Practice exam-style paper

Paper 4 Core and Supplement

[1 hour 15 min]

Write your answers on the question paper.

The number of marks is given in brackets [ ] at the end of each question or part question.

1 A block of ice has dimensions 5.0 cm × 8.0 cm × 10.0 cm.

a Calculate the volume of the block.

volume of block = ... cm^3 [1]

b The block of ice is placed in a beaker of mass 140 g. Together, their mass is found to be 508 g.

Calculate the mass of the ice.

mass of ice = ... g [1]

c Calculate the density of ice.

density of ice = ...

..... .

..... . [3]

[Total: 5]

2 The graphs shown in Fig. 2.1 represent the motion of two cars, A and B.

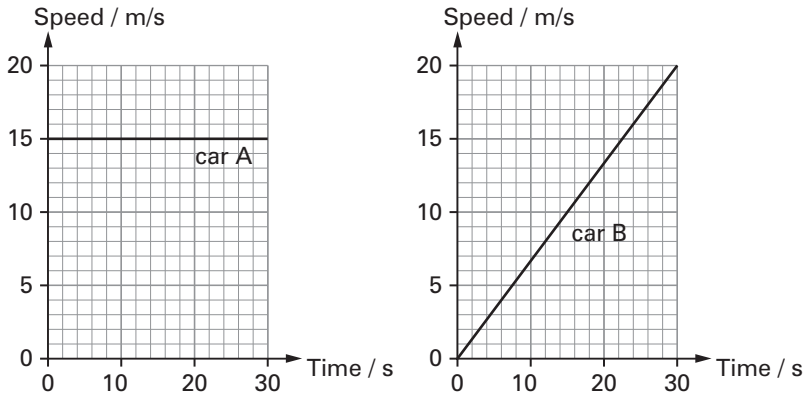

Fig. 2.1

a Calculate the distance travelled in 30 s by car A.

distance travelled = ... m [2]

b Calculate the distance travelled in 30 s by car B.

distance travelled = ... m [2]

c Calculate the acceleration of car B.

acceleration = ...

.....

..... [3]

[**Total: 7**]

3 Fig. 3.1 shows a ball falling through the air.

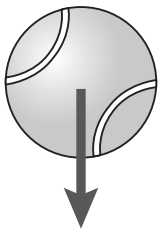

Fig. 3.1

a The arrow represents the gravitational force acting on the ball (its weight).
The ball is falling through air so that a second force, air resistance, acts on it.

Add an arrow to Fig. 3.1 to represent this force. [1]

b Later, when the ball is falling at a greater speed, the two forces acting on it are equal and opposite.

State the resultant force acting on the ball. ..... [1]

State the value of the ball's acceleration. ..... [2]

c The ball bounces on the ground so that its velocity is now directed upwards. Again it is acted on by two forces: its weight, and air resistance.

In the space below, draw a diagram to show the directions of these forces acting on the ball. [2]

[Total: 6]

4 A crane uses an electric motor to lift a heavy load. Fig 4.1 shows a load of mass 450 kg that has been lifted from the ground by a crane. Energy has been transferred to the load by the crane.

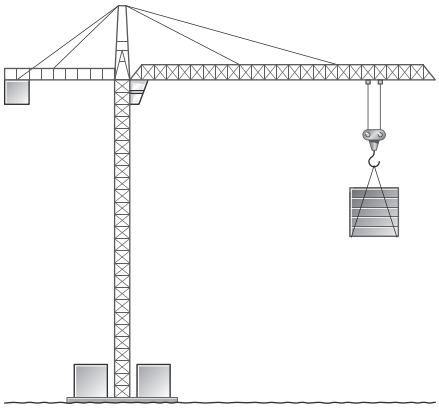

Fig. 4.1

a Which process correctly describes the transfer of energy to the load? Tick the box.

electrical working	☐
mechanical working	☐
heating	☐

[1]

b The load has been raised through a height of 15 m. Calculate the amount of gravitational energy that has been transferred to the load by the crane. (gravitational field strength = 10 N/kg)

energy transferred = ... J [2]

[Total: 3]

5 Fig 5.1 represents the particles of a solid material.

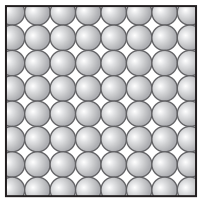

Fig. 5.1

a Describe how the particles move.

.....

..... [2]

b The solid material is heated so that it expands.

The list below shows four properties of the solid. Tick the box if the property increases as the temperature of the solid increases:

the internal energy of the solid	☐
the size of the particles	☐
the amplitude of the vibrations of the particles	☐
the separation of each particle from its neighbours	☐

[2]

c Fig 5.2 shows a bimetallic strip, in which strips of aluminium and steel are welded tightly together.

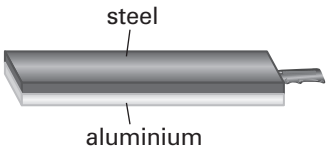

Fig. 5.2

When heated, aluminium expands more than steel. This causes the strip to bend. In the space beside Fig. 5.2, draw the strip to show how it will bend when heated. Label the two metals. [2]

[Total: 6]

6 A small pebble is heated using an electrical heater. The heater supplies 480 J of energy to the pebble and its temperature rises from 15 °C to 55 °C.

a Calculate the heat capacity of the pebble.

.....

.....

.....

heat capacity of pebble = ... [4]

b What other quantity must be known in order to find the specific heat capacity of the material of the pebble?

..... [1]

[Total: 5]

7 Two metal containers are filled with ice and placed in a warm room (Fig. 7.1). Container A has a shiny white surface; container B has a shiny black surface.

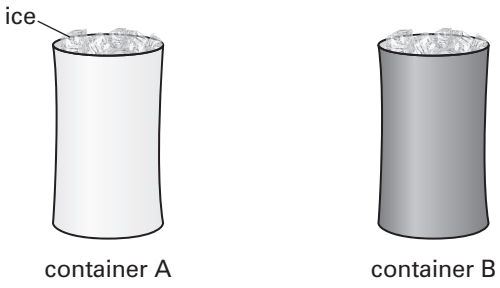

Fig. 7.1

a Explain why the ice in the containers starts to melt.

.....

.....

..... [2]

b In which container will the ice melt more quickly? Explain your answer.

.....

.....

..... [2]

c Describe how you could adapt this experiment to show that a shiny black surface is a better emitter of infrared radiation than a shiny white one.

.....

.....

.....

.....

..... [3]

[Total: 7]

8 Fig. 8.1 shows a ray of light directed into a semi-circular glass block.

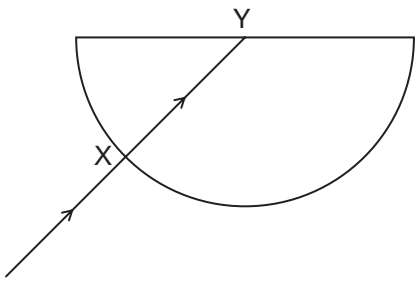

Fig. 8.1

a Explain why the ray is not refracted when it enters the block at point X.

.....

..... [2]

b When the ray meets the straight side of the block at point Y, its angle of incidence is greater than the critical angle.

On Fig. 6.2, using a ruler, draw the rest of the ray until it has emerged from the block.

[2]

c The refractive index of the glass is 1.42. Calculate the critical angle for this material.

critical angle = ... [3]

[Total: 7]

9 Fig. 9.1 is a ray diagram which shows how an image can be formed by a thin converging lens. The object is represented by the arrow labelled O.

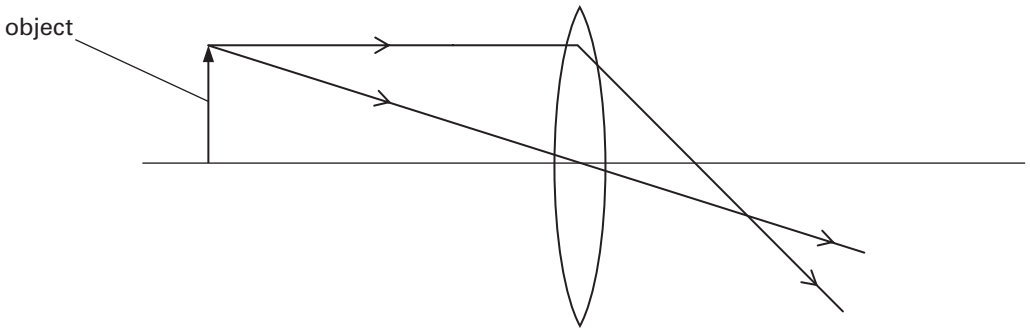

Fig. 9.1

a On Fig. 9.1, mark with an F the principal focus of the lens. **[1]**

b On Fig. 9.1, show where the image of the object will be formed. **[2]**

c State whether the image is:

enlarged / same size / diminished .....

upright / inverted .....

real / virtual ..... **[3]**

d A converging lens can also be used as a magnifying glass to produce a magnified image of the object. State where the object must be placed in order to achieve this.

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

[Total: 7]

10 Humans have an approximate audible range from 20 Hz to 20 kHz.

a Calculate the wavelength in air of sounds of frequency 20 Hz.
(Speed of sound in air = 330 m/s.)

wavelength = ... m **[3]**

b Fig. 10.1 shows sound waves of frequency 20 Hz, as represented on the screen of an oscilloscope.

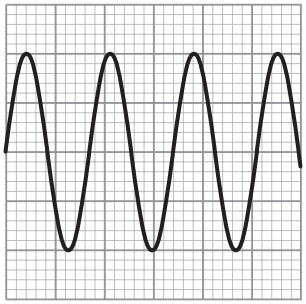

Fig. 10.1

In the space beside Fig. 10.1, draw a sound wave whose frequency is less than 20 Hz but whose amplitude is the same as that of the 20 Hz wave. [2]

[**Total: 5**]

11 In the circuit shown in Fig. 11.1, an ammeter is being used to measure the current in a resistor.

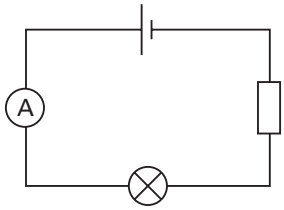

Fig. 11.1

a The ammeter reads 0.25 A. Calculate the amount of electric charge that flows through the resistor in 1 minute.

charge = ... [3]

b The resistor has a resistance of 24 Ω. Calculate the potential difference across it.

potential difference = ... V [2]

c A second resistor of resistance 12 Ω is connected in parallel with the first resistor. Calculate the combined resistance of the two resistors.

combined resistance = ... Ω [2]

d When the second resistor is added to the circuit, will the reading on the ammeter increase, decrease or stay the same? Explain your answer.

.....

.....

..... [3]

[Total: 10]

12 Fig. 12.1 shows a coil of wire connected to a voltmeter. The north pole of a permanent magnet is being moved into the open end of the coil.

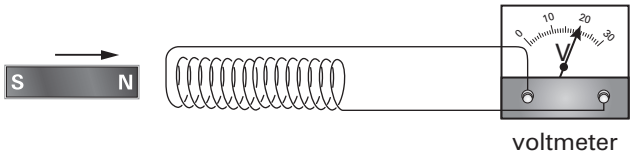

Fig. 12.1

a Explain why a voltage is shown on the voltmeter.

.....

.....

..... [2]

b State one way in which the experiment could be changed to give a bigger reading on the voltmeter.

.....

..... [1]

c What reading will the voltmeter show if the magnet is held in a stationary position next to the coil? Explain your answer.

.....

.....

..... [2]

d As shown in the diagram, the magnet's north pole is being pushed into the coil. A current flows in the coil, causing it to become an electromagnet. State whether the left-hand end of the coil will be a north pole or a south pole.

..... [1]

[Total: 6]

13 A particular isotope of the element oxygen, known as oxygen-19, is represented by the symbol

$$^{19}_{8}\mathrm{O}$$

a Calculate the neutron number of this isotope

neutron number = ... [2]

b Oxygen-19 undergoes radioactive decay. It emits a beta particle and becomes an isotope of fluorine (chemical symbol F). In the space below, write the symbol for the nuclide of fluorine which is formed in this decay.

[2]

c The half-life of oxygen-19 is 30 s. A sample of oxygen-19 contains 1000 atoms. Calculate the number that will remain undecayed after 60 s.

number undecayed = ... [2]

[**Total: 6**]