Energy Transfers

Total Marks : 19

Q1.

A cyclist has a mass of 64 kg.

(i) The cyclist rides from a flat road to the top of a hill.

The top of the hill is 24 m above the flat road.
Calculate the gain in gravitational potential energy, ΔGPE, of the cyclist.
Use g = 10 N/kg
Use the equation

$$\Delta GPE = m \times g \times \Delta h$$

(2)

gain in gravitational potential energy = ... J

(ii) The cyclist returns to the flat road.

The mass of the cyclist is 64 kg.
Calculate the kinetic energy of the cyclist when the cyclist is travelling at 6.0 m/s.
Use the equation

$$KE = \frac{1}{2} \times m \times v^2$$

(3)

kinetic energy = ... J

(iii) The cyclist then uses the brakes on the bicycle to stop.

Explain what happens to the kinetic energy of the cyclist.

(2)

....

....

....

....

Q2.

A model train has a mass of 8.0 kg.
It travels at a speed of 1.5 m/s.

Calculate the kinetic energy of the model train.

Use the equation

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

(3)

kinetic energy = ... J

Q3.

(i) Which of these would be a typical speed for a racing cyclist travelling down a steep straight slope?

(1)

- ☐ **A** 0.2 m/s
- ☐ **B** 2 m/s
- ☐ **C** 20 m/s
- ☐ **D** 200 m/s

(ii) A cyclist travels down a slope.
The top of the slope is 20 m vertically above the bottom of the slope.
The cyclist has a mass of 75 kg.

Calculate the change in gravitational potential energy of the cyclist between the top and the bottom of the slope.

The gravitational field strength, g, is 10 N/kg.

(3)

change in gravitational potential energy = ... J

Q4.

Figure 7 shows a skier going down a hill.

Figure 7

She descends through a vertical height of 200 m.

The skier's mass is 65 kg.

(i) Calculate the change in gravitational potential energy.

Use the equation

$$\Delta GPE = m \times g \times \Delta h$$

Take the gravitational field strength, *g*, as 10 N / kg.

(2)

change in gravitational potential energy = ... J

(ii) At the bottom of the slope her speed was 36 m/s.

Calculate her kinetic energy at the bottom of the slope.
Use the equation

$$KE = \frac{1}{2} \times m \times v^2$$

(3)

kinetic energy = ... J

Mark Scheme – Energy Transfers

Q1.

Question number	Answer	Additional guidance	Mark
(i)	substitution (1) (ΔGPE =) 64 x 10 x 24 evaluation (1) 15 000 (J)	accept 15 360(J) or 15 400(J) award full marks for correct answer without working.	**(2)** **AO2**
Question number	**Answer**	**Additional guidance**	**Mark**
(ii)	substitution (1) (KE=) ½ x 64 x 6$^{(2)}$ calculation of 6^2 (1) evaluation (1) 1200 (J)	accept 1152(J) award full marks for correct answer without working. 192 (J) scores 2 marks	**(3)** **AO2**

Question number	Answer	Additional guidance	Mark
(iii)	an explanation linking any **two** from:		**(2)** **AO2**
	the kinetic energy (store)/it decreases (to zero) (1)		
	(the energy) has dissipated (1)	transferred	
	to the surroundings (1)	to ground/brake(s) pads	
	thermal energy (store) increases (1)	make the brakes hot	

Q2.

Question Number	Answer	Additional guidance	Mark
	substitution (1) ½ x 8 x 1.5(²) calculation of v^2 (1) 2.25 evaluation (1) 9(.0) (J)	9000 (J) scores 2 marks 6(.0)(J) scores 2 marks 6000 (J) scores 1 mark award full marks for the correct answer without working	**(3)**

Q3.

Question Number	Answer	Mark
(i)	The only correct answer is **C 20 m/s** A is not correct because 0.2 m/s is too slow B is not correct because 2 m/s is too slow D is not correct because 200 m/s is too fast	(1)

Question Number	Answer	Additional guidance	Mark
(ii)	recall (1) (ΔGPE) = m × g × Δh substitution (1) (ΔGPE =) 75 x 10 x 20 evaluation (1) 15 000 (J)	NO PoT error NO ecf from wrong equation mgh or m x g x h 75 x 10 x 20 scores the first 2 marks accept 14700 (J) from using g = 9.8 (N/kg) award full marks for the correct answer without working	(3)

Q4.

Question Number	Answer	Additional guidance	Mark
(i)	substitution (1) (ΔGPE =) 65 x 10 x 200 evaluation (1) 1.3×10^5 / 130 000 (J)	allow substitution mark with 65000 (g) allow 1 mark for answers that round to 1.3 with any other power of ten do not allow 13000 award full marks for the correct answer without working	(2) AO 2 1

Question Number	Answer	Additional guidance	Mark
(ii)	substitution (1) (KE) ½×65×36(^{2}) squaring (1) 36^2 (=1296) (completing) evaluation (1) 42 120 / $4.2(1) \times 10^4$ (J)	using 36 → 1170 (J) OR 36x2 → 2340 (J) scores 2 marks (apply power of ten error as well if occurring e.g. 117000 (J) gets 1 mark) award full marks for the correct answer without working allow 2 marks for answers that round to 4.2 with any other power of ten omitting ½ gives 84240(J) scores 2 marks	(3) AO 2 1