# Cambridge IGCSE™

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**PHYSICS** **0625/42**

Paper 4 Theory (Extended) **May/June 2020**

**1 hour 15 minutes**

You must answer on the question paper.

No additional materials are needed.

**INSTRUCTIONS**

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.
- Take the weight of 1.0 kg to be 10 N (acceleration of free fall = 10 m/s$^2$).

**INFORMATION**

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **12** pages. Blank pages are indicated.



[Turn over

**1** Fig. 1.1 shows the speed–time graph of a person on a journey.

On the journey, he walks and then waits for a bus. He then travels by bus. He gets off the bus and waits for two minutes. He then walks again. His journey takes 74 minutes.

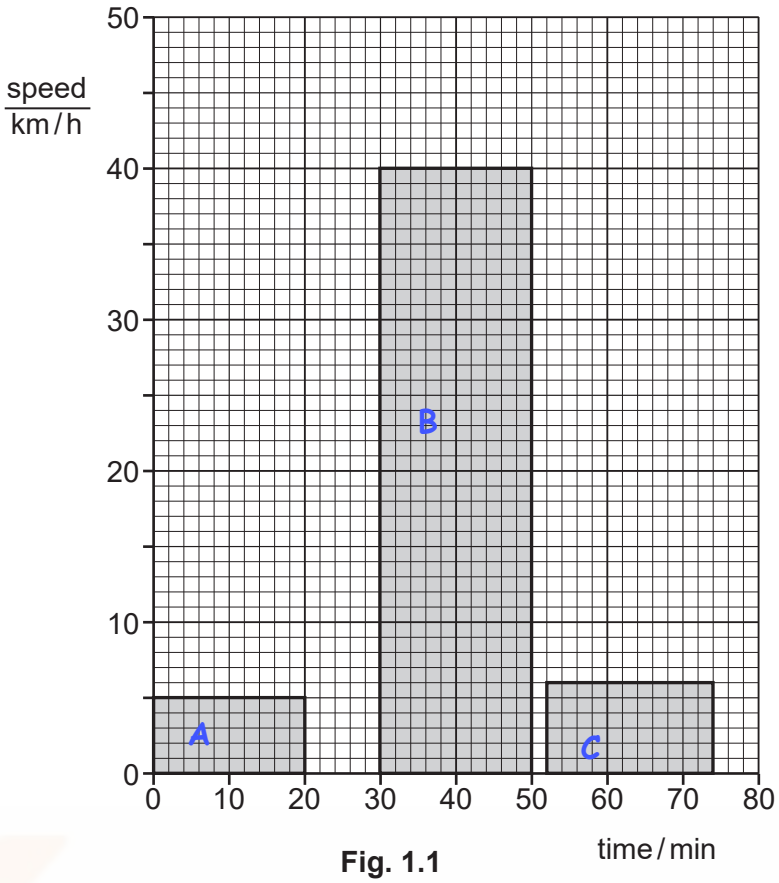



**Fig. 1.1**

**(a)** For the whole journey calculate:

**(i)** the distance travelled

s= vt in any form OR (s =) vt OR relates distance to area (under graph) C1
any one of:
Part (A) 5× 20 / 60 =1.667
Part (B) 40× 20 / 60 =13.333
Part (C) 6× 22 / 60 =2.2
Total distance=
1.667+ 13.333 + 2.2 =17 km

distance = 17km ..... [3]

**(ii)** the average speed.

Average speed=
Total distance/Total time
=17× 60/74=13.78=14km/h

average speed = 14km/h ..... [2]

**(b)** State and explain which feature of a speed–time graph shows acceleration.

Feature shown: gradient

Because: Gradient =change of speed / time

..... [2]

**(c)** State and explain the acceleration of the person at time = 40 minutes.

Acceleration=0

Because the gradient is constant and constant gradient=0

..... [2]

[Total: 9]

**2** Fig. 2.1 shows a train.

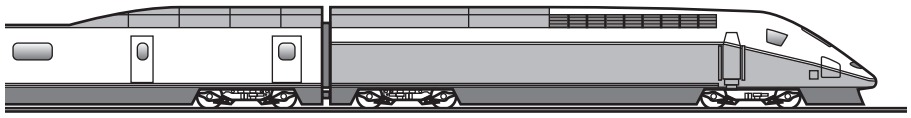


**Fig. 2.1**

The total mass of the train and its passengers is 750 000 kg. The train is travelling at a speed of 84 m/s. The driver applies the brakes and the train takes 80 s to slow down to a speed of 42 m/s.

**(a)** Calculate the impulse applied to the train as it slows down.

impulse $\Delta p$
$= m(v - u)$
impulse $= 750\,000\,(84 - 42)$
$= 3.2 \times 10^7$ N s

impulse = $3.2 \times 10^7$ Ns ..... [3]

**(b)** Calculate the average resultant force applied to the train as it slows down.

$Ft$ = impulse
$\Delta p$ in any form
OR $F = \Delta p) / t$
$= 3.2 \times 10^7 / 80$
$= 3.9 \times 10^5$ N

force = $3.9 \times 10^5$ ..... [2]

**(c)** Suggest how the shape of the train helps it to travel at high speeds.

It reduces the drag experienced by the train.
.....

..... [1]

**(d)** The train took 80 s to reduce its speed from 84 m/s to 42 m/s. Explain why, with the same braking force, the train takes more than 80 s to reduce its speed from 42 m/s to zero.

There is less drag at slower speeds
.....

..... [1]

**(e)** On a wet day, the train travels a greater distance before it stops along the same track. The train has the same speed of 84 m/s before the brakes are applied.

Suggest a reason for this.

Because on wet days, the maximum frictional force between rails and train is reduced , causing the train to slide
.....

..... [1]

[Total: 8]

Input energy

3 **(a)** A solar panel receives energy from the Sun at a rate of 5.0 kW.

Thermal energy is transferred from the solar panel to water with an efficiency of 20%.

Cold water of mass 15 kg enters the solar panel every hour. 1hr=60x60=3600s

The specific heat capacity of water is 4200 J/(kg °C).

Calculate the temperature increase of the water.

E= mcΔT
(E-output)= 15× 4200×ΔT
ΔT= (E-output)/ 15× 4200
Efficiency = (energy) output / (energy) input
(E-output)= 5000× 0.2 x 3600
Hence:ΔT= E-output) / 15× 4200 becomes;
ΔT= 5000 × 3600× 0.2 / 15× 4200
=57 °C



57⁰

temperature increase = ..... °C [4]

**(b)** State and explain **one** advantage and **one** disadvantage of heating the water in a solar panel compared with heating the water in a coal-burning boiler.

advantage Renewable .....

explanation It does not deplete the natural resources and reduces the dependence of non-renewable resources .....

.....

disadvantage Expensive to install .....

explanation The energy output obtained is too low compared to the energy output .....

..... [4]

[Total: 8]

**4** Fig. 4.1 shows a liquid-in-glass thermometer without a temperature scale.
The liquid inside the thermometer has a melting point of –39 °C.

**Fig. 4.1**

**(a)** Describe simple experiments to mark the positions of the fixed points on this liquid-in-glass thermometer.

- Place the bulb in pure melting ice
- When bead has stopped moving , mark the poition as lower fixed point [0 °C ]
- Place the bulb in steam
- When the bead has stopped moving , mark the position as the upper fixed point [100 °C ]



[4]

**(b)** A scientist is measuring temperatures at the South Pole. These temperatures have a minimum value of –90 °C.

State why the liquid used in the thermometer in Fig. 4.1 would **not** be suitable for this scientist.

bead would not be liquid

[1]

**(c)** State a design change that:

**(i)** increases the sensitivity of a liquid-in-glass thermometer

thinner bore

[1]

**(ii)** increases the range of a liquid-in-glass thermometer.

longer tube

[1]

**(d)** State the property of the liquid which ensures that the scale on a liquid-in-glass thermometer is linear.

expands uniformly with temperature

[1]

[Total: 8]

**5** Fig. 5.1 shows crests of a wave approaching a barrier where the wave is reflected.

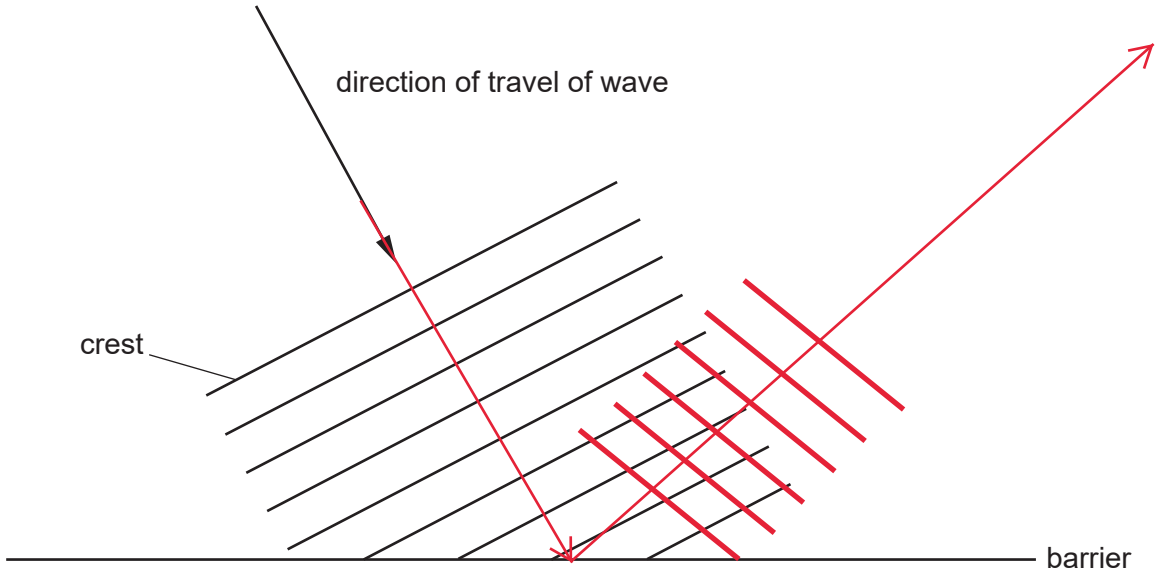





**Fig. 5.1**

**(a)** On Fig. 5.1, draw **three** crests of the reflected wave. [3]

**(b)** The wave has a wavelength of 36 cm and a speed of 1.2 m/s.

Calculate the frequency of the wave.

$v = f\lambda$
$f = v/\lambda$
$f = 1.2 / 0.36$
$= 3.3$ Hz

frequency = 3.3Hz ..... [3]

**(c)** Complete the following sentences.

An echo is the name for a reflected sound ..... wave.

The waves that form an echo are a type of longitudinal wave. Longitudinal waves are made up of compressions ..... and rarefactions.

[2]

[Total: 8]

**6** **(a)** Fig. 6.1 shows an arrangement of glass prisms inside a box. The angles of the prisms are 45°, 45° and 90°.

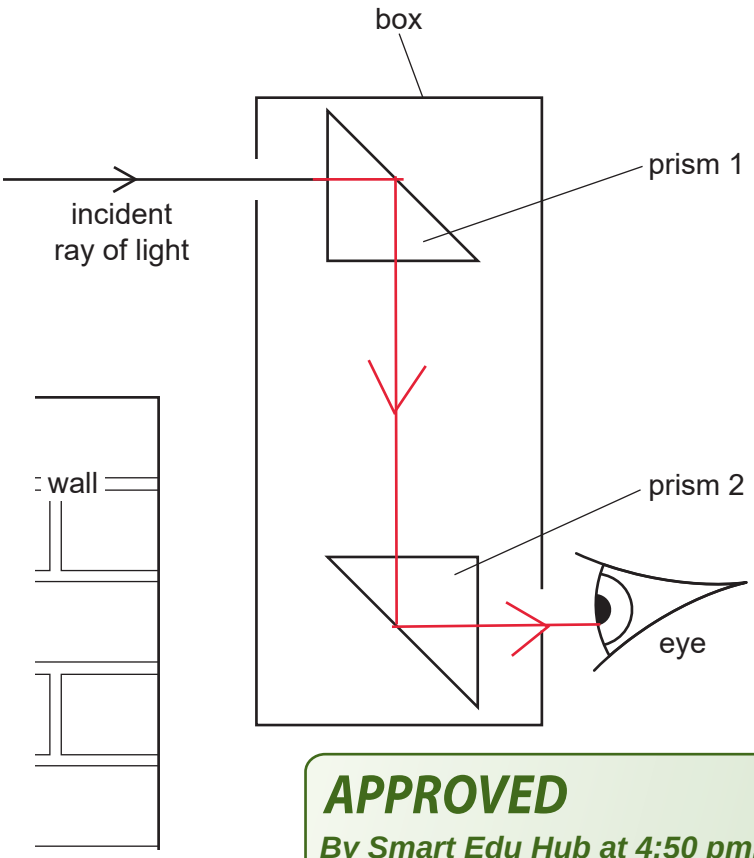





**Fig. 6.1** (not to scale)

This is a device used to view objects that are behind a wall.
The incident ray of light undergoes total internal reflection in the prisms.

On Fig. 6.1, complete the path of the ray through the device and show the ray as it emerges from the box. [3]

**(b)** Show that the refractive index of glass with a critical angle of 45° is 1.41.

n= 1 / sin C
=1 / sin 45
1 / 0.707
=1.41

[2]

[Total: 5]

7 **(a)** A student makes a transformer that uses an alternating current (a.c.) supply with an electromotive force (e.m.f.) of 12.0 V to induce an output potential difference (p.d.) of 2.0 V.

The student is provided with two lengths of insulated wire and the U-shaped piece of iron shown in Fig. 7.1.

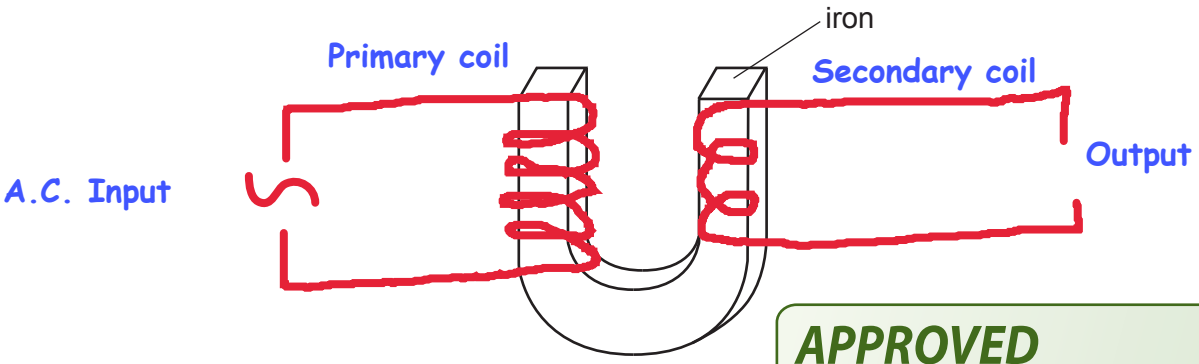



Fig. 7.1

APPROVED
By Smart Edu Hub at 4:50 pm, Nov 02, 2022

**(i)** Complete and label Fig. 7.1 to show the transformer connected to the supply and the output from the transformer. [3]

**(ii)** Explain the function of the piece of iron in the transformer.

- It links magnetic fields of both the coils
- It creates a stronger magnetic field in secondary

..... [2]

**(iii)** The output of the transformer is connected to a lamp. The current in the lamp is 100 mA. The transformer is 100% efficient.

=100/1000A
=0.010A

Calculate the input current to the transformer.

$V_1I_1 = V_2I2$
$I_1 = V_2I_2 / V_1$
$= 2 \times 0.10 / 12$
$= 0.017A$

Note:
1 subscript=Primary coil
2 subscript=Secondary coil

current = 0.017A [2]

**(b)** Another transformer is used in a school laboratory to step down a mains supply with a p.d. of 110 V to 12 V. This transformer is mounted in a metal case.

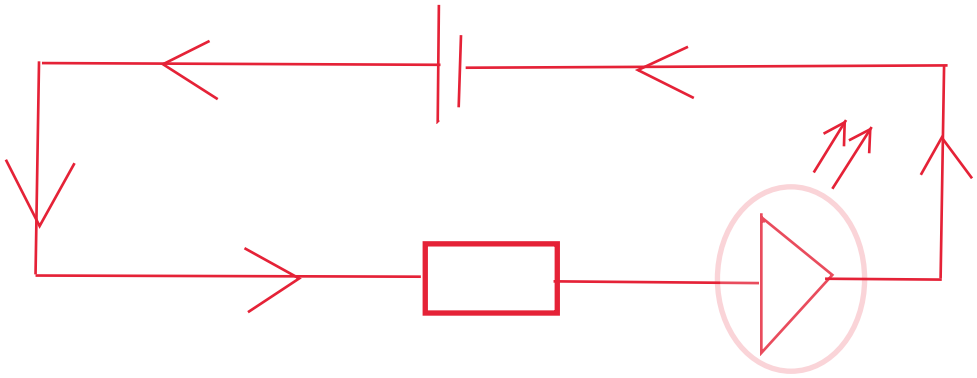
State and explain an essential safety feature required for this arrangement.

The metal case is earthed to prevent possible electrocution ,if in case wire falls off and touches case .

..... [2]

[Total: 9]

8 **(a)** A light-emitting diode (LED) is a diode that emits light when there is a current in it. Draw a circuit diagram showing an LED, connected so that it is lit, in series with a battery and a fixed resistor. Use standard electrical symbols.



[4]

**(b)** The p.d. across the LED when lit is 3.1 V and the current in the LED is 0.030 A.

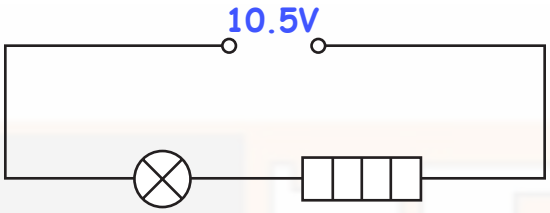
Calculate the value of the resistance of the LED when lit.

R=V / I
=3.1 / 0.030
=100Ω



resistance = 100Ω ..... [2]

**(c)** Fig. 8.1 shows a power supply of e.m.f. 10.5 V connected in series with a lamp and a heater. The p.d. across the lamp is 2.1 V and the current in the lamp is 1.5 A.




V=2.1V
I=1.5A

**Fig. 8.1**

Note: Total resistance in the circuit= resistance of (lamp + heater)

Calculate:

**(i)** the resistance of the heater

R( Total)=V/I
R(lamp+Heater)= 10.5/ 1.5=7Ω
R(lamp)=V/I=2.1/1.5=1.4
R(Total)=7= 10.5/ 1.4 +R (heater)=7-1.4=5.6Ω

resistance = 5.6Ω ..... [2]

**(ii)** the power of the heater.

Power (heater)
= I x V
=1.5 x (I x R)of heater
=1.5 x 1.5 x 5.6
=12.6W

power = 12.6W ..... [2]

[Total: 10]

**9** **(a)** Complete the truth table shown in Table 9.1 for a NAND gate.

**Table 9.1**

| input 1 | input 2 | output |
|---|---|---|
| 0 | 0 | 1 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |

[1]

**(b)** The circuit shown in Fig. 9.1 contains two different types of gate, labelled X and Y.

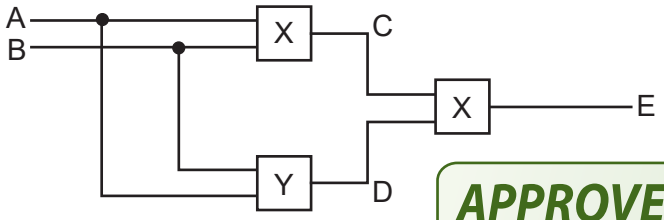



**Fig. 9.1**



Table 9.2 shows a partially completed truth table for this circuit.

**Table 9.2**

| input | | intermediate point | | output |
|---|---|---|---|---|
| A | B | C | D | E |
| 0 | 0 | 0 | 0 | 0 |
| 0 | 1 | 1 | 0 | 1 |
| 1 | 0 | 1 | 0 | 1 |
| 1 | 1 | 1 | 1 | 1 |

**(i)** From Table 9.2, deduce the name of logic gate Y.

Ring your answer from the list.

AND NAND NOR NOT OR [1]

**(ii)** Complete the truth table in Table 9.2. [2]

**(c)** There is a current of 3.0 A in a copper wire. Calculate how many electrons pass through the copper wire every 60 s. The charge on an electron is $1.6 \times 10^{-19}$ C.

$Q = It$
$= 3 \times 60$
$= 180\ C$
Hence:
number of electrons passing through the wire in 60s:
$= 180 / 1.6 \times 10^{-19}$
$= 1.1 \times 10^{21}$

number of electrons = $1.1 \times 10^{21}$ ..... [3]

[Total: 7]

**10** Fig. 10.1 shows a vacuum tube with a radioactive source. The radioactive source emits α-particles, β-particles and γ-rays. There is a very strong magnetic field between the N pole and the S pole of the magnet.

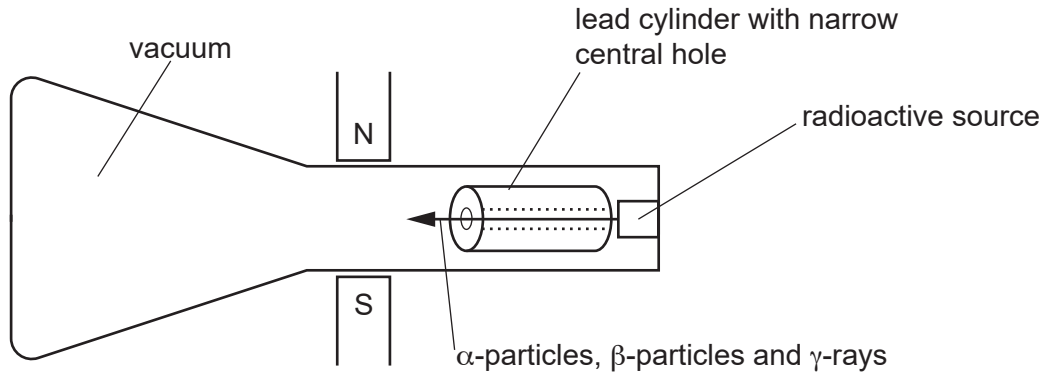



**Fig. 10.1**

**(a)** The lead cylinder has a narrow central hole. State and explain the effect of the lead cylinder.

There is a narrow beam in one direction , while the radiation in other directions is absorbed

..... [2]

**(b)** Describe the paths of the α-particles, β-particles and γ-rays as they pass through the magnetic field. Explain your answers.

**(i)** α-particles

It will be directed out of page and is equivalent to current in the direction of the beam

..... [2]

**(ii)** β-particles

It will be in the opposite direction to the alpha particles because it is equivalent to the current in opposite direction to the beam

..... [2]



**(iii)** γ-rays

There will be no deflection a they are none uncharged.

..... [2]

[Total: 8]