Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

1020540899

PHYSICS **0625/31**

Paper 3 Extended **October/November 2015**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.
Take the weight of 1 kg to be 10 N (i.e. acceleration of free fall = $10\,m/s^2$).

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

The syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 1/Level 2 Certificate.

This document consists of **16** printed pages.

DC (CW/SW) 96031/2

CAMBRIDGE International Examinations

1 Fig. 1.1 shows a rocket-powered sled travelling along a straight track. The sled is used to test components before they are sent into space.

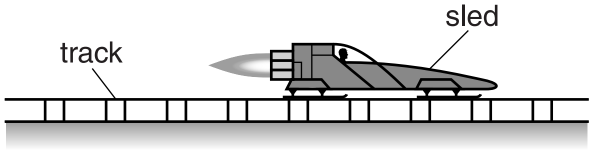


Fig. 1.1

Fig. 1.2 is the speed-time graph for the sled from time $t = 0$ s.

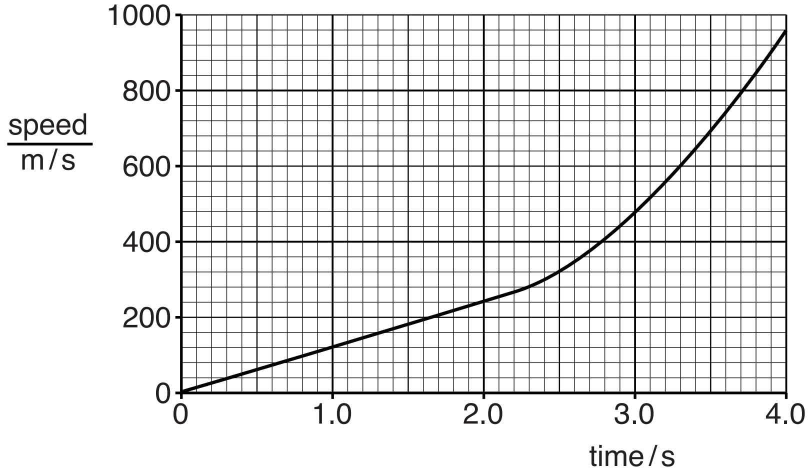


Fig. 1.2

(a) On Fig. 1.2, mark a point labelled P to indicate a time when the acceleration of the sled is not constant. [1]

(b) (i) Calculate the acceleration of the sled at $t = 1.0$ s.

acceleration = ... [2]

(ii) Determine the distance travelled by the sled between $t = 1.0$ s and $t = 2.0$ s.

distance = ... [2]

(c) The resultant force acting on the sled remains constant during the test.

Suggest why the acceleration of the sled is not constant.

....

....[1]

[Total: 6]

2 **(a)** **(i)** Mass is a scalar quantity.

State another scalar quantity.

....

(ii) Force is a vector quantity.

State another vector quantity.

....
[2]

(b) A boat is floating on still water.

The mass of the boat is 290 000 kg. A resultant force of 50 kN acts on the boat.

Calculate the acceleration of the boat.

acceleration = ...[3]

(c) Fig. 2.1, not to scale, shows the view from above of the boat, now on a fast-flowing river. The boat accelerates.

Two forces are shown acting on the boat. The resultant of these forces is at right angles to the river banks.

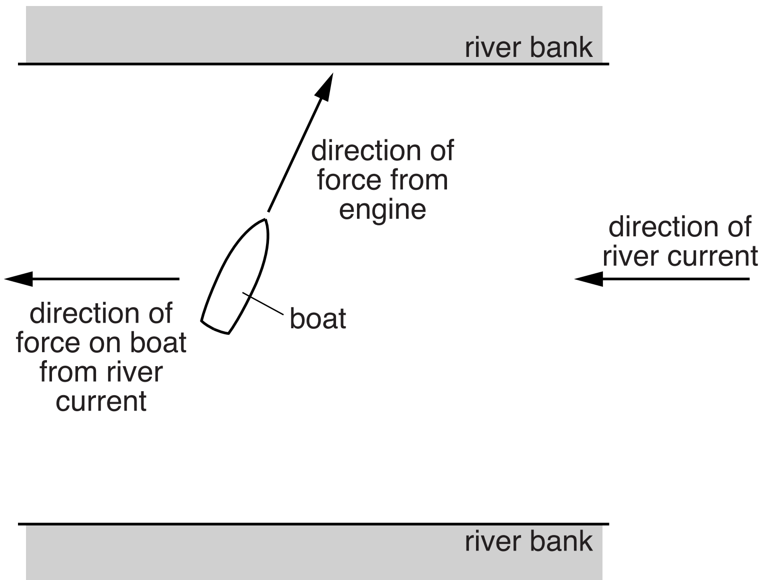


Fig. 2.1 (not to scale)

Fig. 2.2 is an incomplete vector diagram of the forces acting on the boat.

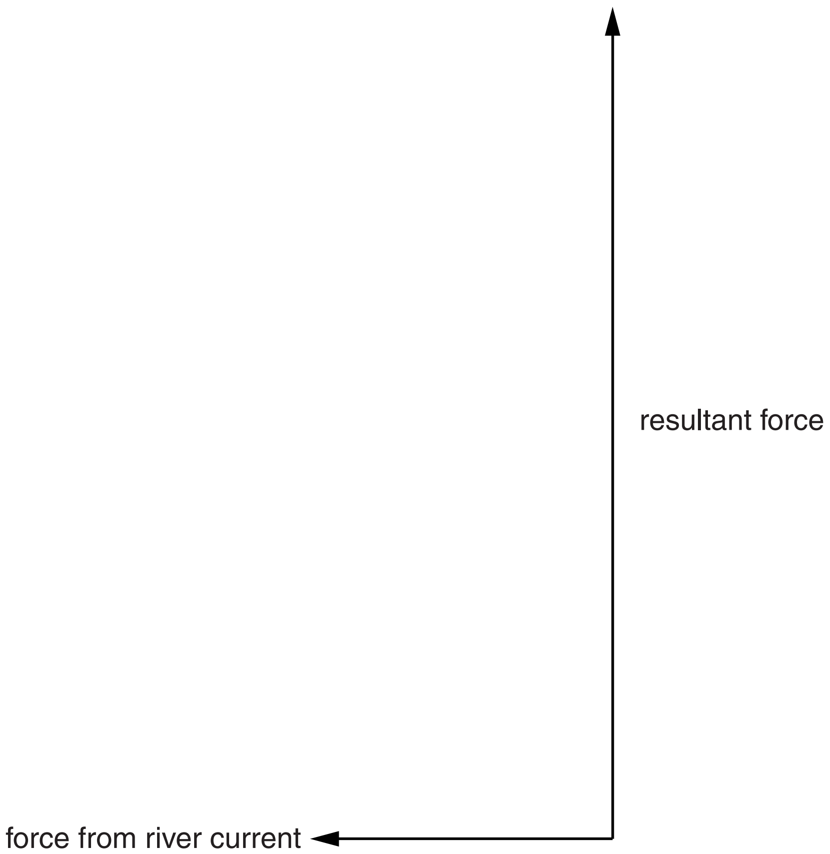


Fig. 2.2

The force from the river current is 80 kN.

(i) Determine the scale that has been used in the vector diagram.

scale is ....

(ii) On Fig. 2.2, complete the vector diagram to determine the magnitude and direction of the force from the engine. Measure the angle between the direction of the current and the force from the engine.

magnitude of force from engine = ...

angle = ...
[4]

[Total: 9]

3 Fig. 3.1 shows a skier taking part in a downhill race.

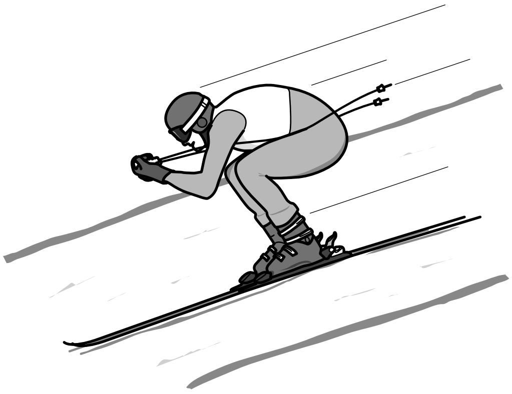


Fig. 3.1

(a) The mass of the skier, including his equipment, is 75 kg. In the ski race, the total vertical change in height is 880 m.

Calculate the decrease in the gravitational potential energy (g.p.e.) of the skier.

decrease in g.p.e. = ...[2]

(b) The skier starts from rest. The total distance travelled by the skier during the descent is 2800 m. The average resistive force on the skier is 220 N.

Calculate

(i) the work done against the resistive force,

work done = ...[2]

(ii) the kinetic energy of the skier as he crosses the finishing line at the end of the race.

kinetic energy = ...[2]

(c) Suggest why the skier bends his body as shown in Fig. 3.1.

....[1]

[Total: 7]

4 **(a)** An object of mass *m* and specific heat capacity *c* is supplied with a quantity of thermal energy *Q*. The temperature of the object increases by $\Delta\theta$.

Write down an expression for *c* in terms of *Q*, *m* and $\Delta\theta$.

c = ... [1]

(b) Fig. 4.1 shows the heating system of a hot water shower.

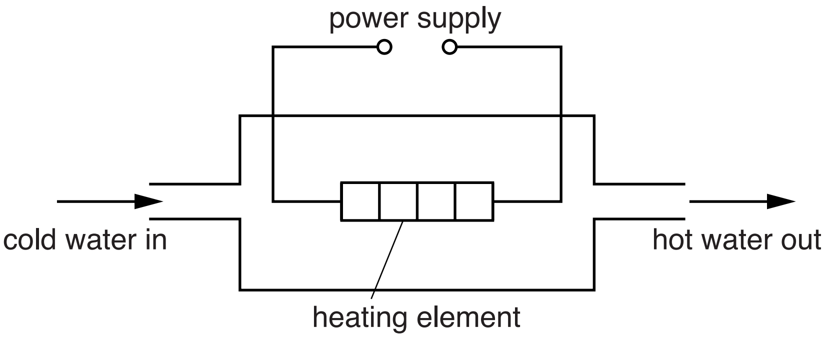


Fig. 4.1

Cold water at 15 °C flows in at the rate of 0.0036 m^3/minute. Hot water flows out at the same rate.

(i) Calculate the mass of water that passes the heating element in one minute. The density of water is 1000 kg/m^3.

mass = ... [2]

(ii) The power of the heating element is 8.5 kW.

Calculate the temperature of the hot water that flows out. The specific heat capacity of water is 4200 J/(kg °C).

temperature = ... [4]

[Total: 7]

5 **(a)** Smoke particles are introduced into a glass box containing air. Light shines into the box so that, when observed through a microscope, the smoke particles can be seen as bright points of light.

Describe the motion of the smoke particles and account for this motion in terms of the air molecules.

....

....

....

....

....

....[4]

(b) Fig. 5.1 shows a quantity of gas in a cylinder sealed by a piston that is free to move.

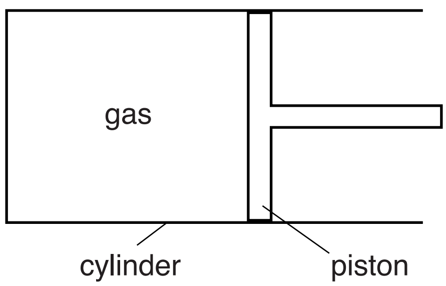


Fig. 5.1

(i) The temperature of the gas is increased.

State what happens, if anything,

1. to the piston,

....

2. to the pressure of the gas.

....
[2]

(ii) The piston is now fixed in place and the temperature of the gas is increased further.

Explain, in terms of the behaviour of molecules, what happens to the pressure of the gas.

....

....

....[2]

[Total: 8]

6 A sound wave, travelling in air, approaches a solid barrier with a gap in the middle. Fig. 6.1 represents the compressions and rarefactions of the sound wave. The compressions are labelled A, B and C.

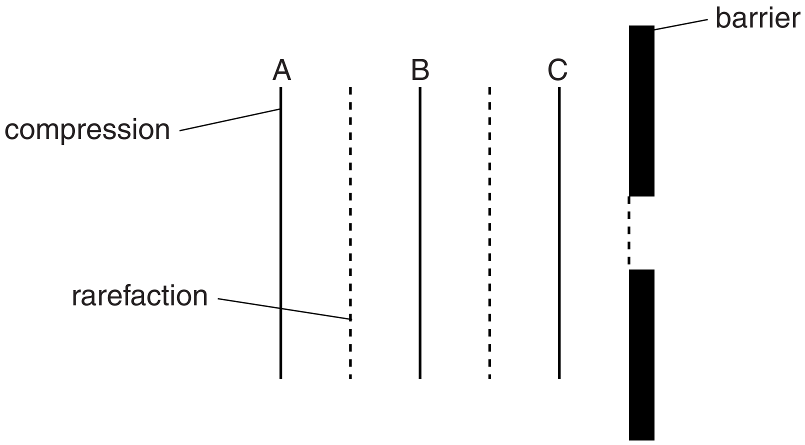


Fig. 6.1

(a) State how a *compression* differs from a *rarefaction*.

....

....[1]

(b) The speed of sound in air is 340 m/s. The frequency of the sound is 850 Hz.

For this wave, determine

(i) the wavelength,

wavelength = ...[2]

(ii) the time that elapses before compression A reaches the barrier.

time = ...[2]

(c) On Fig. 6.1, draw the shape and positions of compressions B and C as compression A reaches the barrier. [2]

(d) Sound waves can also travel in water.

State how the speed of sound in water compares with the speed of sound in air.

....[1]

[Total: 8]

7 **(a)** Fig. 7.1 shows a convex lens being used to produce an image of an object.

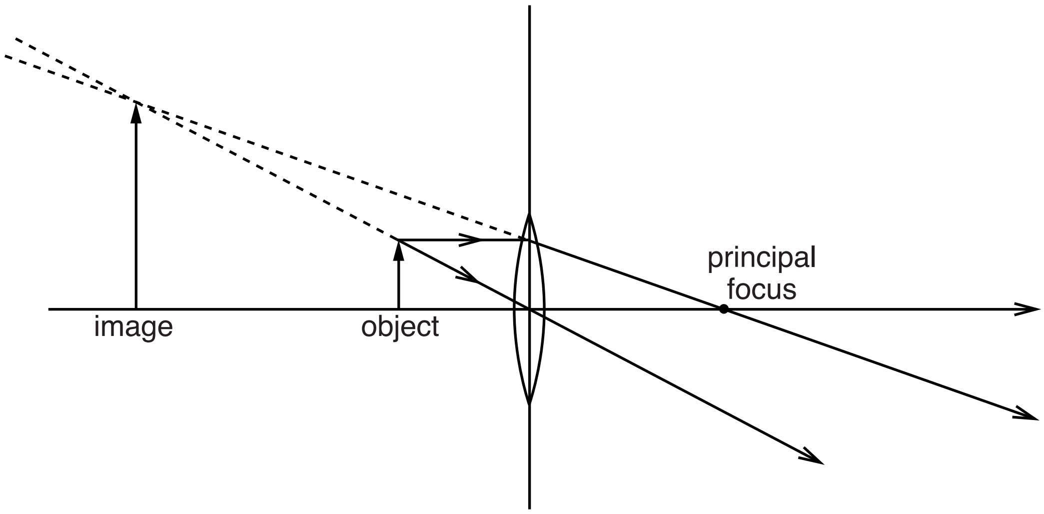


Fig. 7.1

(i) Place **three** ticks in the table that describe this image.

can only be formed on a screen	
diminished	
enlarged	
inverted	
real	
same size	
upright	
virtual	

[3]

(ii) On Fig. 7.1, mark a letter E to indicate a possible position for an eye to be placed to observe this image. [1]

(iii) State an application in which a convex lens is used in this way.

....[1]

(b) In the space below, draw a ray diagram to locate the image of an object of height 1.0 cm placed 5.0 cm from a convex lens of focal length 2.0 cm. Draw your diagram full size. You are advised to locate the lens roughly in the centre of the space. Label the image.

[3]

[Total: 8]

8 A digital watch is powered by a 1.3 V cell. The cell supplies a current of 4.1×10^{-5} A (0.000041 A) for 1.6×10^{7} s.

Calculate

(a) the charge that passes through the cell in this time,

charge = ...[2]

(b) the resistance of the electrical circuit in the watch,

resistance = ...[2]

(c) the output power of the cell.

power = ...[2]

[Total: 6]

9 Fig. 9.1 shows two separate coils of wire wound around an iron core.

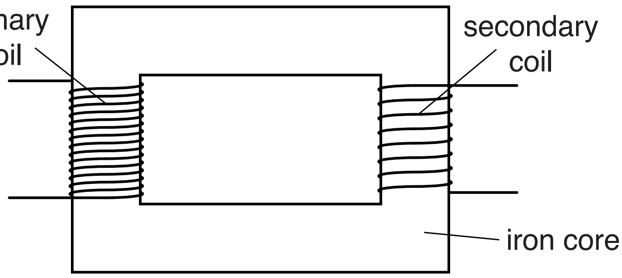


Fig. 9.1

An a.c. supply is connected across the primary coil and a 12V lamp is connected across the secondary coil. The lamp glows with normal brightness.

(a) State the name of the device shown in Fig. 9.1.

....[1]

(b) Explain why there is a current in the lamp.

....

....

....

....

....[4]

(c) **(i)** The coil connected to the lamp has 450 turns. The e.m.f. of the a.c. supply is 240V.

Calculate the number of turns on the coil connected to the a.c. supply.

number of turns = ...[2]

(ii) A 240V d.c. supply is used instead of the 240V a.c. supply. Tick **one** box to indicate what happens to the lamp.

☐ glows more brightly

☐ glows with the same brightness

☐ glows less brightly

☐ does not glow

[1]

[Total: 8]

10 **(a)** Fig. 10.1 shows the symbol for a logic gate.

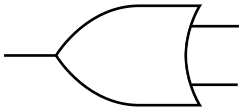


Fig. 10.1

(i) State the name of this gate. .... [1]

(ii) On Fig. 10.1, label an input and an output. [1]

(iii) In the space below, draw the symbol for a NAND gate.

[1]

(b) A very low frequency alternating voltage is applied between A and B in the circuit shown in Fig. 10.2.

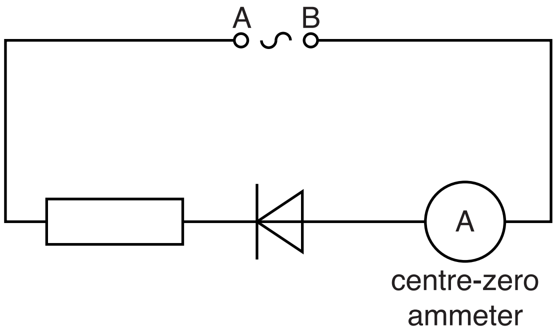
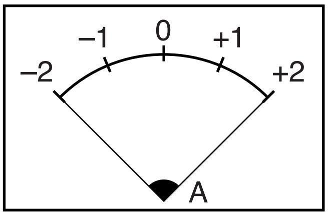


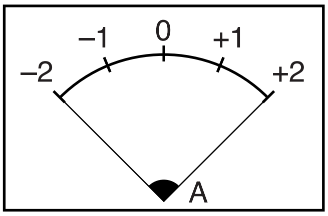
Fig. 10.2

On each diagram, draw a possible position of the indicator needle of the ammeter at the time in the cycle when

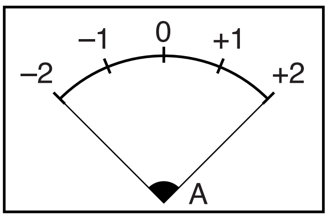
(i) A is positive and B is negative,



(ii) there is no p.d. between A and B,



(iii) A is negative and B is positive.



[3]

[Total: 6]

11 **(a)** State, in terms of the particles in each nucleus, how the nuclei of two isotopes of the same element are different.

....[1]

(b) Fig. 11.1 shows a graph of nucleon number against proton number. The nucleus $^{212}_{83}Bi$ is plotted on the graph at the cross marked P.

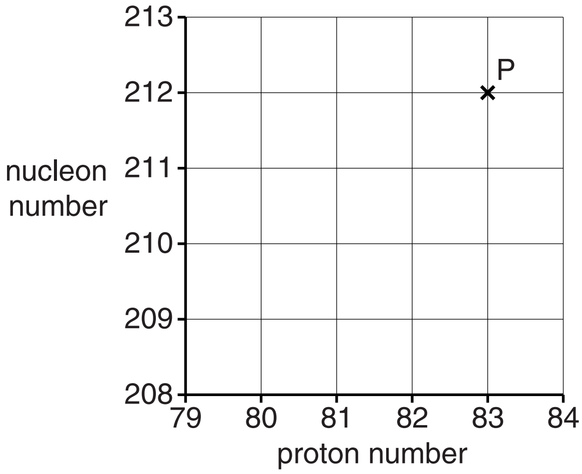


Fig. 11.1

(i) On Fig. 11.1,

1. plot a cross labelled Q for the nucleus formed when the $^{212}_{83}Bi$ nucleus emits an α-particle,

2. plot a cross labelled R for the nucleus formed when the $^{212}_{83}Bi$ nucleus emits a β-particle.

[4]

(ii) The half-life for the decay of $^{212}_{83}Bi$ is 60 minutes.

A sample of $^{212}_{83}Bi$ is placed at a fixed distance from a detector. The initial measurement of the count rate from the sample of $^{212}_{83}Bi$ is 2400 counts per minute.

Calculate the count rate from the sample 5.0 hours later.

count-rate = ...[2]

[Total: 7]