Cambridge IGCSE

**Cambridge International Examinations**
Cambridge International General Certificate of Secondary Education

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**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.

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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.

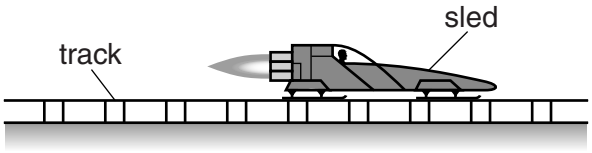


**Fig. 1.1**

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

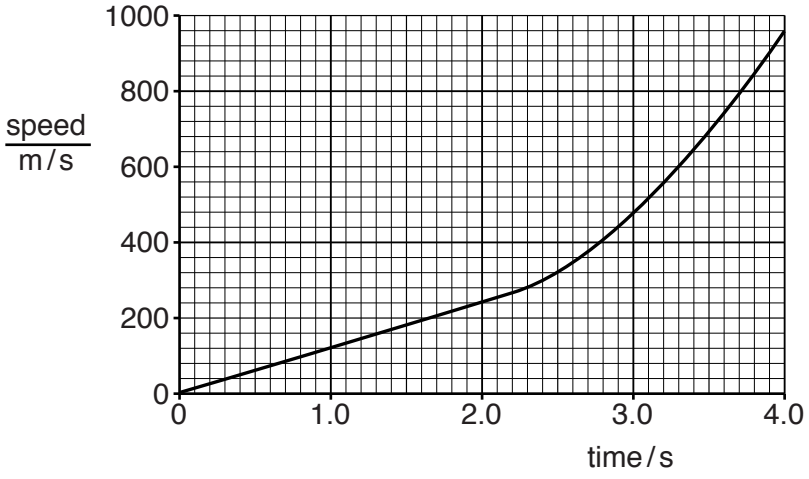


**Fig. 1.2**

View solution

**(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.

View solution

acceleration = .....[2]

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

View solution

distance = .....[2]

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

View solution

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.

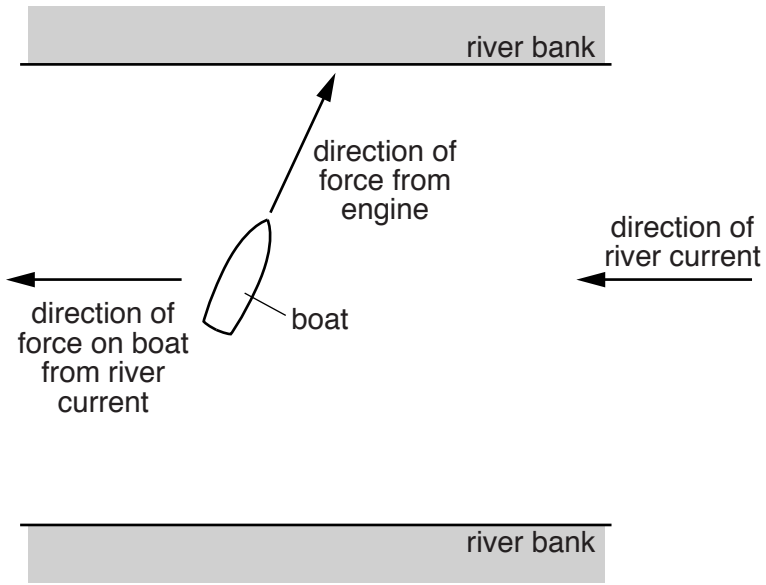


**Fig. 2.1** (not to scale)

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

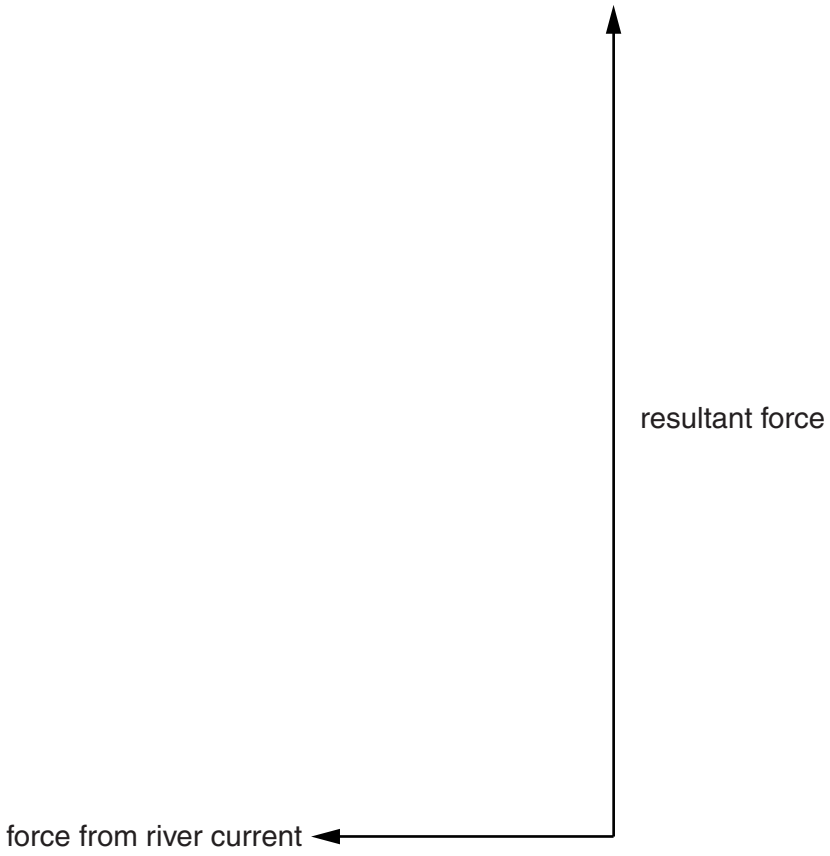


**Fig. 2.2**

The force from the river current is 80 kN.

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

View solution

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]

View solution

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

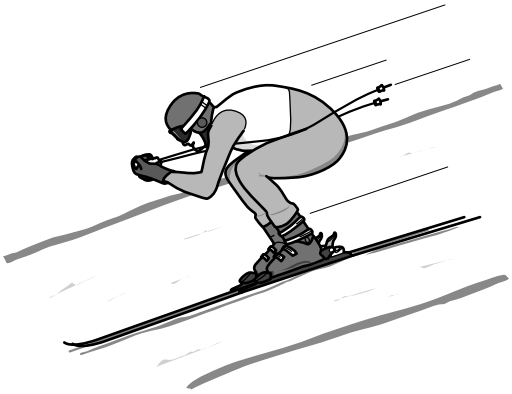

**Fig. 3.1**

**(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.

View solution

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.

View solution

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.

View solution

kinetic energy = .....[2]

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

View solution

.....[1]

[Total: 7]

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**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 $\Delta\theta$.

View solution

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.

View solution

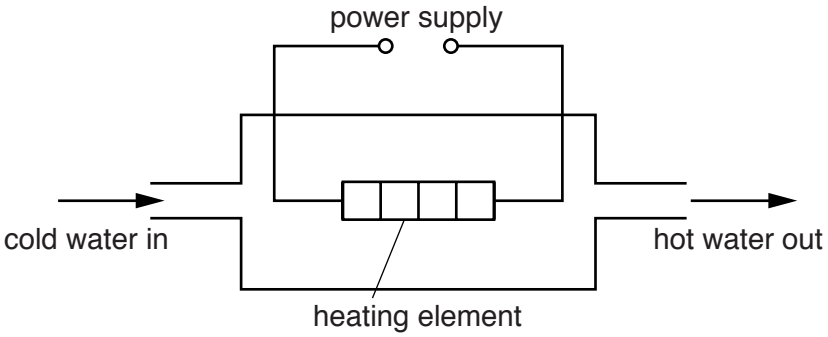


**Fig. 4.1**

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).

View solution

temperature = .....[4]

[Total: 7]

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**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.

View solution

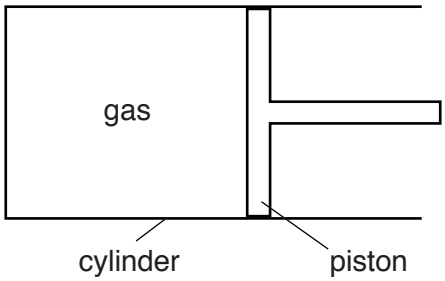


**Fig. 5.1**

**(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]

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**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.

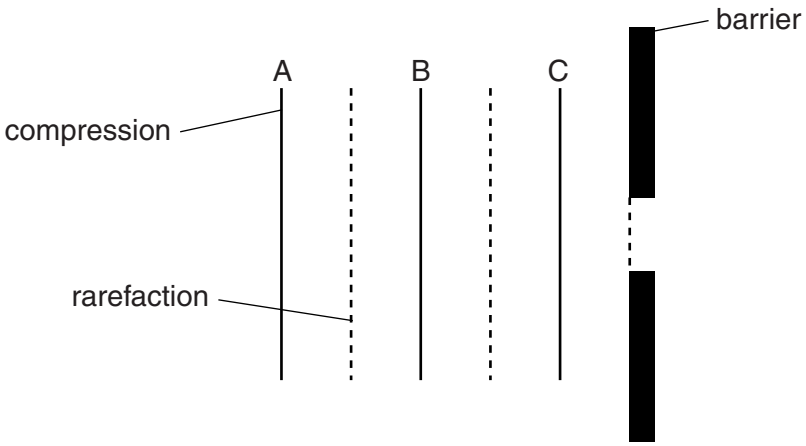


**Fig. 6.1**

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

View solution

.....

.....[1]

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

View solution

For this wave, determine

**(i)** the wavelength,

wavelength = .....[2]

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

View solution

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.

View solution

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

.....[1]

[Total: 8]

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

View solution

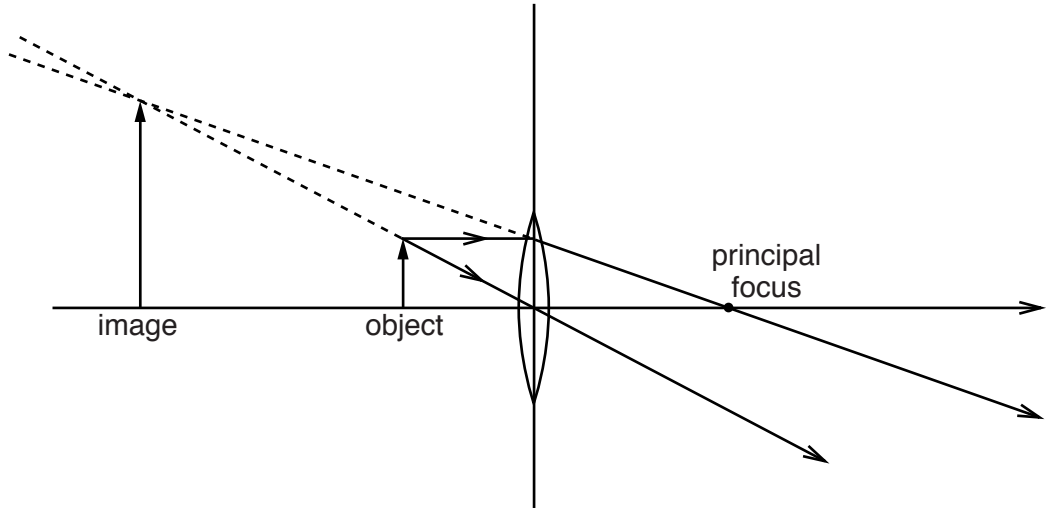


**Fig. 7.1**

**(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]

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**(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.

View solution

[3]

[Total: 8]

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

Calculate

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

View solution

charge = .....[2]

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

View solution

resistance = .....[2]

**(c)** the output power of the cell.

View solution

power = .....[2]

[Total: 6]

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

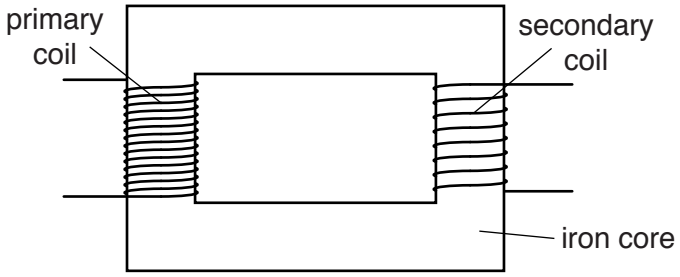


**Fig. 9.1**

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.

View solution

.....[1]

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

View solution

.....

.....

.....

.....

.....[4]

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

View solution

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.

View solution

- ☐ glows more brightly
- ☐ glows with the same brightness
- ☐ glows less brightly
- ☐ does not glow

[1]

[Total: 8]

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

View solution

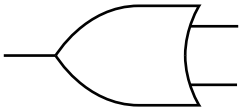

**Fig. 10.1**

**(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]

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

View solution

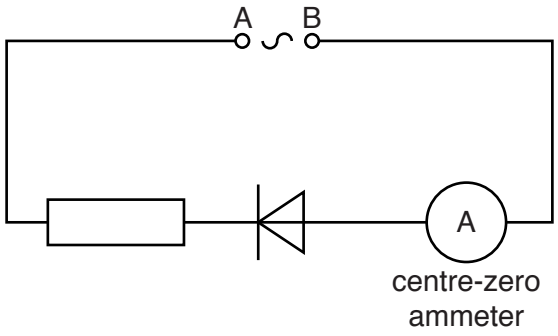
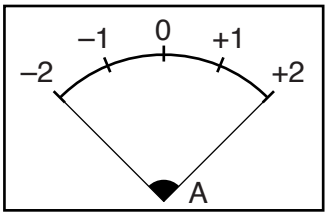



**Fig. 10.2**

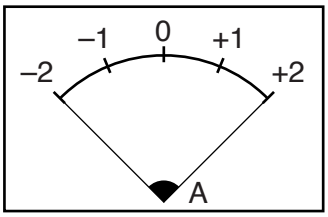
On each diagram, draw a possible position of the indicator needle of the ammeter at the time in the cycle when

**(i)** A is positive and B is negative,



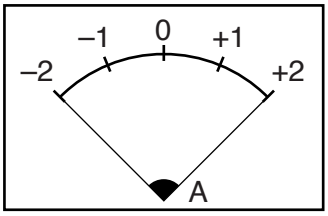

View solution

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




View solution

**(iii)** A is negative and B is positive.




View solution

[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.

View solution

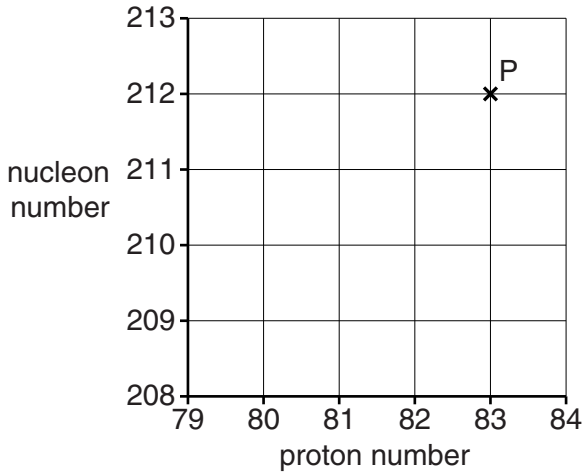



**Fig. 11.1**

**(i)** On Fig. 11.1,

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

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

View solution

count-rate = .....[2]

[Total: 7]

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