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| **Conservation of Energy (Chapter 1) Exam Questions** |
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| Name: | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| Class: | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| Date: | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

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|  |
| Time: | **103 minutes** |
| Marks: | **103 marks** |
| Comments: |  |
|  |

**Q1.**The figure below shows a car with an electric motor.

The car is moving along a flat road.

(a)     (i)      Use the correct answers from the box to complete each sentence.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|   | **light** | **electrical** | **kinetic** | **potential** | **sound** |

The car’s motor transfers ............................................. energy

into useful ............................................. energy as the car moves.

Some energy is wasted as ............................................. energy.

**(3)**

(ii)     What happens to the wasted energy?

...............................................................................................................

...............................................................................................................

**(1)**

(b)     The electric motor has an input energy of 50 000 joules each second.

The motor transfers 35 000 joules of useful energy each second.

Calculate the efficiency of the electric motor.

Use the correct equation from the Physics Equations Sheet.

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........................................................................................................................

Efficiency = ...............................................................

**(2)**

**(Total 6 marks)**

**Q2.**          The picture shows a solar-powered aircraft. The aircraft has no pilot.

Photo by NASA.

(a)     Use words from the box to complete the following sentence.

|  |
| --- |
|        **electrical**                **heat**                       **light**                    **sound** |

          Solar cells are designed to transform .............................................................. energy into

.............................................................. energy.

**(2)**

(b)     On a summer day, 175 000 joules of energy are supplied to the aircraft’s solar cells every second. The useful energy transferred by the solar cells is 35 000 joules every second.

(i)      Use the equation in the box to calculate the efficiency of the solar cells.

|  |
| --- |
|  |

         Show clearly how you work out your answer.

...........................................................................................................................

...........................................................................................................................

Efficiency = ..............................................................

**(2)**

(ii)     What happens to the energy that is **not** usefully transferred by the solar cells?

...........................................................................................................................

**(1)**

(c)     The aircraft propellers are driven by electric motors. As well as the solar cells, there are fuel cells that provide additional power to the electric motors.

(i)      Suggest **one** advantage of the aircraft having fuel cells as well as the solar cells.

...........................................................................................................................

**(1)**

(ii)     Give **one** environmental advantage of using electric motors to drive the aircraft propellers rather than motors that burn a fuel.

...........................................................................................................................

...........................................................................................................................

**(1)**

(iii)     Eventually, the designers want to produce an unmanned aircraft that can fly at twice the height of a passenger jet for up to six months.

         Suggest **one** possible use for an aircraft such as this.

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**(1)**

**(Total 8 marks)**

**Q3.**          A powerlifter lifts a 180 kg bar from the floor to above his head.

(a)     Use the equation in the box to calculate the weight of the bar.

|  |
| --- |
| weight    =    mass    ×    gravitational field strength |

gravitational field strength = 10 N/kg

Show clearly how you work out your answer.

........................................................................................................................

........................................................................................................................

                                               Weight = ............................................. N

**(2)**

(b)     The powerlifter uses a constant force to lift the bar a distance of 2.1 m.

Use the equation in the box to calculate the work done by the powerlifter.

|  |
| --- |
| work done    =    force applied    ×    distance moved in direction of force |

Show clearly how you work out your answer and give the unit.

Choose the unit from the list below.

|  |  |  |
| --- | --- | --- |
| **joule** | **newton** | **watt** |

........................................................................................................................

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                                           Work done = .............................................

**(3)**

(c)     At the end of the lift, the powerlifter holds the bar stationary, above his head, for two seconds.

How much work does the powerlifter do on the bar during these two seconds?

Draw a ring around your answer.

|  |  |  |  |
| --- | --- | --- | --- |
| **0** | **90** | **360** | **900** |

Give a reason for your answer.

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**(2)**

**(Total 7 marks)**

**Q4.**The diagram shows a climber part way up a cliff.

(a)     Complete the sentence.

When the climber moves up the cliff, the climber

gains gravitational ............................................ energy.

**(1)**

(b)     The climber weighs 660 N.

(i)      Calculate the work the climber must do against gravity, to climb to the top of the cliff.

Use the correct equation from the Physics Equations Sheet.

...............................................................................................................

...............................................................................................................

Work done = .................................................. J

**(2)**

(ii)     It takes the climber 800 seconds to climb to the top of the cliff.
During this time the energy transferred to the climber equals the work done by the climber.

Calculate the power of the climber during the climb.

Use the correct equation from the Physics Equations Sheet.

...............................................................................................................

...............................................................................................................

Power = .................................................. W

**(2)**

**(Total 5 marks)**

##

          (a)     In Britain most power stations burn fuel to produce heat. The diagram shows the stages by which the heat is transferred into electrical energy.
Complete the diagram by filling in the missing word.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Water heated to produce steam | → | Steam turns a turbine | → | Turbine turns a coil in a.......................... | → | Electricity is produced |

**(1)**

(b)     A fuel burning power station uses 2000 joules of fuel energy to generate 600 joules of electrical energy. The rest of the fuel energy is wasted as heat.

(i)      For every 600 joules of electrical energy generated, how much fuel energy is wasted as heat?

...........................................................................................................................

...........................................................................................................................

**(1)**

(ii)     Use the following equation to calculate the efficiency of the power station.
Show clearly how you work out your answer.

efficiency =

...........................................................................................................................

...........................................................................................................................

efficiency = ......................................................................

**(2)**

(c)     List **A** gives three energy resources used to generate electricity. List **B** gives environmental problems that may be caused by using different energy resources. Draw a straight line from each energy resource in List **A** to the environmental problem it may cause in List **B**. Draw **three** lines only.

**(3)**

(d)     A small wind generator is used to charge a battery. The graph shows the power output of the generator at different wind speeds.



(i)      What is the maximum power produced by the generator?

................................................................................................................. watts

**(1)**

(ii)     The generator is designed to stop if the wind speed is too high.

         At what wind speed does the generator stop working?

.................................................................................................................... m/s

**(1)**

(iii)     Give **one** disadvantage of using a wind generator to charge a battery.

...........................................................................................................................

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**(1)**

**(Total 10 marks)**

**Q6.**         The appliances shown below transfer electrical energy to other types of energy.

(a)     The vacuum cleaner is designed to transfer electrical energy to kinetic energy.

Three more of the appliances are also designed to transfer electrical energy to kinetic energy. Which **three**?

Draw a ring around each correct appliance.

**3**

(b)     Which **two** of the following statements are true?

Tick () **two** boxes.



|  |  |
| --- | --- |
| Appliances only transfer part of the energy usefully. |  |
| The energy transferred by appliances will be destroyed. |  |
| The energy transferred by appliances makes the surroundings warmer. |  |
| The energy output from an appliance is bigger than the energy input. |  |

**(2)**

**(Total 5 marks)**

**Q7.**          (a)     The pictures show four objects. Each object has had its shape changed.

          Which of the objects are storing elastic potential energy?

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          Explain the reason for your choice or choices.

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**(3)**

(b)     A student makes a simple spring balance. To make a scale, the student uses a range of weights. Each weight is put onto the spring and the position of the pointer marked

          The graph below shows how increasing the weight made the pointer move further.



(i)      Which **one** of the following is the unit of weight?.

Draw a ring around your answer.

          **joule**           **kilogram**             **newton**                  **watt**

**(1)**

(ii)     What range of weights did the student use?

...........................................................................................................................

**(1)**

(iii)     How far does the pointer move when 4 units of weight are on the spring?

...........................................................................................................................

**(1)**

(iv)    The student ties a stone to the spring. The spring stretches 10 cm.

         What is the weight of the stone?

...........................................................................................................................

**(1)**

**(Total 7 marks)**

**Q8.**The picture shows a temporary road traffic information board.

The batteries power the LEDs used in the information board.
The solar cells keep the batteries charged.

(a)     Use words from the box to complete each of the following sentences.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|   | **chemical** | **electrical** | **light** | **sound** |

The solar cells transfer light energy to ............................................................. energy.

The batteries transfer ............................................................. energy to electrical energy.

The LEDs transfer electrical energy to ............................................................. energy.

**(3)**

(b)     When the total energy input to the solar cells is 200 joules, the useful energy output from the solar cells to the batteries is 50 joules.

Calculate the efficiency of the solar cells.

Use the correct equation from the Physics Equations Sheet.

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........................................................................................................................

Efficiency = ......................................................

**(2)**

(c)     Which **one** of the following statements gives the reason for using solar cells to charge the batteries?

Tick () **one** box.



|  |  |  |
| --- | --- | --- |
|   | Solar cells will charge the batteries day and night. |   |
|   | The information board can be used anywhere it is needed. |   |
|   | A small number of solar cells produce a lot of electricity. |   |

**(1)**

**(Total 6 marks)**

**Q9.Figure 1** shows a man using a leaf blower to move leaves.

The leaf blower is powered by an electric motor connected to a battery.

(a)     Energy transfers take place when the leaf blower is being used.

Complete the following sentences.

The battery stores ............................................ energy which is transferred into

electrical energy.

The electric motor transfers electrical energy usefully into

............................................ energy.

The motor wastes energy as ............................................ and as energy that

heats the surroundings.

**(3)**

(b)     **Figure 2** shows a Sankey diagram for the leaf blower.

Use **Figure 2** to calculate the efficiency of the leaf blower.

Use the correct equation from the Physics Equations Sheet.

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Efficiency = ............................................

**(2)**

**(Total 5 marks)**

**Q10.**          The pictures show six different household appliances.

(a)     Four of the appliances, including the fan heater, are designed to transform electrical energy into heat.

Name the other **three** appliances designed to transform electrical energy into heat.

1 .................................................................................................................................

2 .................................................................................................................................

3 .................................................................................................................................

**(3)**

(b)     Complete the following sentence using **one** of the words from the box.

|  |
| --- |
| **chemical**            **heat**            **kinetic**             **sound** |

Energy that is not usefully transformed by the fan heater is wasted as

................................................. energy.

**(1)**

(c)     The table gives information about two different fan heaters.

|  |  |  |
| --- | --- | --- |
|   | **Useful energytransferred eachsecond in joules** | **Wasted energytransferred eachsecond in joules** |
| Fan heater **L** | 1200 | 10 |
| Fan heater **M** | 1200 | 20 |

          Complete the following sentence by drawing a ring around the line in the box that is correct.

|  |  |  |
| --- | --- | --- |
| Fan heater **L** | is more efficient thanhas the same efficiency asis less efficient than | fan heater **M**. |

**(1)**

**(Total 5 marks)**

**Q11.**          A car burns petrol as it travels along a flat road.

          The diagram shows what happens to each 100 joules (J) of energy released by burning the petrol.

          Complete the diagram by adding the missing numbers.

**(Total 3 marks)**

**Q12.**          (a)     The diagram shows a builder using a plank to help load rubble into a skip.

The builder uses a force of 220 N to push the wheelbarrow up the plank.

Use information from the diagram and the equation in the box to calculate the work done to push the wheelbarrow up the plank to the skip.

|  |
| --- |
| work done    =    force applied    ×    distance moved in the direction of force |

Show clearly how you work out your answer.

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........................................................................................................................

                          Work done = ............................................................ J

**(2)**

(b)     A student investigated how the force needed to pull a brick up a slope, at a steady speed, depends on the angle of the slope.
The apparatus used by the student is shown in the diagram.

The student used the results from the investigation to plot the points for a graph of force used against the angle of the slope.

(i)      Draw a line of best fit for these points.

**(1)**

(ii)     How does the force used to pull the brick up the slope change as the angle of the slope increases?

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**(1)**

(iii)    Consider the results from this experiment.
Should the student recommend that the builder use a long plank or a short plank to help load the skip?

Draw a ring around your answer.

|  |  |
| --- | --- |
| **long plank** | **short plank** |

Explain the reason for your answer.

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**(2)**

**(Total 6 marks)**

**Q13.**          (a)     The diagram shows a cable car used to take skiers to the top of a mountain.

(i)      The total mass of the cable car and skiers is 7500 kg.

Use the equation in the box to calculate the weight of the cable car and skiers.

|  |
| --- |
| weight    =    mass    ×    gravitational field strength |

gravitational field strength = 10 N/kg

Show clearly how you work out your answer and give the unit.

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...............................................................................................................

      Weight = .........................................................................................

**(3)**

(ii)     The cable car moves at a constant speed. It lifts skiers through a vertical height of 800 metres in 7 minutes.

Use the following equation to calculate the work done to lift the cable car and skiers.

|  |
| --- |
| work done    =    force applied    ×    distance moved in the direction of force |

Show clearly how you work out your answer.

...............................................................................................................

...............................................................................................................

                                       Work done = ............................................... J

**(2)**

(b)     The diagram shows a skier who is accelerating down a steep ski slope.

(i)      Draw an arrow on the diagram to show the direction of the resultant force acting on the skier.

**(1)**

(ii)     How and why does the kinetic energy of the skier change?

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**(2)**

(c)     Last year, 18 000 skiers suffered a head injury. It is thought that nearly 8000 of these injuries could have been avoided if the skier had been wearing a helmet.
However, at present, there are no laws to make skiers wear helmets.

Suggest why skiers should be made aware of the benefits of wearing a helmet.

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........................................................................................................................

**(1)**

**(Total 9 marks)**

**Q14.**          A rocket has a mass of 5000 kg and is travelling at a speed of 600 m/s.



          Calculate the rocket’s kinetic energy in kilojoules. Show your working.

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Kinetic energy = .............................. kJ

**(Total 3 marks)**

**Q15.**          The diagram shows a wind turbine.

(a)     The blades of the turbine are 20 metres long. On average, 15 000 kg of air, moving at a speed of 12 m/s, hit the blades every second.

Use the equation in the box to calculate the kinetic energy of the air hitting the blades every second.

|  |
| --- |
| kinetic energy   =      ×   mass   ×   speed2 |

Show clearly how you work out your answer.

........................................................................................................................

........................................................................................................................

                               Kinetic energy = .................................................. J

**(2)**

(b)     Part of the kinetic energy of the wind is transformed into electrical energy.
The diagram shows that, for the same wind speed, the power output of a turbine, in kilowatts, depends on the length of the turbine blades.

Give a reason why doubling the diameter of the blades more than doubles the power output of a turbine.

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**(1)**

**(Total 3 marks)**

**Q16.**          The diagram below shows water falling over a dam at the end of a reservoir. The water falls a vertical distance of 10 m.



(a)     Calculate the potential energy of 1 kg of water at the top of the waterfall.

.....................................................................................................................................

.....................................................................................................................................

Answer ............................... J

**(2)**

(b)     What will be the kinetic energy of 1 kg of the water just before it lands in the pool?

.....................................................................................................................................

Answer ............................... J

**(1)**

(c)     Use your answer to (b) to calculate the speed of the water as it lands at the bottom of the waterfall.

.....................................................................................................................................

.....................................................................................................................................

.....................................................................................................................................

Answer .......................... m/s

**(3)**

**(Total 6 marks)**

**Q17.**          The diagram shows a high jumper.

          In order to jump over the bar, the high jumper must raise his mass by 1.25 m.
The high jumper has a mass of 65 kg. The gravitational field strength is 10 N/kg.

(a)     The high jumper just clears the bar.

          Use the following equations to calculate the gain in his gravitational potential energy.

|  |
| --- |
| **weight            =            mass              ×            gravitational field strength****(newton, N)               (kilogram, kg)                      (newton/kilogram, N/kg)** |

|  |
| --- |
| **change in gravitational potential energy  =  weight  ×  change in vertical height**           **(joule, J)                                              (Newton, N)           (metre, m)** |

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Gain in gravitational potential energy .................... J

**(4)**

(b)     Use the following equation to calculate the minimum speed the high jumper must reach for take-off in order to jump over the bar.

**kinetic energy =                ×        mass           ×               [speed]2**

**(joule, J)                              (kilogram, kg)               [(metre/second)2, (m/s)2**

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.....................................................................................................................................

.....................................................................................................................................

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Speed .................... m/s

**(3)**

**(Total 7 marks)**

**Q18.**          The molten rock flowing from an erupting volcano can reach a speed of 8 m/s.

(i)      Write down the equation that links kinetic energy, mass and speed.

.....................................................................................................................................

**(1)**

(ii)      Calculate the kinetic energy of 1 tonne of molten rock flowing at 8 m/s.
(1 tonne = 1000 kg)

.....................................................................................................................................

.....................................................................................................................................

Kinetic energy = ............................................ joules

**(1)**

**(Total 2 marks)**