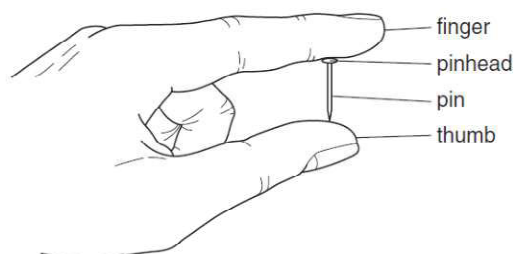


Fig. 6.1

The finger exerts a force of 84 N on the pinhead.

The pinhead has an area of $6.0 \times 10^{-5} \text{ m}^2$.

(i) Calculate the pressure exerted by the finger on the pinhead.

pressure = [2]

(ii) State the value of the force exerted by the pin on the thumb.

..... [1]

(iii) Explain why the pin causes more pain in the man's thumb than in his finger.

.....

..... [2]

2. W10

Fig. 3.1 shows a hydraulic lift in a car repair workshop.

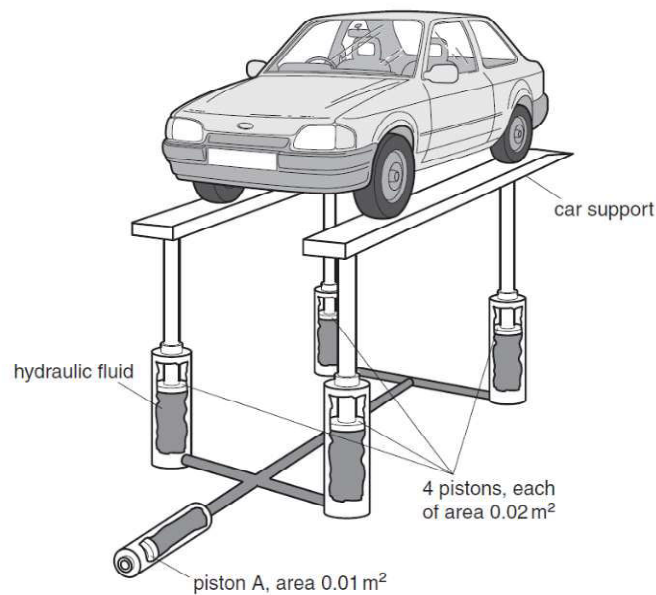


Fig. 3.1

The hydraulic fluid transmits the pressure, caused by piston A, equally to each of the four pistons holding up the car supports. The pressure throughout the fluid is the same.

A force of 1000 N on piston A is just enough to raise the car.

(a) Using values from Fig. 3.1, find

(i) the pressure caused by piston A on the fluid,

pressure = [2]

(ii) the total upward force caused by the fluid.

force = [3]

- (b) The weight of each of the two car supports is 1000 N.
Calculate the mass of the car.

mass = [2]
[Total: 7]

3. W08

- (a) A submarine descends to a depth of 70 m below the surface of water.
The density of the water is 1050 kg/m^3 . Atmospheric pressure is $1.0 \times 10^5 \text{ Pa}$.
Calculate

(i) the increase in pressure as it descends from the surface to a depth of 70 m,
..... [2]

(ii) the total pressure on the submarine at a depth of 70 m.
..... [1]

- (b) On another dive, the submarine experiences a total pressure of $6.5 \times 10^5 \text{ Pa}$. A hatch cover on the submarine has an area of 2.5 m^2 .
Calculate the force on the outside of the cover.

force = [2]

- (c) The submarine undergoes tests in fresh water of density 1000 kg/m^3 .
Explain why the pressure on the submarine is less at the same depth.
..... [1]
[Total: 6]

- (b) The weights are kept as shown in Fig. 6.1. The temperature of the air in the cylinder is increased.
(i) State what happens to the volume of the air in the cylinder as a result of this temperature rise.
..... [1]
(ii) State how, if at all, the pressure of the air changes as the temperature changes.
..... [1]
(iii) State what must be done to prevent the volume change in (b)(i).
..... [1]
(iv) The volume change in (b)(i) is prevented. State what happens to the pressure of the air in the cylinder.
..... [1]
[Total: 12]

4. W09

A vertical cylinder has a smooth well-fitting piston in it. Weights can be added to or removed from a tray on the top of the piston.

- (a) Weights are added to the tray, as shown in Fig. 6.1.

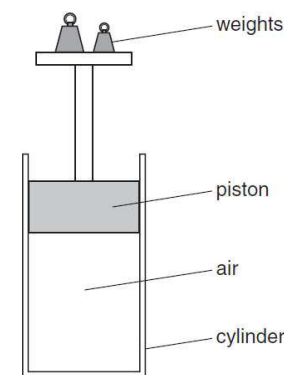


Fig. 6.1

- (i) State what happens to the pressure of the air in the cylinder as a result of adding these weights.
..... [1]
(ii) The initial pressure of the trapped air is $1.05 \times 10^5 \text{ Pa}$. When the weights are added, the volume of the air decreases from 860 cm^3 to 645 cm^3 .
The temperature of the air does not change.
Calculate the final pressure of the trapped air.

pressure = [3]

- (iii) The area of the piston is $5.0 \times 10^{-3} \text{ m}^2$.
Calculate the weight that is added to the piston.

weight added = [4]

5.

Fig. 3.1 shows a pond that is kept at a constant depth by a pressure-operated valve in the base.

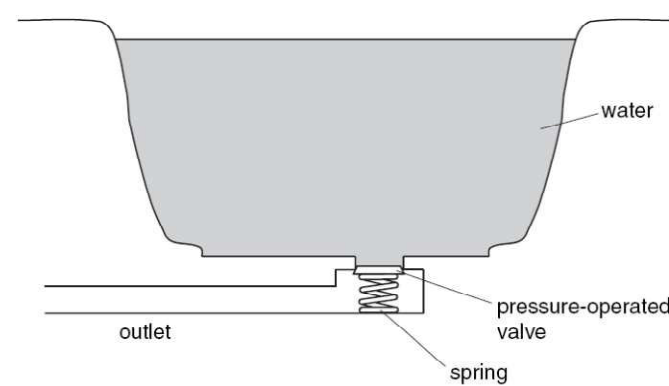


Fig. 3.1

- (a) The pond is kept at a depth of 2.0 m. The density of water is 1000 kg/m^3 .
Calculate the water pressure on the valve.
..... [2]
(b) The force required to open the valve is 50 N. The valve will open when the water depth reaches 2.0 m.
Calculate the area of the valve.
..... [2]
(c) The water supply is turned off and the valve is held open so that water drains out through the valve.
State the energy changes of the water that occur as the depth of the water drops from 2.0 m to zero.
..... [2]

Chapter 6 Thermal Physics

Topic 6.1 Simple kinetic molecular theory

1. S09

(a) Some water is poured onto a plastic table-top, forming a puddle. The same volume of water is poured into a plastic dish, which is placed alongside the puddle. This is illustrated in Fig. 7.1.

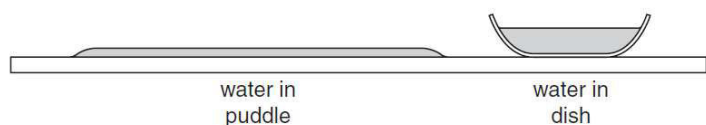


Fig. 7.1

Both lots of water begin to evaporate.

(i) In terms of the behaviour of molecules, describe what happens during the process of evaporation.

.....

 [2]

(ii) Explain why the puddle dries out more rapidly than the water in the dish.

.....

 [2]

(iii) State two changes that would make both lots of water evaporate more rapidly.

1. [2]
2. [2]

Topic 6.2 Thermal Properties

1. S10

5 A certain substance is in the solid state at a temperature of -36°C . It is heated at a constant rate for 32 minutes. The record of its temperature is given in Fig. 5.1.

time/min	0	1	2	6	10	14	18	22	24	26	28	30	32
temperature/ $^{\circ}\text{C}$	-36	-16	-9	-9	-9	-9	32	75	101	121	121	121	121

Fig. 5.1

(a) State what is meant by the term *latent heat*.

..... [2]

(b) State a time at which the energy is being supplied as latent heat of fusion.

..... [1]

(c) Explain the energy changes undergone by the molecules of a substance during the period when latent heat of vaporisation is being supplied.

..... [2]

(d) (i) The rate of heating is 2.0kW.

Calculate how much energy is supplied to the substance during the period 18 – 22 minutes.

energy supplied = [2]

(b) In a place where refrigeration is not possible, a person attempts to keep a bottle of milk cool by using the procedure illustrated in Fig. 7.2.

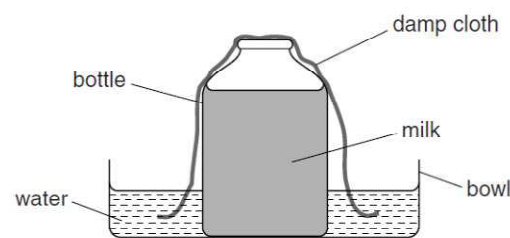


Fig. 7.2

Explain in terms of molecules why this procedure would be successful.

..... [3]

[Total: 9]

2. W10

A student in a laboratory uses the apparatus shown in Fig. 4.1 to determine the specific heat capacity of aluminium.

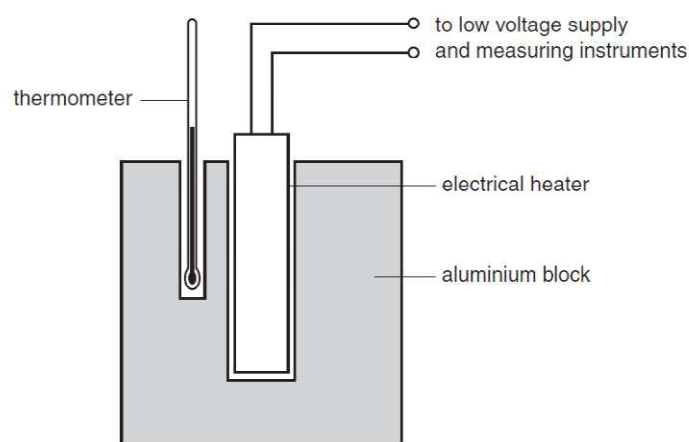


Fig. 4.1

The readings obtained in the experiment are given below.

- mass of aluminium block = 0.930 kg
- initial temperature of block = 13.1°C
- final temperature of block = 41.3°C
- electrical energy supplied = 23 800 J

(a) Define *specific heat capacity*.

..... [2]

(b) Use the readings above to calculate the specific heat capacity of aluminium.

State the equation you use.

specific heat capacity = [3]

- (c) Because the student knows it is good scientific practice to repeat readings, after a short time he carries out the experiment again, supplying the same quantity of electrical energy.

This time the temperature readings are:

initial temperature of block = 41.0 °C

final temperature of block = 62.1 °C

- (i) Use these figures to calculate a second value for the specific heat capacity of aluminium.

specific heat capacity = [1]

- (ii) The student did not make any mistakes when taking the readings.

Suggest why the second value for the specific heat capacity of the aluminium is greater than the first.

..... [2]

- (d) Suggest two ways of improving the experiment in order to give as accurate a result as possible.

- [2]
- [2]

[Total: 10]

- (ii) The specific heat capacity of the substance is 1760 J/(kg °C).

Use the information in the table for the period 18 – 22 minutes to calculate the mass of the substance being heated.

mass heated = [3]

[Total: 10]

3. S09

- (a) A certain volume of water at room temperature and the same volume of ice in a freezer are each heated through the same temperature rise.

Which of them will have the greater expansion, and why?

Which? [1]

Why? [1]

- (b) For strength, concrete pillars are usually reinforced with metal rods, which are embedded in the concrete before it sets.

The list below shows how much a length of 1 m of each material expands when the temperature rises by 1 °C.

aluminium	0.03 mm
concrete	0.01 mm
steel	0.01 mm

Use this information to decide which metal should be used to reinforce concrete, why it is suitable, and why the other metal is not suitable.

Which metal should be used?

Why is it suitable?

Why is the other metal unsuitable?

..... [3]

[Total: 4]

Topic 6.3 Transfer of thermal energy

1.

- (a) Fig. 5.1 shows two identical metal plates. The front surface of one is dull black and the front surface of the other is shiny silver. The plates are fitted with heaters that keep the surfaces of the plates at the same temperature.



Fig. 5.1

- (i) State the additional apparatus needed to test which surface is the best emitter of heat radiation.

.....

- (ii) State one precaution that is needed to ensure a fair comparison.

.....

- (iii) State the result that you expect.

.....

- (iv) Write down another name for heat radiation.

..... [4]

- (b) In the space below, draw a labelled diagram of an everyday situation in which a convection current occurs.

Mark the path of the current with a line and show its direction with arrows. [3]

2. S10

- (a) Four identical metal plates, at the same temperature, are laid side by side on the ground. The rays from the Sun fall on the plates.

One plate has a matt black surface.

One plate has a shiny black surface.

One plate has a matt silver surface.

One plate has a shiny silver surface.

State which plate has the fastest-rising temperature when the sunlight first falls on the plates.

..... [1]

- (b) The apparatus shown in Fig. 4.1 is known as Leslie's Differential Air Thermometer.

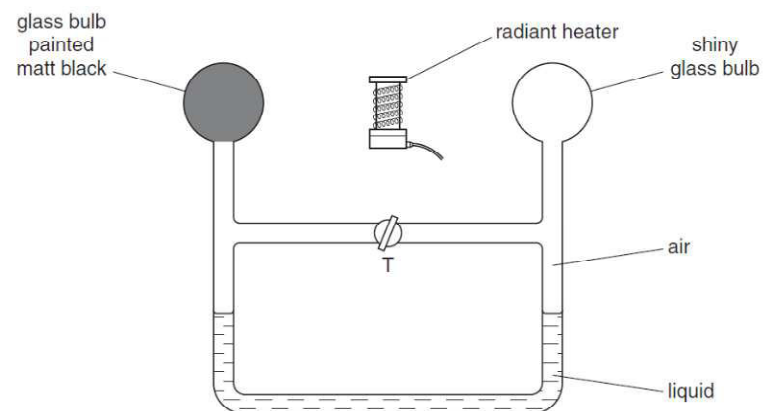


Fig. 4.1

The heater is switched off. Tap T is opened so that the air on the two sides of T has the same pressure. Tap T is then closed.

- (i) The heater is switched on. On Fig. 4.1, mark clearly where the two liquid levels might be a short time later. [1]

- (ii) Explain your answer to (b)(i).

.....

..... [2]

[Total: 4]

Chapter 7 General wave properties – Water waves

1. Fig. 7.1 is a drawing of a student's attempt to show the diffraction pattern of water waves that have passed through a narrow gap in a barrier.

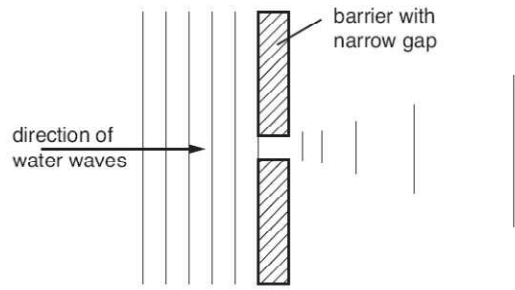


Fig. 7.1

- (a) State two things that are wrong with the wave pattern shown to the right of the barrier.
 - 1.
 - 2.[2]

(b) In the space below, sketch the wave pattern when the gap in the barrier is made five times wider.

(c) The waves approaching the barrier have a wavelength of 1.2cm and a frequency of 8.0Hz. Calculate the speed of the water waves.

speed =[2]

Chapter 8 Light waves

Topic 8.1 Light waves - Reflection

1. Fig. 5.1 shows an arrangement where a plane mirror is used in a shop to watch a display counter. The arrangement is drawn to a scale of 1 cm : 1 m.

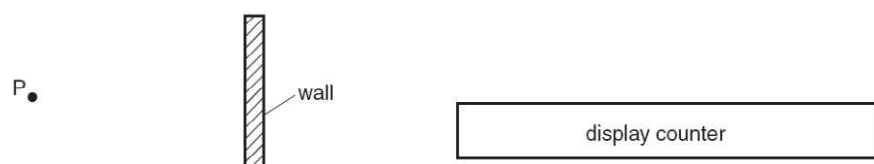


Fig. 5.1

- (a) (i) State the law of reflection.
 -
- (ii) On Fig. 5.1, draw rays to show how much of the display cannot be seen from P. Indicate this by shading in the part that cannot be seen. [3]

(b) By construction on Fig. 5.1 and by using the scale, calculate how far the mirror must be moved so that all of the display counter can be seen from P.

distance moved = [2]

(c) State the characteristics of an image seen in a plane mirror.

 [2]

2. W08 Fig. 7.1 shows a scale drawing of plane waves approaching a gap in a barrier.

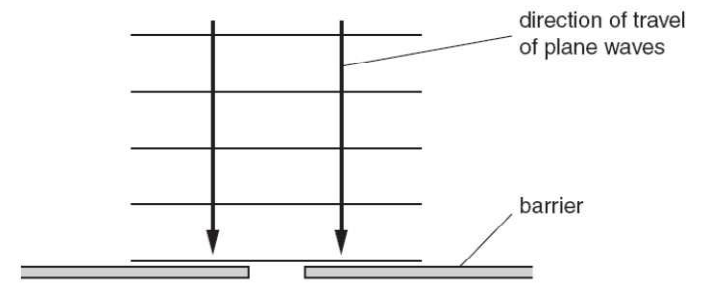


Fig. 7.1

- (a) On Fig. 7.1, draw in the pattern of the waves after they have passed the gap. [3]
- (b) The waves approaching the barrier have a wavelength of 2.5 cm and a speed of 20 cm/s. Calculate the frequency of the waves.

frequency = [2]

(c) State the frequency of the diffracted waves.
 [1]

[Total: 6]

Topic 8.2 Light waves - Refraction

1. S08 Fig. 7.1 and Fig. 7.2 show wavefronts of light approaching a plane mirror and a rectangular glass block, respectively.



Fig. 7.1

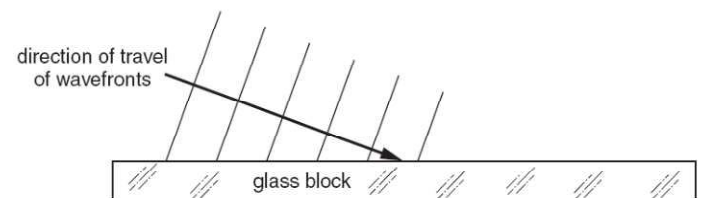


Fig. 7.2

- (a) On Fig. 7.1 and on Fig. 7.2 draw wavefronts to show what happens after the waves strike the surface. [4]
- (b) In Fig. 7.2, the waves approaching the block have a speed of 3.0×10^8 m/s and an angle of incidence of 70° . The refractive index of the glass of the block is 1.5.
 - (i) Calculate the speed of light waves in the block.

speed = [2]

(ii) Calculate the angle of refraction in the block.

angle = [2]

2. S09

In an optics lesson, a Physics student traces the paths of three rays of light near the boundary between medium A and air. The student uses a protractor to measure the various angles.

Fig. 8.1 illustrates the three measurements.

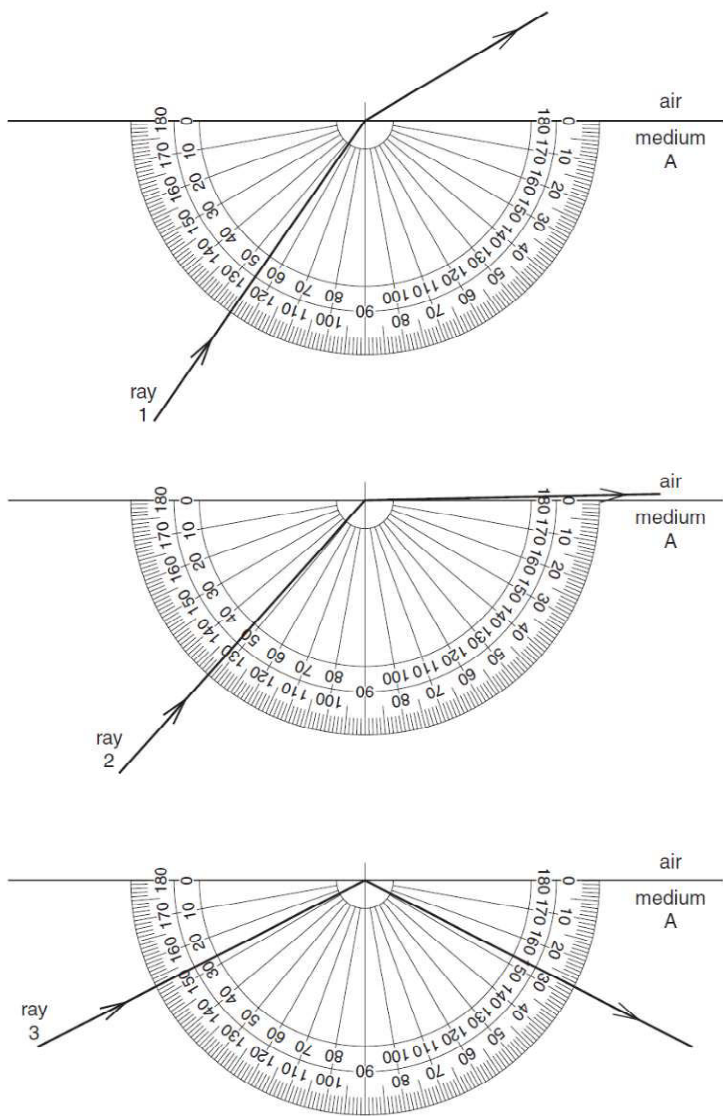


Fig. 8.1

3. Fig. 6.1 shows wavefronts of light crossing the edge of a glass block from air into glass.

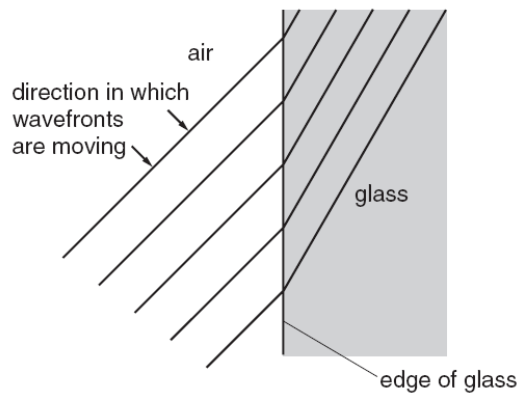


Fig. 6.1

- (a) On Fig. 6.1
 - (i) draw in an incident ray, a normal and a refracted ray that meet at the same point on the edge of the glass block,
 - (ii) label the angle of incidence and the angle of refraction,
 - (iii) measure the two angles and record their values.
- angle of incidence =
- angle of refraction =

[4]

(b) Calculate the refractive index of the glass.

refractive index =[3]

(a) State which is the optically denser medium, A or air, and how you can tell this.

..... [1]

(b) State in which medium the light travels the faster, and how you know this.

..... [1]

(c) State the critical angle of medium A.

.....[1]

(d) State the full name for what is happening to ray 3.

.....[1]

(e) The refractive index of medium A is 1.49.

Calculate the value of the angle of refraction of ray 1, showing all your working.

angle of refraction = [2]

(f) The speed of light in air is 3.0×10^8 m/s.

Calculate the speed of light in medium A, showing all your working.

speed of light = [2]

[Total: 8]

Fig. 6.1 shows part of the path of a ray of light PQ travelling in an optical fibre.

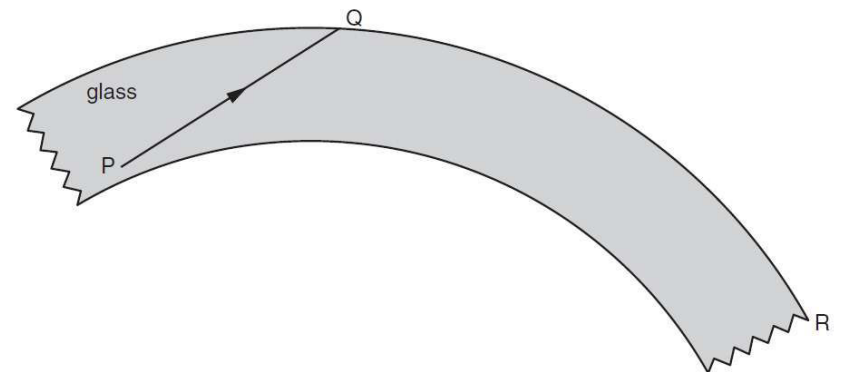


Fig. 6.1

PQ undergoes total internal reflection at Q.

(a) Explain what is meant by *total internal reflection*, and state the conditions under which it occurs.

..... [3]

(b) Carefully complete the path of the ray of light, until it reaches the end R of the optical fibre. [2]

[Total: 5]

Topic 8.3 Light waves - Dispersion & electromagnetic spectrum

1. **W10**

(a) The following list contains the names of types of energy transfer by means of waves.

γ -rays, infra-red, radio/TV/microwaves, sound, visible light, X-rays

(i) Which one of these is **not** a type of electromagnetic wave?

..... [1]

(ii) State the nature of the wave you have named in (a)(i).

..... [1]

(iii) The remaining names in the list are all regions of the electromagnetic spectrum, but one region is missing.

Name the missing region.

..... [1]

(b) A television station emits waves with a frequency of 2.5×10^8 Hz. Electromagnetic waves travel at a speed of 3.0×10^8 m/s.

Calculate the wavelength of the waves emitted by this television station. State the equation you use.

wavelength = [3]

[Total: 6]

3.

Fig. 7.1 shows the parts of the electromagnetic spectrum.

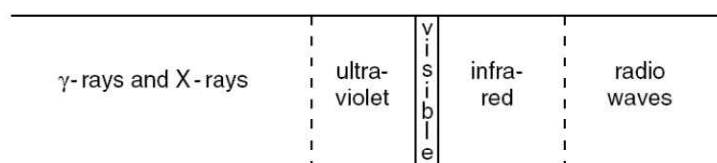


Fig. 7.1

(a) Name one type of radiation that has

(i) a higher frequency than ultra-violet,

..... [1]

(ii) a longer wavelength than visible light.

..... [1]

(b) Some γ -rays emitted from a radioactive source have a speed in air of 3.0×10^8 m/s and a wavelength of 1.0×10^{-12} m.

Calculate the frequency of the γ -rays.

frequency = [2]

(c) State the approximate speed of infra-red waves in air.

..... [1]

2.

Fig. 6.1 shows white light incident at P on a glass prism. Only the refracted red ray PQ is shown in the prism.

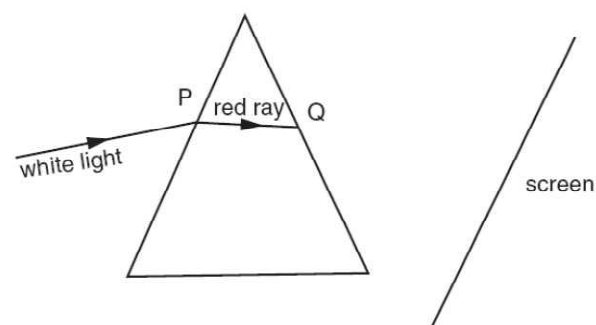


Fig. 6.1

(a) On Fig. 6.1, draw rays to complete the path of the red ray and the whole path of the violet ray up to the point where they hit the screen. Label the violet ray. [3]

(b) The angle of incidence of the white light is increased to 40° . The refractive index of the glass for the red light is 1.52. Calculate the angle of refraction at P for the red light.

angle of refraction = [3]

(c) State the approximate speed of

(i) the white light incident at P,

speed = [1]

(ii) the red light after it leaves the prism at Q.

speed = [1]

Topic 8.4 Light waves - Lenses

1. **S08**

Fig. 6.1 shows an object, the tip of which is labelled O, placed near a lens L.

The two principal foci of the lens are F_1 and F_2 .

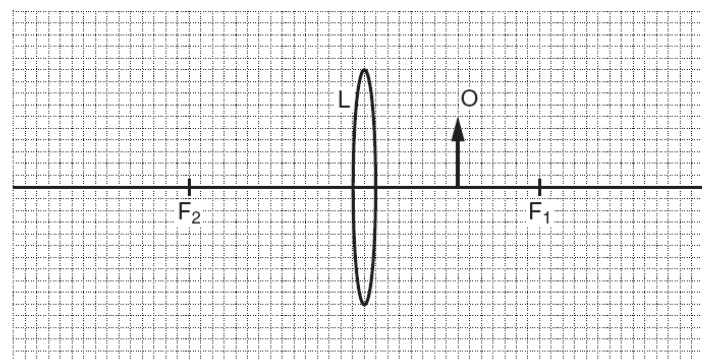


Fig. 6.1

(a) On Fig. 6.1, draw the paths of two rays from the tip of the object so that they pass through the lens and continue beyond.

Complete the diagram to locate the image of the tip of the object. Draw in the whole image and label it I. [3]

(b) Describe image I.

.....

 [3]

Fig. 8.1 shows a thin converging lens. The two principal foci are shown.

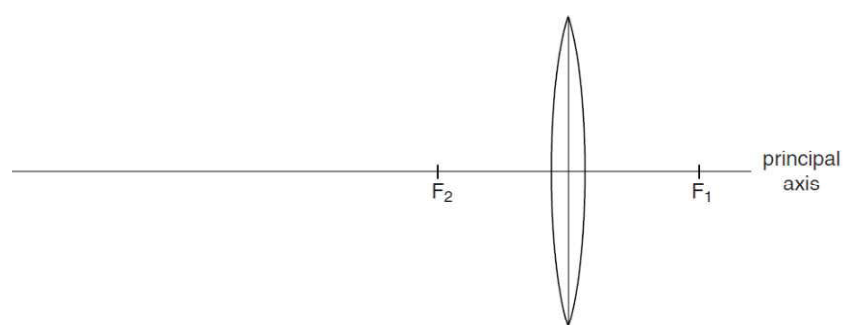


Fig. 8.1

A vertical object, 2cm tall, is to be positioned to the left of the lens, with one end on the principal axis.

On Fig. 8.1,

- (a) draw the object in a position which will produce a virtual image, labelling the object with the letter O, [1]
- (b) draw two rays showing how the virtual image is formed, [2]
- (c) draw in the image, labelling it with the letter I. [1]

[Total: 4]

2. S10

7 During a thunderstorm, thunder and lightning are produced at the same time.

- (a) A person is some distance away from the storm.

Explain why the person sees the lightning before hearing the thunder.

.....

 [1]

- (b) A scientist in a laboratory made the following measurements during a thunderstorm.

time from start of storm /minutes	0.0	2.0	4.0	6.0	8.0	10.0
time between seeing lightning and hearing thunder/s	3.6	2.4	1.6	2.4	3.5	4.4

Fig. 7.1

- (i) How many minutes after the storm started did it reach its closest point to the laboratory? [1]

- (ii) How can you tell that the storm was never immediately over the laboratory? [1]

- (iii) When the storm started, it was immediately above a village 1200m from the laboratory.
 Using this information and information from Fig. 7.1, calculate the speed of sound.

speed of sound = [2]

- (iv) State the assumption you made when you calculated your answer to (b)(iii). [1]

Chapter 9 Sound waves

1.

Fig. 7.1 shows an unlabelled diagram which a teacher draws to represent a sound wave in air.

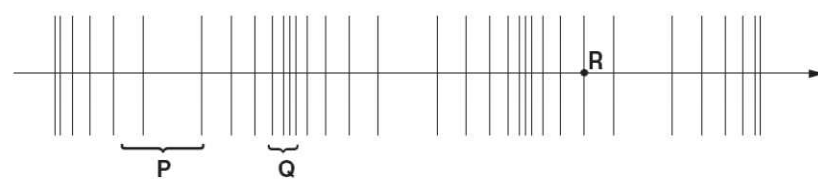


Fig. 7.1

- (a) What label should be put on the line with the arrow? [1]
- (b) (i) What does the uneven spacing of the lines show?
- (ii) What is being shown at P?
- (iii) What is being shown at Q? [2]
- (c) Describe the motion of an air particle at R. [2]
- (d) From Fig. 7.1, measure the wavelength of the sound wave. wavelength = [1]

- (c) Some waves are longitudinal; some waves are transverse.

Some waves are electromagnetic; some waves are mechanical.

Put ticks (✓) in the table below to indicate which of these descriptions apply to the light waves of the lightning and the sound waves of the thunder.

	light waves	sound waves
longitudinal		
transverse		
electromagnetic		
mechanical		

[3]

[Total: 9]

3.

Chapter 10 Electricity

Topic 10.1 Electricity-Static

1.

- (a) Two non-conducting spheres, made of different materials, are initially uncharged. They are rubbed together. This causes one of the spheres to become positively charged and one negatively charged.

Describe, in terms of electron movement, why the spheres become charged.

.....

 [2]

- (b) Once charged, the two spheres are separated, as shown in Fig. 7.1.



Fig. 7.1

On Fig. 7.1, draw the electric field between the two spheres. Indicate by arrows the direction of the electric field lines. [2]

- (c) A conducting wire attached to a negatively charged metal object is connected to earth. This allows 2.0×10^{10} electrons, each carrying a charge of 1.6×10^{-19} C, to flow to earth in 1.0×10^{-3} s.

Calculate

- (i) the total charge that flows,

charge

- (ii) the average current in the wire.

current [3]

2. W10

In Fig. 9.1, A and B are two conductors on insulating stands. Both A and B were initially uncharged.

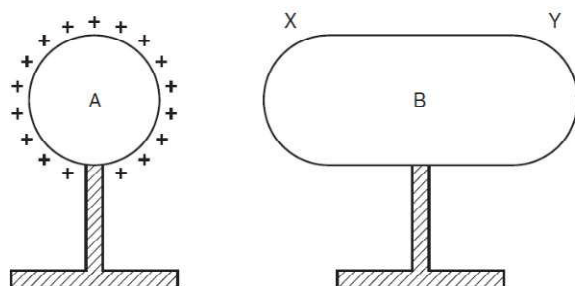


Fig. 9.1

- (a) Conductor A is given the positive charge shown on Fig. 9.1.

- (i) On Fig. 9.1, mark the signs of the charges induced at end X and at end Y of conductor B. [1]

- (ii) Explain how these charges are induced.

.....

 [3]

- (iii) Explain why the charges at X and at Y are equal in magnitude.

.....
 [1]

- (b) B is now connected to earth by a length of wire.

Explain what happens, if anything, to

- (i) the charge at X,

.....
 [1]

- (ii) the charge at Y.

.....
 [2]

[Total: 8]

Topic 10.2 Electricity-Circuits

1. S11

The manufacturer's label on an electric heater is as shown in Fig. 5.1.

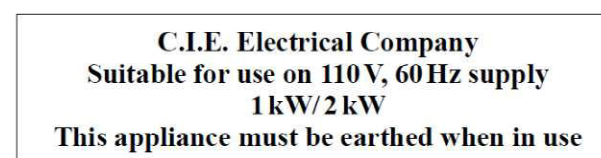


Fig. 5.1

- (a) State what electrical quantity is represented by

- (i) 110V,
- (ii) 60Hz,
- (iii) 1kW. [1]

- (b) (i) Which part of the electric heater must be earthed?

..... [1]

- (ii) Explain what the hazard might be if the heater is not earthed.

.....
 [2]

- (c) The heater has two 110V heating elements, with two switches, so that either one or both elements may be switched on.

In the space below, draw a circuit diagram showing how the heating elements and switches are connected to the mains supply. Use the symbol \square for each heating element.

[2]

[Total: 6]

2. W10

The circuit in Fig. 8.1 contains a 2.0V cell, whose resistance you should ignore. There are also three resistors, a 3-position switch, an ammeter and another component, P.

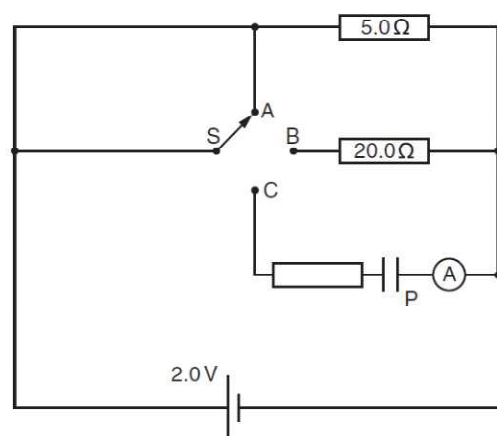


Fig. 8.1

(a) State the name of component P. [1]

(b) Deduce the resistance of the circuit when switch S is

(i) in position A,

resistance = [1]

(ii) in position B.

resistance = [3]

3. W09

Alternating current electricity is delivered at 22000V to a pair of transmission lines. The transmission lines carry the electricity to the customer at the receiving end, where the potential difference is V . This is shown in Fig. 10.1. Each transmission line has a resistance of 3Ω .

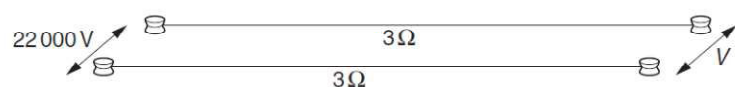


Fig. 10.1

(a) The a.c. generator actually generates at a much lower voltage than 22000V.

(i) Suggest how the voltage is increased to 22000V.

..... [1]

(ii) State one advantage of delivering electrical energy at high voltage.

..... [1]

(b) The power delivered by the generator is 55 kW. Calculate the current in the transmission lines.

current = [2]

(c) Calculate the rate of loss of energy from one of the 3Ω transmission lines.

rate of energy loss = [2]

(c) Describe and explain what is seen on the ammeter when S is moved to position C.

.....

 [2]

(d) With S in position A, calculate how long it takes for the circuit to transfer 320J of electrical energy to other forms.

time taken = [3]

[Total: 10]

(d) Calculate the voltage drop across one of the transmission lines.

voltage drop = [2]

(e) Calculate the potential difference V at the receiving end of the transmission lines.

$V =$ [2]

[Total: 10]

4. S08

Fig. 8.1 is the plan of a small apartment that has four lamps as shown.

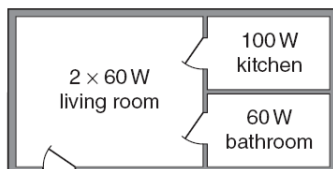


Fig. 8.1

Power for the lamps is supplied at 200V a.c. and the lamps are all in parallel.

(a) In the space below, draw a lighting circuit diagram so that there is one switch for each room and one master switch that will turn off all the lamps. Label the lamps as 60W or 100W.

[3]

(b) The 100W lamp is switched on. Calculate

(i) the current in the lamp,

current = [2]

(ii) the charge passing through the lamp in one minute.

charge = [2]

(c) The three 60W lamps are replaced by three energy-saving ones, that give the same light output but are rated at only 15W each.

Calculate

(i) the total reduction in power,

reduction in power = [1]

(ii) the energy saved when the lamps are lit for one hour.

energy saved = [2]

[Total: 10]

5.

Fig. 8.1 shows a 240 V a.c. mains circuit to which a number of appliances are connected and switched on.

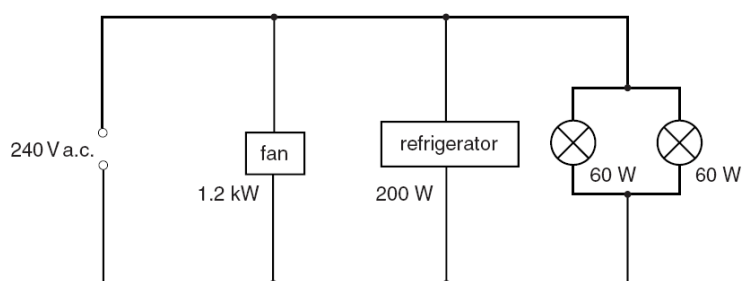


Fig. 8.1

(a) Calculate the power supplied to the circuit.

power =[1]

(b) The appliances are connected in parallel.

(i) Explain what connected *in parallel* means.

.....

(ii) State two advantages of connecting the appliances in parallel rather than in series.

advantage 1
 advantage 2

[3]

(c) Calculate

(i) the current in the refrigerator,

current =

(ii) the energy used by the fan in 3 hours,

energy =

(iii) the resistance of the filament of one lamp.

resistance =

[7]

Chapter 11 Magnetism

Topic 11.1 Magnet

1.

Fig. 7.1 shows an arrangement that could be used for making an electromagnet or a permanent magnet.

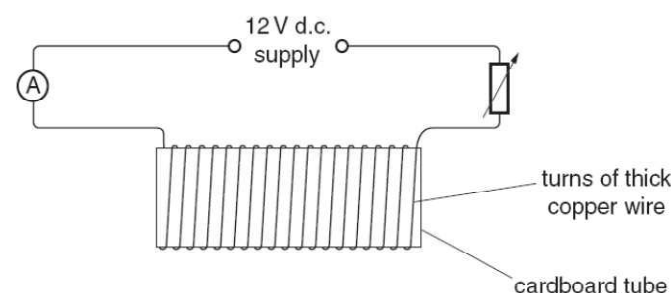


Fig. 7.1

Two bars of the same size are also available, one made of iron and the other of steel.

(a) (i) State which bar should be used to make a permanent magnet.

.....

(ii) Describe how the apparatus would be used to make a permanent magnet.

.....

(iii) Suggest one reason why the circuit contains an ammeter and a variable resistor.

.....

[3]

Topic 11.2 Electromagnetic effect-Induction

1. Fig. 8.1 shows a simple electrical generator. By turning the handle, the single coil may be spun between the poles of the magnet.

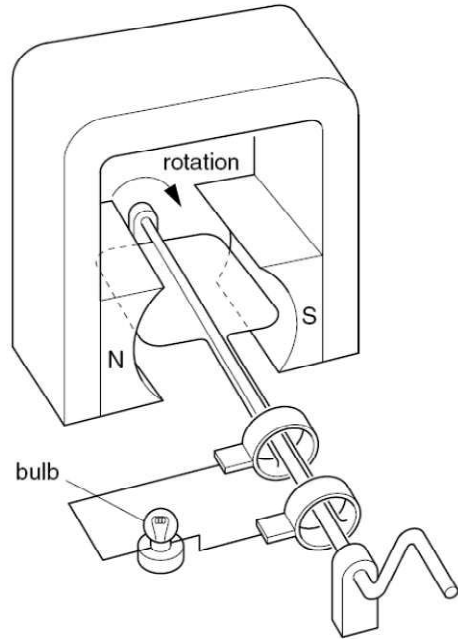


Fig. 8.1

(a) The handle is turned so that the coil makes two complete revolutions per second. The maximum output is 7 V. On Fig. 8.2, sketch this output over a period of 1 s.

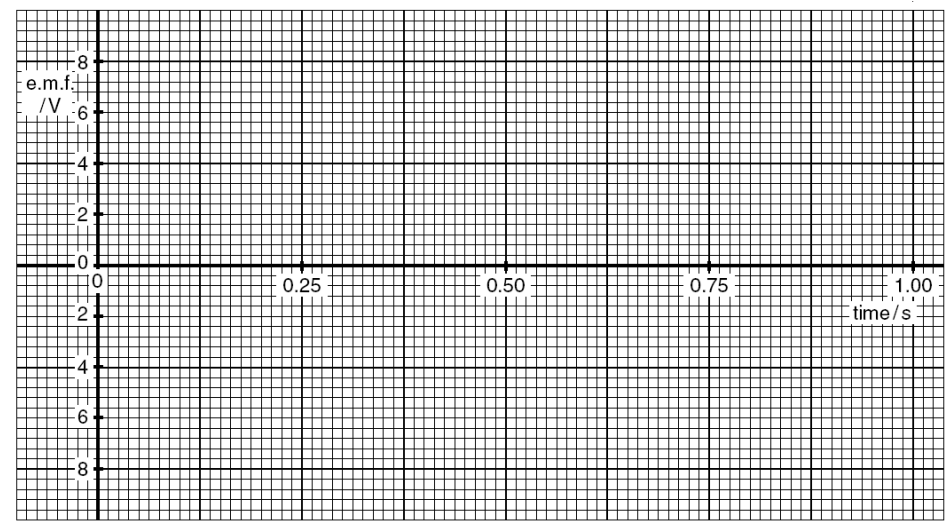


Fig. 8.2

[3]

(b) Explain

(i) how an e.m.f. is induced,

.....

.....

.....

.....

(ii) why the e.m.f. varies in magnitude and direction.

.....

.....

.....

.....

[4]

2. Electromagnetic induction may be demonstrated using a magnet, a solenoid and other necessary apparatus.

(a) Explain what is meant by *electromagnetic induction*.

.....

.....

.....

..... [2]

(b) In the space below, draw a labelled diagram of the apparatus set up so that electromagnetic induction may be demonstrated. [2]

(c) Describe how you would use the apparatus to demonstrate electromagnetic induction.

.....

.....

..... [2]

(d) State two ways of increasing the magnitude of the induced e.m.f. in this experiment.

1. [1]

.....

2. [1]

..... [2]

[Total: 8]

Topic 11.3 Motor effect

1. S08

Fig. 9.1 shows apparatus used to investigate electromagnetic effects around straight wires.

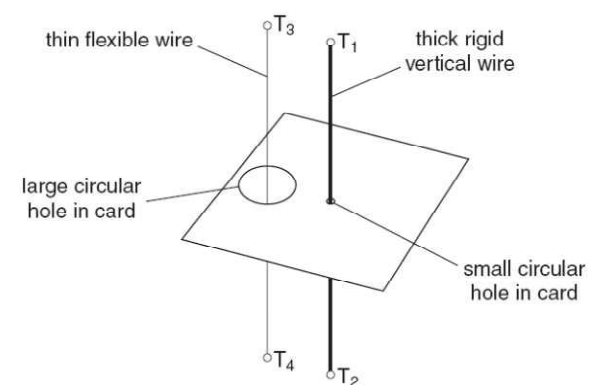


Fig. 9.1

Fig. 9.2 is a view looking down on the apparatus shown in Fig. 9.1.

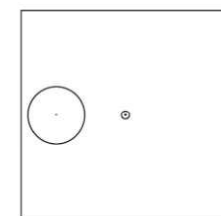


Fig. 9.2

(a) A battery is connected to T₁ and T₂ so that there is a current vertically down the thick wire.

On Fig. 9.2, draw three magnetic field lines and indicate, with arrows, the direction of all three. [2]

(b) Using a variable resistor, the p.d. between terminals T₁ and T₂ is gradually reduced.

State the effect, if any, that this will have on

- (i) the strength of the magnetic field, [1]
- (ii) the direction of the magnetic field, [1]

2. S10

(a) Fig. 9.1 illustrates the left hand rule, which helps when describing the force on a current-carrying conductor in a magnetic field.

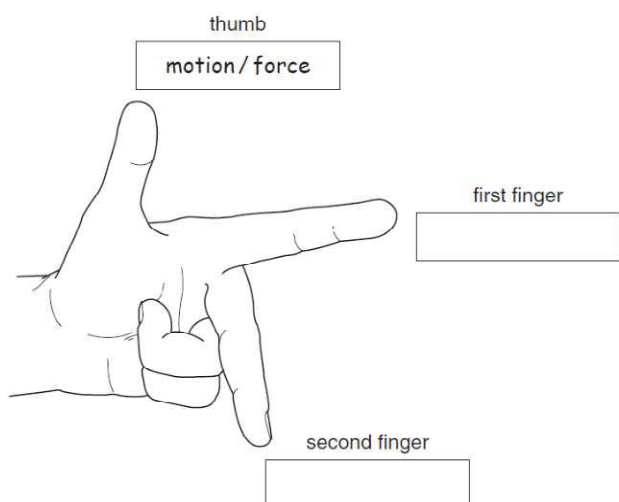


Fig. 9.1

One direction has been labelled for you.

In each of the other two boxes, write the name of the quantity that direction represents. [1]

(b) Fig. 9.2 shows a simple d.c. motor connected to a battery and a switch.

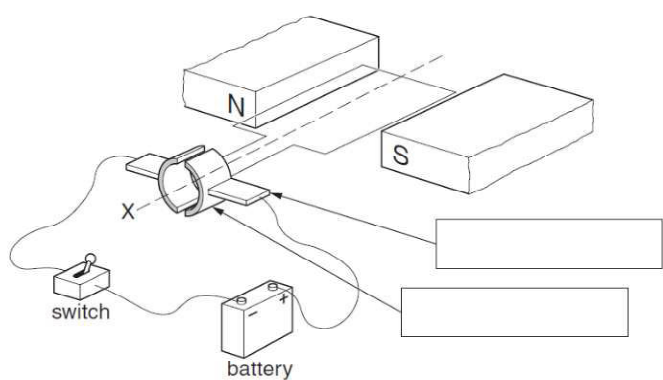


Fig. 9.2

(i) On Fig. 9.2, write in each of the boxes the name of the part of the motor to which the arrow is pointing. [2]

(ii) State which way the coil of the motor will rotate when the switch is closed, when viewed from the position X. [1]

(iii) State two things which could be done to increase the speed of rotation of the coil. [2]

1. [1]
2. [2]

[Total: 6]

(c) The battery is now connected to terminals T₃ and T₄, as well as to terminals T₁ and T₂, so that there is a current down both wires. This causes the flexible wire to move.

(i) Explain why the flexible wire moves. [2]

..... [2]

(ii) State the direction of the movement of the flexible wire. [1]

..... [1]

(iii) The battery is replaced by one that delivers a smaller current. [1]

State the effect that this will have on the force acting on the flexible wire. [1]

..... [1]

Topic 11.4 Electromagnetic effect-Transformer

1. W08

9 Fig. 9.1 is a block diagram of an electrical energy supply system, using the output of a coal-fired power station.

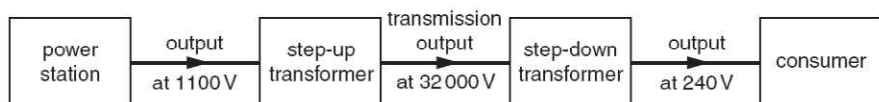


Fig. 9.1

(a) Suggest one possible way of storing surplus energy when the demand from the consumers falls below the output of the power station. [1]

..... [1]

(b) State why electrical energy is transmitted at high voltage. [1]

..... [1]

(c) A transmission cable of resistance R carries a current I . Write down a formula that gives the power loss in the cable in terms of R and I . [1]

..... [1]

(d) The step-up transformer has 1200 turns on the primary coil. Using the values in Fig. 9.1, calculate the number of turns on its secondary coil. Assume that the transformer has no energy losses. [2]

number of turns = [2]

(e) The input to the step-up transformer is 800kW. [3]

Using the values in Fig. 9.1, calculate the current in the transmission cables, assuming that the transformer is 100% efficient. [3]

current = [3]

[Total: 8]

2. S10

(a) The transformer in Fig. 8.1 is used to convert 240V a.c. to 6V a.c.

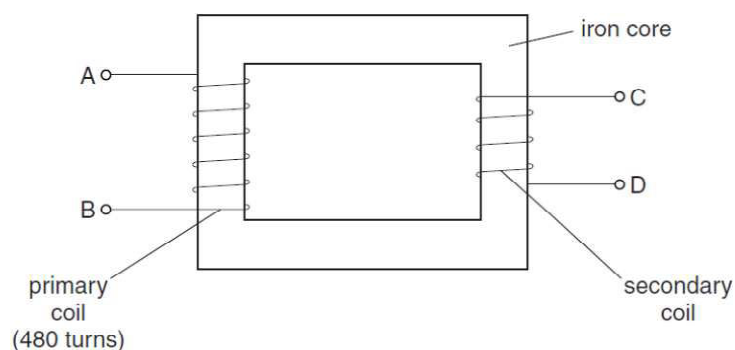


Fig. 8.1

(i) Using the information above, calculate the number of turns on the secondary coil. [2]

number of turns = [2]

(ii) Describe how the transformer works. [3]

..... [3]

(iii) State one way in which energy is lost from the transformer, and from which part it is lost. [1]

..... [1]

(b) Fig. 8.2 shows a device labelled "IGCSE Transformer".

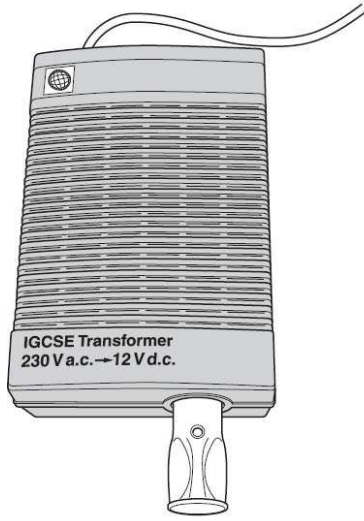


Fig. 8.2

Study the label on the case of the IGCSE Transformer.

- (i) What is the output of the device? [1]
- (ii) From the information on the case, deduce what other electrical component must be included within the case of the IGCSE Transformer, apart from a transformer.
..... [1]
- (c) A transformer supplying electrical energy to a factory changes the 11 000V a.c. supply to 440V a.c. for use in the factory. The current in the secondary coil is 200A.
Calculate the current in the primary coil, assuming no losses from the transformer.

current = [2]

[Total: 10]

Chapter 12 Electronics

1. W08

Fig. 10.1 shows a circuit for a warning lamp that comes on when the external light intensity falls below a pre-set level.

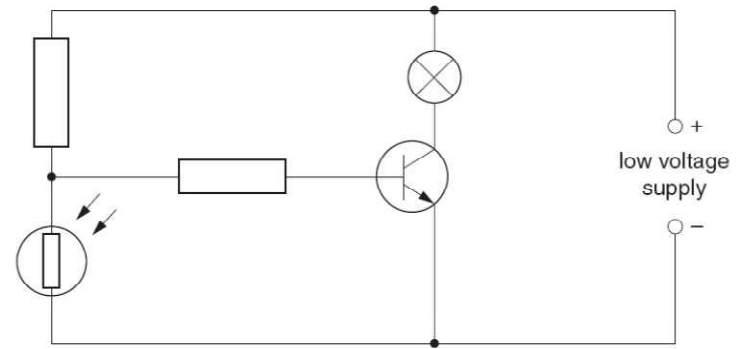


Fig. 10.1

- (a) On Fig. 10.1, label
 - (i) with the letter X the component that detects the change in external light intensity,
 - (ii) with the letter Y the lamp,
 - (iii) with the letter Z the component that switches the lamp on and off. [3]
- (b) Describe how the circuit works as the external light intensity decreases and the lamp comes on.

.....

 [3]

[Total: 6]

2. W09

Fig. 11.1 is a schematic diagram of an electronic circuit controlling a lamp.

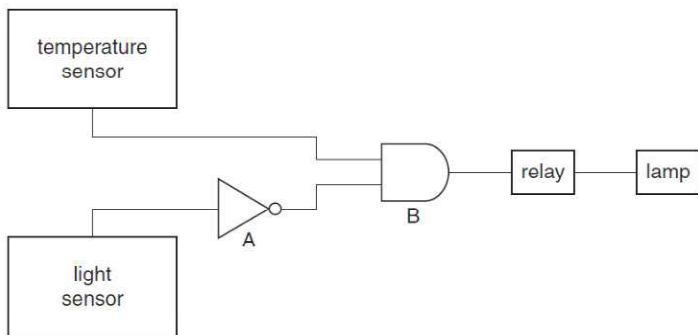


Fig. 11.1

- (a) State the names of the logic gates A and B.
A B [2]
- (b) The output of the temperature sensor is high (logic 1) when it detects raised temperature. The output of the light sensor is high (logic 1) when it detects raised light levels.
State the outputs of A and B when the surroundings are
 - (i) dark and cold, output of A =
output of B = [1]
 - (ii) dark and warm, output of A =
output of B = [1]
 - (iii) bright and warm. output of A =
output of B = [1]
- (c) (i) Suggest why B is connected to a relay, rather than directly to the lamp.
..... [1]
- (ii) The relay switches on when its input is high. In which of the three combinations in (b) will the lamp light up?
..... [1]
- (iii) Suggest a practical use for this circuit.
..... [1]

[Total: 8]

Chapter 13 Cathode ray oscilloscope

1. W10

When no circuit is connected to the input of a cathode-ray oscilloscope (CRO), there is a horizontal trace across the middle of the screen.

Fig. 11.1 shows three circuits, each connected to a CRO.

On the grid alongside each circuit, draw the trace that might be seen on the screen of the CRO.

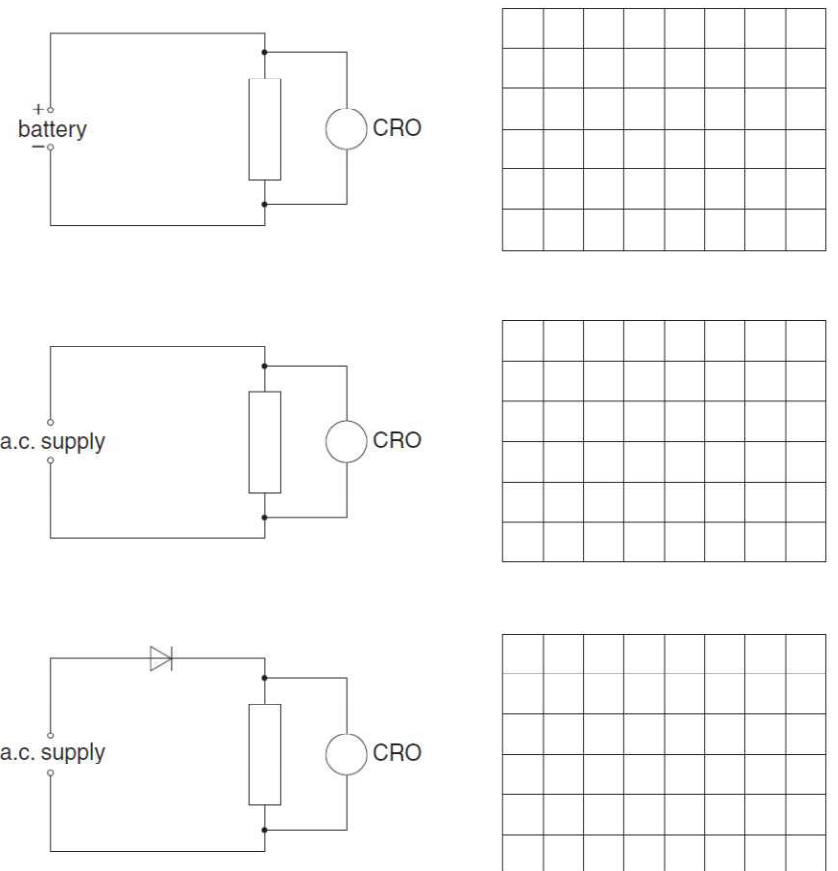


Fig. 11.1

[6]

[Total: 6]

2. W08
11 Fig. 11.1 shows the basic design of the tube of a cathode ray oscilloscope (CRO).

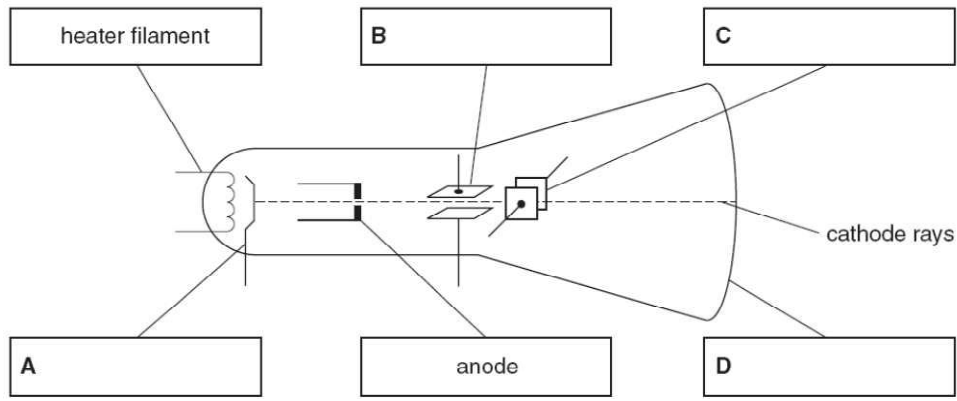


Fig. 11.1

- (a) On Fig. 11.1, write the names of parts A, B, C and D in the boxes provided. [2]
- (b) State the function of:
part A,
part B, [2]
- (c) A varying p.d. from a 12V supply is connected to a CRO, so that the waveform of the supply is shown on the screen.
To which of the components in Fig. 11.1
(i) is the 12V supply connected, [1]
(ii) is the time-base connected? [1]
- [Total: 6]

- (b) From the data given, deduce the type of emission being detected, if any, at A, at B and at C when the radiation source is present.
State the reasons for your answers.
detector at A [2]
detector at B [3]
detector at C [3]
- [Total: 10]

2. S10
A certain element is known to exist as two different isotopes.
- (a) State one thing that is the same for atoms of both isotopes. [1]
- (b) State one thing that is different between atoms of these two isotopes. [1]
- (c) An atom of one of these isotopes is unstable and decays into a different element by emitting a β -particle.
(i) State one thing about the atom that remains the same during this decay. [1]
(ii) State one thing about the atom that changes as a result of this decay. [1]
- [Total: 4]

Chapter 14 Radioactivity

1. W10
Emissions from a radioactive source pass through a hole in a lead screen and into a magnetic field, as shown in Fig. 10.1.

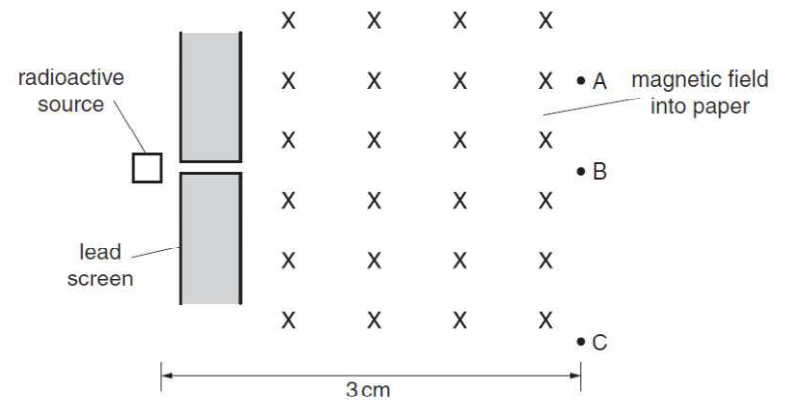


Fig. 10.1

Radiation detectors are placed at A, B and C. They give the following readings:

A	B	C
32 counts/min	543 counts/min	396 counts/min

The radioactive source is then completely removed, and the readings become:

A	B	C
33 counts/min	30 counts/min	31 counts/min

- (a) Explain why there are still counts being recorded at A, B and C, even when the radioactive source has been removed, and give the reason for them being slightly different. [2]

3.
Fig. 11.1 shows an experiment to test the absorption of β -particles by thin sheets of aluminium. Ten sheets are available, each 0.5mm thick.

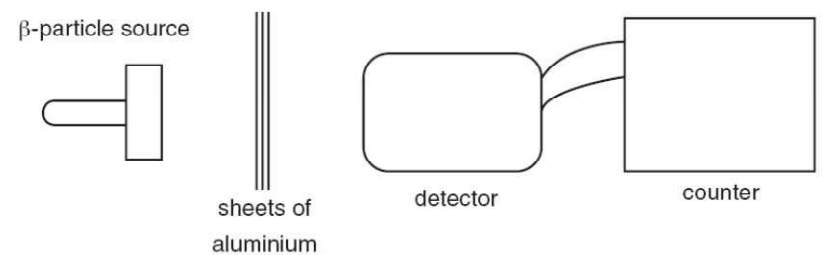


Fig. 11.1

- (a) Describe how the experiment is carried out, stating the readings that should be taken. [4]
- (b) State the results that you would expect to obtain. [2]

[Total: 6]

4. (a) Fig. 10.1 is the decay curve for a radioactive isotope that emits only β -particles.

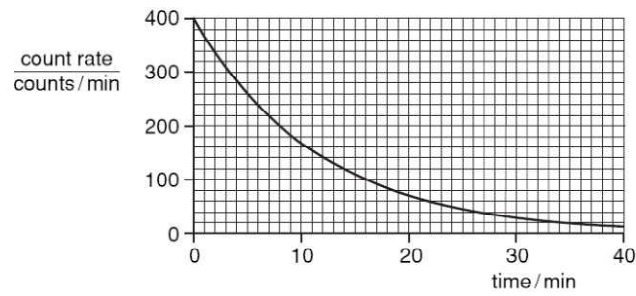


Fig. 10.1

Use the graph to find the value of the half-life of the isotope.

Indicate, on the graph, how you arrived at your value.

half-life [2]

- (b) A student determines the percentage of β -particles absorbed by a thick aluminium sheet. He uses a source that is emitting only β -particles and that has a long half-life.

- (i) In the space below, draw a labelled diagram of the apparatus required, set up to make the determination.

[2]

(ii) List the readings that the student needs to take.

 [3]

5. (a) The decay of a nucleus of radium $^{226}_{88}\text{Ra}$ leads to the emission of an α -particle and leaves behind a nucleus of radon (Rn).
 In the space below, write an equation to show this decay. [2]

- (b) In an experiment to find the range of α -particles in air, the apparatus in Fig. 11.1 was used.

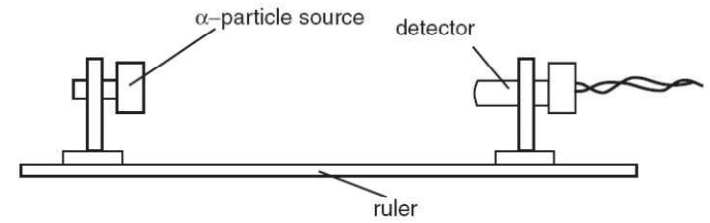


Fig. 11.1

The results of this experiment are shown below.

count rate / (counts/minute)	681	562	441	382	317	20	19	21	19
distance from source to detector/cm	1	2	3	4	5	6	7	8	9

- (i) State what causes the count rate 9 cm from the source.

- (ii) Estimate the count rate that is due to the source at a distance of 2 cm.

- (iii) Suggest a value for the maximum distance that α -particles can travel from the source.

- (iv) Justify your answer to (iii).

 [4]