

K EDUCATION CENTRE

GCSE COMBINED SCIENCE PHYSICS - HIGHER TIER

Motion and Forces
Conservation of Energy
Waves
Light & the Electromagnetic Spectrum

Candidate name	
Date	
Teacher	

Time	1 hour 10 minutes
Total marks	60
Equipment	Calculator, ruler and the equation sheet provided
Paper type	Original Pearson Edexcel-style topic practice paper

Important: This is an original K Education Centre practice paper. It is designed to reflect Pearson Edexcel GCSE Combined Science Higher question styles but is not an official Pearson paper.

Instructions

- Answer **all** questions.
- Write your answers in the spaces provided. There may be more space than you need.
- Show all your working for calculations and include units where appropriate.
- A calculator may be used.
- The marks for each question are shown in brackets. Use these as a guide to how much detail is needed.
- For the question marked with an asterisk (*), organise your answer logically and link your scientific ideas clearly.

Information

Total marks	60
Recommended time	1 hour 10 minutes
Topics assessed	Motion and Forces; Conservation of Energy; Waves; Light and the Electromagnetic Spectrum
Tier	Higher

Answer ALL questions. Write your answers in the spaces provided.

Question 1 Waves**7 marks**

(a) Which statement is correct? Tick one box. **(1)**

- A Longitudinal waves always travel more slowly than transverse waves.
B Waves transfer matter from one place to another.
C Waves transfer energy without transferring matter overall.
D All waves can travel through a vacuum.

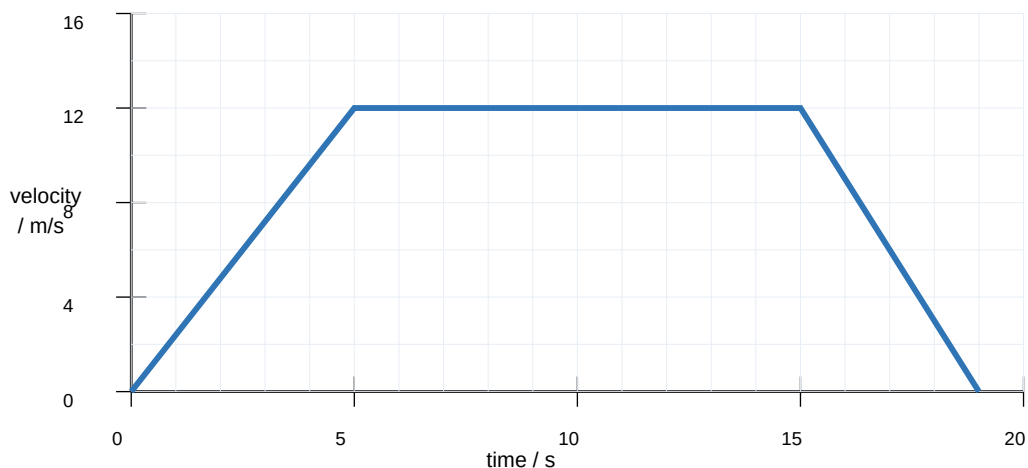
(b) Describe the difference between a transverse wave and a longitudinal wave. Refer to the direction of oscillations and the direction of energy transfer. **(2)**

(c) Water waves have a frequency of 5.0 Hz and a wavelength of 0.12 m. Calculate the speed of the water waves. **(2)**

(d) A student counts 20 complete wave crests passing a fixed point in 8.0 s. Calculate the frequency of the waves. **(2)**

Question 2 Motion and velocity-time graphs**8 marks**

Figure 1 shows the velocity-time graph for a small electric train.



(a) Calculate the acceleration of the train during the first 5.0 s. **(2)**

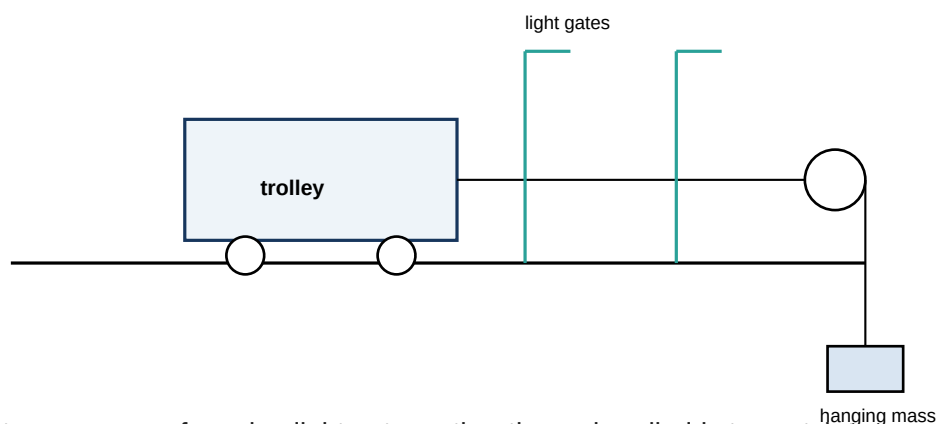
(b) Calculate the total distance travelled by the train during the 19 s shown on the graph. **(3)**

(c) During which time interval is the resultant force on the train zero? Give a reason for your answer. **(1)**

(d) Calculate the average speed of the train over the 19 s. Give your answer to 2 significant figures. **(2)**

Question 3 Force, mass and acceleration**8 marks**

A student investigates the relationship between force, mass and acceleration using the apparatus shown in Figure 2.



- (a)** State one reason for using light gates rather than a handheld stopwatch to measure the motion of the trolley. **(1)**

- (b)** The student investigates how acceleration changes when the pulling force is changed. State one variable, other than the pulling force, that should be kept constant and explain why it should be kept constant. **(2)**

- (c)** In one trial, the total mass of the moving system is 1.20 kg and its acceleration is 1.80 m/s². The frictional force opposing the motion is 0.30 N. Calculate the pulling force acting on the system. **(3)**

- (d)** State the relationship between resultant force and acceleration when mass is constant. **(1)**

- (e)** Give one reason why the student should repeat each measurement. **(1)**

Question 4 Conservation of energy**9 marks**

A skateboarder and skateboard have a total mass of 55 kg. They start from rest at the top of a ramp, 4.5 m above the bottom. Use **$g = 9.8 \text{ N/kg}$** .

- (a)** Calculate the decrease in gravitational potential energy as the skateboarder moves from the top to the bottom of the ramp. **(2)**

- (b)** The speed of the skateboarder at the bottom is 8.0 m/s. Calculate the kinetic energy at the bottom of the ramp. **(2)**

- (c)** The kinetic energy at the bottom is less than the decrease in gravitational potential energy. Explain why. **(2)**

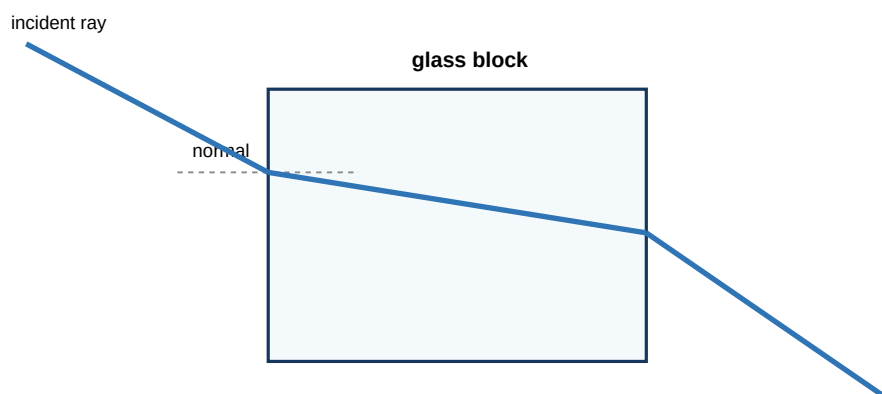
- (d)** A motor transfers 5000 J of energy. 3750 J is transferred usefully. Calculate the efficiency of the motor as a percentage. **(2)**

- (e)** State one way unwanted energy transfer in a mechanical system can be reduced. **(1)**

Question 5 Light and refraction

8 marks

Figure 3 shows a ray of light entering and leaving a rectangular glass block.



(a) State what happens to the speed of light when it travels from air into glass. (1)

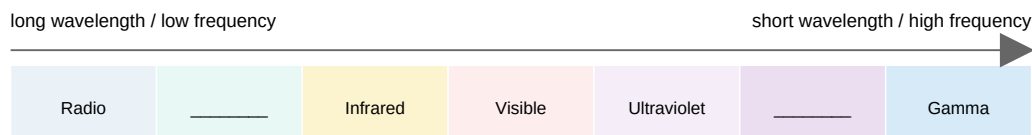
(b) Explain why the ray changes direction when it enters the glass. (2)

(c) Describe how a student could investigate refraction in a rectangular glass block and obtain reliable values for the angle of incidence and angle of refraction. (3)

A student obtains the results shown in Table 1.

Angle of incidence / °	20	40	60
Angle of refraction / °	13	25	35

(d) The student says, "The angle of refraction is directly proportional to the angle of incidence." (2)
Evaluate this conclusion using the data in Table 1.

Question 6 The electromagnetic spectrum**8 marks**

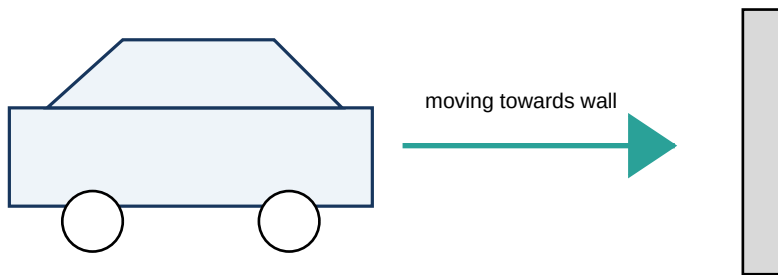
(a) Complete the sequence by naming the two missing regions of the electromagnetic spectrum: **(2)**

radio waves → _____ → infrared → visible light → ultraviolet → _____ → gamma rays

(b) State one use of infrared radiation. **(1)**

(c) A microwave transmitter operates at a frequency of 2.4×10^9 Hz. Electromagnetic waves travel at 3.0×10^8 m/s in a vacuum. Calculate the wavelength of the microwaves. **(3)**

(d) Explain why excessive exposure to X-rays is generally more dangerous to body cells than excessive exposure to infrared radiation. **(2)**

Question 7 Vehicle safety**6 marks**

***(a)** A car collides with a wall and comes to rest. Explain how a seat belt and a crumple zone can reduce the risk of injury to the occupants.

(6)

In your answer you should use ideas about **momentum, collision time, force and energy transfers**.

Question 8 Higher-tier momentum calculation**6 marks**

A 0.25 kg ball travels horizontally towards a wall at 12 m/s. It rebounds from the wall at 8.0 m/s in the opposite direction. The ball is in contact with the wall for 0.020 s.

- (a)** Calculate the change in momentum of the ball. Take the direction towards the wall as positive. **(3)**

- (b)** Calculate the magnitude of the average force exerted on the ball by the wall. **(2)**

- (c)** Explain why the direction of velocity must be included when calculating momentum. **(1)**

TOTAL FOR PAPER = 60 MARKS

Equation Sheet - Relevant Equations for This Practice Paper

This page mirrors the current practice of providing an equation sheet for GCSE Physics/Combined Science examinations. Use equations only where relevant.

$$\text{average speed} = \text{distance} \div \text{time}$$

$$\text{acceleration} = (\text{final velocity} - \text{initial velocity}) \div \text{time}$$

$$(\text{final velocity})^2 - (\text{initial velocity})^2 = 2 \times \text{acceleration} \times \text{distance}$$

$$\text{force} = \text{mass} \times \text{acceleration}$$

$$\text{weight} = \text{mass} \times \text{gravitational field strength}$$

$$\text{momentum} = \text{mass} \times \text{velocity}$$

$$\text{force} = \text{change in momentum} \div \text{time}$$

$$\text{change in gravitational potential energy} = \text{mass} \times \text{gravitational field strength} \times \text{change in vertical height}$$

$$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times (\text{speed})^2$$

$$\text{efficiency} = \text{useful energy transferred} \div \text{total energy supplied}$$

$$\text{wave speed} = \text{frequency} \times \text{wavelength}$$

$$\text{wave speed} = \text{distance} \div \text{time}$$

Useful reminders

- Use SI units unless the question tells you otherwise.
- Show substitutions into equations before calculating.
- Give answers to a sensible number of significant figures.
- Include the correct unit in every numerical answer.