Write your name, centre number and candidate number in the boxes below.

Surname	Other names

Centre number | | | | | |

Candidate number | | | | |

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Energy, work and power

Time allowed: 1 hour 15 minutes

Subject code **0625**

Physics

Questions from Paper 3 and Paper 4

You must have: a ruler marked in centimetres and millimetres, a protractor, compasses, a pen, an HB pencil and an eraser.

Total marks

/ 78

Instructions

- Answer every question in the space provided on this paper.
- Write in black or dark blue ink. Pencil may be used for diagrams and graphs.
- Fill in your name, centre number and candidate number above.
- Show your working: a correct method can earn marks even if the answer is wrong.

Information

- This paper has 10 questions worth 78 marks in total.
- The marks for each question or part are shown in brackets, for example [3].

Advice

- Read every question through once before you write anything.
- Use the marks in brackets to judge how long to spend on each part.
- If you finish early, go back and check your working.

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Print at 100% (Actual size) so diagrams keep their real measurements.

1 **(a)** Nuclear power stations generate electricity.

Which of these statements describe an advantage of using nuclear power stations, and which of them describe a disadvantage?

Put a tick (✓) in the correct column for each statement. The first one is done for you.

statement	advantage	disadvantage
nuclear power stations require high levels of security		✓
nuclear power stations produce small amounts of carbon dioxide		
nuclear power stations have a small effect on climate change		
waste radioactive material can take a very long time to decay		

[3]

(b) Describe how electricity may be generated using geothermal resources.

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 6]

Energy resources and efficiency Click for more variations

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1(a)	2nd line – advantage	B1
	3rd line – advantage	B1
	4th line – disadvantage	B1
1(b)	any three from: (cold) water is pumped into the ground warm rocks heat water / hot water turns to steam / water boils (steam) drives or turns or moves turbine (turbine) drives or turns or moves generator	B3

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2 **(a)** A power station burns fossil fuel to produce electrical energy.

(i) State the form of the energy stored in the fuel.

..... [1]

(ii) Some of the energy stored in the fuel is **not** converted to electrical energy.

Suggest how energy is wasted in the generator.

.....

.....

..... [2]

(b) Solar panels produce electrical energy.

State **two** advantages and **two** disadvantages of using solar panels, rather than fossil fuels, to produce electrical energy.

advantages

1. .....

.....

2. .....

.....

disadvantages

1. .....

.....

2. .....

..... [4]

[Total: 7]

Energy resources and efficiency Click for more variations

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2(a)(i)	chemical (energy)	**B1**
2(a)(ii)	any **two** from: friction thermal / heat vibrations / sound resistance in wires	**B2**
2(b)	any **two** advantages: free fuel renewable no air pollution / no SO_2 / no acid rain no greenhouse gases / CO_2 emissions little / no maintenance quiet	**B2**
	any **two** disadvantages: needs a lot of space no energy at night less energy when cloudy / winter D.C.	**B2**

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3 An electric motor lifts a load, as shown in Fig. 5.1.

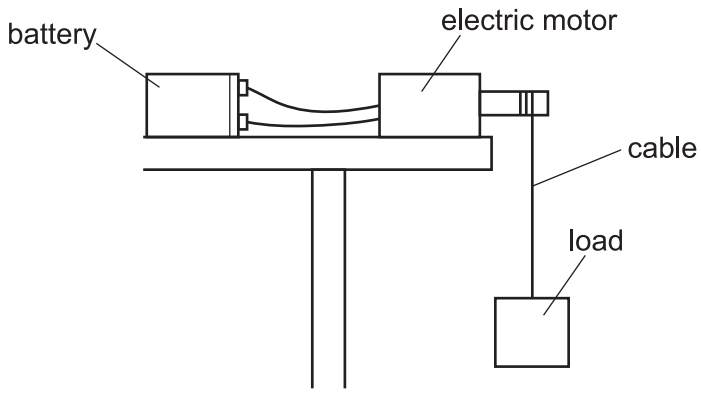


Fig. 5.1

(a) After lifting the load, the motor is switched off. Fig. 5.2 represents the transfer of energy from the battery to the load in Fig. 5.1.

In Fig. 5.2, add the names of the energy stores.

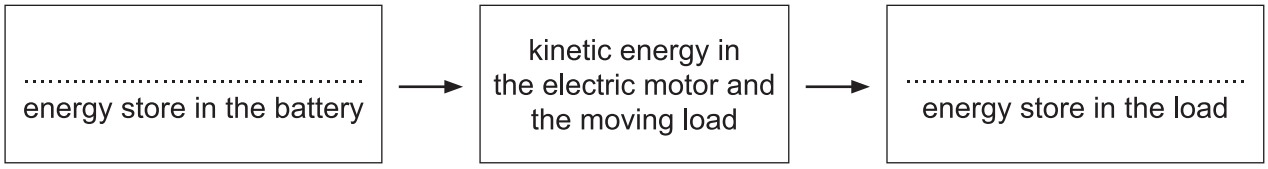


Fig. 5.2

[2]

(b) The weight of the load is 8.0 N. The motor lifts the load through a vertical distance of 0.60 m.

Calculate the work done on the load.

work done on load = ... J [3]

(c) The current in the motor is 0.40 A. The potential difference across the motor is 6.0 V.

Calculate the power of the electric motor.

power of electric motor = ... W [3]

[Total: 8]

Work and power Click for more variations

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3(a)	chemical (energy)	**B1**
	gravitational potential (energy)	**B1**

3(b)	4.8 (J)	**A3**
	(work done =) 8(.0) × 0.6	(C2)
	(work done =) force × distance (moved in direction of force)	(C1)
3(c)	2.4 (W)	**A3**
	(power input =) 0.4(0) × 6(.0)	(C2)
	(power input =) $I \times V$	(C1)

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4 A student uses an electric motor to lift a load. Fig. 4.1 shows the arrangement.

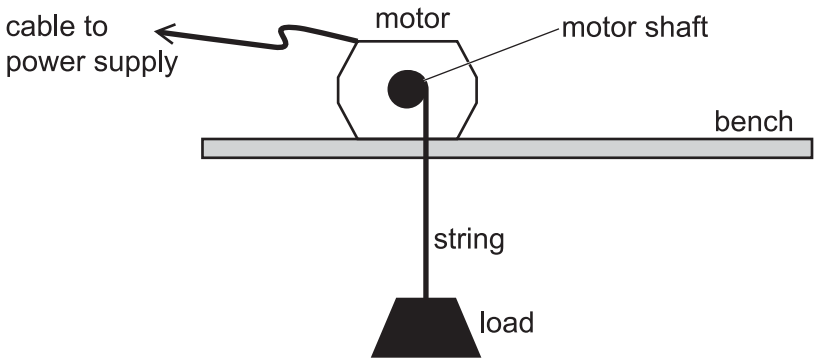


Fig. 4.1 (not to scale)

(a) (i) The motor exerts a force of 25 N on the load. It lifts the load a vertical distance of 2.0 m.

Calculate the work done by the motor on the load.

work done on the load = ... J [3]

(ii) State the useful energy output of the electric motor when it lifts the load 2.0 m.

useful energy output = ... J [1]

(iii) The useful energy output of the motor is less than the energy input to the motor.

Explain why the useful energy output is less than the energy input.

.....

..... [2]

(b) The student uses the motor to lift a different load. The motor does 80 J of work when it lifts this load. It takes 5.0 s to lift the load.

Calculate the power output of the electric motor.

power output = ... W [3]

[Total: 9]

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Work and power Click for more variations

4(a)(i)	50 (J)	**A3**
	(work done =) 25 × 2.0	(C2)
	(work done =) force × distance (moved in the direction of the force)	(C1)
4(a)(ii)	same as answer to (a)(i) **OR** 50 (J)	**B1**
4(a)(iii)	(some input energy is transferred as) thermal energy	**B1**
	to surroundings / motor	**B1**
4(b)	(power output =) 16 (W)	**A3**
	(power output =) 80 ÷ 5(.0)	(C2)
	(power output =) energy output ÷ time	(C1)

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5 **(a)** State the principle of conservation of energy.

.....

.....

..... [2]

(b) A wind turbine has a maximum output power of 1.8 MW. The turbine operates at maximum power for 4.0 h.

(i) Define the unit kW h.

.....

.....

..... [1]

(ii) Calculate the energy produced by the wind turbine operating at maximum power for 4.0 h. Give your answer in kW h.

energy = ... kW h [2]

(c) Radiation from the Sun is the main source of energy for most of our energy resources.

State **two** energy resources that are **not** due to radiation from the Sun.

.....

..... [2]

[Total: 7]

Electrical energy and power Click for more variations

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5(a)	energy cannot be created or destroyed	**B1**
	energy can be transferred / transformed (between energy stores)	**B1**
5(b)(i)	energy transferred in one hour at a rate of transfer of 1 kW	**B1**
5(b)(ii)	7200 (kWh)	**A2**
	$(\Delta)E$ = Pt **OR** (ΔE) = Pt **OR** 1800 × 4.0 **OR** 1.8 × 4.0 **OR** 7.2 × 10^n	(C1)
5(c)	any **two** from: • geothermal • nuclear • tidal	**B2**

6 A car of mass 900 kg is travelling at a steady speed of 30 m/s against a resistive force of 2000 N, as illustrated in Fig. 2.1.

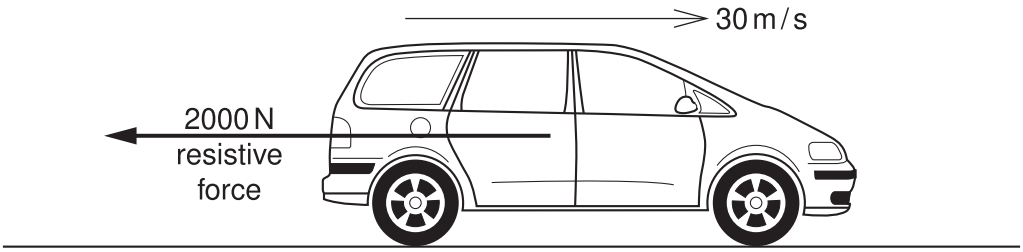


Fig. 2.1

(a) Calculate the kinetic energy of the car.

kinetic energy = ... [2]

(b) Calculate the energy used in 1.0 s against the resistive force.

energy = ... [2]

(c) What is the minimum power that the car engine has to deliver to the wheels?

minimum power = ... [1]

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(d) What form of energy is in the fuel, used by the engine to drive the car?

..... [1]

(e) State why the energy in the fuel is converted at a greater rate than you have calculated in **(c).**

.....

..... [1]

[Total: 7]

Energy stores and transfers Click for more variations

6 **(a)** ½mv^2 OR ½ × 900 x 30^2 C1
405 000 J A1

(b) force x distance OR 2000 x 30 C1
60 000 J OR 60 kJ A1

(c) 60 000 W OR 60 000 J/s OR 60kW OR 60 kJ/s ecf from (b) B1

(d) chemical B1

(e) idea of energy loss / heat / sound / inefficiency / energy used within car / possibility of increase in P.E. Ignore work done against against friction B1 [7]

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7 Two workmen are employed on a building project, as shown in Fig. 5.1.

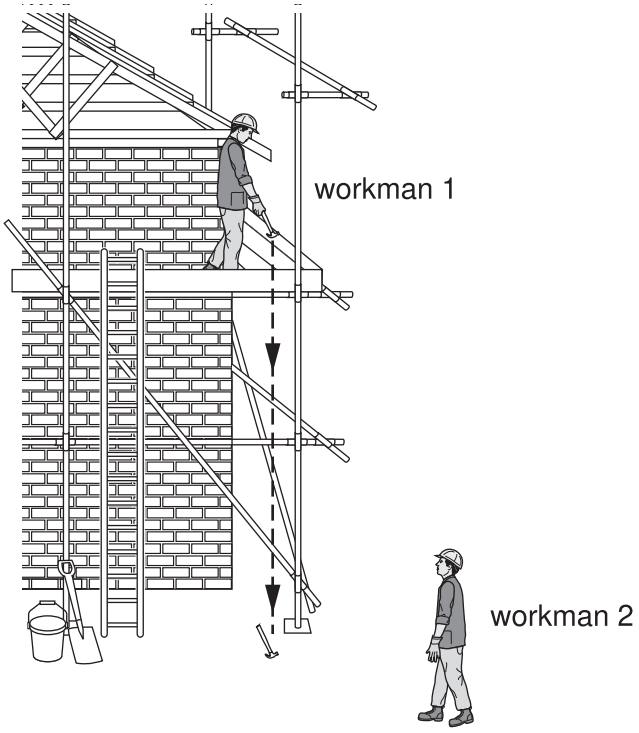


Fig. 5.1

(a) Workman 1 drops a hammer, which falls to the ground. The hammer has a mass of 2.0 kg, and is dropped from a height of 4.8 m above the ground.

(i) Calculate the change in gravitational potential energy of the hammer when it is dropped.

change in gravitational potential energy = ...[2]

(ii) Describe the energy changes from the time the hammer leaves the hand of workman 1 until it is at rest on the ground.

.....

.....

.....

.....[2]

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(b) Workman 2 picks up the hammer and takes it back up the ladder to workman 1.

He climbs the first 3.0 m in 5.0 s. His total weight, including the hammer, is 520 N.

(i) Calculate the useful power which his legs are producing.

power = ...[2]

(ii) In fact his body is only 12% efficient when climbing the ladder.

Calculate the rate at which energy stored in his body is being used.

rate = ...[1]

[Total: 7]

Energy stores and transfers Click for more variations

7	**(a)**	**(i)**	*mgh* in any form OR 2.0 × 10 × 4.8 96 J	C1 A1	
		(ii)	GPE → KE (+ heat and/or sound) → heat and/or sound –1 e.e.o.o.	B2	
	(b)	**(i)**	force × distance/time OR 520 × 3/5 312 W	C1 A1	
		(ii)	2600 W ecf **(i)**	B1	[7]

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8 **(a)** Tidal power derives most of its energy from the Moon and part of its energy from the Sun.

(i) State **one** other source of power which derives its energy from the Sun.

..... [1]

(ii) State **one** source of power which does **not** derive its energy from the Sun.

..... [1]

(b) Fig. 3.1 shows a small water turbine driven by a tidal flow of water to generate electrical power.

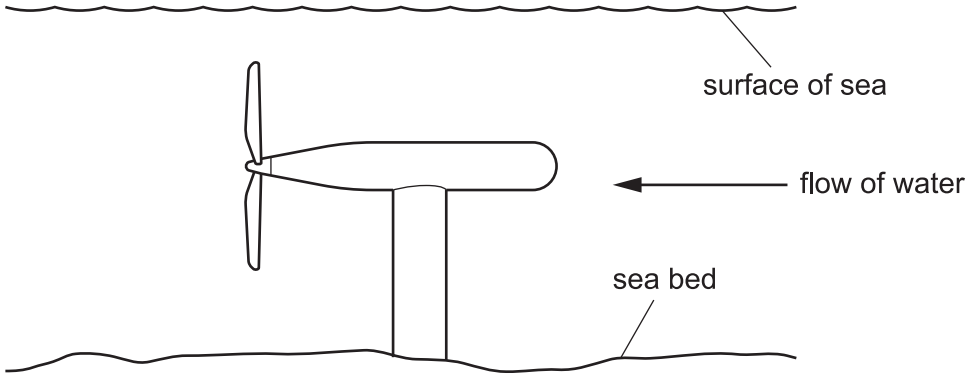


Fig. 3.1

(i) Explain whether this method of generation of electrical power is renewable.

.....

.....

..... [2]

(ii) The mass of water passing through the turbine each second is 6.0×10^3 kg. The speed of the water is 2.0 m/s. 40% of the kinetic energy of the water is converted to electrical energy.

Calculate the electrical power generated.

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power = ... [4]

[Total: 8]

Work and power Click for more variations

8(a)(i)	*any one from*: • fossil fuel / named fossil fuel • biofuel / wood / crops • hydro • wave • wind • solar cell / panel.	**B1**
8(a)(ii)	geothermal **OR** nuclear	**B1**
8(b)(i)	yes **OR** it is renewable	**B1**
	tides are continuous / regular / happen every day / always there / owtte **OR** Moon / Sun always there **OR** nothing is consumed / used up **OR** tides are an unlimited resource	**B1**
8(b)(ii)	(power =) 4800 W	**A4**
	KE = $\frac{1}{2}mv^2$	C1
	$(P =)\ E / t$ **OR** $(P =)$ KE / s **OR** (KE / s =) $\frac{1}{2} \times 6(.0) \times 10^3 \times 2(.0)^2$	C1
	electrical (output) power = 40% of KE / s **OR** $0.4 \times 12\,000$	C1

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9 An athlete of mass 64 kg is bouncing up and down on a trampoline.

At one moment, the athlete is stationary on the stretched surface of the trampoline. Fig. 3.1 shows the athlete at this moment.

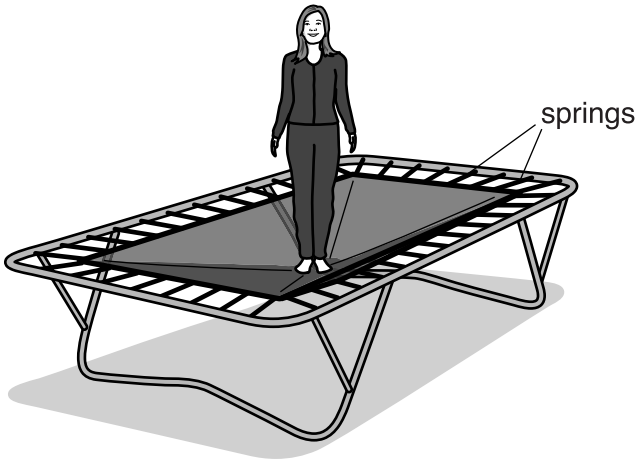


Fig. 3.1

(a) State the form of energy stored due to the stretching of the surface of the trampoline.

.....[1]

(b) The stretched surface of the trampoline begins to contract. The athlete is pushed vertically upwards and she accelerates. At time *t*, when her upwards velocity is 6.0 m/s, she loses contact with the surface.

(i) Calculate her kinetic energy at time *t*.

kinetic energy = ...[2]

(ii) Calculate the maximum possible distance she can travel upwards after time *t*.

maximum distance = ...[3]

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(iii) In practice, she travels upwards through a slightly smaller distance than the distance calculated in **(ii)**.

Suggest why this is so.

.....

.....[1]

(c) The trampoline springs are tested. An extension-load graph is plotted for one spring. Fig. 3.2 is the graph.

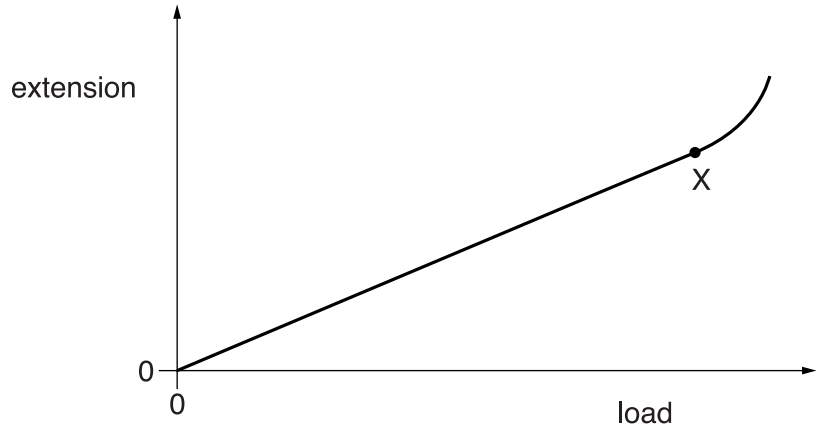


Fig. 3.2

(i) State the name of the point X.

.....[1]

(ii) State the name of the law that the spring obeys between the origin of the graph and point X.

.....[1]

[Total: 9]

Energy stores and transfers Click for more variations

9 **(a)** strain / elastic (potential) (energy) B1

(b) **(i)** (KE =) ½ m v^2 in any form C1

1200 J A1

(ii) (G)PE (gained) = KE (lost) in any form C1

(G)PE = *m g h* OR *h* = PE ÷ *mg* in any form C1

1.8 m e.c.f. from **(b)(i)** A1

(iii) friction with air OR air resistance OR thermal energy / heat produced/lost B1

(c) **(i)** limit of proportionality B1

(ii) Hooke's law B1

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10 A train of mass 1.8×10^5 kg is at rest in a station. At time $t = 0$, the train begins to accelerate along a straight, horizontal track and reaches a speed of 20 m/s at $t = 15$ s. The train continues at a speed of 20 m/s for 10 s.

At $t = 25$ s, the driver applies the brakes and the resistive force on the train causes it to decelerate uniformly to rest in a further 24 s.

Fig. 4.1 is an incomplete distance–time graph for this journey.

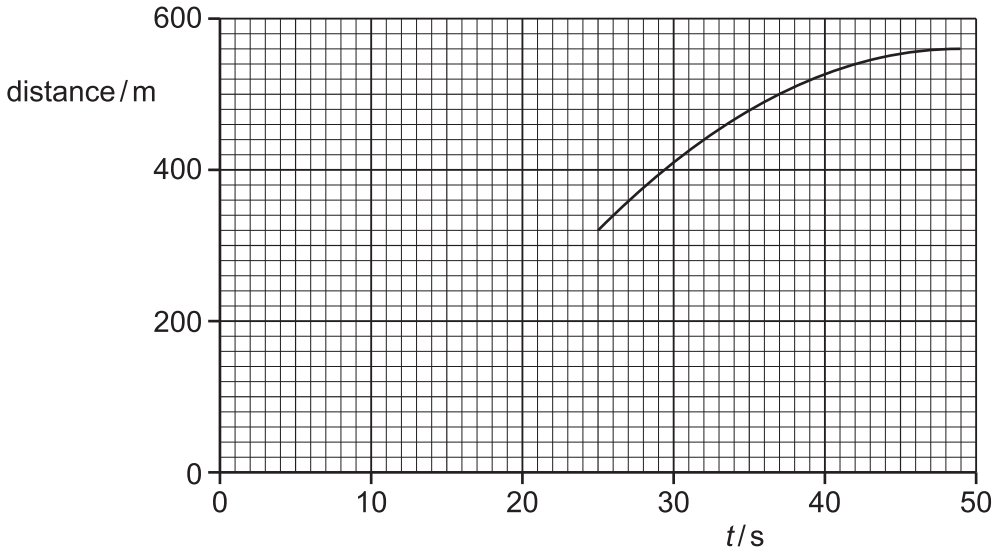


Fig. 4.1

(a) Complete Fig. 4.1 by drawing:

(i) a line to represent the motion of the train between $t = 15$ s and $t = 25$ s [1]

(ii) a curve to represent the motion of the train between $t = 0$ and $t = 15$ s. [1]

(b) Calculate the kinetic energy of the train between $t = 15$ s and $t = 25$ s.

kinetic energy = ... [3]

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(c) While the train decelerates to rest, it does work against the resistive force and its kinetic energy decreases.

(i) Define *work done*.

.....

..... [2]

(ii) Using Fig. 4.1, determine the distance moved by the train while it decelerates.

distance moved = ... [1]

(iii) Calculate the resultant force acting on the train while it decelerates.

resultant force = ... [2]

[Total: 10]

Work and power Click for more variations

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10(a)(i)	straight line begins at (15 s, 120 m) **and** continues to end of given line	**B1**
10(a)(ii)	curve with increasing gradient from origin to beginning of candidate's **(a)(i)**	**B1**
10(b)	(E_k =) ½mv^2 in any form	**C1**
	½ × 1.8 × 10^5 × 20^2	**C1**
	3.6 × 10^7 J	**A1**
10(c)(i)	(work done =) force × distance (moved in the direction of the force)	**C1**
	(work done =) force × distance moved in the direction of the force	**A1**
10(c)(ii)	240 m **c.a.o.**	**B1**
10(c)(iii)	3.6 × 10^7 / 240 **or** kinetic energy / distance **or** (a =) 20 / 24 **or** $\Delta v / t$ in any form **or** 0.83 **or** (F =) ma in any form	**C1**
	1.5 × 10^5 N	**A1**

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