Name: _____

IGCSE(9-1) Physics

Date:

Time: 1 hour 10 minutes

Total marks available: 110

Total marks achieved: _____

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Questions

Q1.

A helicopter is stationary above the ground.

A bag of sand is dropped from the helicopter.

(a) (i) The bag falls 6.3 m.

The mass of the bag is 19 kg.
Calculate the gravitational potential energy (GPE) change for the bag.
[GPE change = mass × gravitational field strength × height change]

(2)

GPE change = ... J

(ii) State the kinetic energy (KE) gained by the bag after falling 6.3 m.
You can ignore the effects of air resistance.

(1)

KE gained = ... J

(b) Closer to the ground, the effects of air resistance cannot be ignored.

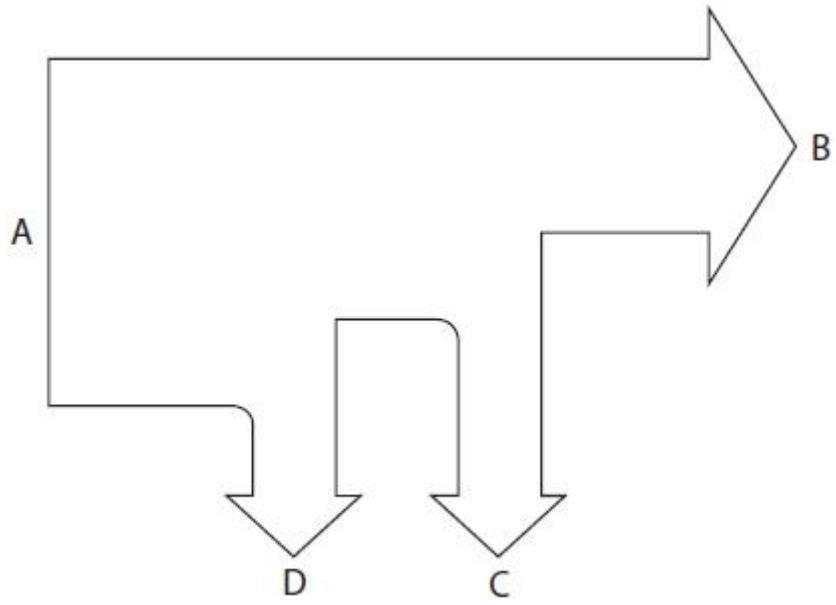
The bag travels at a constant speed when the air resistance equals the weight of the bag.
The bag has a mass of 19 kg.
Calculate the value of the air resistance when the bag travels at constant speed.

(2)

air resistance = ... N

(c) The bag hits the ground and stops without bouncing.

The Sankey diagram shows energy transfers for the bag from just before the bag hits the ground to when the bag stops.



Use words from the box to complete the labels A, B and D. Label C has been done for you. Each word may be used once, more than once or not at all.

thermal	magnetic	mechanically	electrically
kinetic	nuclear	by heating	by radiation

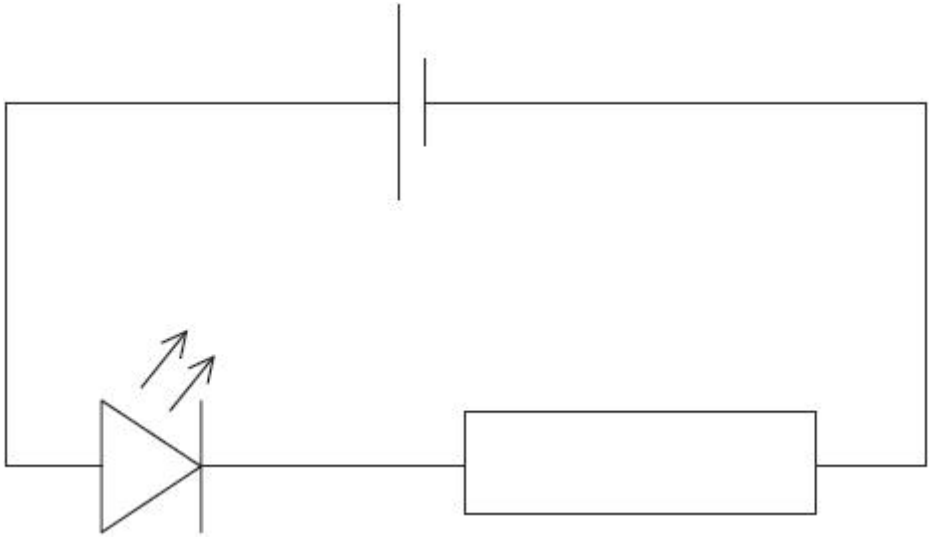
(3)

A: energy transferred mechanically from the bag's ..... store
B: energy transferred mechanically to the bag's ..... store
C: energy transferred mechanically to the ground's thermal store
D: energy transferred ..... to the surroundings

(Total for question = 8 marks)

Q2.

The diagram shows a circuit containing a light emitting diode (LED) and a resistor.



(a) Add meters to the diagram to measure the voltage of the resistor and the current in the resistor.

(3)

(b) (i) State the formula linking voltage, resistance and current.

(1)

(ii) The current in the resistor is 7.3 mA.
The voltage of the resistor is 0.92 V.
Calculate the resistance of the resistor.

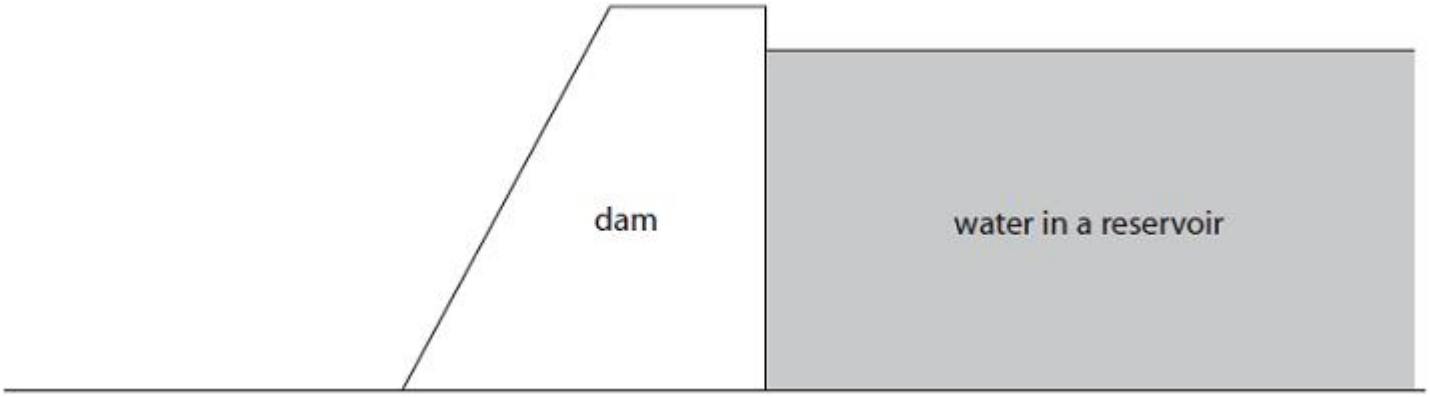
(3)

resistance = ... Ω

(Total for question = 7 marks)

Q3.

A dam is a structure designed to hold water in a reservoir.



(a) The water in the reservoir has a depth of 35 m.

(i) State the formula linking pressure difference, height, density and *g*.

(1)

(ii) Atmospheric pressure at the surface of the reservoir is 100 kPa.
Calculate the total pressure at the bottom of the reservoir.
[for water, density = 1000 kg / m^3]

(3)

pressure = ... kPa

(b) An underwater camera is used in the water reservoir.

The camera lens experiences a force of 430 N at a pressure of 260 kPa.

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

(1)

(ii) Calculate the area of the camera lens.
Give a suitable unit.

(4)

area = ... unit .....

(c) Sea water has a density of 1030 kg / m^3.

Explain how the design of the dam would need to be changed to hold the same depth of sea water safely.

(2)

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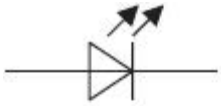
(Total for question = 11 marks)

Q4.

This question is about a filament lamp.

(a) Which of these is the correct circuit symbol for a filament lamp?

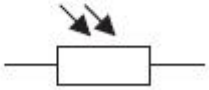
(1)



☒ **A**

☒ **B**

☒ **C**



☒ **D**

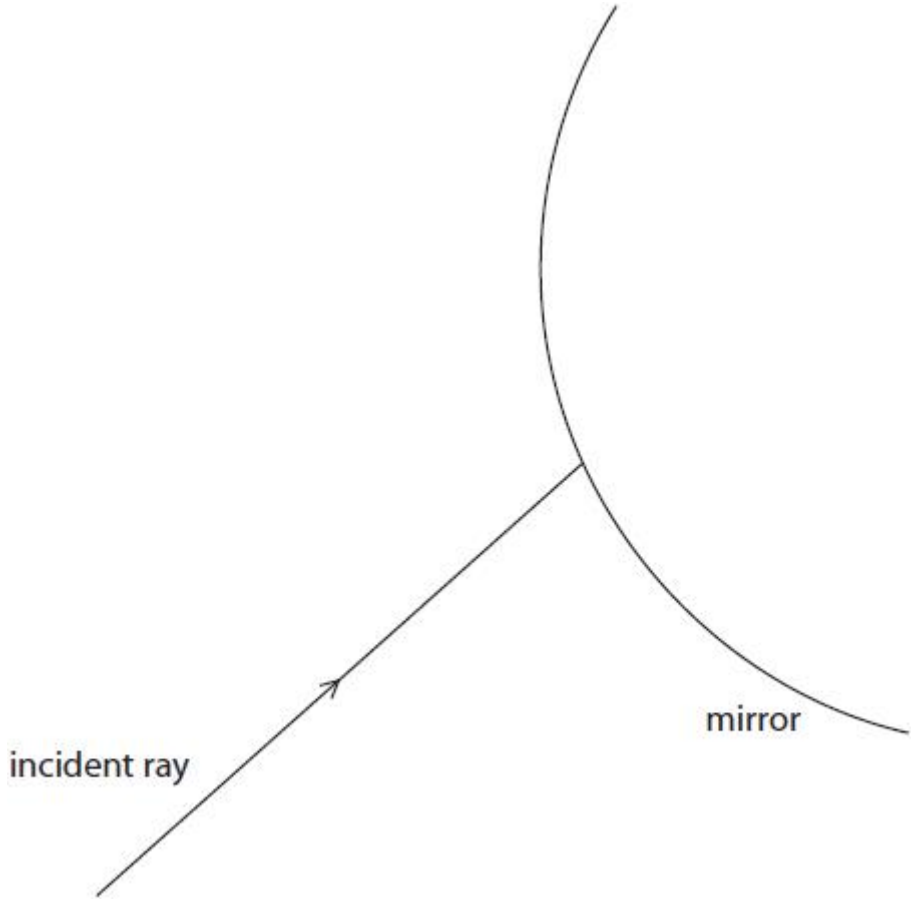
(b) The filament lamp emits visible light.

The table gives some statements about visible light.
Place ticks (✓) in the boxes to show which statements are correct for visible light.

(2)

Statements	Correct (✓)
visible light is a longitudinal wave	
visible light transfers energy	
visible light transfers matter	
visible light has a longer wavelength than x-rays	
visible light travels faster in water than in air	

(c) The diagram shows a ray of light from the filament lamp incident on the reflective side of a curved mirror.



Complete the diagram by drawing

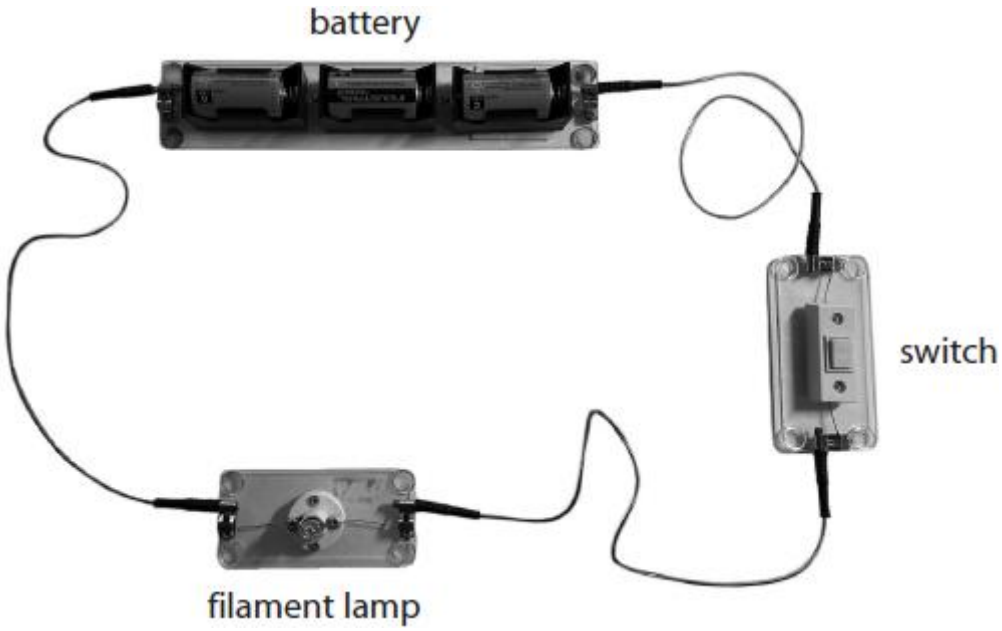
(i) the normal line where the ray is incident on the mirror.

(1)

(ii) the reflected ray of light.

(2)

(d) The filament lamp is connected in a circuit with a switch and a battery of three cells.



(i) When the switch is on, the filament lamp transfers 120 J of energy in a time of 3.0 minutes.
Each cell has a voltage of 1.5 V.
Calculate the current in the filament lamp.

(3)

current = ... A

(ii) A small plotting compass is placed near the wires in the circuit.
When the switch is turned on, the compass needle moves to a new position.
Give a reason why the compass needle moves.

(1)

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(Total for question = 10 marks)

Q5.

(a) Diagram 1 shows a metal ball held at rest above the floor.

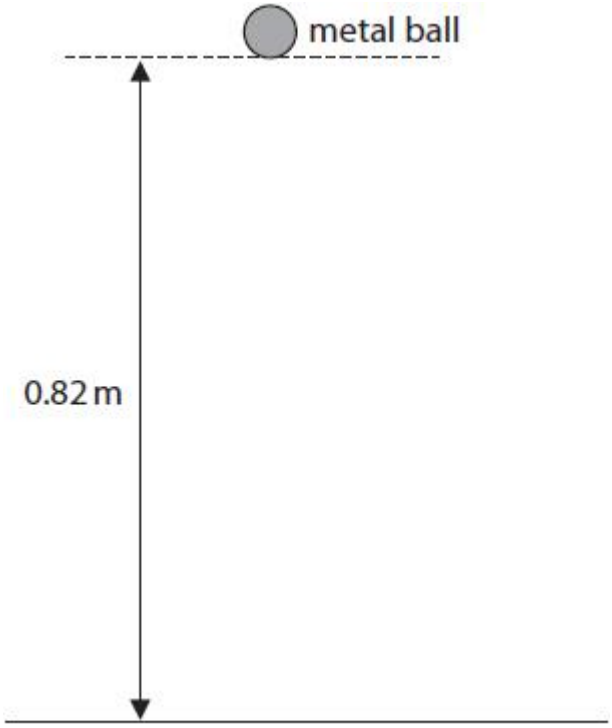

Diagram 1

The metal ball has a mass of 0.52 kg and is held at a height of 0.82 m above the floor.

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

(1)

(ii) Calculate the decrease in the metal ball's GPE store when the ball falls to the floor from this height.

(2)

decrease in GPE store = ... J

(iii) State the amount of energy in the metal ball's kinetic store just before it hits the floor.
Ignore the effects of air resistance.

(1)

energy in kinetic store = ... J

(iv) Calculate the speed of the metal ball just before it hits the floor.

(4)

speed = ... m/s

(b)The metal ball is dropped from rest again from the same height above the floor, as shown in diagram 2.

The metal ball now falls through a cylinder containing oil rather than the air.

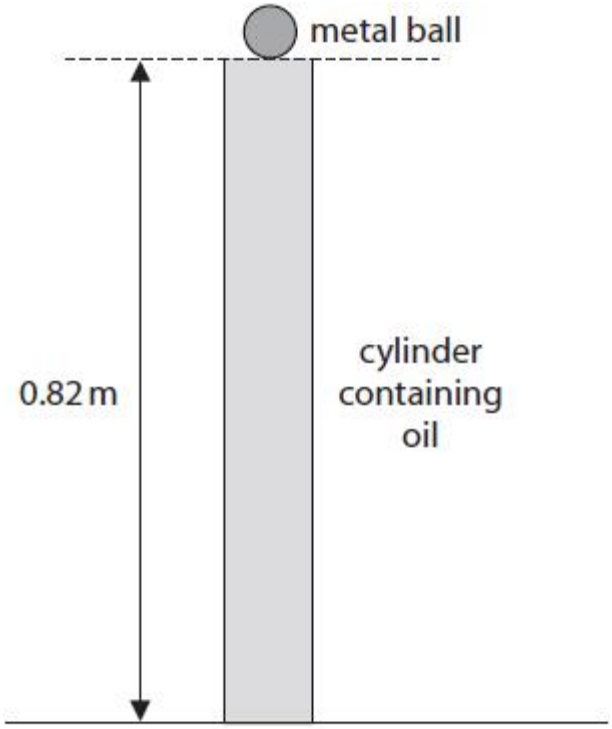

Diagram 2

The speed of the ball just before it hits the floor when moving in oil is less than the speed of the ball just before it hits the floor when moving in air.
Explain, using ideas about energy, the difference in speeds.

(3)

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(Total for question = 11 marks)

Q6.

A device called a metal detector can be used to find metal buried underground.

(Source: © mArt88/Shutterstock)

The metal detector has two circuits, each containing a coil of copper wire.

Diagram 1 shows the circuit for the transmitter coil.

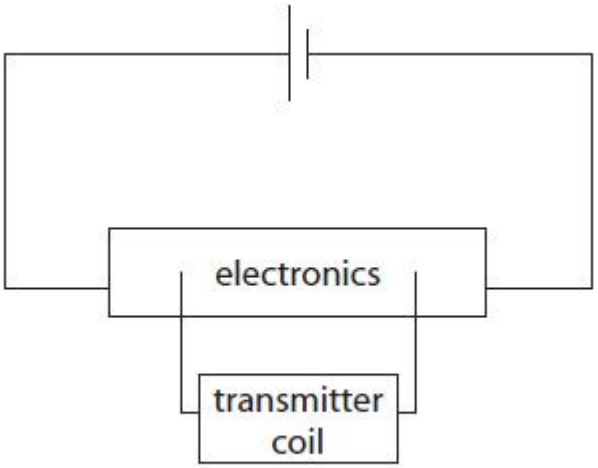

Diagram 1

(a) Suggest why there is a magnetic field around the transmitter coil.

(1)

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(b) The cell supplies direct current (d.c.). The electronics in diagram 1 change the direct current into alternating current (a.c.) in the coil.

(i) Describe the difference between direct current (d.c.) and alternating current (a.c.).

(2)

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(ii) Alternating current is supplied to the transmitter coil.
Diagram 2 shows a gold ring in the soil below the metal detector.

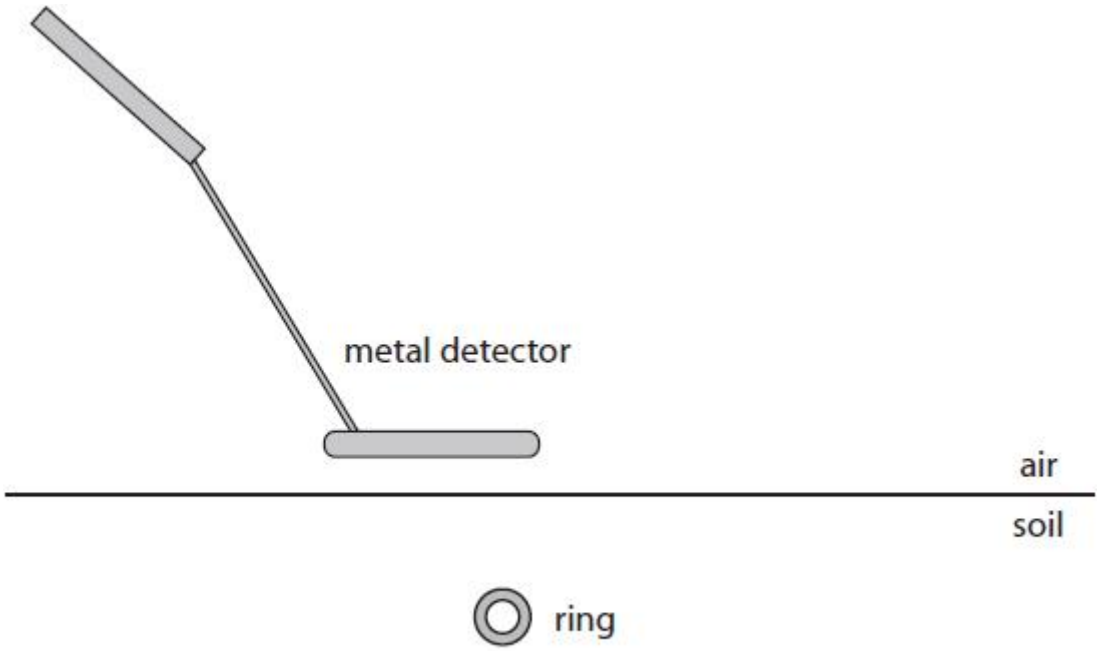

Diagram 2

Explain why there is an alternating current in the gold ring.

(3)

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(c) Diagram 3 shows the circuit for the receiver coil.

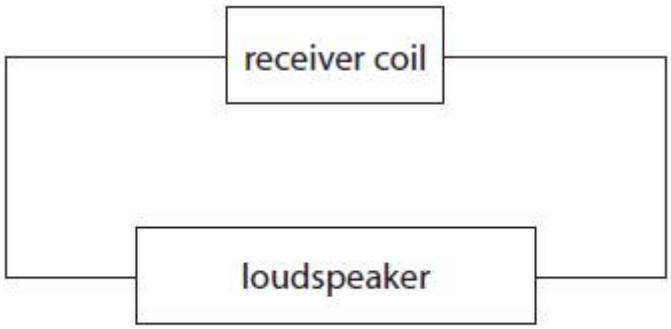

Diagram 3

As a result of the alternating current in the gold ring, there is an alternating current in the receiving coil. Explain how an alternating current in the receiving coil causes a sound to be emitted from the loudspeaker.

(4)

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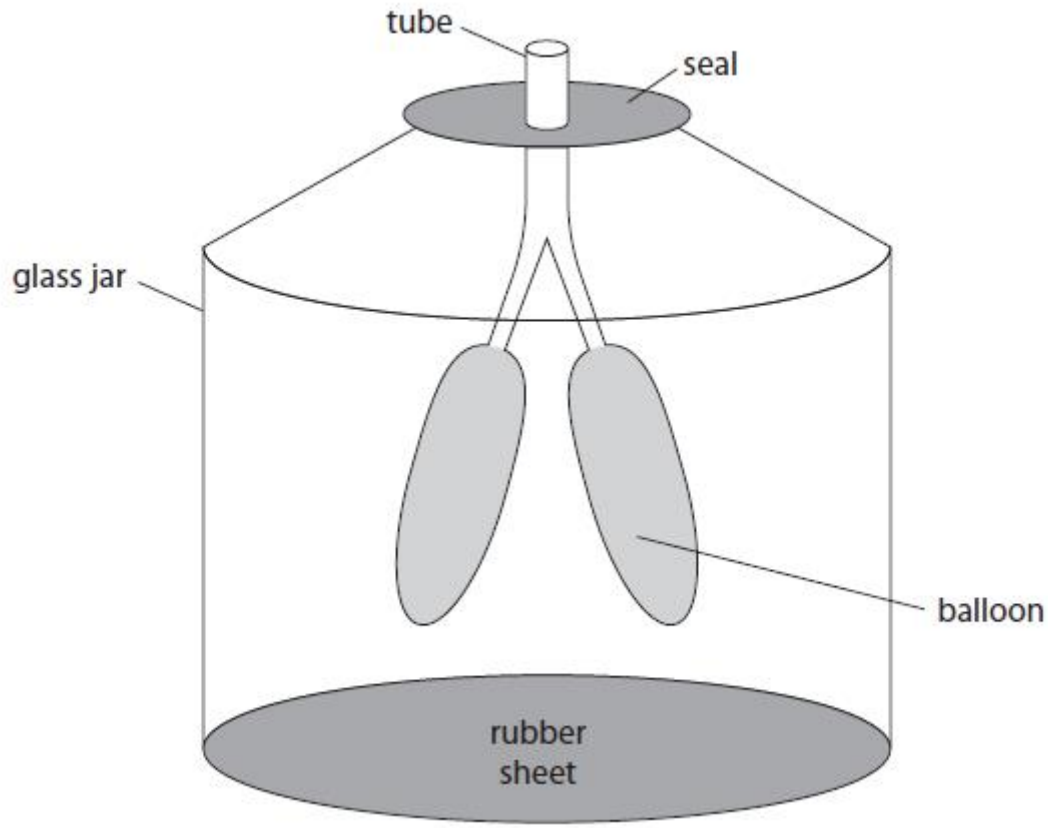
(Total for question = 10 marks)

Q7.

The diagram shows a model of the human breathing system.



The rubber sheet is pulled downwards so that the air inside the glass jar occupies a larger volume.

The temperature of the air does not change.

(a) Explain, in terms of particles, why the pressure of the air inside the glass jar decreases.

(3)

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(b) Before the rubber sheet is pulled down, the air inside the jar is at atmospheric pressure.

The volume of gas inside the jar increases from 110 cm^3 to 140 cm^3.

Calculate the pressure inside the jar after the rubber sheet is pulled down.
[atmospheric pressure = 101 kPa]

(3)

pressure = ... Pa

(c) The jar is sealed, but the balloons are open to the atmosphere.

Before the rubber sheet is pulled down, the air inside the balloons is at atmospheric pressure.
Explain why the balloons start to expand when the rubber sheet is pulled down.

(3)

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(Total for question = 9 marks)

Q8.

The driver of a racing car makes a pit stop during a race to change the tyres on the racing car.

The area where the tyres are changed is called the pit lane.

(Source: © Hafiz Johari/Shutterstock)

(a) Before entering the pit lane, the speed of the car must decrease for safety reasons.

(i) The mass of the racing car is 830 kg.
The maximum braking force is 41 000 N.
Show that the maximum deceleration of the racing car is approximately 50 m / s^2.

(3)

(ii) The racing car is travelling at an initial speed of 72 m / s.
Calculate the minimum distance needed to decrease the speed of the racing car from 72 m / s to 26 m / s.

(3)

distance = ... m

(b) The racing car slows down using its brakes.

The brakes work using friction.
The brakes become very hot when the racing car slows down.
Using ideas about energy, explain why the brakes become hot.

(3)

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(c) The tyres of the racing car also get very hot during a race.

A mechanic has to handle the hot tyres during the pit stop.
They wear protective gloves which have several layers of insulating materials.
Explain how the layers of insulating materials in the gloves reduce the risk of the mechanic burning their hands on the hot tyres.

(2)

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(Total for question = 11 marks)

Q9.

This question is about a parachutist.

(a) A parachutist leaves a helicopter that is hovering above the ground.

The parachutist is initially at rest and falls vertically downwards.
Calculate the speed of the parachutist after they have fallen through a distance of 1300 m.
Ignore the effect of air resistance.

(4)

speed = ... m/s

(b) When the parachutist is much nearer to the ground, they open their parachute.

The parachutist slows down.
(i) Explain the change in speed of the parachutist.
Use ideas about forces in your answer.

(3)

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(ii) It is observed that from when the parachute opens to just before the parachutist touches the ground, the GPE store and the KE store of the parachutist both decrease, yet energy is still conserved.

Justify these observations.

(3)

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(Total for question = 10 marks)

Q10.

The photograph shows a toy called a marble run.

A student lifts a marble from the table to the top of the marble run at point A. They release the marble from point A and it rolls through pipes to reach the bottom of the marble run at point B.

The marble leaves the marble run at point B and rolls across the table.

As the marble rolls, energy is transferred due to the different forces acting on the marble.

(a) Describe the energy transfers from before the student lifts the marble to when the marble reaches point B of the marble run.

(5)

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(b) The student wants to measure how much energy the marble loses as it moves from point A to point B.

(i) The student needs to measure the speed of the marble as it leaves the marble run at point B.
Describe a method the student could use to measure this speed.

(3)

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(ii) The difference in height between point A and point B is 0.21 m.
The mass of the marble is 5.5 g.
The marble leaves the marble run at point B with a speed of 0.76 m/s.
Calculate the energy lost by the marble as it rolls from point A to point B.

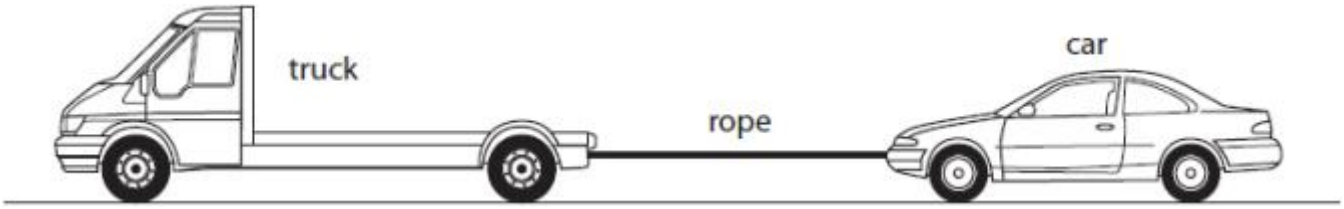
(5)

energy lost = ... J

(Total for question = 13 marks)

Q11.

The diagram shows a truck using a rope to pull a car along a level road.



(a) The truck and car are travelling at a velocity of 14 m / s.

The truck and car then accelerate at 1.6 m / s^2 until they are travelling at a velocity of 22 m / s.

(i) State the formula linking acceleration, change in velocity and time taken.

(1)

(ii) Calculate the time taken for the truck and car to accelerate from 14 m / s to 22 m / s.

(3)

time taken = ... s

(iii) State the formula linking unbalanced force, mass and acceleration.

(1)

(iv) The car has a mass of 1200 kg.

Calculate the unbalanced force acting on the car to produce an acceleration of 1.6 m / s^2 .

Give your answer to two significant figures.

(3)

unbalanced force = ... N

(b) The rope breaks so the car and the truck are no longer connected.

The engine of the car is not working.

Explain what happens to the motion of the car after the rope breaks.

(2)

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(Total for question = 10 marks)