Explaining motion – 2022 GCSE 21st Physics Combined Science B

1. June /2022/Paper_ J250/03/No.3

This diagram shows a greyhound accelerating at the start of a race.

(a) A greyhound has a mass of 30 kg and accelerates at 6.3 m/s^2.

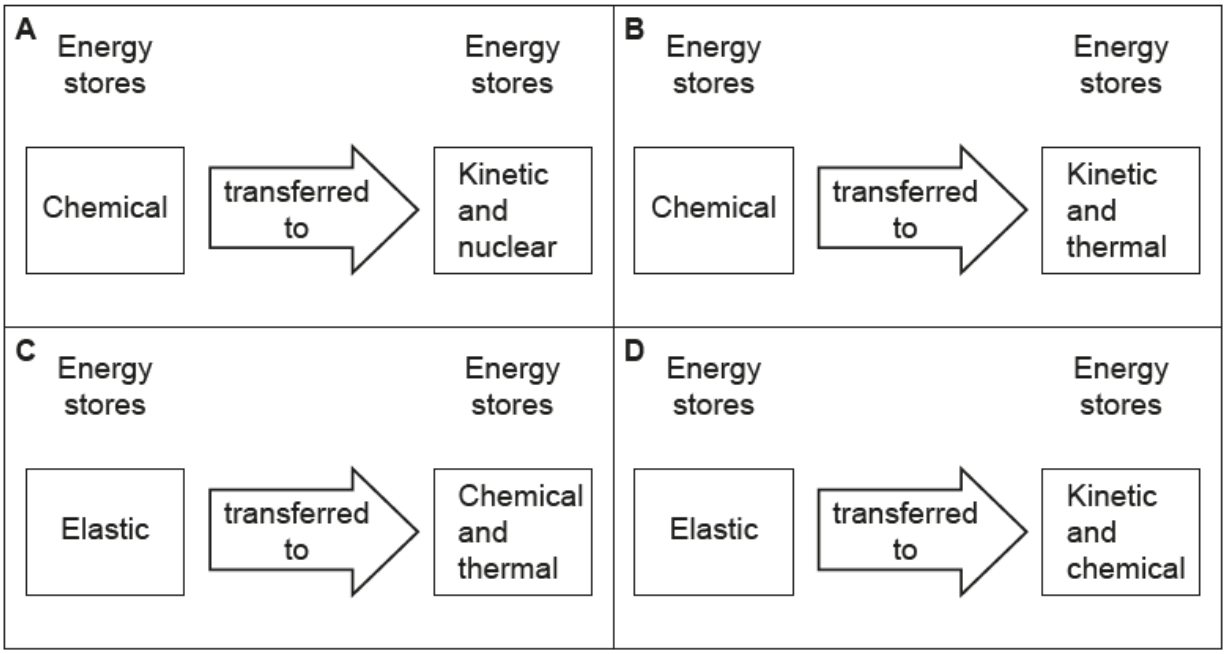
Calculate the force the greyhound uses to accelerate.

Use the Data Sheet.

Force = ... N **[3]**

(b) The force to accelerate the stationary greyhound is provided by its muscles.

Which diagram describes the transfer between energy stores when the greyhound does work to accelerate?



Tick (✓) **one** box.

A ☐

B ☐

C ☐

D ☐

[1]

(c) The greyhound runs for 540 m in 30 s.

Calculate the average speed of the greyhound.

Use the Data Sheet.

Average speed = ... m/s **[3]**

2. June /2022/Paper_ J250/03/No.6

Layla drives her car.

(a) The speed of the car increases from 22 m/s to 28 m/s in 3 s.
Use the Data Sheet.
Calculate the acceleration of the car.

Acceleration ..... m/s^2 **[3]**

(b) Complete the sentences to describe how energy is transferred as the car changes speed.

Use words from the list.

chemical	**elastic**	**gravitational**	**kinetic**	**nuclear**	**thermal**

The car increases its speed when energy is transferred from the fuel's ..... store, to the car's ..... store. Some energy from the fuel will be wasted when energy is transferred to the ..... store of the car and its surroundings.

When the car brakes, energy is transferred from the car's ..... store to the ..... store of the brakes, raising their temperature.

[5]

(c) Layla travels on the motorway at a speed of 108 km/h.

Which is the correct method to calculate the speed in metres per second (m/s)?

Put a (ring) around the correct option.

$\frac{108 \times 1000}{60 \times 60}$ $\frac{108 \times 60 \times 60}{1000}$ $\frac{108 \times 1000}{60}$ $\frac{1000 \times 60 \times 60}{108}$

[1]

Layla applies the brakes to stop the car.

The braking distance is the distance the car travels before it stops.

(d) Give **two** factors that affect the braking distance.

1 .....

2 .....

[2]

(e) Layla makes an emergency stop. The braking force is 17 000 N and the car travels 75 m before it stops.

Calculate the work done by the brakes.

Use the equation: work done = force × distance

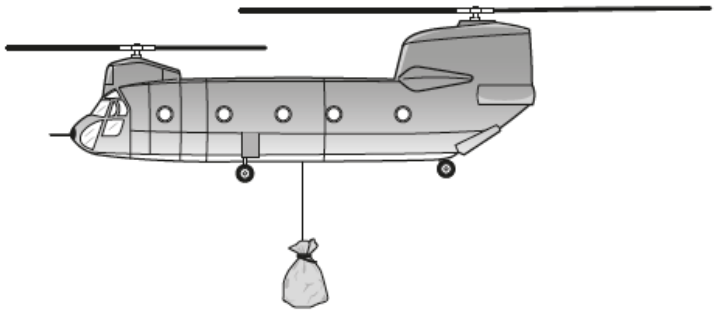
Give your answer to **2** significant figures.

Work done = ... J **[3]**

3. June /2022/Paper_ J250/07/No.6

In 2019 the wall of the dam at the Toddbrook water reservoir was damaged.

The wall of the dam was strengthened using large bags of rock.
The image shows a helicopter carrying a large bag of rock.



(a) Draw a free body force diagram for the bag of rock when the helicopter is stationary in the air above the dam.

[3]

(b) The height of the water in the reservoir was reduced by removing 966 000 m^3 of water.

(i) Calculate the weight of this volume of water.

Use the equation: density = mass ÷ volume

Density of water = 1000 kg/m^3
Gravitational field strength = 10 N/kg

Weight = ... N **[4]**

(ii) The water was pumped out of the reservoir by 23 pumps.

The 23 pumps worked together to raise the water a distance of 4.1 m.

Calculate the mean work done by **one** of the 23 pumps to raise the water a distance of 4.1 m.

Use the equation: Work done = force × distance

Use your answer to **(i)**.

Work done = ... J **[3]**

4. June /2022/Paper_ J250/07/No.10

Jane investigates the motion of a model car.
She records some data for her model car in a table:

Initial velocity	0 m/s
Final velocity	1.9 m/s
Mass	0.82 kg
Time	3.8 s
Acceleration	0.5 m/s^2

(a) Calculate the rate of change of momentum of the car.

Use the equation: rate of change of momentum = $\frac{\text{change in momentum}}{\text{time}}$

Use the Data Sheet.

Rate of change of momentum = ... kgm/s^2 **[4]**

(b) Calculate the force used to accelerate the car.

Use the Data Sheet.

Force = ... N **[3]**

(c) Explain how your answers to **(a)** and **(b)** are related.

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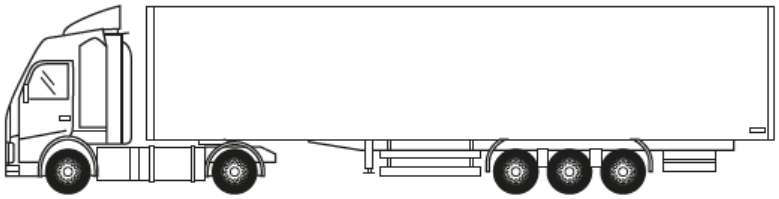
..... **[1]**

5. June /2022/Paper_ J250/08/No.4

The picture shows a goods lorry.



When the lorry is empty, it has a mass of 1.45×10^4 kg.

The lorry can carry a maximum load of 2.95×10^4 kg.

The lorry is travelling at a velocity of 25 m/s on a motorway.

Explain why the stopping distance of the lorry is different when the lorry is empty compared to when it is fully loaded.

Include calculations in your answer.

Use the equation

momentum (kg m/s) = mass (kg) × velocity (m/s)

and ideas about change in momentum in your answer.

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..... **[6]**