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Surname	Other names	

L6 Scholarship Paper

March 2023

Subject: PHYSICS

Time: 1 Hour

Attempt all Questions Candidates answer on the question paper	**Total Marks** **60**

Instructions

- There are **9** questions in this paper
- Answer all questions in the spaces provided. There may be more space than needed

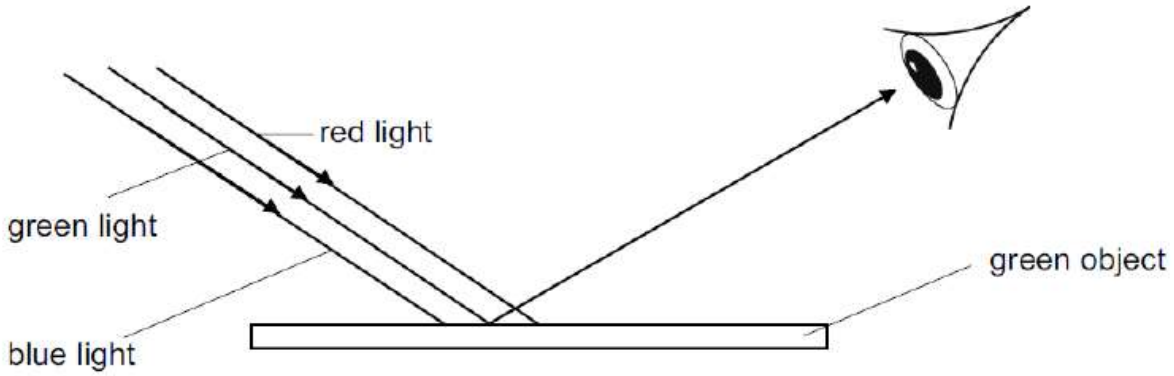
Information

- The total mark for this paper is **60**
- Any rough working should be done on this question paper.
- Where necessary, use acceleration due to gravity on Earth, g = 10 m/s^2

1.

Tomas investigates coloured lights.

(a) Tomas shines red, green and blue light onto a green object.
He draws a diagram to help explain what happens.



(i) What colour does the object appear?

.....

[1]

(ii) Explain what happens at the surface of the green object.

.....

.....

[2]

(b) Tomas adds some coloured lights together.

(i) Draw lines to match the **colours added together** and the **colour produced**.

colours added together	**colour produced**
red and green	yellow
red and blue	cyan
blue and green	magenta

[1]

(ii) What happens if red, green and blue lights of equal intensity are added together?

.....

[1]

2.

A driving instructor gives a student a sudden order to stop the car in the shortest possible time.

Fig. 1.1 shows the speed-time graph of the motion of the car from the moment the order is given.

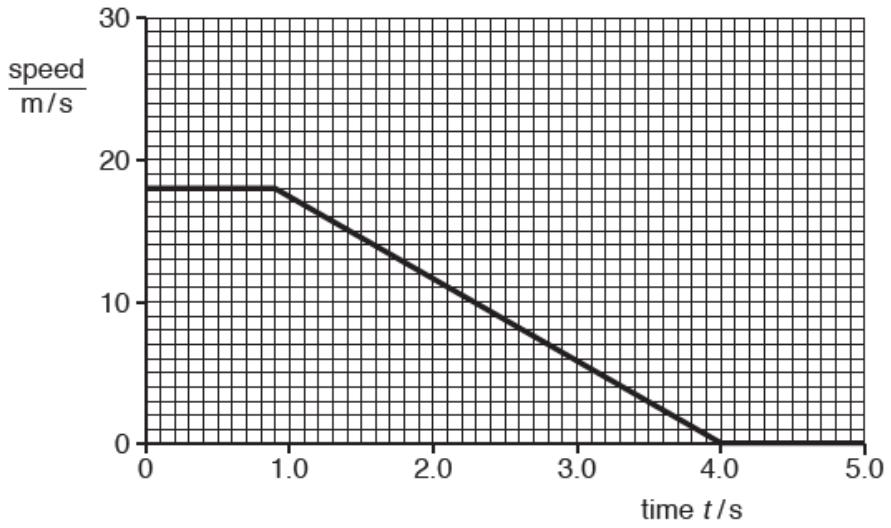


Fig. 1.1

(a) The order to stop is given at time $t = 0$ s.

(i) State the speed of the car at $t = 0$ s.

speed = ...[1]

(ii) Suggest why the car continues to travel at this speed for 0.9 s.

.....

.....[1]

(b) Calculate

(i) the deceleration of the car between $t = 0.9$ s and $t = 4.0$ s,

deceleration = ...[2]

(ii) the total distance travelled by the car from $t = 0$ s.

distance = ...[3]

(c) Describe and explain a danger to a driver of not wearing a safety belt during a sudden stop.

.....

.....

.....

.....[2]

3.

Fig. 2.1 shows a hammer being used to drive a nail into a piece of wood.

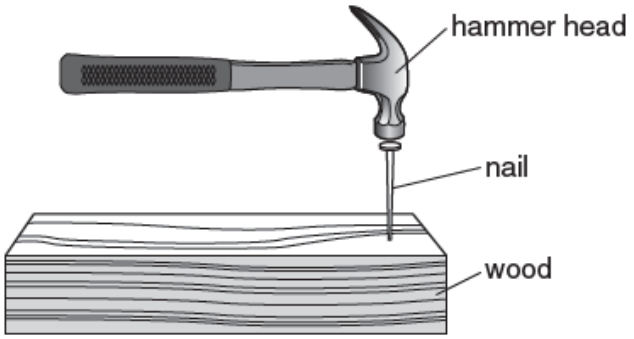


Fig. 2.1

The mass of the hammer head is 0.15kg.
The speed of the hammer head when it hits the nail is 8.0m/s.
The time for which the hammer head is in contact with the nail is 0.0015s.

The hammer head stops after hitting the nail.

(a) Calculate the change in momentum of the hammer head.

change in momentum = ...[2]

(b) State the impulse given to the nail.

impulse = ...[1]

(c) Calculate the average force between the hammer and the nail.

average force = ...[2]

4.

A test-tube containing solid wax is heated by placing it in a beaker of very hot water for several minutes. The solid wax becomes a liquid.

(a) State, in terms of molecules, how a solid differs from a liquid.

.....

.....

.....

..... [2]

(b) Explain, in terms of molecules, why thermal energy must be supplied for a solid to become a liquid.

.....

.....

..... [1]

(c) The test-tube is removed from the hot water and held in a clamp stand.

Fig. 3.1 shows the test-tube and liquid wax cooling in air.

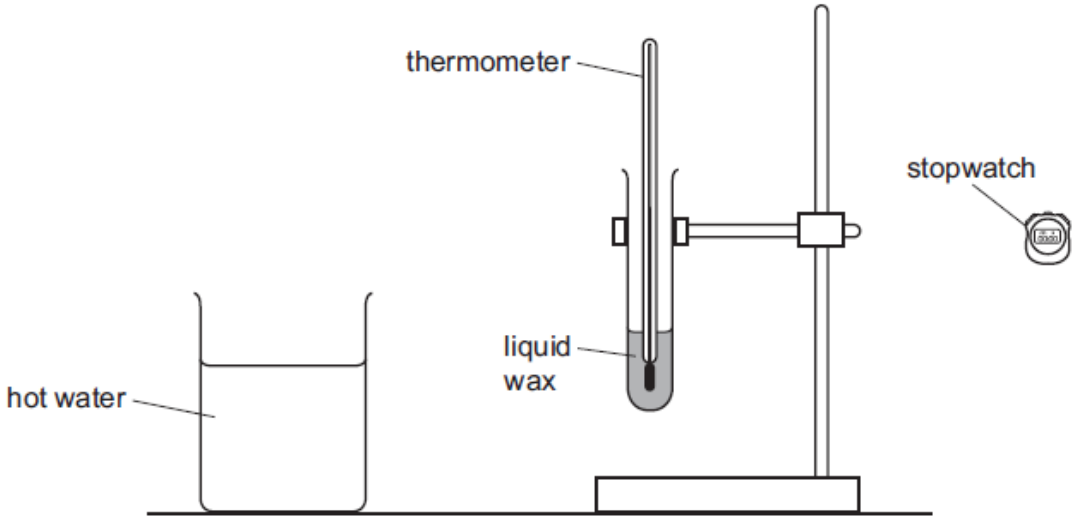


Fig. 3.1

As the wax cools, its temperature is recorded at regular time intervals.

Fig. 3.2 is the temperature-time graph for the wax.

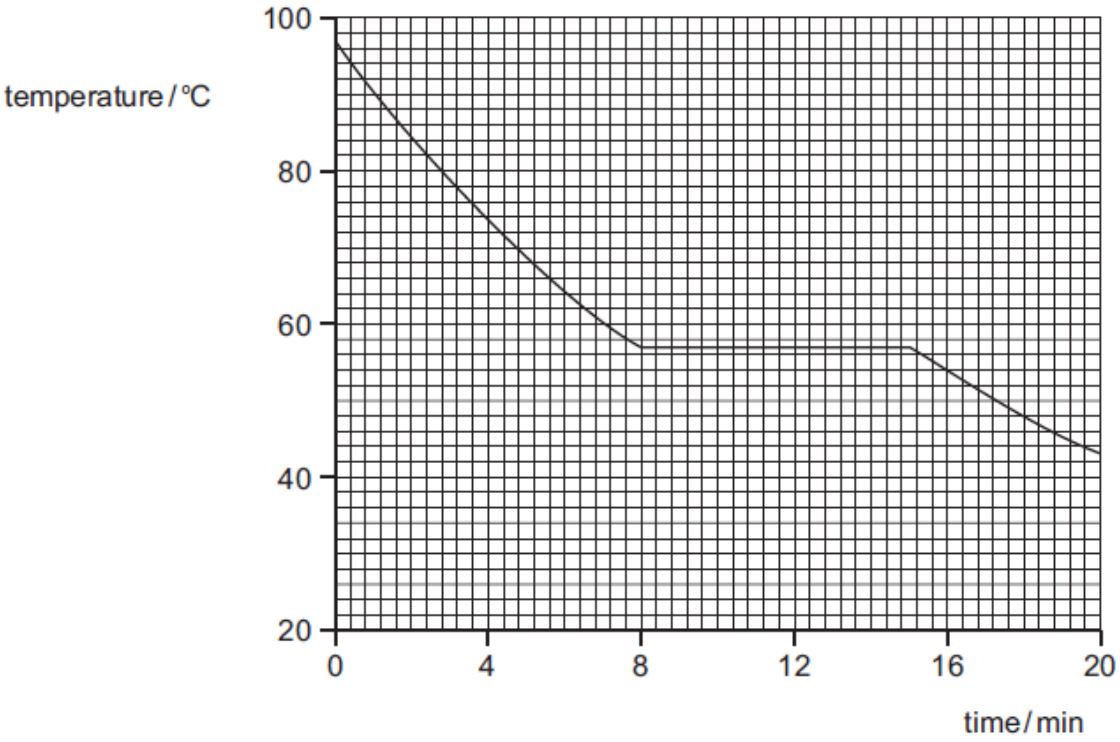


Fig. 3.2

(i) Using Fig. 3.2, determine the melting point of the wax.

melting point = ... [1]

(ii) The specific latent heat of fusion of the wax is 210 J / g. The test-tube contains 50 g of wax.

Using Fig. 3.2, determine the rate at which the wax is losing internal energy as the wax solidifies. Give your answer in J / min.

rate of loss of energy = ... J / min [4]

5.

(a) Radio waves, ultrasound and visible light are all waves.

(i) State what is meant by *ultrasound* and suggest a value for the minimum possible frequency of ultrasound waves.

.....

.....

..... [2]

(ii) State which of these waves are

- electromagnetic,

.....

- longitudinal.

.....

[2]

(b) Ultrasound passes through both human flesh and bone.

Fig. 5.1 shows an ultrasound source sending an ultrasound wave into human flesh.

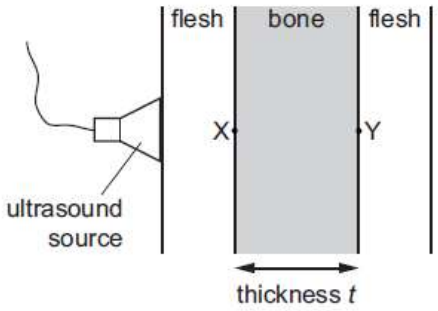


Fig. 5.1

The ultrasound wave travels through the flesh to point X and then through the thickness of the bone to point Y. At Y, some ultrasound is reflected and returns to X.

The total time taken for ultrasound to travel in the bone from X to Y and back to X is 9.0×10^{-6} s. The speed of ultrasound in bone is 4100 m / s.

Calculate the thickness *t* of the bone.

thickness *t* = ... [3]

6.

(a) **(i)** State a typical value for the speed of sound in air.

speed = ...[1]

(ii) State the range of frequencies that can be heard by a healthy human ear.

.....[1]

(b) A sound wave in air has a wavelength of 22 mm.

Fig. 6.1 represents wavefronts of this sound. These wavefronts are successive compressions.

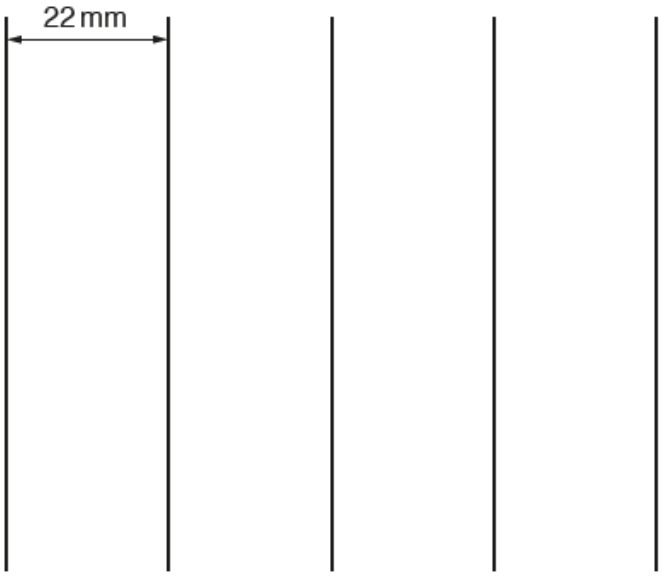


Fig. 6.1

(i) Using your value for the speed of sound in **(a)(i)**, calculate the frequency of the sound wave.

frequency = ...[2]

(ii) On Fig. 6.1, draw dotted lines to represent **three** different rarefactions. [1]

(iii) State, in terms of both molecules and pressure, what is meant by a *rarefaction*.

.....

.....

.....

.....[2]

7.

A battery is made up of 8 cells in series. Each cell has an e.m.f. of 1.5 V.

The battery is connected to one 8.0 Ω resistor for 40 minutes.

(a) Calculate the e.m.f. of the battery.

e.m.f. = ...[1]

(b) Calculate the energy transferred from the battery in 40 minutes.

energy = ...[4]

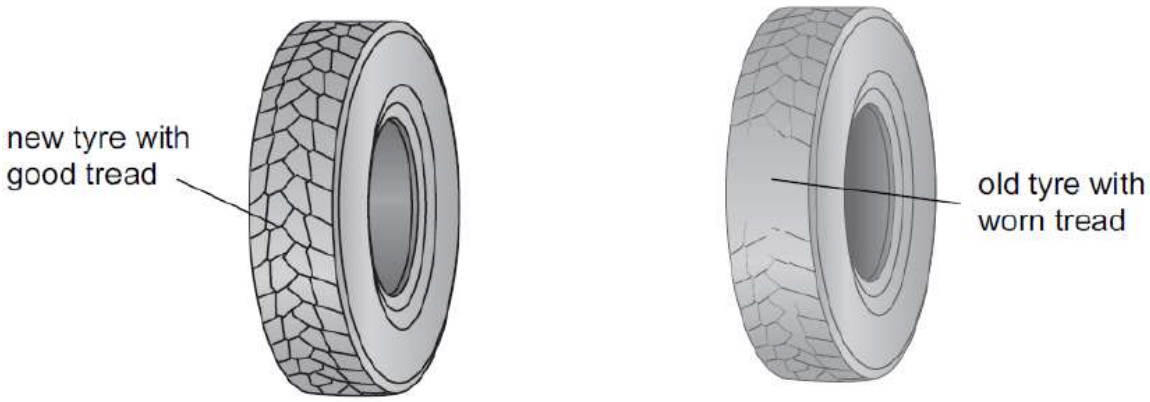
(c) Describe the energy changes that take place during the 40 minutes.

.....

.....[2]

8.

Car tyres lose tread as they get older.



(a) Complete the sentences about two cars travelling at the same speed.

The drivers brake suddenly.

The force of friction between the ..... and

the ..... makes the cars stop.

The car with old worn tyres takes 20 metres to stop.

The other car has new tyres.

This car only takes 18 metres to stop.

This is because the force of friction has ..... . [2]

(b) The condition of the road surface changes the force of friction.

Tick (✓) the **two** correct statements.

Water on the road surface increases friction. ☐

Oil on the road surface decreases friction. ☐

Ice on the road surface does not change friction. ☐

Rougher road surface increases friction. ☐

Smoother road surface does not change friction. ☐

[2]

9.

(a) A stationary object is acted upon by a number of forces.

State the conditions which **must** be true if the object

(i) does not accelerate,

.....[1]

(ii) does not rotate.

.....[1]

(b) Fig. 3.1 shows a boat that has been lifted out of a river. The boat is suspended by two ropes. It is stationary.

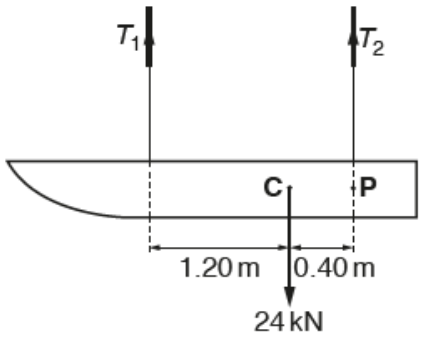


Fig. 3.1 (not to scale)

The weight of the boat, acting at the centre of mass, is 24 kN. The tensions in the ropes are T_1 and T_2.

Determine

(i) the moment of the weight of the boat about the point **P**,

moment = ...[1]

(ii) the tension T_1,

T_1 = ...[3]

(iii) the tension T_2.

T_2 = ...[2]