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CP3 Calculation Booklet

EXAM BOOKLET

MCKELVIE. S

(a) In one lift, he does 5040 J of work against gravity.

(i) One lift takes 4 seconds.

Complete the sentence by putting a cross (☒) in a box next to your answer.

The power used to lift the weight is

(1)

☐ **A** 1260 W

☐ **B** 2016 W

☐ **C** 12600 W

☐ **D** 20160 W

(ii) The weight he lifts has a mass of 240 kg.
Gravitational Field Strength = 10 N/Kg
The energy gained by the mass is equal to the work done when lifting it.

Calculate the height he lifts this mass.

(3)

height = ... m

The swing

5 A child is stationary on a swing.

(a) The child is given a push by his brother to start him swinging.
His brother applies a steady force of 84 N over a distance of 0.25 m.

(i) Calculate the work done by this force.

(2)

work done = ... J

(ii) State how much energy is transferred by this force.

(1)

energy transferred = ... J

(iii) After several more pushes, the child has a kinetic energy of 71 J.

The mass of the child is 27 kg.

Show that the velocity of the child at this point is about 2.3 m/s.

(2)

(iii) The first motor has a power rating of 20 W.

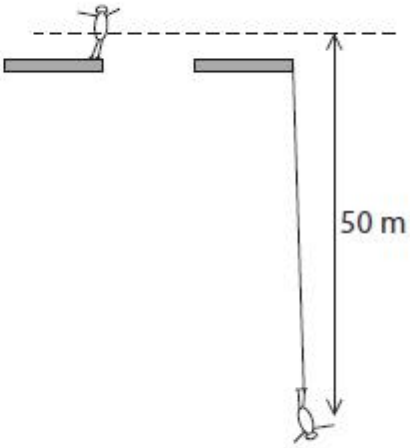
The motor is used for 15 s.

Calculate the energy supplied to the motor.

(2)

energy supplied to the motor = ... J

2 A 60 kg student weighs 600 N.
He does a bungee jump.



The bungee cord becomes straight and starts to stretch when he has fallen 50 m.

(c) (i) Calculate the change in gravitational potential energy as the student falls 50 m.

Give the unit.

(3)

change in gravitational potential energy = ... unit .....

(iii) The child and cart have a total mass of 50 kg. They travel at a velocity of 4 m/s.

Calculate the momentum of the child and cart.

(2)

momentum = ... kg m/s

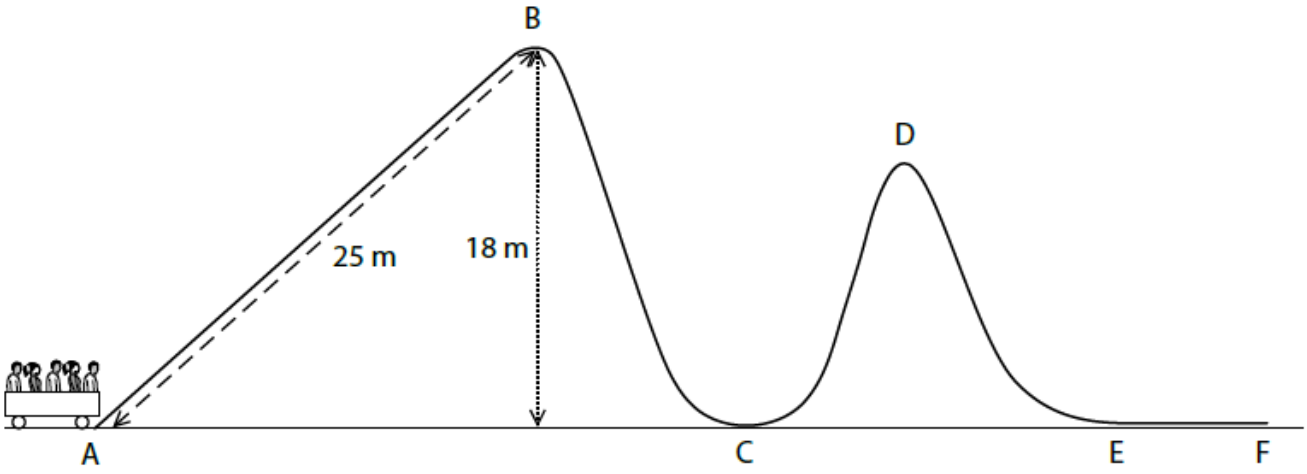
(iv) The father applies a steady force for a time of 1.5 s. The momentum of the child and cart increases by 450 kg m/s.

Calculate the force which the father applies.

(2)

force = ... N

3 The diagram shows a car and passengers at the start of a roller coaster ride at an amusement park.



(a) An electric motor pulls the car from A to B at a steady speed.

The total mass of the car and passengers is 9500 kg.

Calculate the amount of work done on the car and passengers.
[Gravitational field strength, g = 10 N/kg]

(2)

work done = ... J

(b) The car is released at B and continues down the track.

State the maximum possible kinetic energy of the car and passengers at C.

(1)

maximum KE = ... J

(iv) One cyclist produces an average power output of 600 W during the race.
She completes the race in exactly 4 minutes.

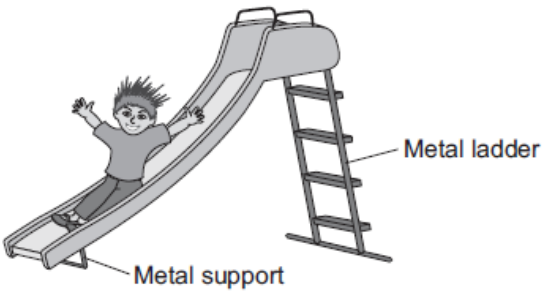
Calculate the work done by the cyclist during the race.

(3)

work done = ... J

1 **Figure 1** shows a slide in a children's playground.

Figure 1



1 (a) A child of mass 18 kilograms goes down the slide.

The vertical distance from the top to the bottom of the slide is 2.5 metres.

Calculate the decrease in gravitational potential energy of the child sliding from the top to the bottom of the slide.

Gravitational field strength = 10 N/kg

Use the correct equation from the Physics Equations Sheet.

[2 marks]

.....

.....

.....

Decrease in gravitational potential energy = ... J

3 (b) (i) The cyclist used the brakes to slow down and stop the bicycle.

A constant braking force of 140 N stopped the bicycle in a distance of 24 m.

Calculate the work done by the braking force to stop the bicycle. Give the unit.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

.....

.....

.....

Work done = ...

6 (b) The speed of the rocket just after being launched is 12 m/s.
The mass of the rocket is 0.05 kg.

6 (b) (i) Calculate the kinetic energy of the rocket just after being launched.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

.....

.....

.....

Kinetic energy = ... J

6 (b) (ii) As the rocket moves upwards, it gains gravitational potential energy.

State the maximum gravitational potential energy gained by the rocket.

Ignore the effect of air resistance.

[1 mark]

Maximum gravitational potential energy = ... J

6 (b) (iii) Calculate the maximum height the rocket will reach.

Ignore the effect of air resistance.

Gravitational field strength = 10 N/kg.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

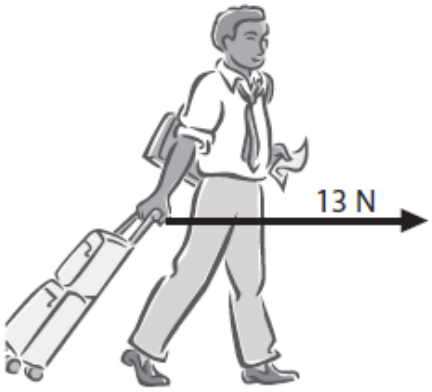
.....

.....

.....

Maximum height = ... m

6 A person has a suitcase with wheels.



(a) The person pulls the suitcase with a horizontal force of 13 N for 110 m.

(i) State the equation linking work done, force and distance moved.

(1)

(ii) Calculate the work done on the suitcase by the person.

(2)

work done = ... J

(iii) How much energy is transferred to the suitcase?

(1)

energy transferred = ... J

7 The photograph shows a car tyre that needs to be inflated.

Author: Ildar Sagdejev

The tyre exerts a pressure on the road of 270 kPa.

The area of the tyre touching the road is 0.016 m^2.

(a) (i) State the equation linking pressure, force and area.

(1)

(ii) Calculate the force exerted on the road by the tyre.

Give the unit.

(4)

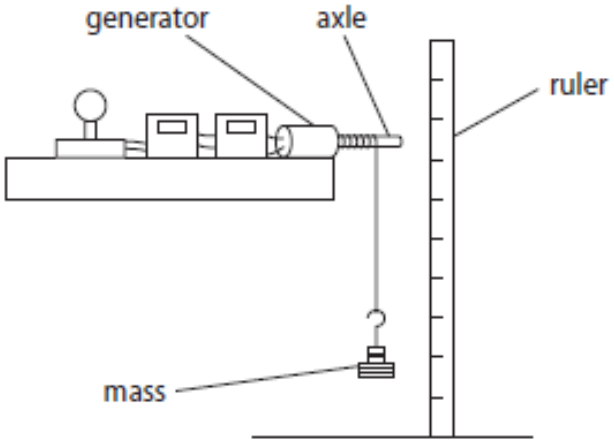
force = ... unit .....

8 (a) A student investigates the energy transfers in a small generator.

She connects the generator to a circuit that includes a lamp.

She hangs a mass from a string wound around the axle.

The lamp lights as the mass falls to the ground.



The table shows the student's results.

height that mass falls	0.61 m
mass	2.75 kg
time taken for mass to fall	1.3 s
average current in the lamp	0.46 A
average voltage across the lamp	12.7 V

(i) State the equation linking gravitational potential energy, mass, *g* and height.

(1)

(ii) Calculate the gravitational potential energy, GPE, lost by the mass.

(2)

GPE = ... J

(c) The mass of ball Y is 45 g.

The golfer gives the ball 36 J of kinetic energy when he hits it.

(i) State the equation linking kinetic energy, mass and speed.

(1)

(ii) Calculate the initial speed of ball Y.

(4)

initial speed = ... m/s

7 A skydiver jumps from an aircraft.

(a) The mass of the skydiver is 70 kg.

(i) State the equation linking weight, mass and *g*.

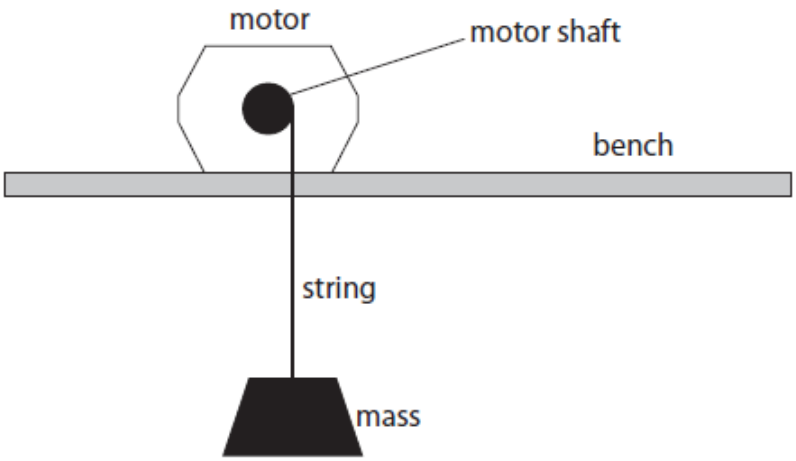
(1)

(ii) Calculate the weight of the skydiver and state the unit.

(2)

weight = ... unit .....

8 A student investigates the efficiency of an electric motor.



She uses the motor to lift a mass.

The table shows her measurements.

Current in motor	1.3 A
Voltage across motor	10.3 V
Time taken to lift mass	4.7 s
Force needed to lift mass	20 N
Distance the mass was lifted	0.85 m

(a) Calculate the electrical energy supplied to the motor during this time.

(2)

energy supplied = ... J

(b) (i) State the equation linking work done, force and distance moved.

(1)

(ii) Calculate the work done on the mass.

(2)

work done = ... J

(iii) State the useful energy transferred to the mass.

(1)

.....

(c) (i) State the equation linking efficiency, useful energy output and total energy input.

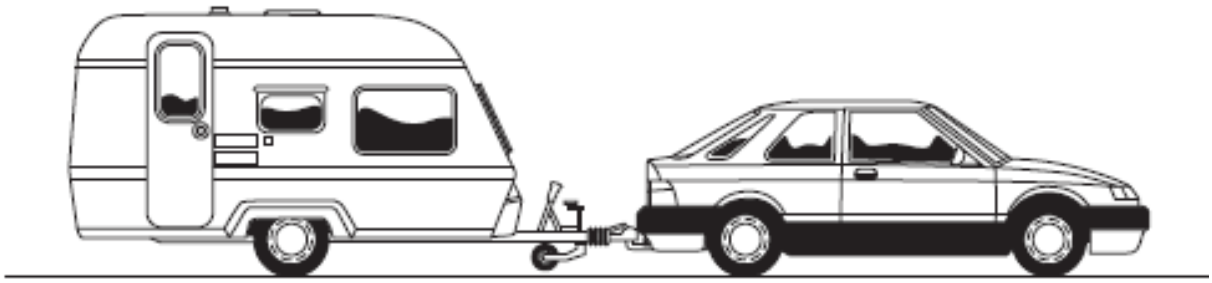
(1)

(ii) Calculate the efficiency of the motor.

(2)

efficiency = ...

8 A car pulls a caravan along a horizontal road.



(a) The car pulls the caravan with a resultant force of 170 N for a distance of 110 m.

(i) State the equation linking work done, force and distance.

(1)

(ii) Calculate the work done by the car on the caravan.

(2)

work done = ... J

(iii) State how much energy is transferred to the caravan.

(1)

energy transferred = ... J

(b) The mass of the car is 1650 kg.

The mass of the caravan is 950 kg.

(i) State the equation linking kinetic energy, mass and velocity.

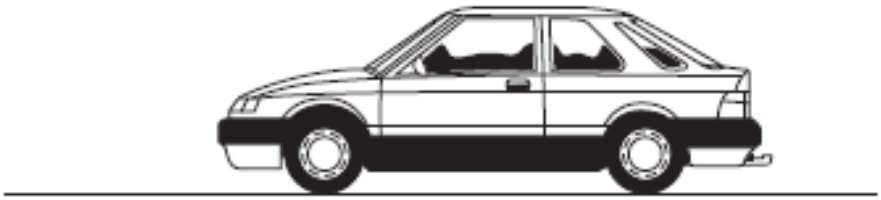
(1)

(ii) Calculate the total kinetic energy when the car and caravan travel together at a constant speed of 23 m/s.

(3)

total kinetic energy = ... J

(c) The caravan is removed and the car makes the return journey without it.



(c) In 1971, astronaut Alan Shepard hit a golf ball on the surface of the Moon.

The golf ball had a mass of 50 g and he transferred 56 J of energy to it.

(i) State the equation linking kinetic energy, mass and velocity.

(1)

(ii) Calculate the initial velocity of the ball.

(3)

initial velocity = ... m/s

(d) At its highest point the ball had gained 12 J of gravitational potential energy.

(i) State the kinetic energy of the ball at its highest point.

(1)

kinetic energy = ... J

(ii) State the equation linking gravitational potential energy, mass, g and height.

(1)

(iii) Calculate the maximum height that the ball reached.
(gravitational field strength on the Moon, g = 1.6 N/kg)

(2)

maximum height = ... m

7 A flying squirrel is an animal that can glide through the air.

It spreads out its limbs to stretch a membrane that helps it to glide.

© Robert Savannah

(a) The mass of a flying squirrel is 0.19 kg.

It climbs 17 m up a tree.

(i) State the equation linking gravitational potential energy (GPE), mass, *g* and height.

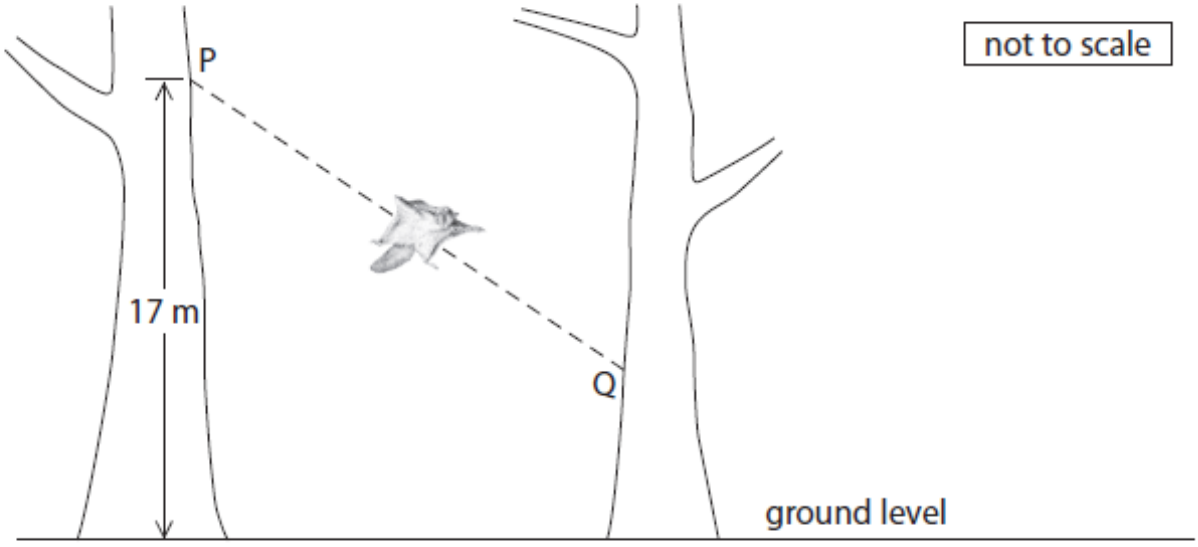
(1)

(ii) Calculate the GPE gained by the squirrel during this climb.

(2)

GPE = ... J

(b) The flying squirrel glides from P to Q with a constant velocity of 13 m/s.



(i) Add labelled arrows to the diagram to show the directions of the forces of weight and drag acting on the squirrel.

(2)

(ii) State the equation linking kinetic energy (KE), mass and velocity.

(1)

(iii) Calculate the KE of the squirrel as it glides.

(2)

KE = ... J

5 A man uses a wheelbarrow to carry some logs along a flat path, as shown.

©http://commons.wikimedia.org/wiki/file:wheelbarrow_%28PSF%29.png

(a) He pushes with a horizontal force of 140 N and the wheelbarrow moves 39 m.

(i) State the relationship between work done, force and distance moved.

(1)

(ii) Calculate the work done moving the wheelbarrow.

(2)

work done = ... J

(iii) State how much energy is transferred to the wheelbarrow.

(1)

energy transferred = ... J

(iii) The average acceleration of the shot while in the athlete's hand is 20.6 m/s^2.
The mass of the shot is 7.26 kg.

Calculate the average force that the athlete applies to the shot during the throw.

(2)

force = ... N

(iv) In another throw, the shot is in the athlete's hand for 0.48 s.
The average acceleration during this time is 23 m/s^2.

Calculate the velocity of the shot as it leaves the athlete's hand.

(3)

velocity = ... m/s

) In one throw, the shot continues to rise by another 1.3 m after it leaves the athlete's hand.
The mass of the shot is 7.26 kg.

Calculate the amount of gravitational potential energy gained by the shot.

(2)

gravitational potential energy gained = ... J

10 (a) Figure 13 shows two ice skaters during a performance.

Figure 13

(i) The two ice skaters are travelling together in a straight line at 3.50 m/s.

Their total momentum is 371 kgm/s.

The man has a mass of 64.5 kg.

Calculate the mass of the woman.

(4)

mass = ... kg

(ii) Calculate the kinetic energy of the man.

(2)

kinetic energy = ... J