CCEA GCSE SCIENCE: DOUBLE AWARD (MODULAR)

SCIENCE



EXAM QUESTION PACK

END OF MODULE TEST C HIGHER TIER GDC02 PAPERS

STEMUP

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Rewarding Learning

Centre Number

71	

Candidate Number

General Certificate of Secondary Education
2011–2012

Science: Double Award (Modular)

Forces and Energy

End of Module Test

Higher Tier

C

[GDC02]

GDC02

THURSDAY 24 MAY 2012, MORNING

TIME

45 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Write your answers in the spaces provided in this question paper.
Answer **all twelve** questions.

INFORMATION FOR CANDIDATES

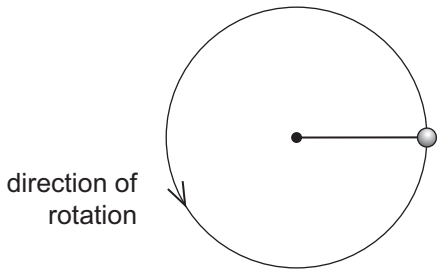
The total mark for this paper is 50.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
Total Marks	

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Examiner Only	
Marks	Remark

1 The diagram shows a bird's eye view of a ball being whirled in a horizontal circle.



(a) Draw an arrow to show the direction in which the ball moves as soon as the string breaks. [1]

(b) The ball has a mass of 0.6 kg and at the instant the string breaks the velocity of the ball is 3.0 m/s.

Calculate the momentum of the ball.

You are advised to show your working out.

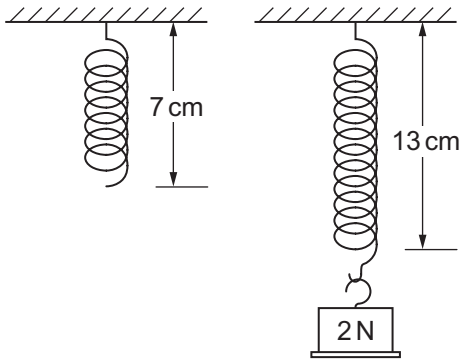
Momentum = _____ kg m/s [3]

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Examiner Only	
Marks	Remark

2 **(a)** A spring has a natural length of 7 cm.

When loaded with a 2 N weight, the total length of the spring is 13 cm.



What weight would extend the spring so that its total length is 22 cm?

You are advised to show your working out.

Weight = _____ N [3]

(b) Describe what happens to the spring if it is stretched beyond its elastic limit.

_____ [1]

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Examiner Only	
Marks	Remark

3 A soldier on guard weighs 650 N. His boots have a total area of 0.02 m^2 in contact with the ground.



Calculate the pressure the soldier exerts on the ground.

Remember to include the unit for pressure.

You are advised to show your working out.

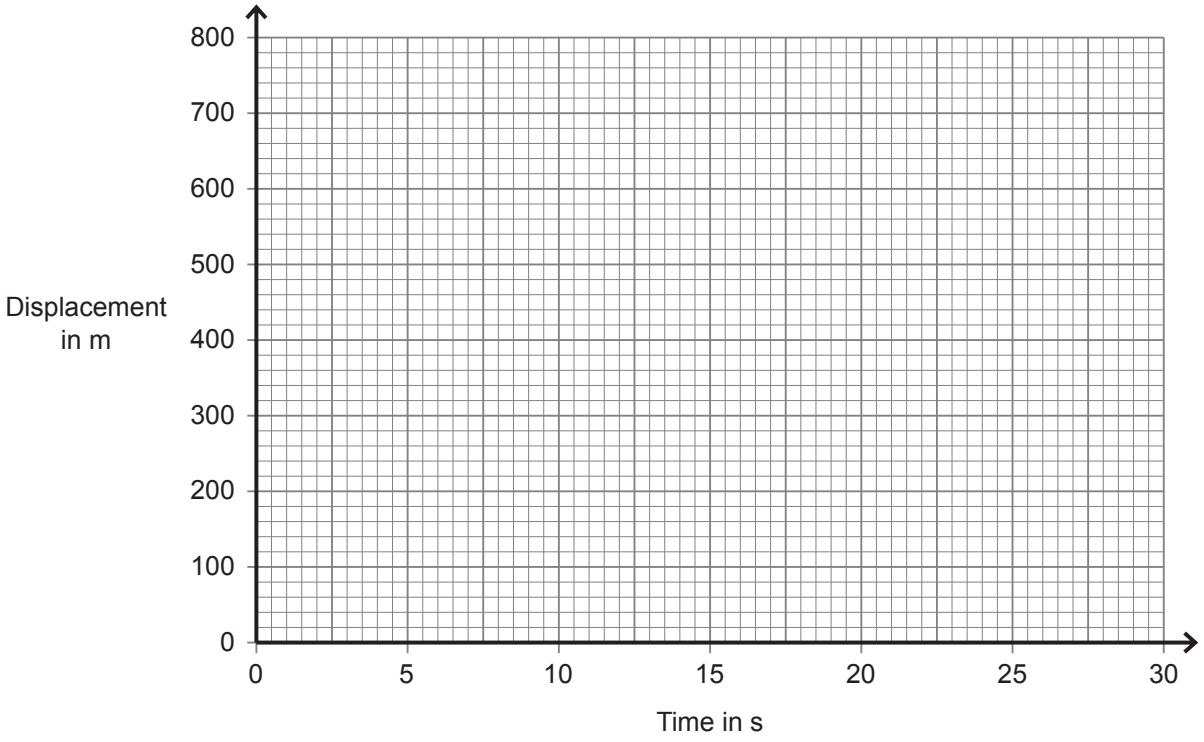
Pressure = _____ [4]

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4 The table of results shows how the displacement of a car varies with time.

Displacement in m	0	150	300	450	600	750
Time in s	0	5	10	15	20	25

(a) Use the grid to draw a graph of displacement against time for the car.



[2]

(b) Use the graph to calculate the velocity of the car.

You are advised to show your working out.

Velocity = _____ m/s [3]

Examiner Only

Marks	Remark

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Examiner Only	
Marks	Remark

5 **(a)** When a lawnmower is supplied with 1500 J of electrical energy, the useful work done is 240 J.

Calculate the efficiency of the lawnmower.

You are advised to show your working out.

Efficiency = _____ [3]

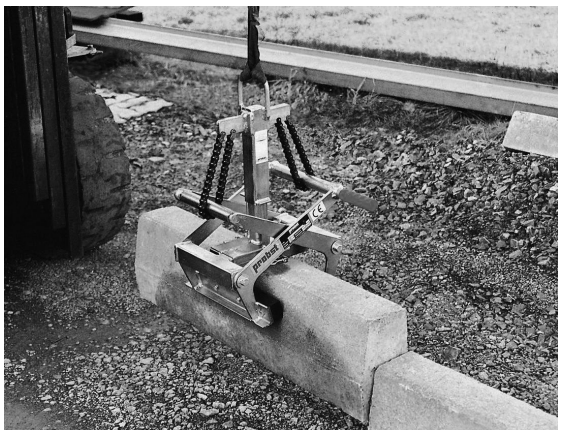
(b) Calculate the amount of energy converted into heat and sound.

Energy converted = _____ J [1]

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Examiner Only	
Marks	Remark

6 A motor is used on a building site to lift a block of stone.



© Probst Handling Equipment

(a) Calculate the work done by the motor in lifting the block of stone of weight 120 N through a height of 1.5 m.

You are advised to show your working out.

Work done = _____ J [3]

(b) Calculate the power of the motor if it does this work in 15 seconds.

You are advised to show your working out.

Power = _____ W [3]

7 Various energy resources are used to produce electricity.

Name an energy resource which is:

(i) renewable but does not get its energy from the sun.

_____ [1]

(ii) renewable but unreliable.

_____ [1]

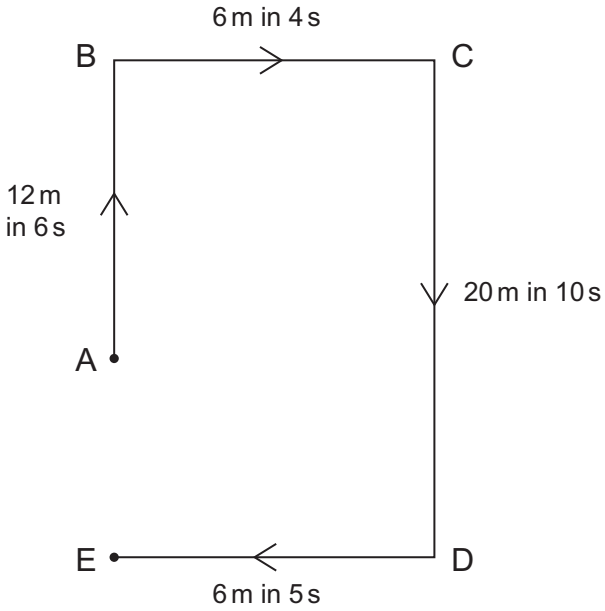
(iii) a fossil fuel and responds quickest to changes in demand.

_____ [1]

Examiner Only	
Marks	Remark

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8 The diagram below shows a bird's eye view of a child running in the playground. Distances and times are given for each stage.



Calculate the child's average velocity for the whole journey from A to E.

You are advised to show your working out.

Average velocity = _____ m/s [3]

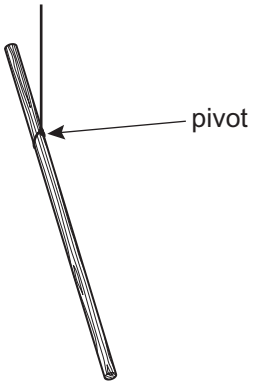
Examiner Only

Marks	Remark

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Examiner Only	
Marks	Remark

9 Maureen makes a simple bird perch by tying a piece of string to a uniform piece of wooden rod.

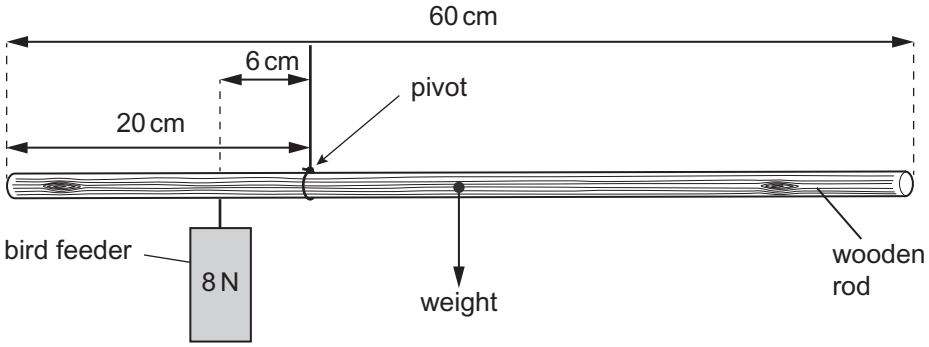


(a) Why does the wooden rod not lie horizontally?

_____ [1]

The rod is 60 cm long and Maureen ties the string 20 cm from one end.

She now hangs a bird feeder, of weight 8 N, on one side and moves it until the perch is horizontal, as in the diagram below.



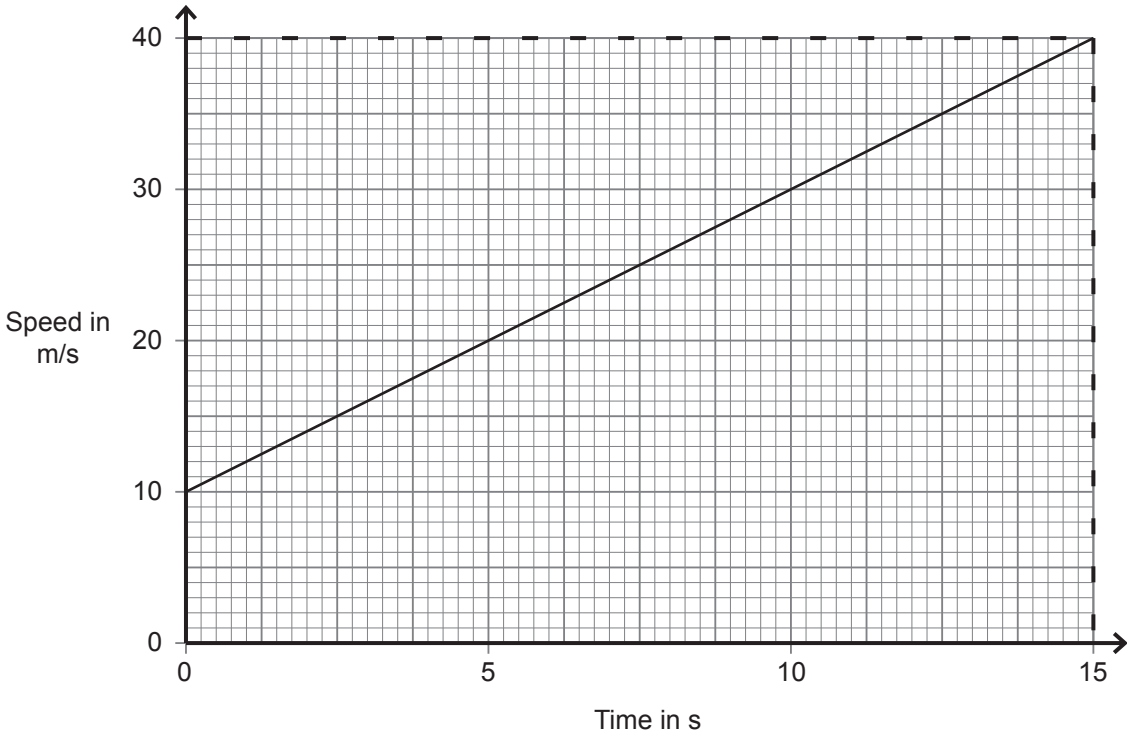
(b) Use the principle of moments to calculate the weight of the wooden rod.

You are advised to show your working out.

Weight = _____ N [4]

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10 During part of a journey a car accelerates from 10 m/s to 40 m/s in 15 seconds. A graph of this part of the journey is shown.



Calculate the distance travelled during this time.

You are advised to show your working out.

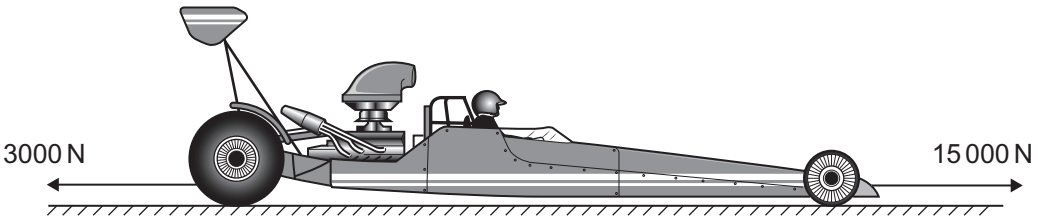
Distance = _____ m [4]

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Marks	Remark

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11 The forces acting on a dragster car of mass 800 kg are shown below.



By first finding the resultant force, calculate the acceleration of the dragster car.

You are advised to show your working out.

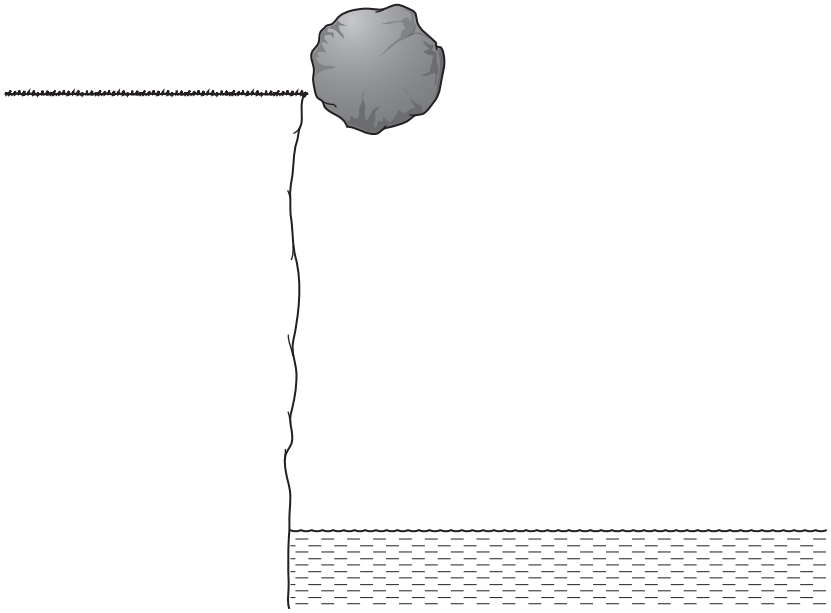
Acceleration = _____ m/s^2 [4]

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Marks	Remark

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12 A boulder of mass 15 kg and gravitational potential energy of 6750 J falls off the edge of a cliff into the sea.



Use the principle of conservation of energy to calculate the velocity of the boulder just as it strikes the water.

You are advised to show your working out.

Velocity = _____ m/s [4]

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Marks	Remark

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Rewarding Learning

General Certificate of Secondary Education
2011–2012

Science: Double Award (Modular)

Forces and Energy
End of Module Test
Higher Tier

C

[GDC02]

THURSDAY 24 MAY 2012
9.15 am–10.00 am

MARK SCHEME

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			AVAILABLE MARKS
1	**(a)** Arrow tangentially upwards	[1]	
	(b) Momentum = Mass × Velocity **or** p = mv [1] = 0.6 × 3.0 [1] = 1.8 (kg m/s) [1]	[3]	4
2	**(a)** 2 N ≡ 6 cm [1] 1 N ≡ 3 cm [1] 5 N ≡ 15 cm [1]	[3]	
	(b) Permanently deformed	[1]	4
3	Pressure = $\frac{\text{Force}}{\text{Area}}$ **or** P = F/A [1] = $\frac{650}{0.02}$ [1] = 32 500 [1] Pa or N/m^2 [1]	[4]	4
4	**(a)** 5 or 6 points correct [1] Straight line through (0,0) [1]	[2]	
	(b) e.g. Grad. = Velocity [1] = $\frac{300}{10}$ [1] = 30 (m/s) [1]	[3]	5
5	**(a)** Efficiency = $\frac{\text{Useful output energy}}{\text{Input energy}}$ [1] = $\frac{240}{1500}$ [1] = 0.16 or 16% [1]	[3]	
	(b) 1260 (J)	[1]	4
6	**(a)** WD = F × d [1] = 120 × 1.5 [1] = 180 (J) [1]	[3]	
	(b) Power = $\frac{WD}{t}$ [1] = $\frac{180}{15}$ [1] allow e.c.f. from (**a**) = 12 (W) [1]	[3]	6

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			AVAILABLE MARKS
7	**(i)** Geothermal	[1]	
	(ii) Wind **or** Wave **or** Solar	[1]	
	(iii) Gas	[1]	3
8	Average velocity = displacement/time [1] = 8/25 [1] = 0.32 (m/s) [1]	[3]	3
9	**(a)** String not tied at c of g (or middle) **or** weight provides a (turning) moment **or** moments not balanced	[1]	
	(b) CM = ACM [1] W × 10 [1] = 8 × 6 [1] W = 4.8 (N) [1]	[4]	5
10	Distance = area under graph [1] = (10 × 15) [1] + $\frac{1}{2}$ (30 × 15) [1] = 375 (m) [1]	[4]	4
11	F_R = 12 000 (N) [1] F_R = ma [1] 12 000 = 800 × a [1] a = 15 (m/s^2) [1]	[4]	4
12	PE = KE [1] KE = $\frac{1}{2}$ mv^2 [1] 6750 = $\frac{1}{2}$ × 15 × v^2 [1] v = 30 (m/s) [1]	[4]	4
		Total	**50**

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Rewarding Learning

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71	

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General Certificate of Secondary Education
2011–2012

Science: Double Award (Modular)

Forces and Energy

End of Module Test

Higher Tier

C

[GDC02]

GDC02

WEDNESDAY 29 FEBRUARY 2012
9.30 am–10.15 am

TIME

45 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Write your answers in the spaces provided in this question paper.
Answer **all twelve** questions.

INFORMATION FOR CANDIDATES

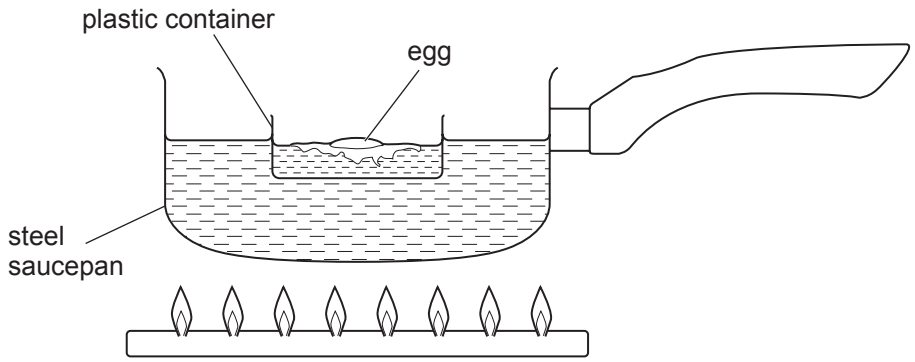
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12	
Total Marks	

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Examiner Only	
Marks	Remark

1 Jamie poaches an egg by setting it in a plastic container which floats in a saucepan of hot water. The saucepan is made of steel and sits on a gas cooker.



(a) (i) What is the method of heat transfer through the bottom of the steel saucepan?

_____ [1]

(ii) What is the particle mainly responsible for this process?

_____ [1]

(b) (i) What is the method of heat transfer through the plastic container?

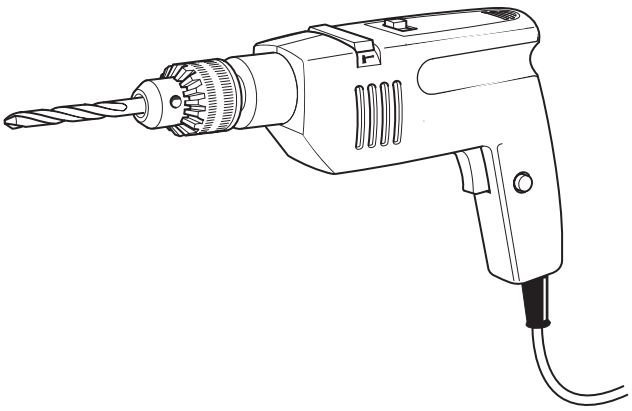
_____ [1]

(ii) What is the particle responsible for this process?

_____ [1]

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2 Patricia uses an electric drill to drill a hole.



Choose the appropriate data to calculate the efficiency of the drill.

75 J of heat energy were produced.
200 J of electrical energy were used.
80 J of kinetic energy were produced in the drill bit.
45 J of sound energy were produced.

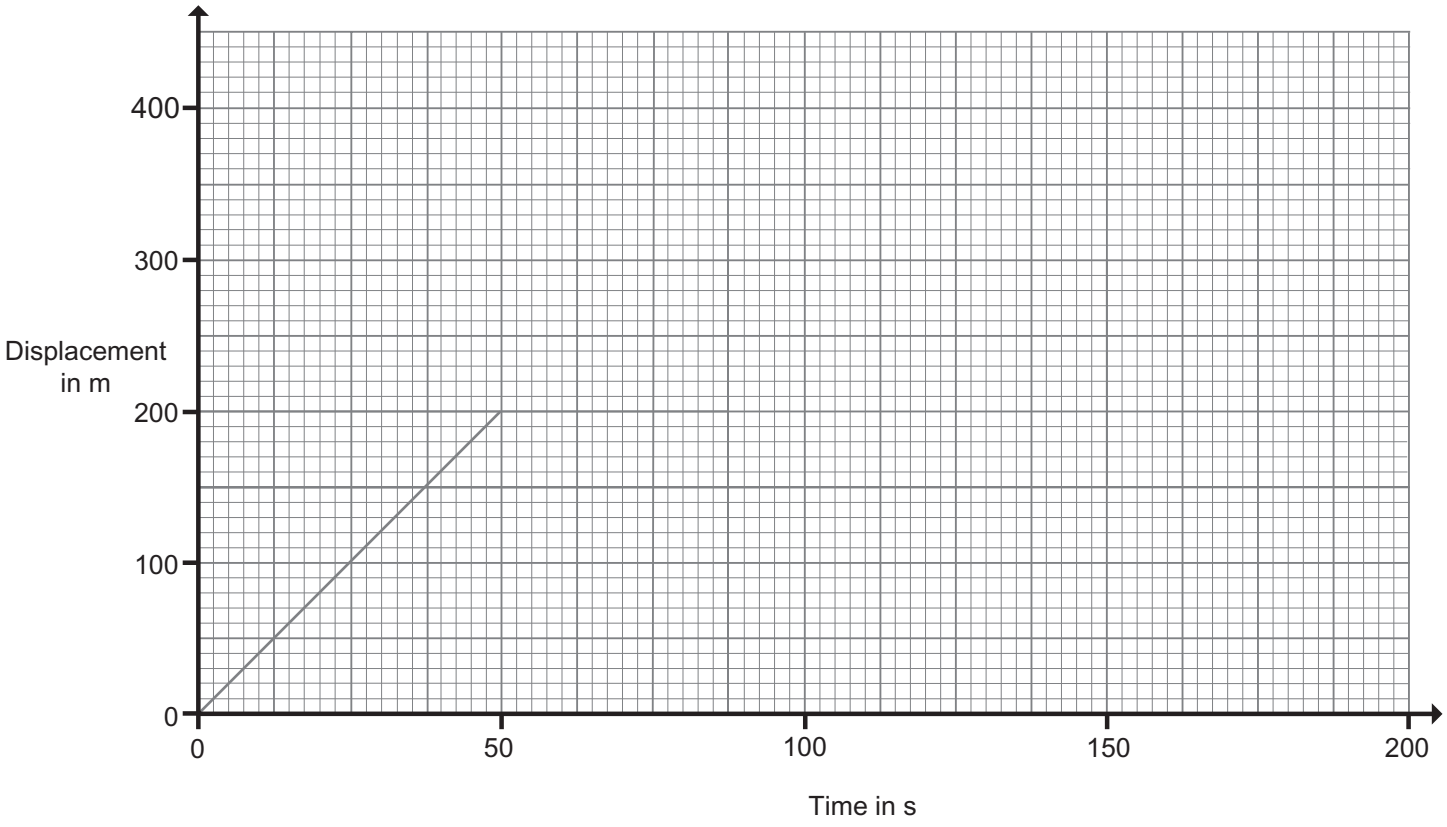
You are advised to show your working out.

Efficiency = _____ [3]

Examiner Only

Marks	Remark

3 A cyclist travels a distance of 200 m in 50 seconds. This is shown in the displacement–time graph below.



The cyclist then rests for 50 seconds before returning to his starting point at a steady speed in a further 100 seconds.

(i) Complete the displacement–time graph for the journey. [2]

(ii) What is the total distance travelled by the cyclist in 200 seconds?

Total distance = _____ m [1]

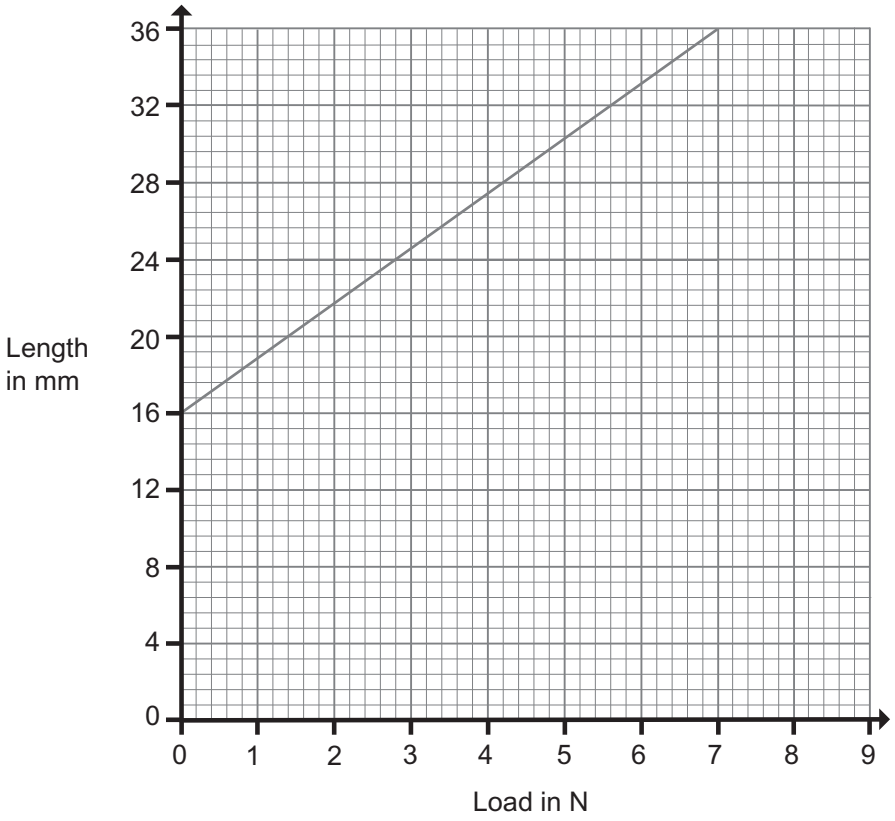
Examiner Only	
Marks	Remark

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Examiner Only	
Marks	Remark

4 Phyllis carries out a Hooke's Law investigation using a spiral spring.

She plots her results on a graph as shown.



(a) What is the unstretched length of the spring?

Unstretched length = _____ mm [1]

(b) How can you tell, from the graph, that the spring has not been stretched beyond its elastic limit?

_____ [1]

(c) **(i)** Phyllis could have investigated Hooke's Law by plotting a more suitable graph. What should she have plotted on the vertical y-axis?

_____ [1]

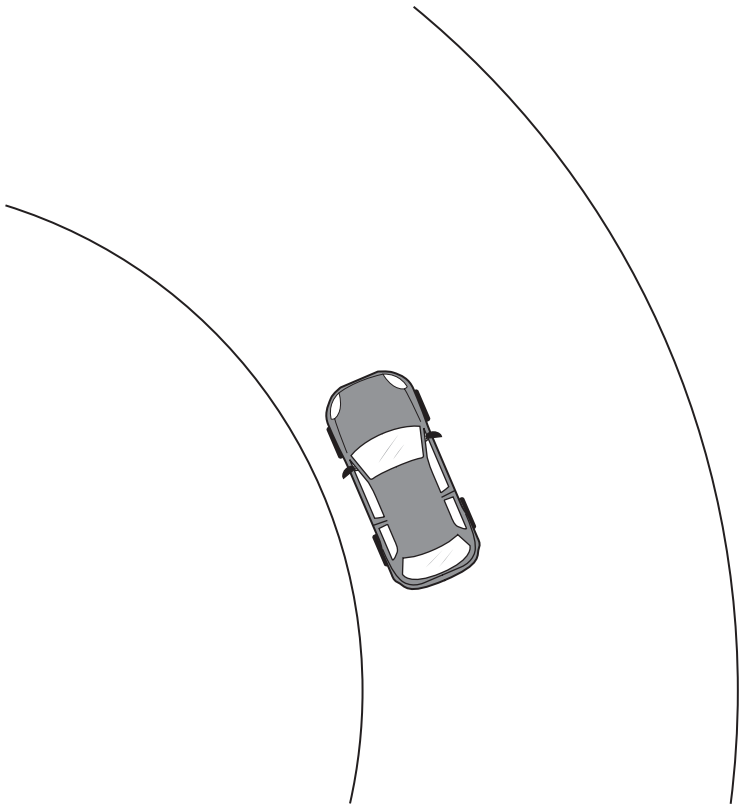
(ii) An unknown load is hung on the spring and the extension produced is 20 mm.
What is the unknown load?

You are advised to show your working out.

Load = _____ N [2]

Examiner Only	
Marks	Remark

5 The diagram shows a bird's eye view of a car of mass 2000 kg going round a circular track at a constant speed of 7 m/s.



(a) Calculate the momentum of the car.

You are advised to show your working out.

Momentum = _____ kgm/s [3]

In order to move in a curve around the corner a force, called a centripetal force, must act on the car.

(b) What supplies the centripetal force in this case?

Centripetal force supplied by _____ [1]

(c) In what direction does this force act?

_____ [1]

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Examiner Only	
Marks	Remark

6 A weightlifter raises a set of weights into the air.



The weight at each end of the bar is 200 N and the bar weighs 100 N.

(a) What is the **total** weight lifted by the weightlifter?

Total weight = _____ N [1]

The weightlifter raises the total weight through a distance of 2 m into the air in a time of 1.5 seconds.

(b) Calculate the power developed by the weightlifter.
Remember to include the unit.

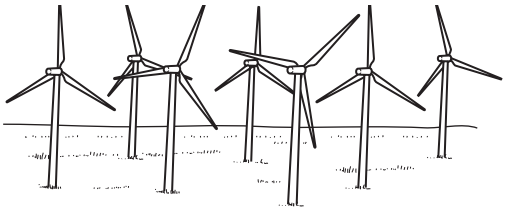
You are advised to show your working out.

Power = _____ [5]

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Examiner Only	
Marks	Remark

7 The picture shows a wind farm using several wind generators to produce electricity.



(a) What energy change is a wind generator designed to bring about?

_____ [1]

(b) **(i)** State one disadvantage of using wind power to generate electricity.

_____ [1]

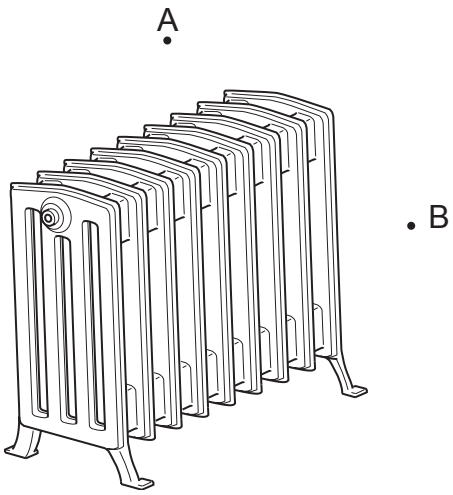
(ii) State one advantage of using wind power to generate electricity.

_____

_____ [1]

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8 The diagram shows a steel radiator containing hot water.



Point A is vertically above the radiator whereas point B is to the side of the radiator. A and B are the same distance from the radiator.

Explain fully why the temperature at A is higher than the temperature at B.

_____

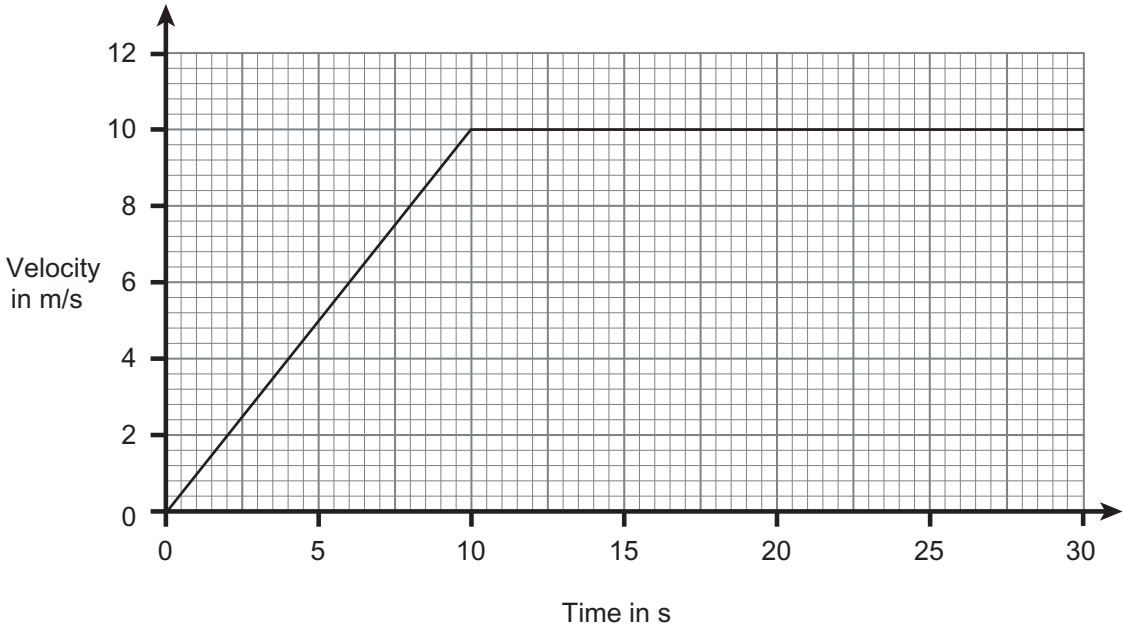
_____ [2]

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Marks	Remark

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9 The velocity-time graph for a car moving off from traffic lights is shown below.



How far did the car travel in the 30 seconds of its journey?

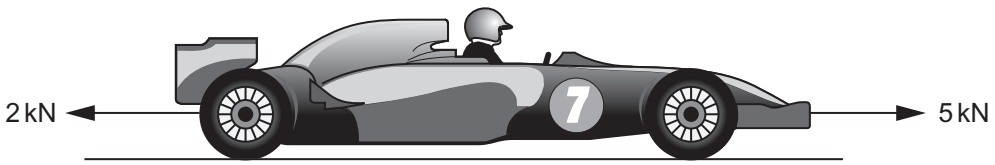
You are advised to show your working out.

Distance = _____ m [4]

Examiner Only

Marks	Remark

10 The forces acting on a racing car are as shown in the diagram.



(a) Explain why the racing car is accelerating.

_____

_____ [1]

(b) The mass of the racing car is 750 kg.

Calculate the acceleration of the racing car.

You are advised to show your working out.

Acceleration = _____ m/s^2 [3]

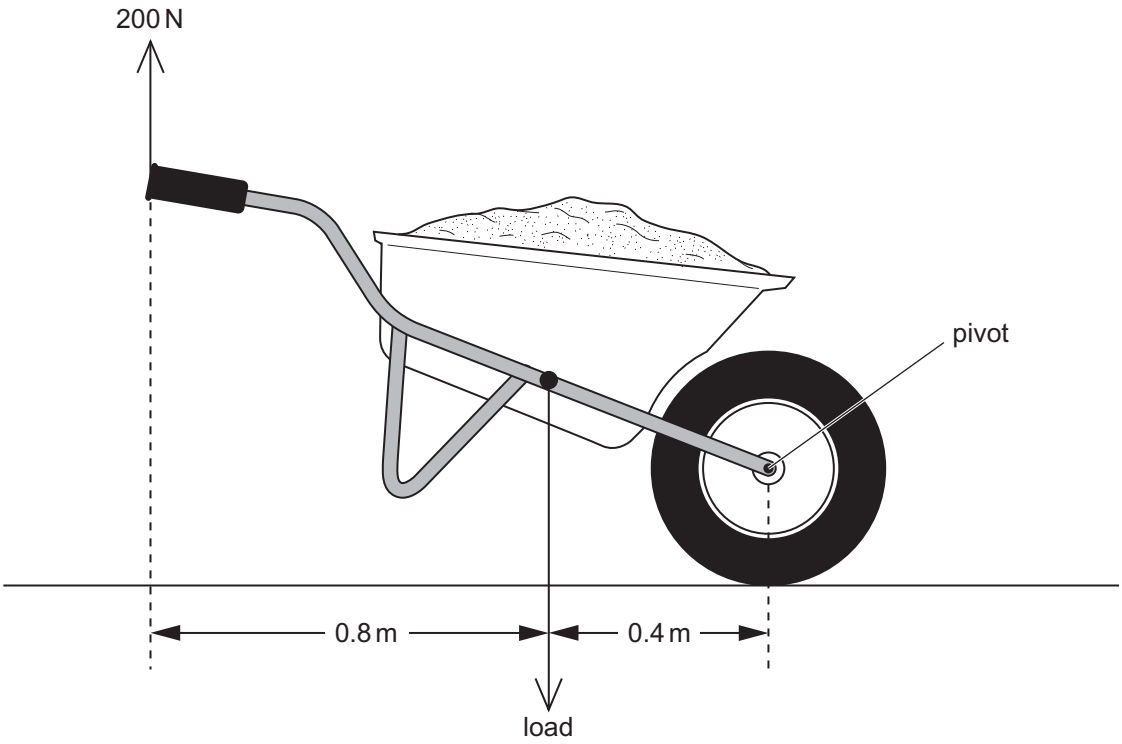
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Marks	Remark

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11 A gardener is moving sand in a wheelbarrow.

Examiner Only	
Marks	Remark



The gardener exerts a force of 200 N at the ends of the handles of the wheelbarrow, as shown, so that he can just lift the wheelbarrow.

(a) What is the moment about the pivot in Nm that the gardener can produce with this 200 N force?

You are advised to show your working out.

Moment = _____ Nm [2]

(b) Use the Principle of Moments to calculate the maximum load the gardener can lift in the wheelbarrow.

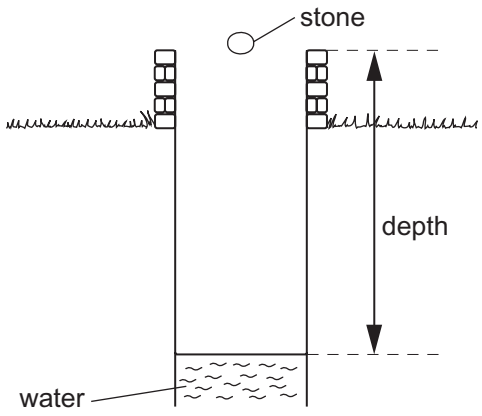
You are advised to show your working out.

Maximum load = _____ N [3]

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Examiner Only	
Marks	Remark

12 A stone of mass 1.5 kg is dropped from rest down a well. The stone hits the water with a speed of 40 m/s.



(a) Calculate the kinetic energy of the stone as it hits the water.

You are advised to show your working out.

Kinetic energy = _____ J [3]

(b) Use the Principle of Conservation of Energy to calculate the depth of the well.

You are advised to show your working out.

Depth = _____ m [3]

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Rewarding Learning

General Certificate of Secondary Education
2011–2012

Science: Double Award (Modular)

Forces and Energy

End of Module Test

Higher Tier

C

[GDC02]

WEDNESDAY 29 FEBRUARY 2012

9.30 am–10.15 am

MARK SCHEME

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			AVAILABLE MARKS
1	**(a)** **(i)** conduction	[1]	
	(ii) electron	[1]	
	(b) **(i)** conduction	[1]	
	(ii) atom/molecule	[1]	4
2	E = useful energy output/energy input [1] = 80/200 [1] = 0.4 (40%) [1]	[3]	3
3	**(i)** horizontal line from (50, 200) to (100, 200) [1] line from (100, 200) to (200, 0) [1]	[2]	
	(ii) 400 (m) [1]	[1]	3
4	**(a)** 16 (mm)	[1]	
	(b) line is straight	[1]	
	(c) **(i)** Extension	[1]	
	(ii) Total length = 36 mm (or 20 + 16) [1] Load = 7 (N) [1]	[2]	5
5	**(a)** momentum = mass × vel [1] = 2000 × 7 [1] = 14 000 (kgm/s) [1]	[3]	
	(b) friction [1]	[1]	
	(c) towards the centre (of the curve) [1]	[1]	5
6	**(a)** 500 (N)	[1]	
	(b) Power = work done/time [1]	[1]	
	= (500 × 2)/1.5 [2] ecf from (a)	[2]	
	= 666.7 [1] W [1]	[2]	6

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			AVAILABLE MARKS
7	**(a)**	Kinetic to electrical Both for [1] [1]	
	(b) **(i)**	Unreliable, requires a lot of area, visual pollution, remote from population Any 1 for [1] [1]	
	(ii)	Non polluting, conserves fossil fuels, Any 1 for [1] [1]	3
8		More [1] warm air rises [1] or more [1] convection at A [1] or warm air rises [1] and cold air falls [1] [dependent marking]	2
9		Displacement = Area Under [1] or Disp. = Av. Vel × time $= (\frac{1}{2} \times 10 \times 10) + (10 \times 20)$ [2] = 250 [1] (m) [4]	4
10	**(a)**	Forwards force > backwards force or Unbalanced forces or because there is a resultant force [1]	
	(b)	(R)F = m × a [1] 3000 = 750 × a [1] a = 4 [1] (m/s^2) [3]	4
11	**(a)**	moment = F × d or moment = 200 × 1.20 } [1] = 240 (Nm) [1] [2]	
	(b)	ACM = CM [1] Load × 0.40 = 240 [1] allow ecf from (a) Load = 600 (N) [1] [3]	5
12	**(a)**	KE = $\frac{1}{2}mv^2$ [1] KE = $\frac{1}{2} \times 1.5 \times (40)^2$ [1] KE = 1200 (J) [1] [3]	
	(b)	PE = KE [1] 1.5 × g × h = 1200 [1] allow ecf from (a) h = 80 [1] (m) [3]	6
		Total	**50**

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Rewarding Learning

Centre Number

71	

Candidate Number

General Certificate of Secondary Education
2011–2012

Science: Double Award (Modular)

Forces and Energy

End of Module Test

C

Higher Tier

[GDC02]

GDC02

MONDAY 14 NOVEMBER 2011
1.30 pm–2.15 pm

TIME

45 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Write your answers in the spaces provided in this question paper.
Answer **all twelve** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 50.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
Total Marks	

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1 An electric drill uses 800 J of electrical energy. 200 J of this energy is turned into heat and sound.

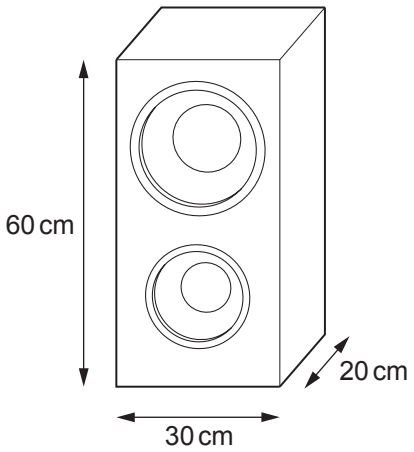
Calculate the efficiency of the electric drill.

You are advised to show your working out.

Efficiency = _____ [3]

Examiner Only	
Marks	Remark

2 A loudspeaker sits on a floor.



(i) Calculate the base area of the loudspeaker, in cm^2.

Area = _____ cm^2 [1]

(ii) The weight of the loudspeaker is 200 N. Use your answer to part **(i)** to calculate the pressure it exerts on the floor, in N/cm^2.

You are advised to show your working out.

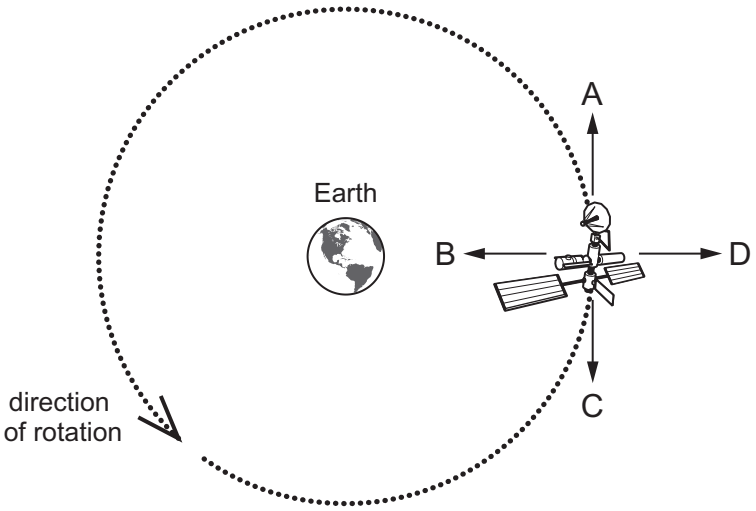
Pressure = _____ N/cm^2 [3]

Examiner Only

Marks	Remark

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3 A satellite orbits the earth. Four directions are shown on the satellite.



(a) (i) Which letter gives the direction of the force which keeps the satellite moving in a circular orbit?

Letter _____ [1]

(ii) Which letter gives the direction of the weight of the satellite?

Letter _____ [1]

(b) The mass of the satellite is 160 kg and it is moving at a steady speed of 2000 m/s. Calculate the satellite's momentum.

You are advised to show your working out.

Momentum = _____ kg m/s [3]

Examiner Only

Marks	Remark

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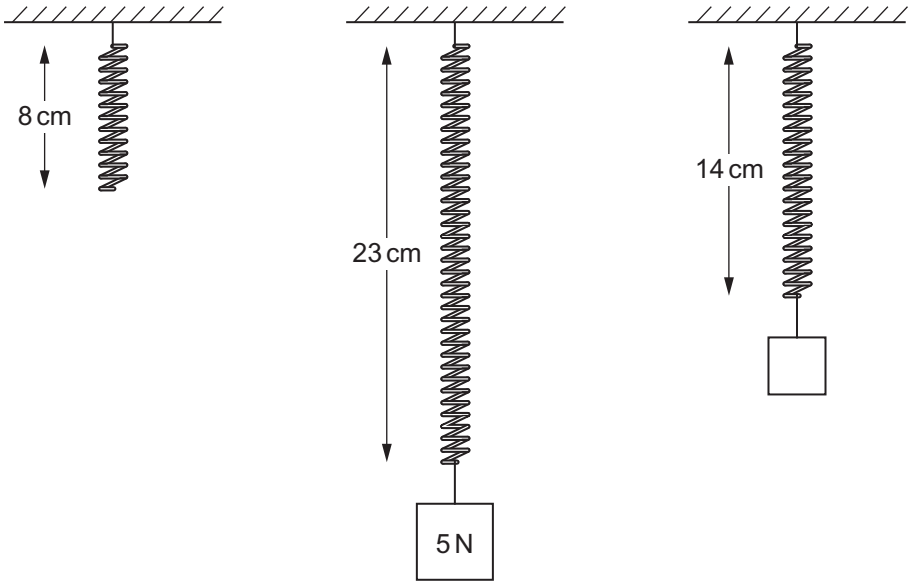
4 **(a)** State Hooke's Law.

Examiner Only

Marks	Remark

_____

_____ [2]



(b) A spring has a natural length of 8 cm. When loaded with a 5 N weight the total length of the spring is 23 cm. What weight would extend the spring so that its total length is 14 cm?

You are advised to show your working out.

Weight = _____ N [3]

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5 Heat energy can be transferred from one point to another by different methods.

Listed below are a number of different statements. After each statement write down the name of the relevant method of heat transfer.

Involves vibrating atoms. _____

Does not require a medium. _____

Involves electrons colliding with atoms. _____

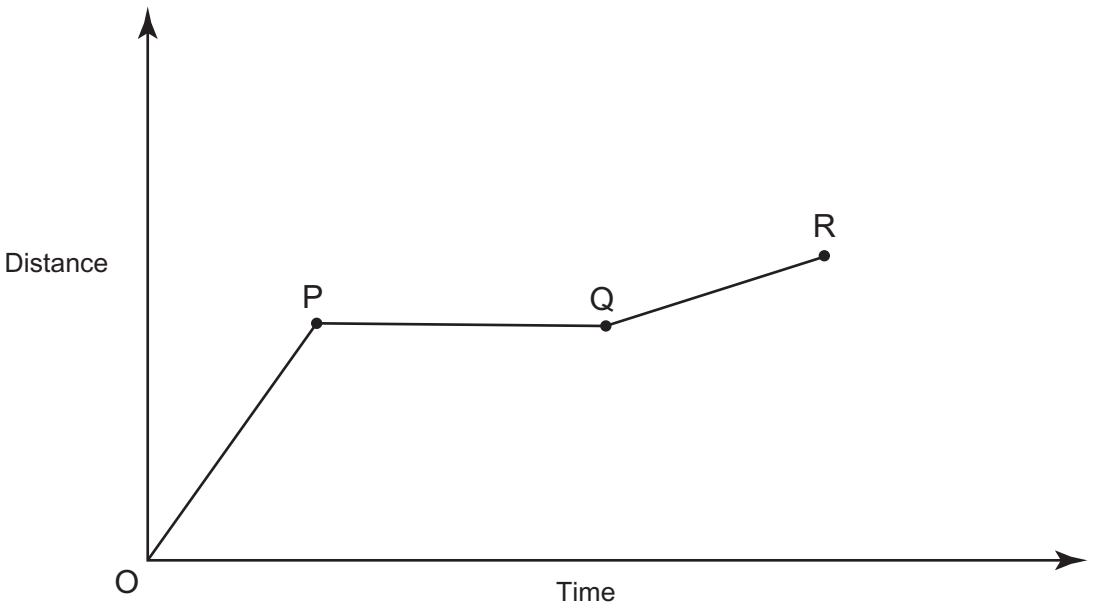
Involves movement of atoms from one place to another. _____

[4]

Examiner Only	
Marks	Remark

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6 Flora walks to school and her distance–time graph is shown.



(a) During which part of the journey does Flora walk fastest?

_____ [1]

A number of statements are made below.

(b) Tick (✓) **two** correct statements which refer to Flora's walk.

Flora stops walking during PQ. ☐

The distance to Flora's school is given by the area under the graph. ☐

Flora's speed is increasing during OP. ☐

Flora's speed during QR could be found by calculating the gradient of QR. ☐

Flora walks slower during OP than during QR. ☐ [2]

(c) Distance and displacement are both measured in metres. What is the difference between distance and displacement?

_____ [1]

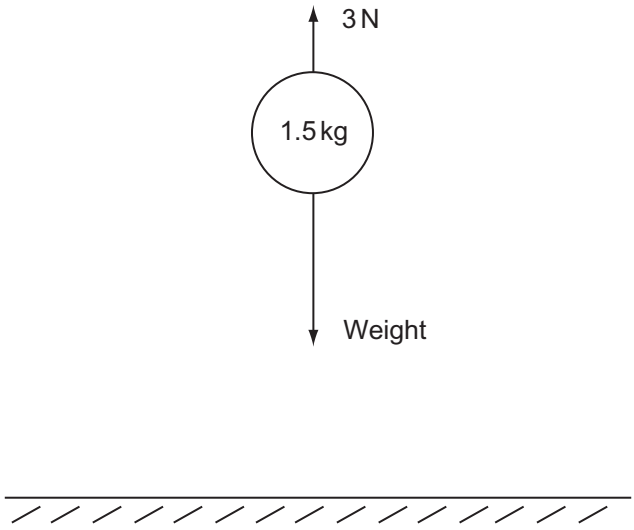
Examiner Only

Marks	Remark

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Examiner Only	
Marks	Remark

7 A ball of mass 1.5 kg falls through the air and the resistive forces acting on it add up to 3 N.



(i) By first finding the resultant force, calculate the acceleration of the ball.

You are advised to show your working out.

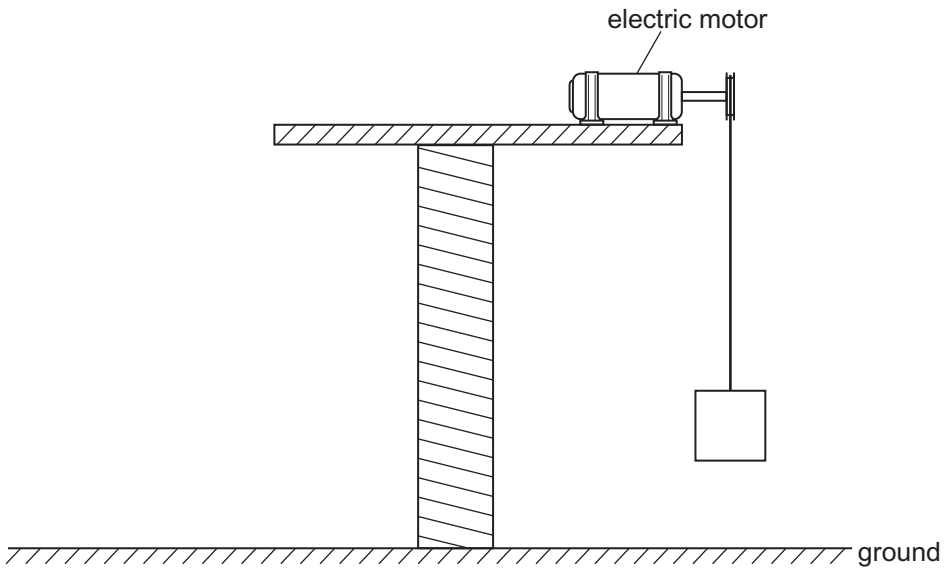
Acceleration = _____ m/s^2 [3]

(ii) The acceleration due to gravity is 10 m/s^2. Why is your answer to part **(i)** not equal to 10 m/s^2?

_____ [1]

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8 An electric motor is rated at 6000 W. In order to raise a load the motor does 36 000 J of work.



Calculate how long it takes the motor to raise the load.

You are advised to show your working out.

Time = _____ s [3]

Examiner Only

Marks	Remark

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9 Roy shoots an arrow vertically into the air.



The arrow has an initial kinetic energy of 30 J.

(i) How much **kinetic** energy does the arrow have when it reaches its maximum height?

Kinetic energy = _____ J [1]

The arrow loses **one sixth** of its initial energy during its upward flight.

(ii) How much energy does the arrow have at its maximum height?

Energy = _____ J [1]

The arrow has a mass of 0.2 kg.

(iii) Calculate the maximum height of the arrow.

You are advised to show your working out.

Height = _____ m [3]

Examiner Only

Marks	Remark

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10 Many scientists believe that Great Britain will have to increase the amount of electricity it produces by nuclear power.

(a) Give an advantage, not related to cost, of generating electricity using a nuclear power station.

_____

_____ [1]

All power stations are decommissioned at the end of their working life.

(b) Explain fully what decommissioning means.

_____

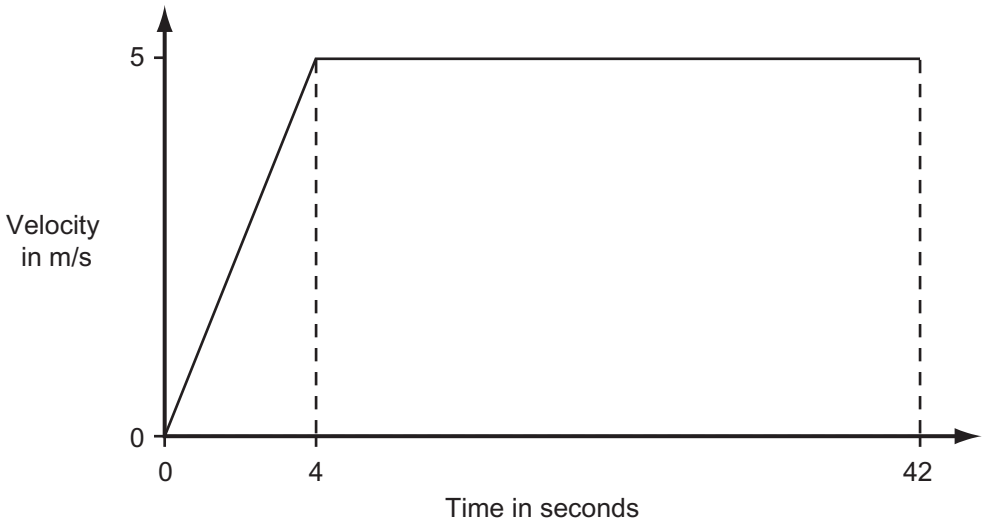
_____

_____ [2]

Examiner Only

Marks	Remark

11 Donal runs a race and the velocity–time graph for the race is shown below.



Donal finishes the race after 42 seconds.

(i) What was the length of the race that Donal had entered?

You are advised to show your working out.

Length of race = _____ m [4]

(ii) What was Donal's acceleration during the first 4 seconds of the race.

You are advised to show your working out.

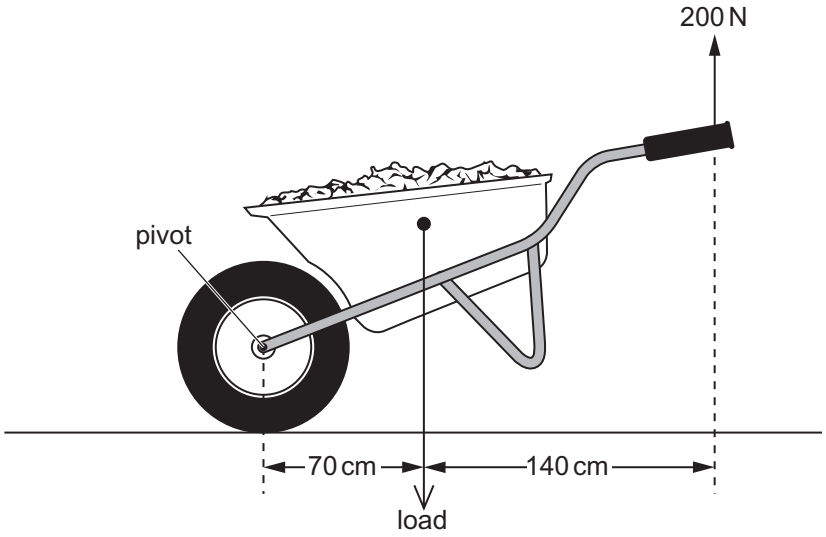
Acceleration = _____ m/s^2 [3]

Examiner Only

Marks	Remark

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12 Kevin lifts a wheelbarrow of soil.



Kevin exerts an upward force of 200 N on the wheelbarrow. Use the principle of moments to find the maximum load he can lift.

You are advised to show your working out.

Maximum load = _____ N [3]

THIS IS THE END OF THE QUESTION PAPER

Examiner Only

Marks	Remark

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Rewarding Learning

General Certificate of Secondary Education
2011–2012

Science: Double Award (Modular)

Forces and Energy

End of Module Test

C

Higher Tier

[GDC02]

MONDAY 14 NOVEMBER 2011
1.30 pm–2.15 pm

MARK SCHEME

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				AVAILABLE MARKS
1	Efficiency = (useful) energy out/energy in or $\frac{EO}{EI}$		[1]	
	= 600/800		[1]	
	= 0.75 (75%)		[1]	3
	or Eff = $\frac{EO}{EI}$			
2	**(i)** 600 (cm^2)		[1]	
	(ii) P = weight/area or $\frac{F}{A}$ or equivalent		[1]	
	= 200/600		[1]	
	= 0.33 (N/cm^2)		[1]	4
	allow e.c.f.			
	or P = $\frac{F}{A}$			
3	**(a)** **(i)** B		[1]	
	(ii) B		[1]	
	(b) p = m × v or Mom = mv etc.		[1]	
	= 160 × 200		[1]	
	= 320 000 (kg m/s)		[1]	5
4	**(a)** Extension is (directly) proportional to force		[1]	
	up to elastic limit depends on proportionality mark		[1]	
	(b) 5 N causes 15 cm ext } look for at least 1 unit for partial credit		[1]	
	1 N causes 3 cm ext }		[1]	
	(Ext of 6 cm caused by) 2 (N)		[1]	5
5	Conduction			
	Radiation			
	Conduction			
	Convection	[1 mark each]		4
6	**(a)** OP		[1]	
	(b) Statements (i) and (iv) are correct	[1 mark each]		
	(c) Displacement is a vector OR displacement has direction			
	(converse reason acceptable)		[1]	4

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				AVAILABLE MARKS
7	**(i)**	$F = ma$ or $RF = ma$	[1]	
		$12 = 1.5\ a$ **or** $(15 - 3) = 1.5\ a$	[1]	
		$a = 8\ (m/s^2)$	[1]	
	(ii)	Not "free fall" **or** Fall is not in a vacuum **or** resistive/drag/friction force/s is/are acting **or** ball is falling in an atmosphere	[1]	4
8		Power = Work done/time	[1]	
		$t = 36\,000/6000$ or any correctly substituted formula	[1]	
		$= 6$ (s)	[1]	3
9	**(i)**	0 (J)	[1]	
	(ii)	25 (J)	[1]	
	(iii)	$pe = mgh$	[1]	
		$h = 25/0.2 \times 10$ allow e.c.f from (ii) or any correctly substituted formula	[1]	
		$= 12.5$ (m)	[1]	5
10	**(a)**	No CO_2 produced/No greenhouse gases produced/no global warming/saves fossil fuels	[1]	
	(b)	(Plant) dismantled/destroyed/taken apart/knocked down	[1]	
		(Site) restored	[1]	3
11	**(i)**	Length of race = area under graph	[1]	
		$= (5 \times 4)/2 + (38 \times 5)$	[1], [1]	
		$= 200$ (m)	[1]	
	(ii)	$a = \Delta v/t$ or $a = \frac{v-u}{t}$ or $a = \frac{v}{t}$	[1]	
		$= 5/4$	[1]	
		$= 1.25\ (m/s^2)$	[1]	7
12		CW(M) = ACW(M) or $M\circlearrowright = \circlearrowleft M$ or $F_1d_1 = F_2d_2$ [**not** $Fd = Fd$]	[1]	
		Load $\times$ 70 = 210 $\times$ 200	[1]	
		Load = 600 (N)	[1]	3
			Total	**50**

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Rewarding Learning

Centre Number

71	

Candidate Number

General Certificate of Secondary Education
2010–2011

Science: Double Award (Modular)

Forces and Energy
End of Module Test
Higher Tier

C

[GDC02]

GDC02

FRIDAY 20 MAY 2011, AFTERNOON

TIME

45 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Write your answers in the spaces provided in this question paper.
Answer **all twelve** questions.

INFORMATION FOR CANDIDATES

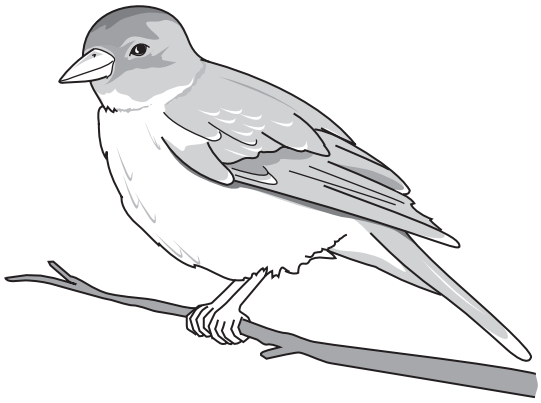
The total mark for this paper is 50.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
Total Marks	

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Examiner Only	
Marks	Remark

1 In winter, birds ruffle their feathers to keep themselves warm as shown in the diagram below.

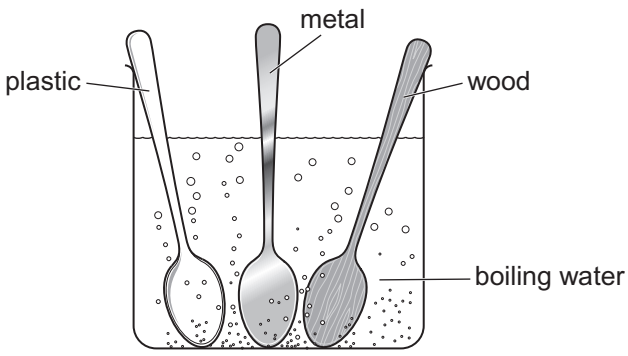


(a) Explain fully how the ruffling of feathers can help keep a bird warm.

_____

_____ [2]

Three spoons, one plastic, one wooden and the other metal, are placed in a beaker containing boiling water.



(b) (i) Which spoon feels warmest to touch?

_____ [1]

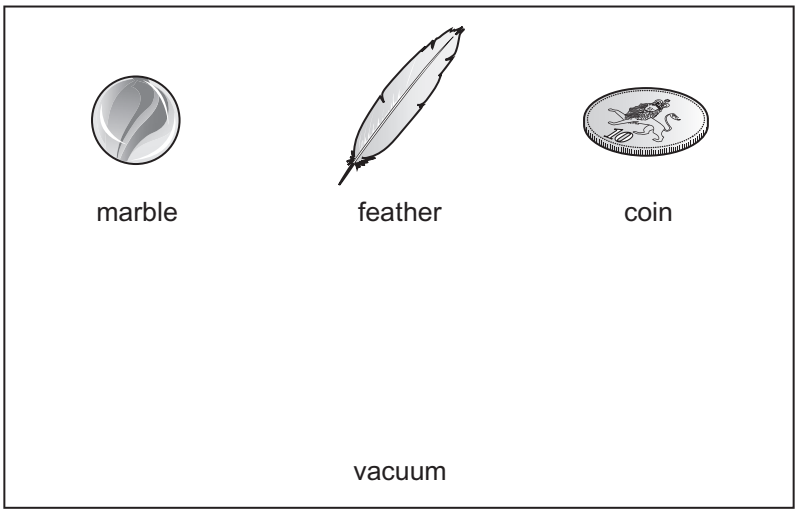
(ii) Explain your answer.

_____

_____ [1]

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2 Three objects are released in a chamber from which all the air has been removed. The objects are released at the same instant and from the same height.



(i) Which **one** of the following statements describes what will happen?

A The feather will hit the bottom first.
B They will not move.
C They will all hit the bottom at the same instant.
D The marble will hit the bottom first.
E The coin will hit the bottom first.

Letter _____ [1]

(ii) Give a reason for your choice.

_____

_____ [1]

(iii) Which object would hit the bottom last if air had been introduced into the chamber?

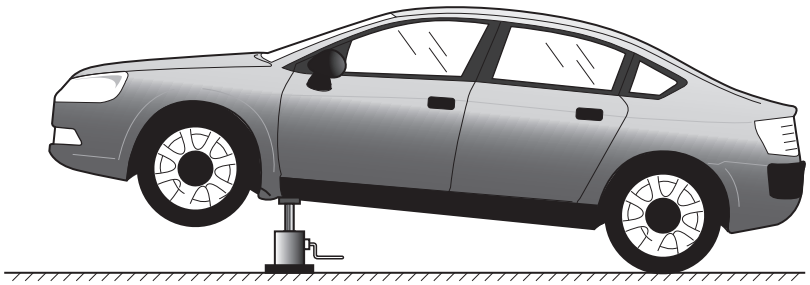
_____ [1]

Examiner Only
Marks | Remark

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Examiner Only	
Marks	Remark

3 A car jack is used to raise a car so that the wheel can be changed. The useful work done in lifting the car is 1200 J.



(a) When using the car jack, the mechanic uses 3000 J of energy to lift the car.
Calculate the efficiency of the car jack.

You are advised to show clearly your working out.

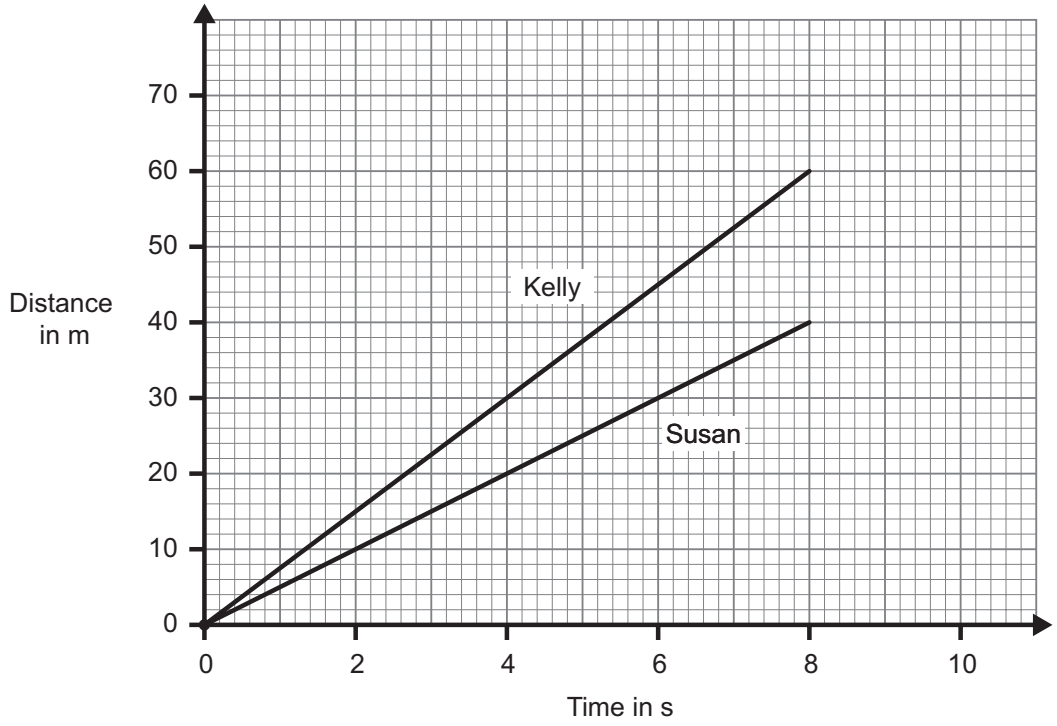
Efficiency = _____ [3]

(b) What fraction of input energy is wasted?

_____ [1]

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4 Below is the distance–time graph for two runners, Kelly and Susan.



(a) How far apart are Kelly and Susan after 8 seconds?

_____ [1]

(b) Use the graph to calculate Kelly's speed.

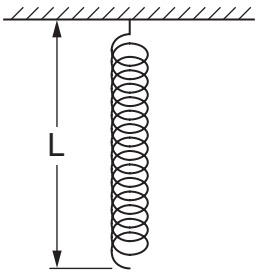
You are advised to show your working out.

Speed = _____ m/s [3]

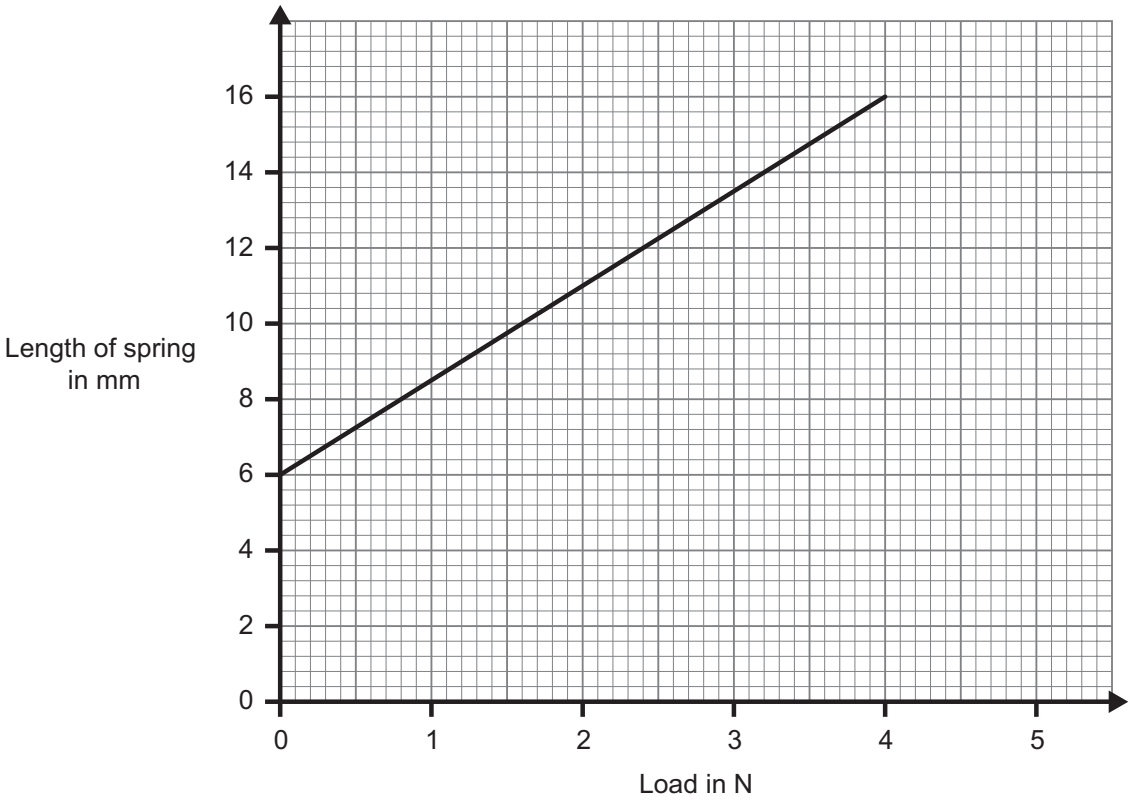
Examiner Only

Marks	Remark

5 Robert carries out a Hooke's Law experiment using a spring of length L.



He plots his results on a graph as shown below.



Use the graph to answer the following questions.

(a) (i) What is the unstretched length, L, of the spring?

L = _____ mm [1]

(ii) Robert could have tested Hooke's Law by plotting a more suitable graph. What should he have plotted on the vertical axis?

_____ [1]

Examiner Only

Marks	Remark

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(b) An unknown load is hung on the spring and the extension produced is 10 mm. Use the graph to find the unknown load.

You are advised to show your working out.

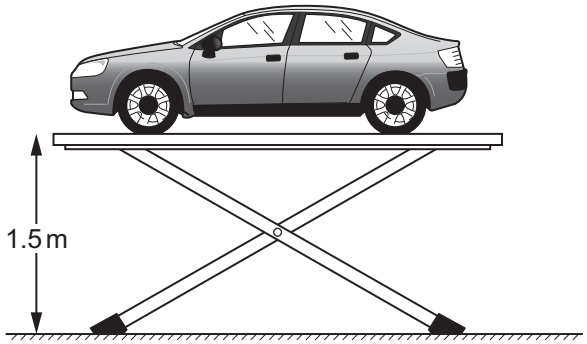
Load = _____ N [2]

Examiner Only	
Marks	Remark

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Examiner Only	
Marks	Remark

6 A garage lift is used to raise a car of mass 2500 kg a distance of 1.5 m.



(a) Calculate the work done by the garage lift.

You are advised to show your working out.

Work done = _____ J [3]

(b) The garage lift uses 42 000 J of energy to raise another car in 30 seconds. Calculate the power developed by the garage lift.

You are advised to show your working out.

Power = _____ W [3]

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7 The table gives a list of different energy sources used in electricity generating stations in the U.K.

For each energy source tick (✓) the box which applies **most** particularly to the source. Tick only **one** box on each row.

Energy source	Highest decommissioning costs	Lowest operating costs	Fossil fuel which responds most quickly to demand	Contributes most to the greenhouse effect
Gas				
Hydroelectric				
Coal				
Nuclear				

[4]

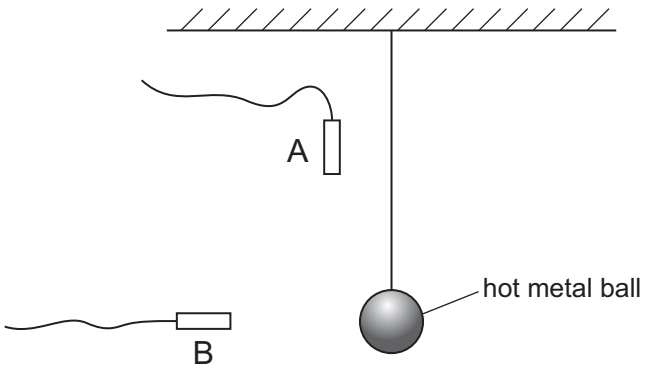
Examiner Only

Marks | Remark

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Examiner Only	
Marks	Remark

8 Donal performs an experiment on heat transfer in the laboratory. A hot metal ball is suspended as shown close to two heat sensors, A and B.



(a) The sensors are **equal distances** from the hot ball. Explain fully why sensor A gives a higher reading than sensor B.

_____

_____ [2]

(b) The experiment is repeated but this time the apparatus is contained in a vacuum.

(i) How does the reading of sensor A now compare with the reading of sensor B?

_____ [1]

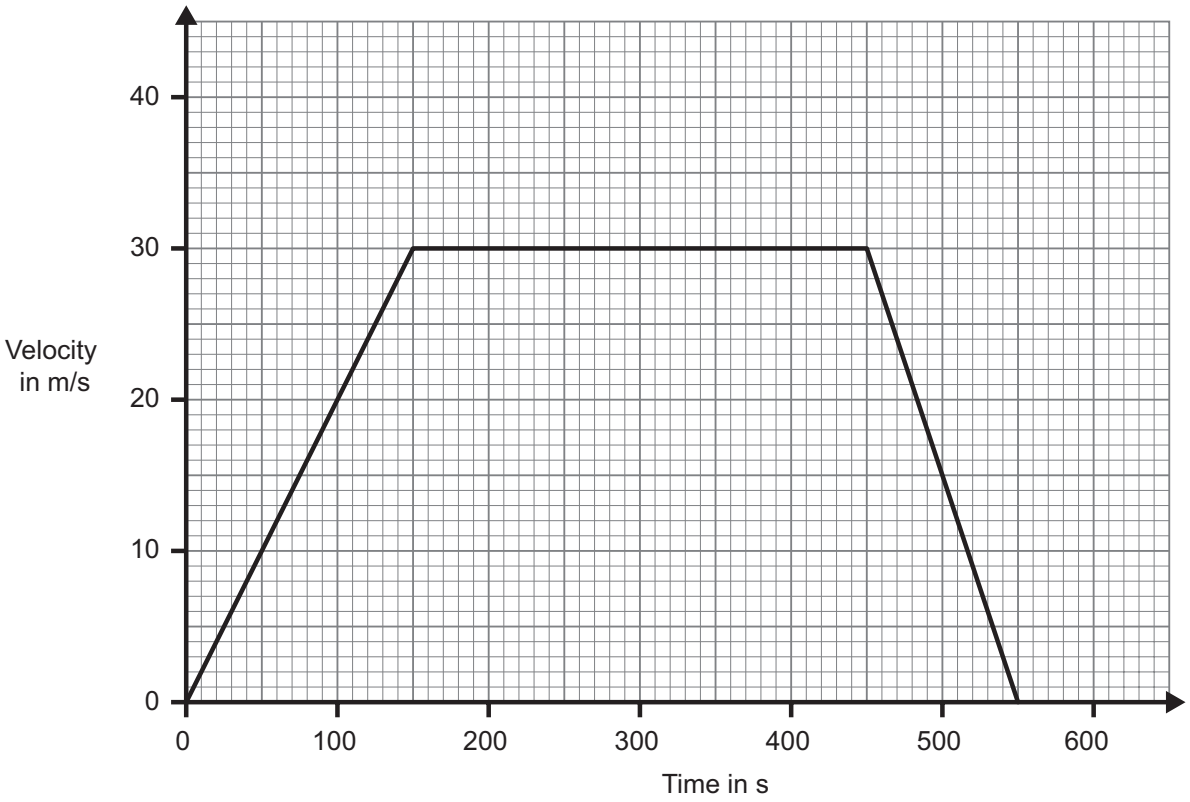
(ii) Explain your answer.

_____ [1]

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Examiner Only	
Marks	Remark

9 The velocity–time graph below represents the motion of a train between two stations.



(a) Complete the following to indicate when the train was

(i) Decelerating

From time t = _____ s to time t = _____ s [1]

(ii) Moving at constant velocity

From time t = _____ s to time t = _____ s [1]

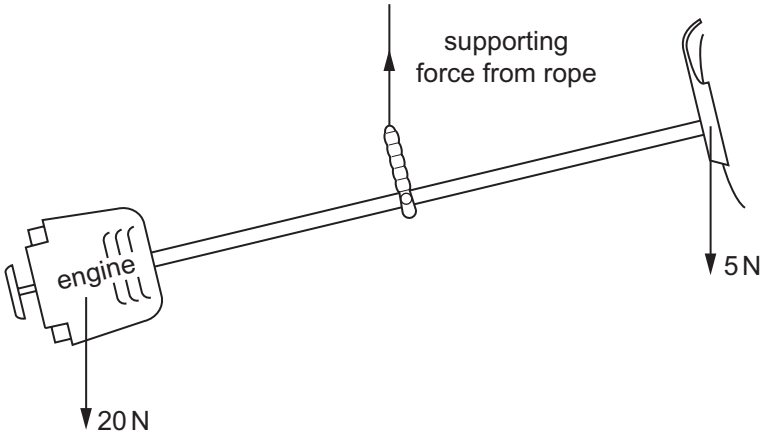
(b) Calculate the acceleration of the train in the first 150 seconds of its journey.

You are advised to show your working out.

Acceleration = _____ m/s^2 [3]

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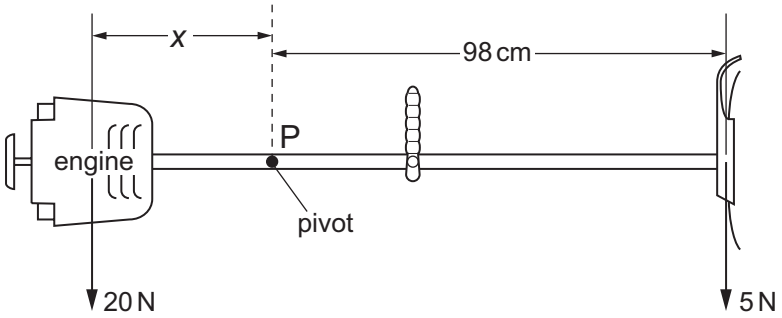
10 A garden strimmer is suspended with a rope. The forces acting on the strimmer are as shown in the diagram below.



(a) Find the size of the supporting force.

Supporting force = _____ N [1]

The owner balances the strimmer when carrying it, at the point P on the shaft.



(b) Use the principle of Moments to find the distance *x* from the pivot to the engine.

You are advised to show your working out.

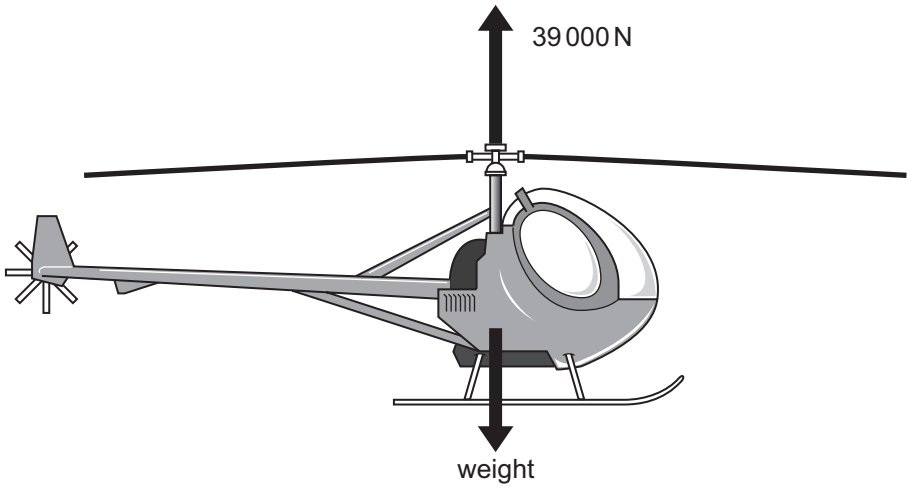
Distance = _____ cm [3]

Examiner Only

Marks	Remark

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11 A helicopter of mass 3000 kg accelerates upwards.



The upwards thrust exerted by the blades of the helicopter is 39 000 N.
The mass of the helicopter is 3000 kg.
Use Newton's Second Law to calculate the acceleration of the helicopter.

You are advised to show your working out.

Acceleration = _____ m/s^2 [4]

Examiner Only

Marks	Remark

12 In hitting a golf ball Rory gives it 50 J of kinetic energy.

The mass of the golf ball is 0.15 kg.

(i) Calculate the velocity of the golf ball immediately it leaves the club face.

You are advised to show your working out.

Velocity = _____ m/s [3]

(ii) State the useful work done by Rory.

Useful work = _____ J [1]

Examiner Only	
Marks	Remark

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Rewarding Learning

General Certificate of Secondary Education
2010–2011

Science: Double Award (Modular)

Forces and Energy
End of Module Test

Higher Tier

[GDC02]

FRIDAY 20 MAY 2011, AFTERNOON

MARK SCHEME

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				AVAILABLE MARKS
1	**(a)**	Air is trapped [1] which is a (good) insulator [1] } Mark independently	[2]	
	(b)	**(i)** Metal	[1]	
		(ii) Best conductor of heat [1] } dependent marking on **b(i)**	[1]	4
2	**(i)**	C	[1]	
	(ii)	All bodies fall at the same rate (under gravity) [1] **or** they are in free fall } dependent marking for **(ii)**	[1]	
	(iii)	Feather	[1]	3
3	**(a)**	Efficiency $=\frac{\text{useful output energy}}{\text{input energy}}$ [1]		
		$=\frac{1200}{3000}$ [1]		
		$= 0.4$ or 40% [1]	[3]	
	(b)	$\frac{3}{5}$ or 60% or 0.6 [1] allow e.c.f. from **(a)** or equivalent	[1]	4
4	**(a)**	20 (m)	[1]	
	(b)	Speed = Gradient or $\frac{\text{distance}}{\text{time}}$ [1]		
		$=\frac{60}{8}$ [1] or equivalent fraction		
		$= 7.5$ [1] (m/s)	[3]	4
5	**(a)**	**(i)** 6 (mm)	[1]	
		(ii) Extension	[1]	
	(b)	Extended length = 16 [1] (mm) or from graph		
		Load = 4 [1] (N)	[2]	4

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	AVAILABLE MARKS

6 **(a)** Work done = Force × distance or equivalent [1]

= 25 000 × 1.5 [1]

= 37 500 [1] (J) [3]

(b) Power = $\frac{\text{work done}}{\text{Time taken}}$ [1]

= $\frac{42\,000}{30}$ [1]

= 1400 [1] (W) [3] 6

7

Energy source	Highest decommissioning costs	Lowest operating costs	Fossil fuel which responds most quickly to demand	Contributes most to the greenhouse effect
Gas			✓	
Hydroelectric		✓		
Coal				✓
Nuclear	✓			

[1] per row [4] 4

8 **(a)** (A gains heat) by convection [1] and radiation [1]
or B gains heat by radiation [1] only [1] [2]

(b) **(i)** Equal (readings) [1] or same [1]

(ii) Heat transfer by convection needs a fluid [1]
or no convection [1]
or only radiation occurs **or** radiation only [1] 4

9 **(a)** **(i)** t = **450** to t = **550** [1]

(ii) t = **150** to t = **450** [1]

(b) Acceleration = Gradient [1] **or** $a = \frac{v - u}{t}$ or equivalent

= $\frac{30}{150}$ [1] or equivalent

= 0.2 [1] (m/s^2) [3] 5

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			AVAILABLE MARKS
10	**(a)** 25 (N)	[1]	
	(b) ACM = CM [1] or $F_1d_1 = F_2d_2$		
	$20 \times x = 5 \times 98$ [1]		
	$\therefore \quad x = 24.5$ [1] (cm)	[3]	4
11	RF = m × a [1] or F = ma or equivalent		
	9000 [1] = 3000 × a [1] Must have "=" for any subs. marks		
	a = 3 (m/s^2) [1]	[4]	4
12	**(i)** KE = 1/2 m v^2 [1] or equivalent, e.g. $v = \sqrt{2KE/m}$		
	$50 = 1/2 \times 0.15 \times v^2$ or $v^2 = 666.6$ [1]		
	v = 25.8 [1] (m/s) or 26	[3]	
	(ii) 50 (J)	[1]	4
		Total	**50**

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Rewarding Learning

Centre Number

71	

Candidate Number

General Certificate of Secondary Education
2010–2011

Science: Double Award (Modular)

Forces and Energy

End of Module Test

Higher Tier

C

[GDC02]

GDC02

FRIDAY 25 FEBRUARY 2011, MORNING

TIME

45 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Write your answers in the spaces provided in this question paper.
Answer **all twelve** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 50.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

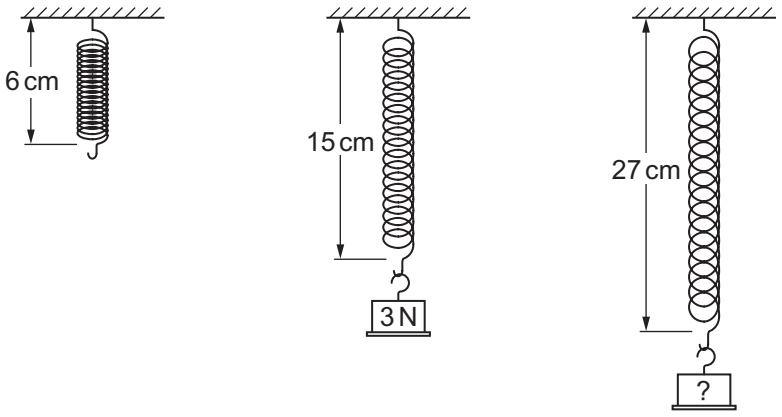
For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
Total Marks	

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Examiner Only	
Marks	Remark

1 **(a)** A spring has a natural length of 6 cm.

When loaded with a 3 N weight, the total length of the spring is 15 cm.



What weight would extend the spring so that its total length is 27 cm?

You are advised to show your working out.

Weight = _____ N [3]

(b) Describe fully what happens to the spring if it is stretched beyond its elastic limit and the load is then removed.

_____ [1]

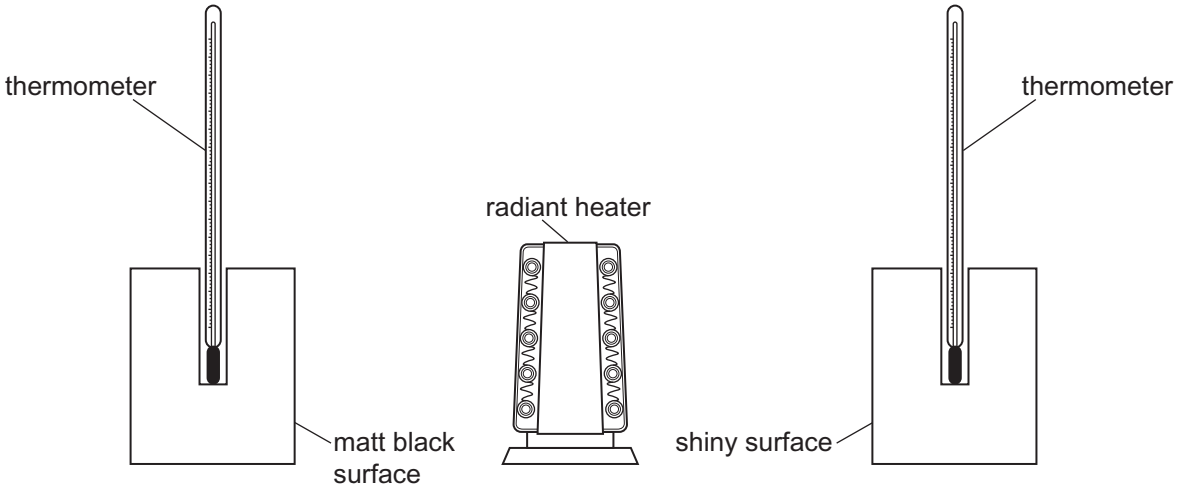
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Examiner Only	
Marks	Remark

2 The nature of the surfaces of materials was investigated in a laboratory to find their effect on heat absorption.

Julie used two metal cylinders, identical in shape and size, with a thermometer in each.

One cylinder had a matt black surface while the other had a shiny surface, as shown in the diagram below.



An electrical radiant heater was placed the same distance from each cylinder.

After a time the two thermometers showed different readings.

(a) Explain fully why they had different readings.

_____

_____

_____ [2]

(b) Explain why a paramedic will sometimes wrap a patient in an aluminium blanket to keep the patient warm.

_____

_____ [1]

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Examiner Only	
Marks	Remark

3 The skier below weighs 650 N. His skis have a total area of $0.5\,m^2$ when in contact with the snow.



Calculate the pressure the skier exerts on the snow.

Remember to include the unit for pressure.

You are advised to show clearly your working out.

Pressure = _____ [4]

4 **(a)** No machine can have an efficiency greater than 1 (100%). What does this mean?

_____

_____ [1]

(b) An electric motor is supplied with 600 J of electrical energy. The motor does 240 J of useful work.

Calculate the efficiency of the electric motor.

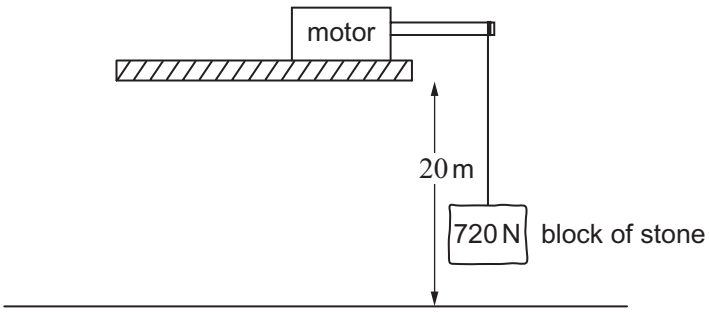
You are advised to show your working out.

Efficiency = _____ [3]

Examiner Only

Marks	Remark

5 A motor is used on a building site to lift a block of stone.



(a) Calculate the work done in lifting the block of stone which has a weight of 720 N through a height of 20 m.

You are advised to show your working out.

Work done = _____ J [3]

(b) Calculate the power of the motor if it does this work in 24 seconds.

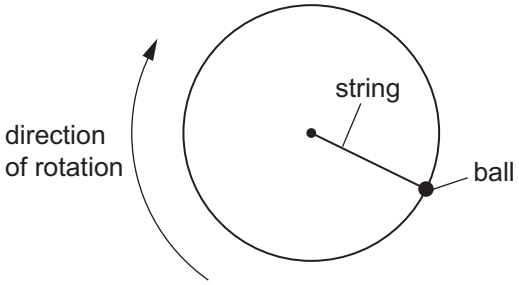
You are advised to show your working out.

Power = _____ W [3]

Examiner Only

Marks	Remark

6 The diagram shows a bird's eye view of a ball being whirled in a horizontal circle.



(a) What is the name of the force which acts towards the centre of the circle?

_____ [1]

(b) The ball has a mass of 2.5 kg and a velocity of 8.0 m/s.

Calculate the momentum of the ball.

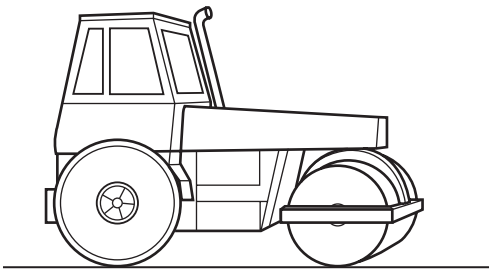
You are advised to show your working out.

Momentum = _____ kg m/s [3]

Examiner Only

Marks	Remark

7 A resultant force of 600 N acts on a steam roller of mass 2400 kg.



Calculate the acceleration of the steam roller.

You are advised to show clearly your working out.

Acceleration = _____ m/s^2 [3]

Examiner Only	
Marks	Remark

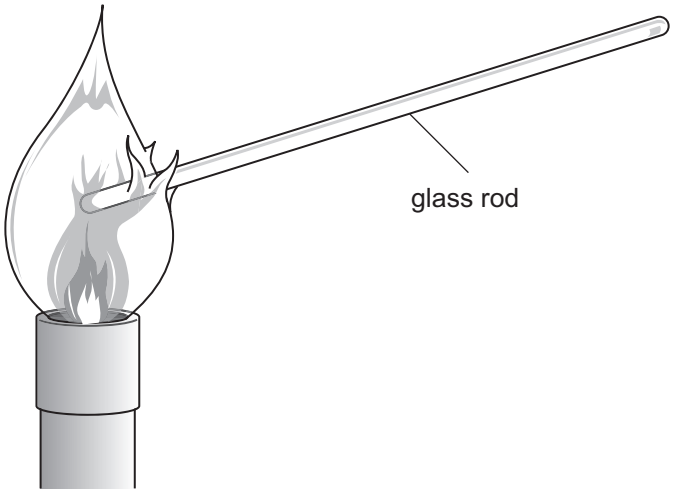
Examiner Only	
Marks	Remark

8 Both copper and glass contain electrons.

(a) In terms of their electrons, what is the difference between copper and glass, which makes copper a much better conductor of heat?

_____ [1]

A glass rod is placed in a Bunsen flame as shown below.



(b) **(i)** What particle is responsible for heat conduction in the glass rod.

_____ [1]

(ii) In terms of these particles describe how heat energy passes along the glass rod.

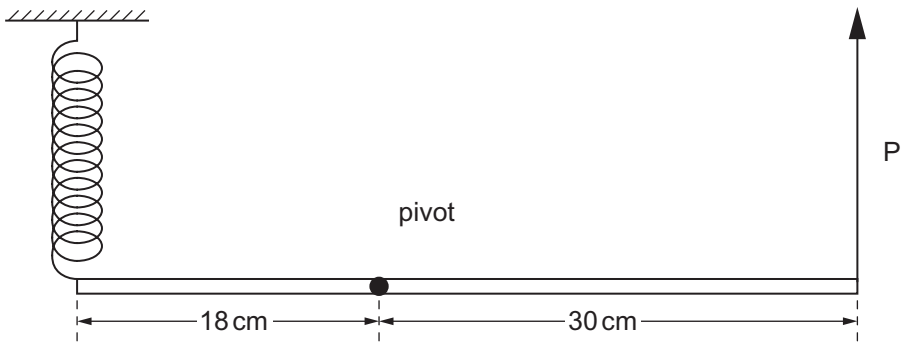
_____

_____ [2]

Examiner Only	
Marks	Remark

9 An unknown force P acts on one end of a lever as shown below.

The lever is kept in a horizontal position by a spring at the other end of the lever.



It is known that a force of 1 N will stretch the spring by 0.5 cm. In the diagram above it is stretched by 2.5 cm.

(i) What force in the spring stretches it by 2.5 cm?

_____ N [1]

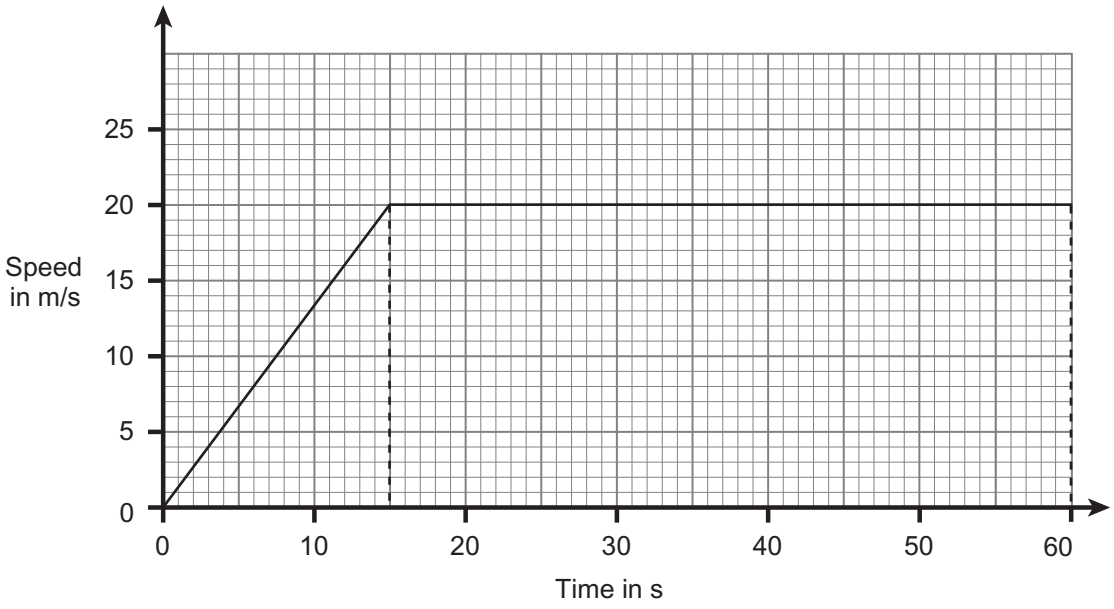
(ii) Use the principle of moments and your answer to **(i)** to calculate the size of the unknown force, P.

You are advised to show clearly your working out.

Force P = _____ N [4]

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10 The speed – time graph for the first 60 s of a train journey is shown below.



By first using the graph to find the distance travelled, calculate the average speed of the train during this interval of 60 s.

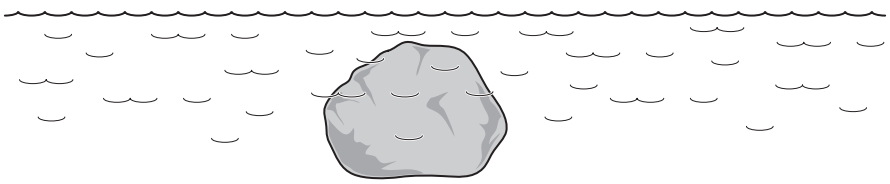
You are advised to show clearly your working out.

Average speed = _____ m/s [6]

Examiner Only

Marks	Remark

11 A boulder falls vertically into the sea and at the instant shown in the diagram it has a velocity of 3 m/s. It falls through the sea water with an acceleration of 0.5 m/s^2.



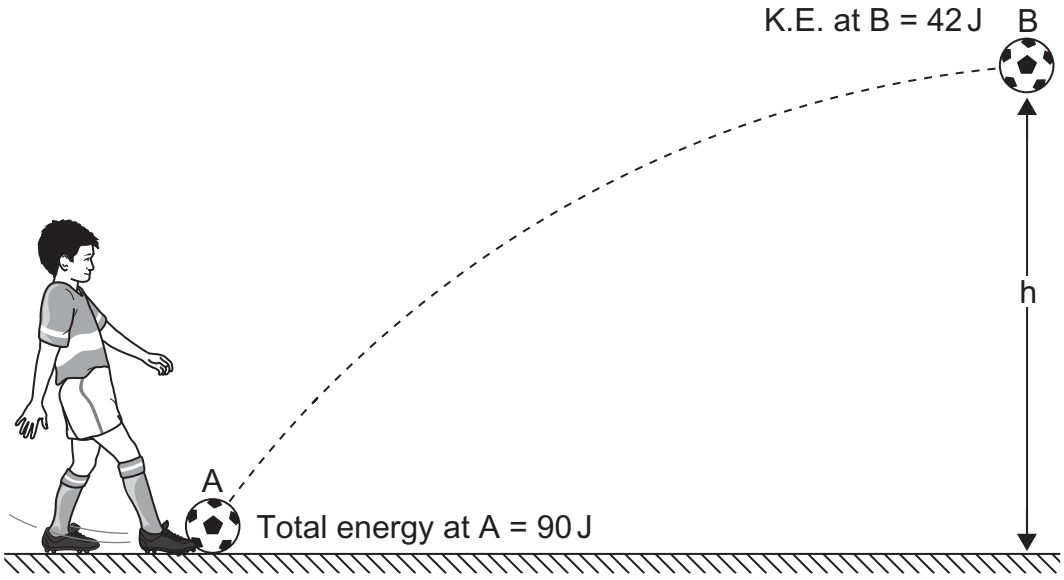
Calculate how long it takes the boulder to reach a velocity of 9 m/s.

You are advised to show clearly your working out.

Time = _____ s [3]

Examiner Only	
Marks	Remark

12 Ben hits a football from position A into the air. The total energy of the ball, as it leaves Ben's foot is 90 J.



By the time the ball reaches position B in the diagram it has a kinetic energy of 42 J. The ball has a mass of 0.8 kg.

Calculate the height (h) of the ball above the ground at position B. Assume no energy losses.

You are advised to show clearly your working out.

Height = _____ m [4]

Examiner Only

Marks	Remark

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Rewarding Learning

General Certificate of Secondary Education
2010–2011

Science: Double Award (Modular)

Forces and Energy

End of Module Test

C

Higher Tier

[GDC02]

FRIDAY 25 FEBRUARY 2011, MORNING

MARK SCHEME

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			AVAILABLE MARKS
1	**(a)** 9 cm = 3 N [1] 1 cm = N [1] 21 cm = 7 N [1] **or** 3 N = 9 cm [1] 1 N = 3 cm [1] 7 N = 21 cm [1]	[3]	
	(b) Permanently deformed	[1]	4
2	**(a)** Black surfaces are better [1] absorbers of heat [1]	[2]	
	(b) Poor radiators of heat [1] **or** reflects heat back in [1]	[1]	3
3	$P = F/A$ or equivalent [1] $= \frac{650}{0.5}$ [1] $= 1300$ [1] N/m^2 **or** Pa [1]	[4]	4
4	**(a)** Contravenes the Law of C of E	[1]	
	(b) Efficiency $= \frac{\text{Useful output energy}}{\text{Input energy}}$ [1] $= \frac{240}{600}$ [1] $= 0.4$ **or** 40% [1]	[3]	4
5	**(a)** WD = F × d [1] = 720 × 20 [1] = 14 400 (J) [1]	[3]	
	(b) $P = \frac{WD}{time}$ [1] $= \frac{14\,400}{24}$ [1] ecf from **(a)** = 600 (W) [1]	[3]	6
6	**(a)** Tension/centripetal force	[1]	
	(b) Momentum = Mass × Velocity [1] = 2.5 × 8 [1] = 20 (kg m/s) [1]	[3]	4

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			AVAILABLE MARKS
7	$F = ma$ [1] or equivalent $600 = 2400 \times a$ [1] $a = 0.25\ (m/s^2)$ [1]	[3]	3
8	**(a)** Copper has free electrons	[1]	
	(b) **(i)** Molecules	[1]	
	(ii) Molecules (at hot end) – vibrate faster/vibrate more – with greater k.e. – greater amplitude Any one → [1] Jostling/colliding [1]	[2]	4
9	**(i)** Force exerted by spring = 5 (N)	[1]	
	(ii) CWM = ACWM [1] $5 \times 18 = P \times 30$ [1], [1] ecf from **(i)** $P = 3$ (N) [1]	[4]	5
10	Distance = area under graph [1] $= \frac{20 \times 15}{2} + (20 \times 45)$ **or** $150 + 900$ [2] $= 1050$ (m) [1] Average speed $= \frac{1050}{60}$ [1] $= 17.5$ (m/s) [1]	[6]	6
11	$a = \frac{\Delta v}{t}$ (**or** equivalent) [1] $0.5 = \frac{6}{t}$ [1] $t = 12$ (s) [1]	[3]	3
12	$pe = mgh$ [1] $48 = 0.8 \times 10 \times h$ [1] + [1] $h = 6$ (m) [1]	[4]	4
		Total	**50**

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Rewarding Learning

Centre Number

71	

Candidate Number

General Certificate of Secondary Education
2010–2011

Science: Double Award (Modular)

Forces and Energy

End of Module Test

Higher Tier

C

[GDC02]

GDC02

THURSDAY 11 NOVEMBER 2010, AFTERNOON

TIME

45 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Write your answers in the spaces provided in this question paper.
Answer **all twelve** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 50.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
Total Marks	

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Examiner Only	
Marks	Remark

1 Flora lifts a bag of potatoes onto a shelf 200 cm high. The bag weighs 80 N.

Calculate the amount of work Flora does in joules.

You are advised to show your working out.

Work = _____ J [4]

2 A jeep and a sports car are shown.



© Hemera/Thinkstock



© Hamann Motorsport GmbH

Give two reasons why the sports car is more stable than the jeep.

1. _____ [1]

2. _____ [1]

3 A loudspeaker changes energy from one type to another.



© CVR - Audio

The loudspeaker shown produces 3 J of sound energy for every 75 J of electrical energy input.

(i) Calculate the efficiency of the loudspeaker.

You are advised to show your working out.

Efficiency = _____ [3]

(ii) Circle the unit, if any, for efficiency from the following list.

joule

newton

no unit

watt [1]

(iii) Why can the efficiency of the loudspeaker never be greater than 1?

_____

_____ [1]

Examiner Only

Marks	Remark

4 A cyclist rides around a bend as shown.



© Cycle Logic Racing

(a) What force allows the cycle to go round the bend?

_____ [1]

The total mass of cyclist and cycle is 115 kg and he goes around the bend at a constant speed of 6 m/s.

(b) Calculate their total momentum.

Remember to include the correct unit.

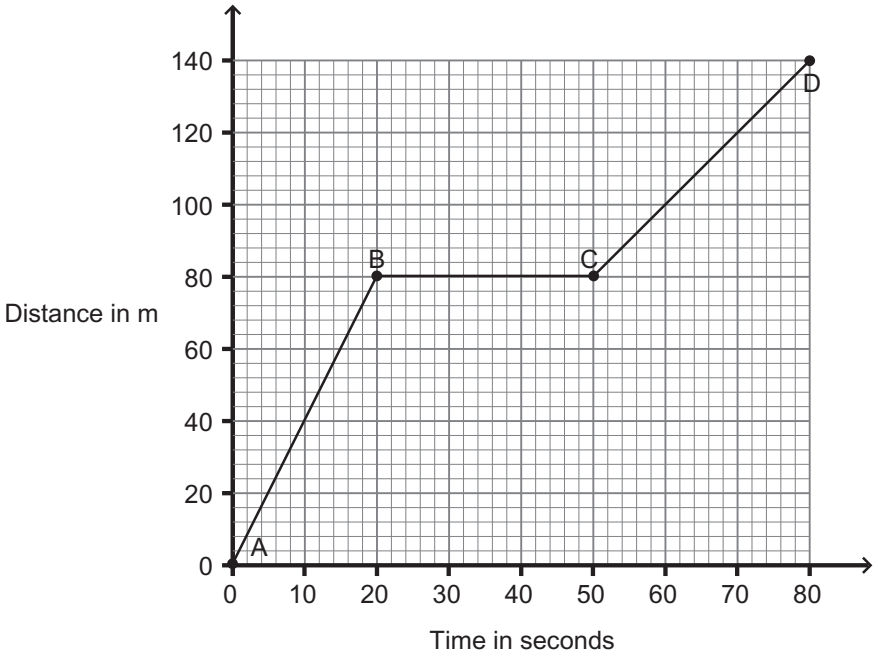
You are advised to show your working out.

Momentum = _____ [4]

Examiner Only

Marks	Remark

5 The distance-time graph for an athlete is shown.



(a) During which region **AB, BC, or CD** is the athlete running fastest? Give a reason for your answer.

Region _____ [1]

Reason _____

_____ [1]

(b) Calculate the athlete's speed during the region **CD**.

You are advised to show your working out.

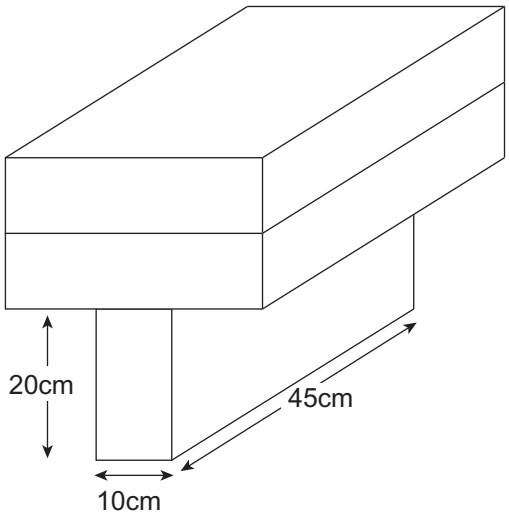
Speed = _____ m/s [3]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

6 The diagram shows three stacked building blocks. Each block has a weight of 300 N.



(a) With the help of the figures on the diagram, calculate the pressure exerted on the ground in N/cm^2.

You are advised to show your working out.

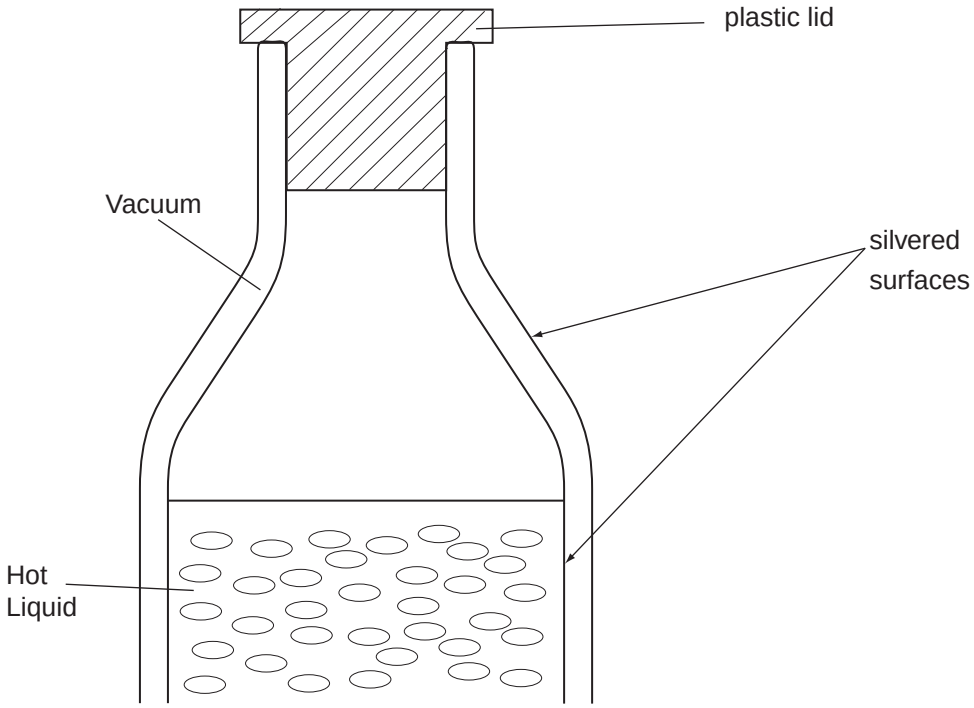
Pressure = _____ N/cm^2 [3]

It is possible to change the bottom block so that the pressure exerted is greater than the value you have calculated.

(b) Suggest how the bottom block should be arranged to give this greater pressure.

_____ [1]

7 A vacuum flask is constructed to keep liquids hot.



Complete the table below to show which methods of heat transfer are reduced by each of the features labelled in the diagram.

The first row has been done for you.

Feature	Conduction	Convection	Radiation
Plastic Lid	✔	✔	
Silvered Surfaces			
Vacuum			

[3]

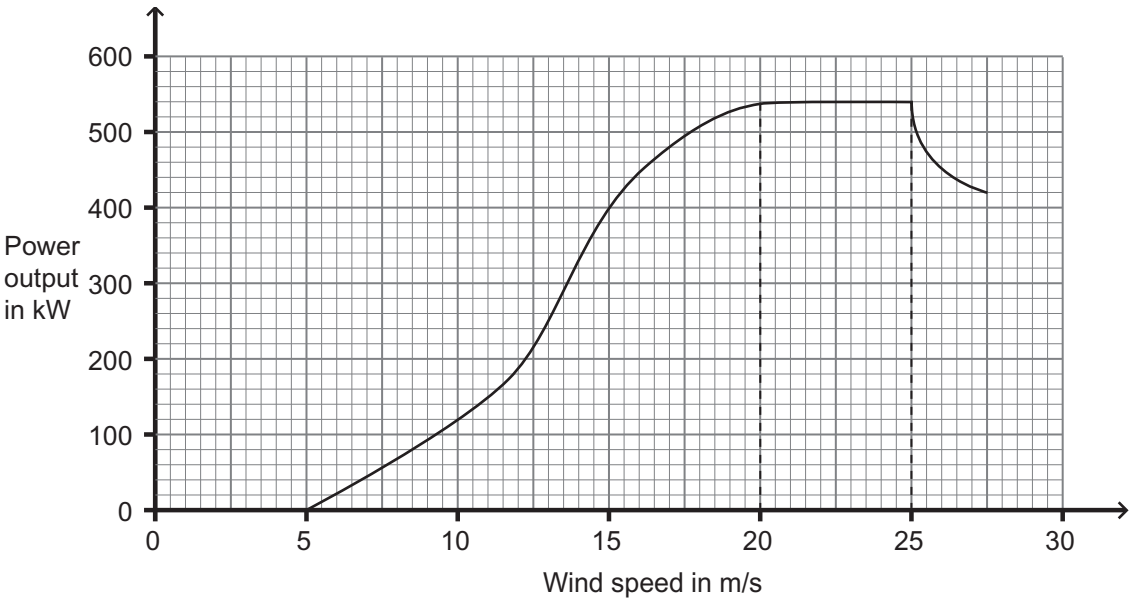
Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

8 To increase the amount of electricity generated in Northern Ireland using renewable energy resources would probably involve constructing many new wind turbines.

The graph shows how the power output of a wind turbine varied with wind speed.



(i) Using the graph, describe in detail how the power output of a turbine varies with the wind speed.

_____

_____

_____

_____

_____ [3]

(ii) State **one** disadvantage of using wind turbines to generate a high proportion of the electricity required in Northern Ireland.

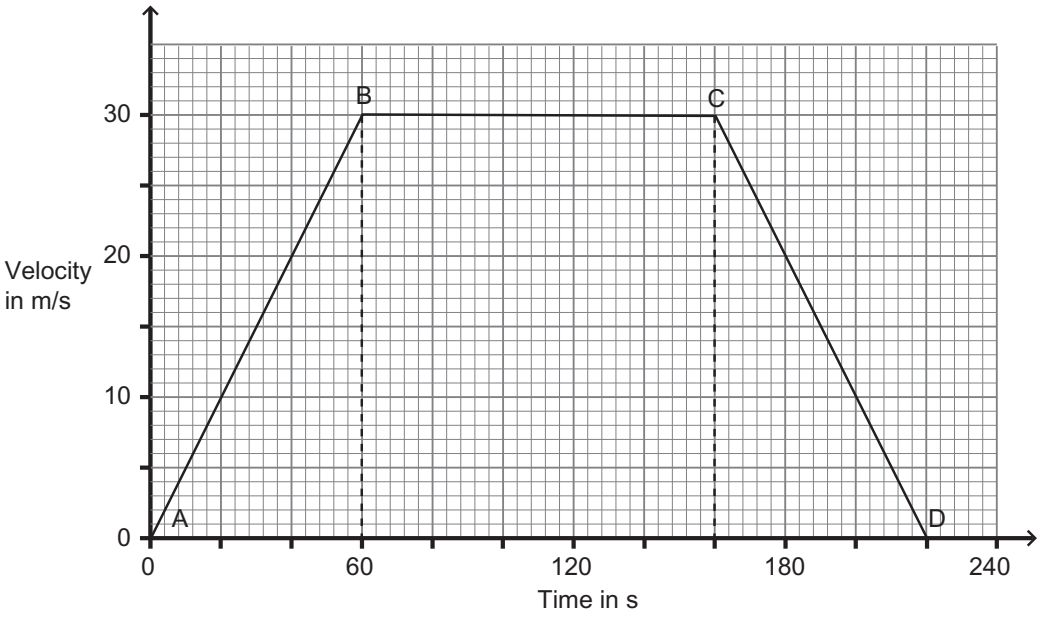
_____

_____ [1]

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Examiner Only	
Marks	Remark

9 The velocity-time graph below shows the motion of a car on a straight road.



(a) Tick (✔) the correct answer describing the motion of the car

The car has changed direction at C ☐

The car is stationary during BC ☐

The car is travelling at a steady velocity during BC ☐ [1]

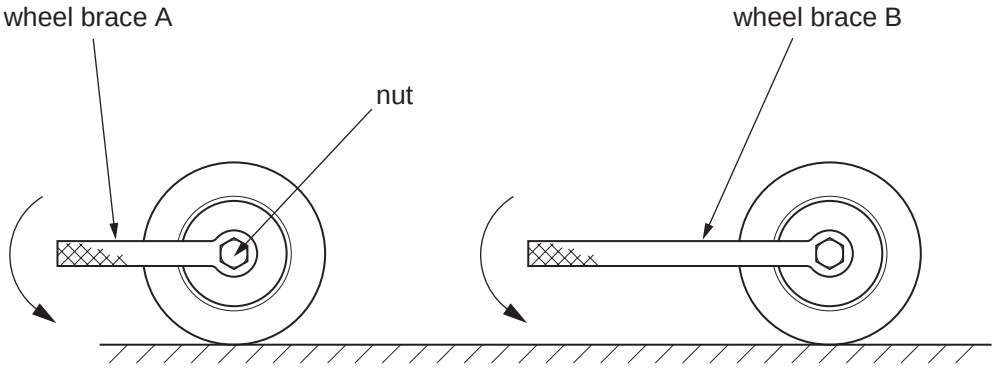
(b) Find the displacement of the car in the first 60 seconds of its motion.

You are advised to show your working out.

Displacement = _____ m [3]

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10 A wheel brace is used to loosen wheel nuts when changing car wheels.



(a) Explain why it is easier to loosen the nut using wheel brace B.

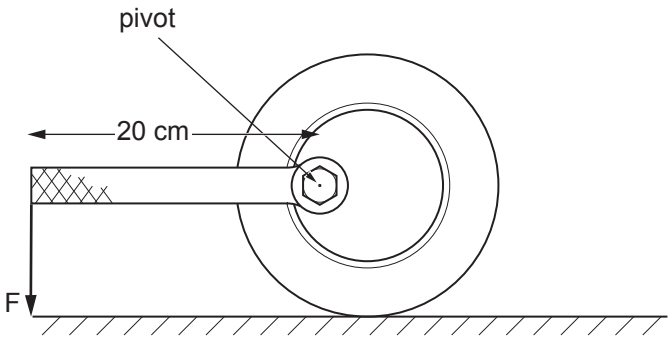
_____

_____ [1]

(b) A different wheel brace is used to loosen a wheel nut. The turning effect is 72 Nm.

Find the size of the force F.

You are advised to show your working out.



Force F = _____ N [2]

Examiner Only

Marks	Remark

11 Patricia, who has a mass of 70 kg, rides a bicycle of mass 45 kg.



(a) Calculate the acceleration produced by the resultant force of 230 N.

You are advised to show your working out.

Acceleration = _____ m/s^2 [3]

(b) Describe and explain the effect on the size of the acceleration if Patricia sat upright on the bicycle, assuming the forward force is constant.

Description:

_____

_____

Explanation:

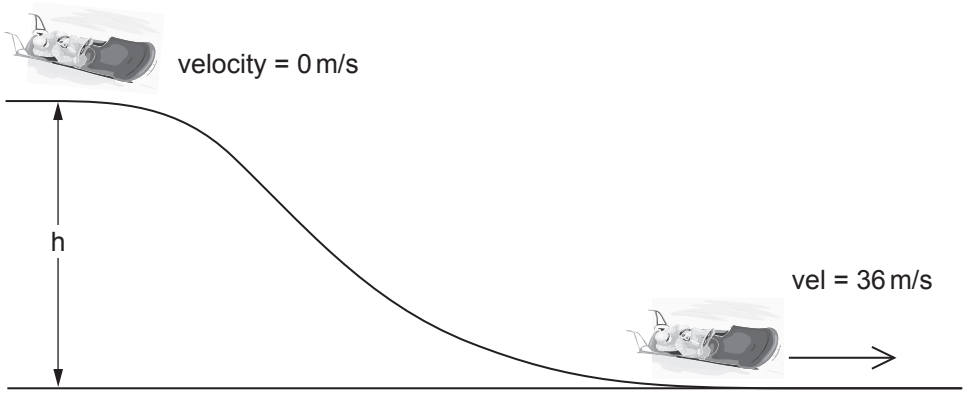
_____

_____ [2]

Examiner Only

Marks	Remark

12 A sleigh goes down a hill from rest.



It has a mass of 200 kg and reaches a velocity of 36 m/s at the bottom of the hill.

(a) Calculate the Kinetic Energy of the sleigh at the bottom of the hill.

You are advised to show your working out.

KE = _____ J [3]

(b) Use the principle of conservation of energy and your answer to **(a)** to calculate the height of the hill h.

You are advised to show your working out.

Height (h) = _____ m [3]

Examiner Only

Marks	Remark

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110975

Rewarding Learning

General Certificate of Secondary Education
2010–2011

Science: Double Award (Modular)

Forces and Energy

End of Module Test

C

Higher Tier

[GDC02]

THURSDAY 11 NOVEMBER 2010, AFTERNOON

MARK SCHEME

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			AVAILABLE MARKS
1	$W = F \times d$ [1] $= 80 \times 2$ [1] [1] $= 160$ (J) [1] (Note: 200 cm $\rightarrow$ 2 m is a free-standing mark)	[4]	4
2	Lower c of g / lower com Wider wheel base or wider base or wider base area	[1] [1]	2
3	**(i)** $E = \frac{\text{energy out}}{\text{energy in}}$ or equiv. or $\frac{EO}{EI}$ $= \frac{3}{75}$ $= 0.04$ or 4%	[3]	
	(ii) No unit	[1]	
	(iii) Energy wasted, Breaks Principle of Conservation of energy, all output is not sound	[1]	5
4	**(a)** Friction or centripetal force	[1]	
	(b) Momentum = mass $\times$ vel. [1] or $p = mv$ $= 115 \times 6$ [1] $= 690$ [1] kg m/s [1] (or Ns)	[4]	5
5	**(a)** AB Biggest slope/gradient **or** biggest distance in same time interval	[1] [1]	
	(b) Speed = grad or $\frac{d}{t}$ [1] $= \frac{60}{30}$ [1] $= 2$ (m/s) [1]	[3]	5
6	**(a)** $P = \frac{\text{Weight}}{\text{Area}}$ [1] or $\frac{W}{A}$ or $\frac{F}{A}$ $= \frac{900}{450}$ [1] $= 2$ (N/cm^2) [1]	[3]	
	(b) on 10 cm by 20 cm side/on smallest side	[1]	4
7	Vacuum: Conduction, Convection S Surface: Radiation	[3]	3

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			AVAILABLE MARKS
8	**(i)**	Any **three** from: Wind speed ≤ 5 m/s: no power Wind speed b/n 5 + 20: power increases Wind speed b/n 20 + 25: max power Wind speed ≥ 25: power decreases [3]	
	(ii)	Too large area of land needed *or* unpredictable *or* visual/noise pollution/*or* kills birds [1]	4
9	**(a)**	steady speed during BC ✓ [1]	
	(b)	Displacement = Area = $\frac{1}{2}$ bh *or* = av. vel. × time [1] = $\frac{1}{2} \times 60 \times 30$ [1] = 900 (m) [1] [3]	4
10	**(a)**	The bigger the distance of force from pivot, (the bigger the moment) *or* moment is proportional to the distance from pivot [1]	
	(b)	72 = F × 0.2 [1] F = 360 [1] (N) [2]	3
11	**(i)**	(R)F = m a [1] 230 = (70 + 45) a [1] a = 2(m/s^2) [1] [3]	
	(ii)	Describe: Decreased or no acceleration [1] Explain: Increased air resistance/smaller resultant force [1] MORE friction or wind drag [2]	5
12	**(a)**	Ke = $\frac{1}{2}$ mv^2 [1] Ke = $\frac{1}{2} \times 200 \times (36)^2$ [1] Ke = 129600 (J) [1] [3] ↓ ecf.	
	(b)	Pe = 129600 (J) [1] 129600 = 200 × 10 × h [1] h = 64.8 m [1] or 65 m [3]	6
		Total	**50**

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Rewarding Learning

Centre Number

71	

Candidate Number

General Certificate of Secondary Education
2009–2010

Science: Double Award (Modular)

Forces and Energy
End of Module Test
Higher Tier

C

[GDC02]

GDC02

THURSDAY 20 MAY 2010, AFTERNOON

TIME

45 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Write your answers in the spaces provided in this question paper.
Answer **all twelve** questions.

INFORMATION FOR CANDIDATES

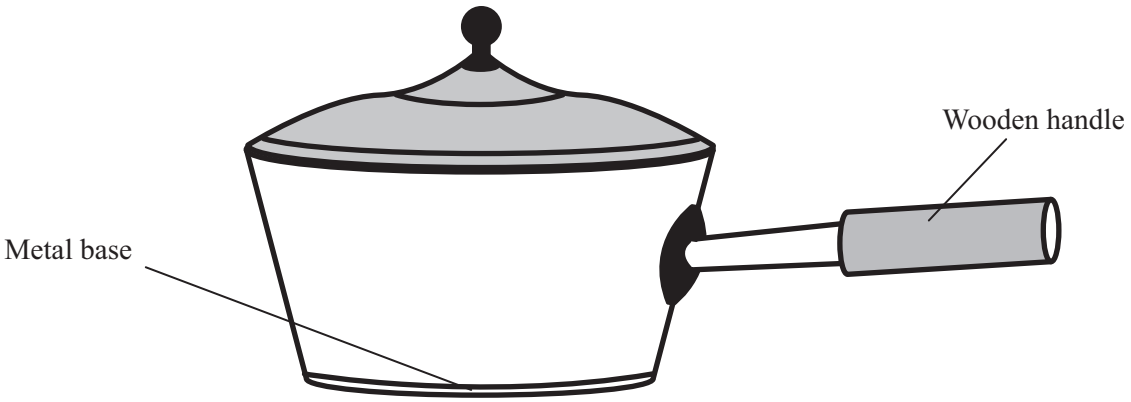
The total mark for this paper is 50.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

For Examiner's use only	
Question Number	**Marks**
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
Total Marks	

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Examiner Only	
Marks	Remark

1 **(a)** The diagram below shows a saucepan designed to cook food.



(i) Why is copper a suitable metal for the base of the saucepan?

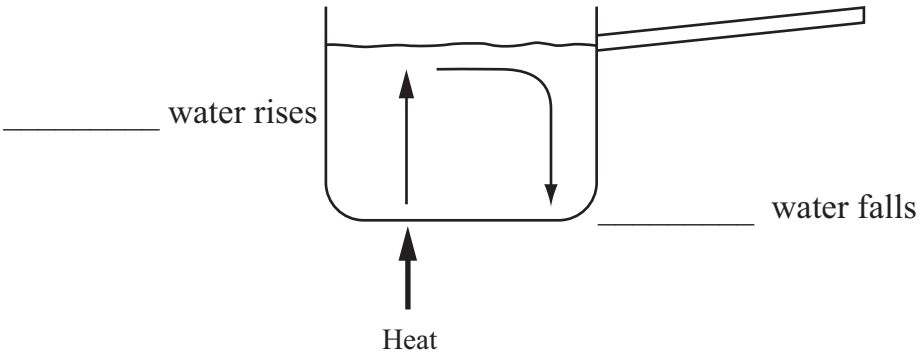
_____ [1]

(ii) Why is the handle of the saucepan made of wood?

_____ [1]

(b) This diagram shows how water in the saucepan becomes hot.

(i) Complete the labels on the diagram.



[2]

(ii) Complete the following sentence.

The movement of the water in the saucepan is called a

_____ current. [1]

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Examiner Only

Marks	Remark

2 **(a)** The table below gives information about three balls. Complete the table.

Ball	Mass	Weight
glass	50 g	0.5 N
brass	250 g	
steel		2.0 N

[2]

The three balls are dropped from the same height at the same instant.

(b) Which ball, if any, will hit the ground first? (Assume air resistance can be ignored.)

Tick (✓) the correct box.

The glass ball will hit the ground first. ☐

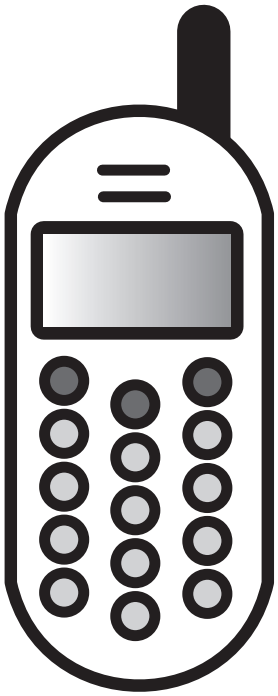
The brass ball will hit the ground first. ☐

The steel ball will hit the ground first. ☐

They all hit the ground at the same instant. ☐ [1]

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3 A mobile phone **wastes** 5 J of energy as heat when the input electrical energy is 25 J.



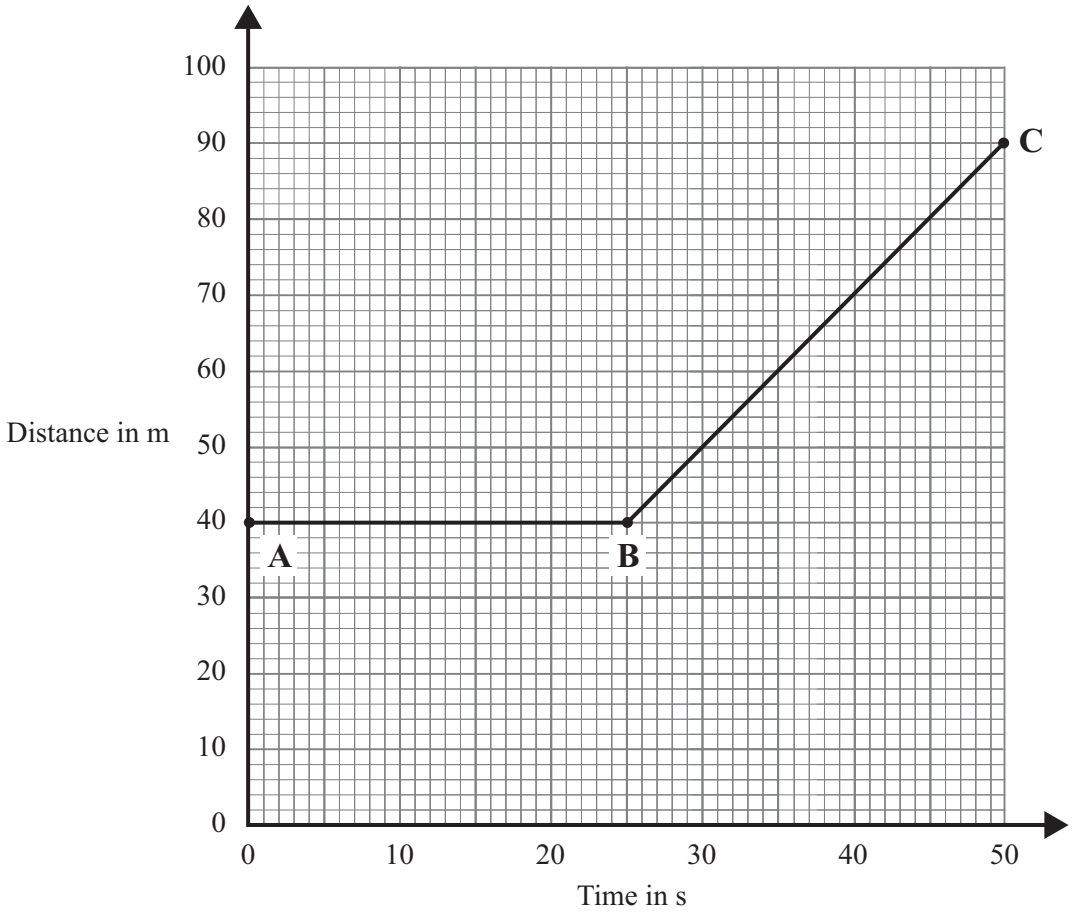
Find the useful output energy and use your answer to calculate the efficiency of the mobile phone.
You are advised to show your working out.

Efficiency = _____ [4]

Examiner Only	
Marks	Remark

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4 The distance–time graph for a train is shown below.



(i) Describe the motion of the train from:

A to B. _____

_____

B to C. _____

_____ [2]

(ii) Calculate the average speed of the train between **B and C**.
You are advised to show your working out.

Average speed = _____ m/s [3]

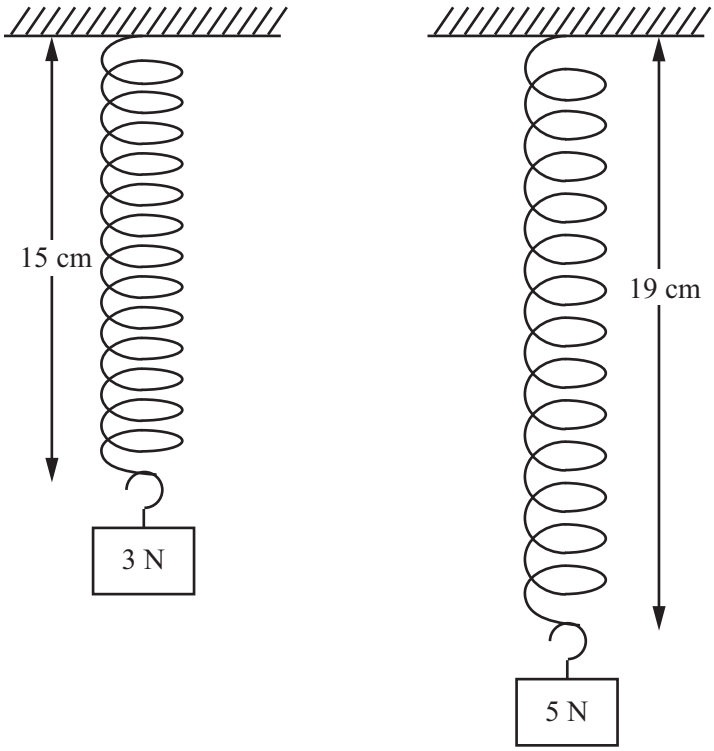
Examiner Only

Marks	Remark

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Examiner Only	
Marks	Remark

5 When a load of 3 N hangs from a spiral spring, its total length is 15 cm. When the load is 5 N, the total length is 19 cm.



(i) What extension would be caused by a load of 1 N?
You are advised to show your working out.

Extension = _____ cm [2]

(ii) Calculate the natural (unextended) length of the spring.
You are advised to show your working out.

Natural (unextended) length = _____ cm [2]

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6 The photograph shows the space shuttle *Discovery* taking off.



© *NASA*

(a) The work done by the engines of the space shuttle during lift-off is 9 400 000 J. This takes the space shuttle 5 seconds.
Calculate the average power generated by the engines during lift-off.
You are advised to show your working out.

Average power = _____ W [3]

(b) One of the engines in the space shuttle exerts a force of 11 750 N. In this time interval of 5 seconds, the space shuttle rises to a height of 200 m.
Calculate the work done by this engine.
You are advised to show your working out.

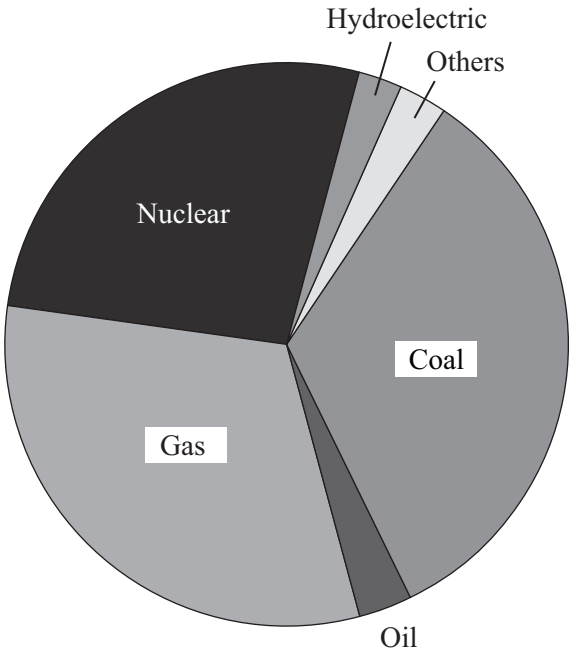
Work done = _____ J [3]

Examiner Only
Marks | Remark

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Examiner Only	
Marks	Remark

7 The chart shows the sources used to generate electricity in the United Kingdom in 2002.



(i) Which resource would have provided the lowest running costs?

Answer _____ [1]

(ii) Which resource would have resulted in the greatest de-commissioning costs?

Answer _____ [1]

(iii) Which named resource does not ultimately depend on the energy of the sun?

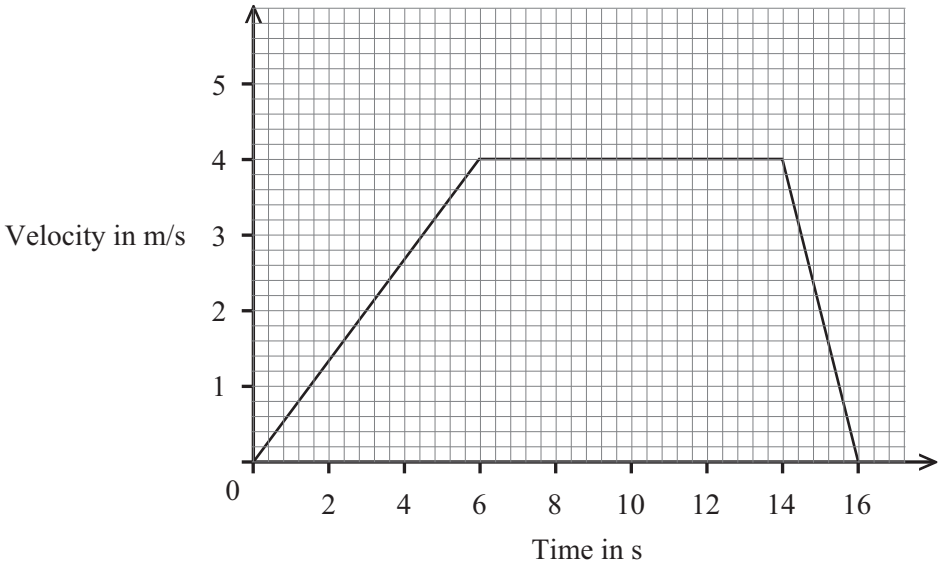
Answer _____ [1]

(iv) Name a renewable resource which could be included in the 'Others' section in the chart.

Answer _____ [1]

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8 The velocity–time graph for a toy car is shown.



The toy car has a mass of 500 g.

Calculate the maximum momentum of the car in kg m/s.

You are advised to show clearly your working out.

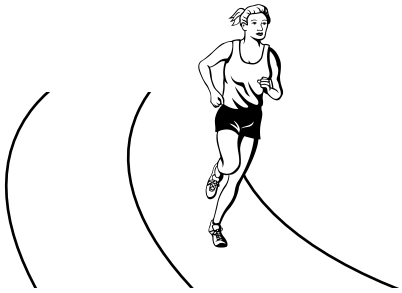
Maximum momentum = _____ kg m/s [3]

Examiner Only

Marks	Remark

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9 Scarlett runs round a circular race-track at a constant speed of 4 m/s.



(a) Explain why her velocity is changing.

_____ [1]

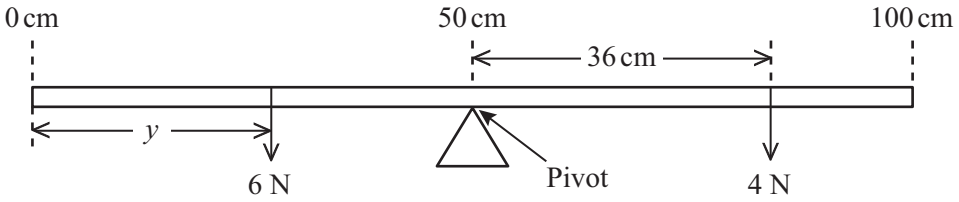
(b) The circumference of the track is 300 m and Scarlett runs one lap.
How long will this take if she maintains a constant speed of 4 m/s?
You are advised to show your working out.

Time = _____ s [3]

Examiner Only	
Marks	Remark

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10 A uniform metre rule is pivoted at its mid-point. The markings on the metre rule start with the zero mark at the left-hand end as shown. A 4 N weight acts on the right-hand side 36 cm from the pivot.



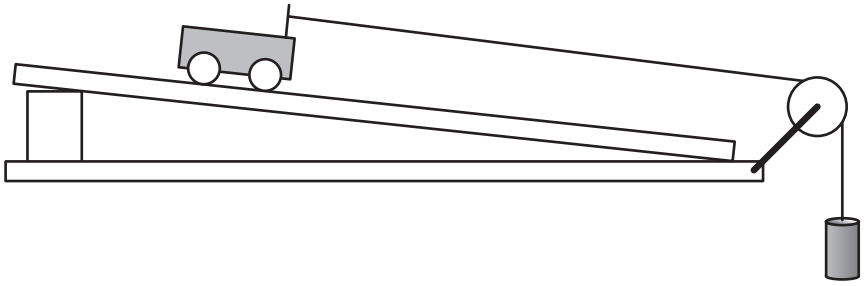
Use the principle of moments to calculate the distance y from the 6 N force to the end of the metre stick.
You are advised to show clearly your working out.

$y =$ _____ cm [4]

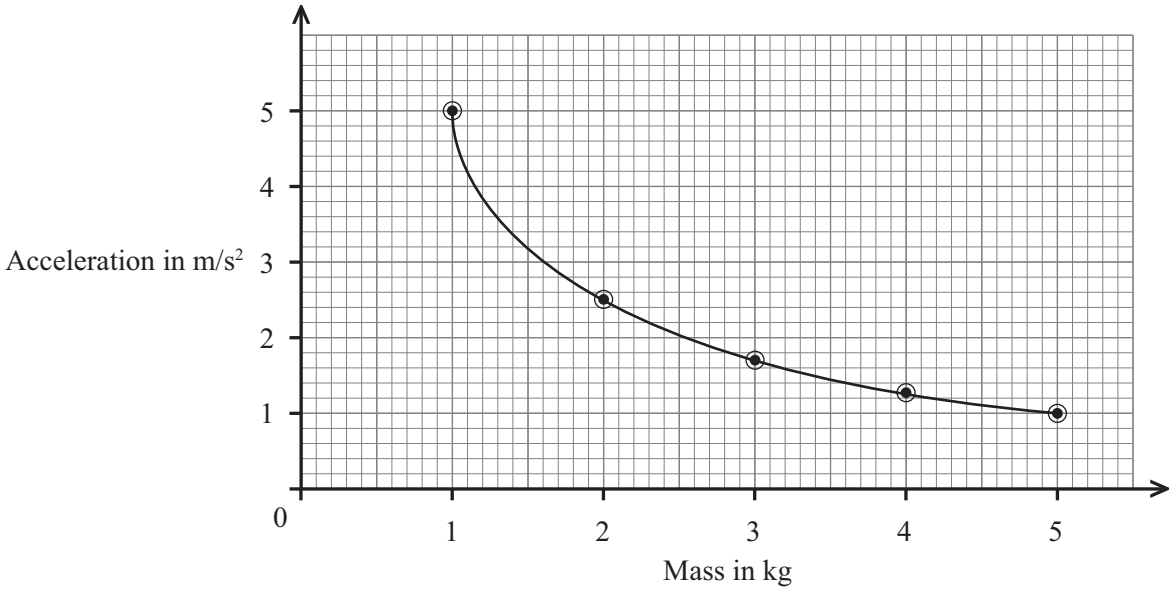
Examiner Only
Marks | Remark

Examiner Only	
Marks	Remark

11 Flora carries out an experiment in the laboratory where trolleys of different masses are accelerated by the **same force** down a runway.



For each trolley, Flora records the acceleration and plots a graph of acceleration against mass. The graph is shown below.



(a) How can you tell from the graph that the acceleration is **not** directly proportional to the mass?

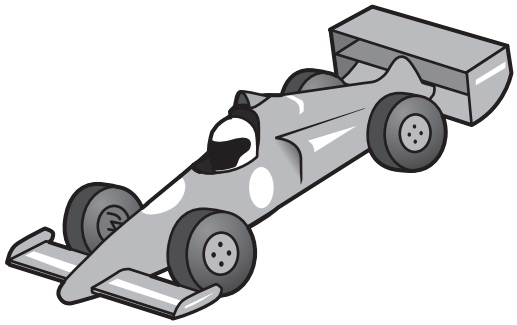
_____ [1]

(b) Use the graph to calculate the size of the force.
You are advised to show your working out.

Force = _____ N [3]

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12 A racing car of mass 1200 kg has a kinetic energy of 960 000 J.



Calculate the speed of the racing car.
You are advised to show your working out.

Speed = _____ m/s [4]

Examiner Only	
Marks	Remark

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GCSE

Science: Double Award (Modular)

End of Module Tests

May 2010

Mark Schemes

Issued: October 2010

Rewarding Learning

General Certificate of Secondary Education
2009–2010

Science: Double Award (Modular)

Forces and Energy
End of Module Test
Higher Tier

[GDC02]

THURSDAY 20 MAY 2010, AFTERNOON

MARK SCHEME

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				AVAILABLE MARKS
1	**(a)**	**(i)** good conductor	[1]	
		(ii) poor conductor/good insulator	[1]	
	(b)	**(i)** hot [1] cold [1]	[2]	
		(ii) convection	[1]	5
2	**(a)**	2.5 N [1] 200 g [1] or 0.2 kg	[2]	
	(b)	They all hit the ground at the same instant	[1]	3
3	**(a)**	Efficiency = $\frac{\text{Useful output energy}}{\text{Input energy}}$ [1] = $\frac{20}{25}$ [2] showing energy output = 20 J award [1] = 0.8 **or** 80% [1]	[4]	4
4	**(i)**	Stationary [1] or stopped [1] Constant speed [1] or steady speed	[2]	
	(ii)	(Average) speed = $\frac{\text{(Total) distance}}{\text{(Total) time}}$ [1] = $\frac{50}{25}$ [1] = 2 (m/s) [1]	[3]	5
5	**(i)**	2 N ≡ 4 cm [1] 1 N ≡ 2 cm [1]	[2]	
	(ii)	$3 \times 2 = 6$ $15 - 6 = 9$ **or** $5 \times 2 = 10$ [1] $19 - 10 = 9$ [1] Answer = 9 (cm) allow ecf from **(i)** if ext ⩽ 3 cm	[2]	4
6	**(a)**	Power = Work done ÷ time [1] or equivalent = 9 400 000 ÷ 5 [1] = 1 880 000 [1] (W) [1]	[3]	
	(b)	Work done = Force × distance [1] = 11 750 × 200 [1] = 2 350 000 [1] (J)	[3]	6

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			AVAILABLE MARKS
7	**(i)** Hydroelectric or HEP	[1]	
	(ii) Nuclear	[1]	
	(iii) Nuclear	[1]	
	(iv) e.g. wind, solar, tidal, waves, biomass, geothermal	[1]	4
8	Momentum = mass × velocity [1] or p = mv = 0.5 × 4 [1] = 2 (kg m/s) [1]	[3]	3
9	**(a)** Direction changes	[1]	
	(b) Speed = $\frac{\text{distance}}{\text{time}}$ (**or** equivalent) [1] $4 = \frac{300}{t}$ [1] or $t = \frac{300}{4}$ t = 75 (s) [1]	[3]	4
10	CWM = ACWM [1] or $F_1 \times d_1 = F_2 \times d_2$ 4 × 36 = 6 × x [1] x = 24 (cm) [1] y = 26 (cm) [1]	[4]	4
11	**(a)** Line is not straight **or** does not pass through origin	[1]	
	(b) F = ma [1] Choose point from graph e.g. F = 5 × 1 [1] = 5 (N) [1]	[3]	4
12	k.e. = $\frac{1}{2}$ mv^2 [1] $v^2 = \frac{2 \times 960\,000}{1200}$ [2] v = 40 (m/s) [1]	[4]	4
		Total	**50**

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Rewarding Learning

Centre Number	
71	

Candidate Number

General Certificate of Secondary Education
2009–2010

Science: Double Award (Modular)

Forces and Energy
End of Module Test
Higher Tier

C

[GDC02]

GDC02

THURSDAY 25 FEBRUARY 2010, MORNING

TIME

45 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Write your answers in the spaces provided in this question paper.
Answer **all twelve** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 50.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
Total Marks	

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1 A ballet dancer of weight 630 N balances on one toe.



If the area of toe in contact with the floor is 3 cm^2, calculate the pressure exerted on the floor in N/cm^2.

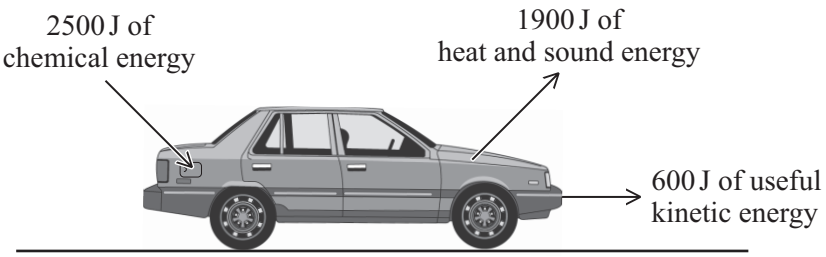
You are advised to show your working out.

Pressure = _____ N/cm^2 [3]

Examiner Only	
Marks	Remark

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2 The diagram below shows what happens to 2500 J of chemical energy input to the engine of a car.



Calculate the efficiency of the car's engine.

You are advised to show your working out.

Efficiency of engine = _____ [3]

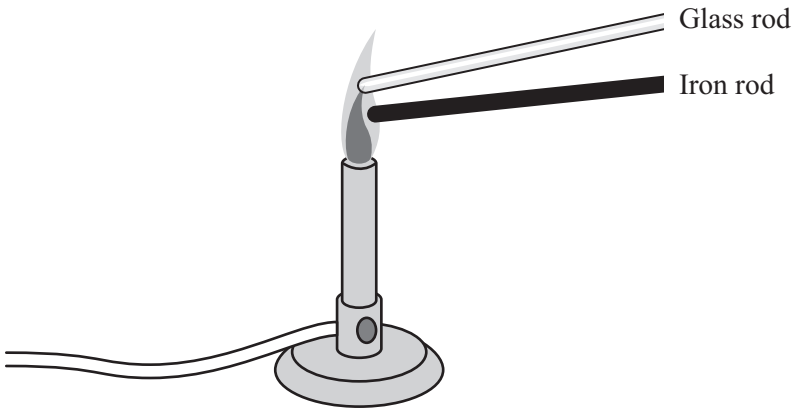
Examiner Only

Marks	Remark

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Examiner Only	
Marks	Remark

3 Two rods, one made of glass and the other of iron, are placed in a Bunsen flame as shown. The dimensions of the rods are exactly the same.



After each of the statements below, write the letter **G** if the statement applies to glass.
Write **I** if the statement applies to iron.
If the statement applies to both rods, then put **GI** in the box.

This rod has no free electrons. ☐

Atoms are mainly responsible for heat conduction. ☐

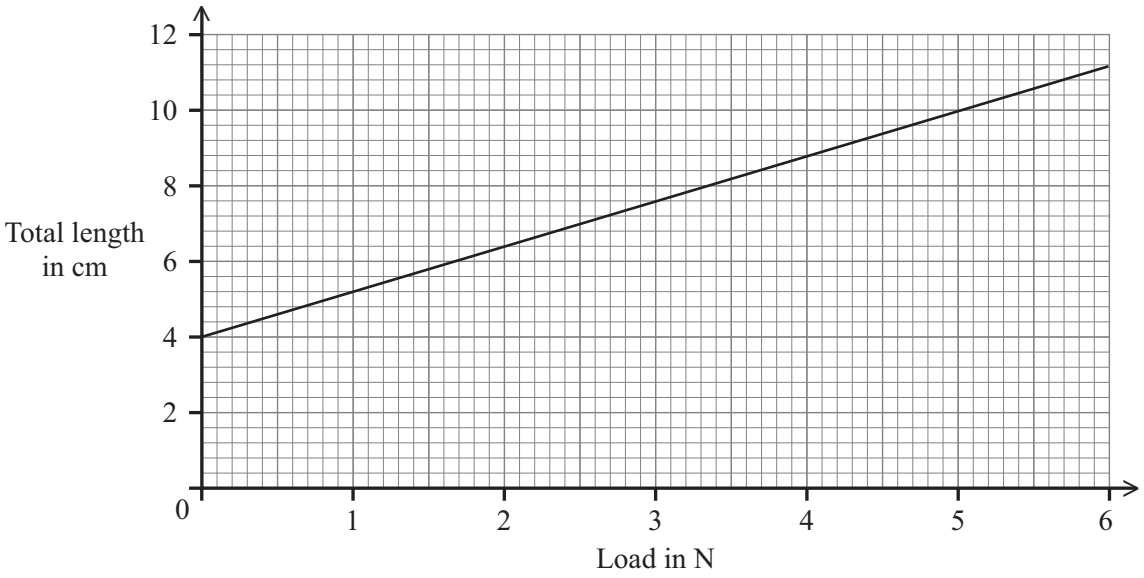
Atoms vibrate more quickly when heat is added. ☐

Heat is transferred when electrons collide with neighbouring atoms. ☐

[4]

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4 The graph below shows results from a Hooke's Law experiment for a steel spring.



(a) Is the load proportional to the total length of the spring?

Tick (✓) the correct box and give a reason for your answer.

Yes ☐

No ☐

Reason: _____ [1]

(b) What is the natural (unextended) length of the spring?

Natural length = _____ cm [1]

(c) An unknown load extends the spring by 6 cm. Use the graph to find the unknown load.

You are advised to show your working out.

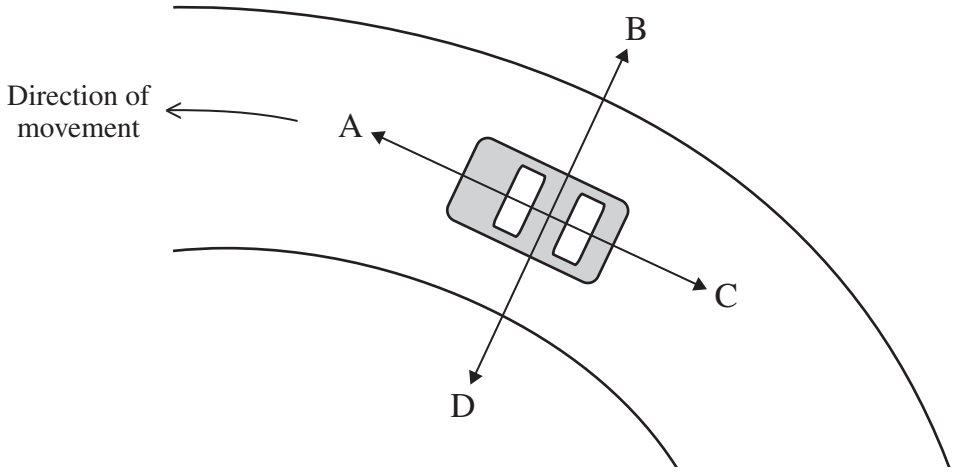
Unknown load = _____ N [2]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

5 The diagram shows a plan view (bird's eye view) of a car going round a circular track.



Four directions, A, B, C and D, are shown.

(a) (i) Which letter indicates the direction of the force which keeps the car moving in a circle?

Letter _____ [1]

(ii) What is the name of this force?

Force _____ [1]

(b) The car has a mass of 1500 kg and it is going at a constant speed of 20 m/s. Calculate the car's momentum.

You are advised to show your working out.

Momentum = _____ kg m/s [3]

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Examiner Only	
Marks	Remark

6 Patricia wants to calculate the power she develops in running up a flight of steps.



The data sheet below gives one set of results recorded by her classmate.

Data Sheet

Patricia's weight = 700 N
Height of one step = 0.15 m
Number of steps = 20
Time to run up steps = 5 seconds

(a) Use the information in the data sheet to calculate the work done in running up the 20 steps.

You are advised to show your working out.

Work done = _____ J [3]

(b) Use the information in the data sheet and your answer to part **(a)** to calculate the power developed by Patricia.

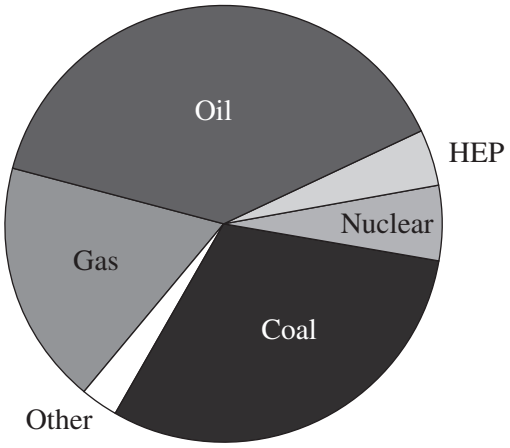
You are advised to show your working out.

Power developed = _____ W [3]

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Examiner Only	
Marks	Remark

7 The pie-chart gives an idea of the main sources of the energy used in the world today.



(a) Which two fuels are we most dependent on?

_____ and _____ [1]

(b) **(i)** Choose an energy resource from the pie-chart which is renewable.

_____ [1]

(ii) Explain why there will be an increase in the use of renewable energy sources by the year 2050.

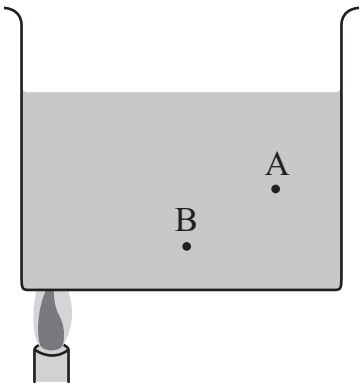
_____

_____

_____ [1]

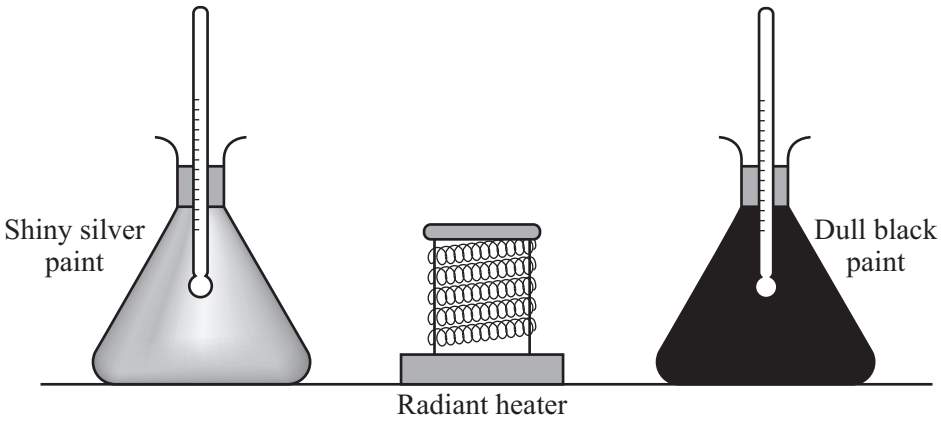
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8 Jenny heats a beaker of water as shown.



(a) Draw an arrow at A and another arrow at B on the diagram, to show the direction of water movement. [2]

Two conical flasks contain the same amount of water at the same temperature. They are placed at equal distances from a radiant heater.



(b) Explain, fully, why the temperature of the water in the flask with the dull black paint rises more than in the flask with the shiny silver paint.

_____

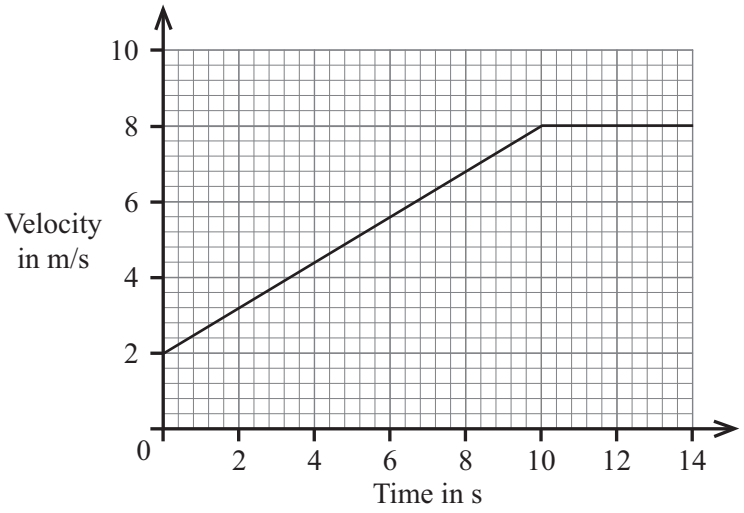
_____ [2]

Examiner Only

Marks	Remark

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9 The graph shows the motion of a lorry.



(a) Use the graph to calculate the acceleration of the lorry during the first 10 seconds.

You are advised to show your working out.

Acceleration = _____ m/s^2 [3]

(b) Describe the motion of the lorry from time $t = 10$ s to time $t = 14$ s.

_____

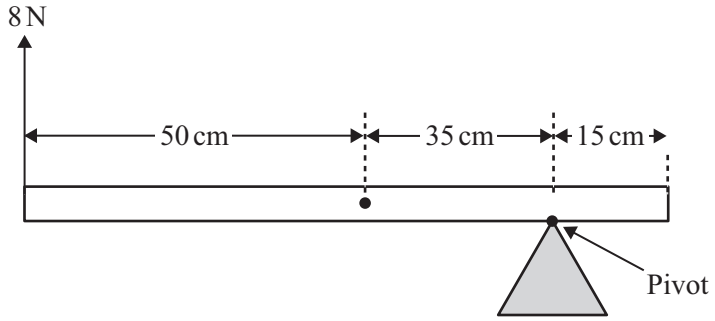
_____ [1]

Examiner Only

Marks	Remark

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10 A uniform rod 1 metre long is pivoted at 15 cm from one end. It is held in equilibrium, by an upward force of 8 N.



(a) Draw an arrow on the rod, labelled W, to show where the weight of the rod acts. [1]

(b) Use the principle of moments to calculate the weight W of the rod.

You are advised to show your working out.

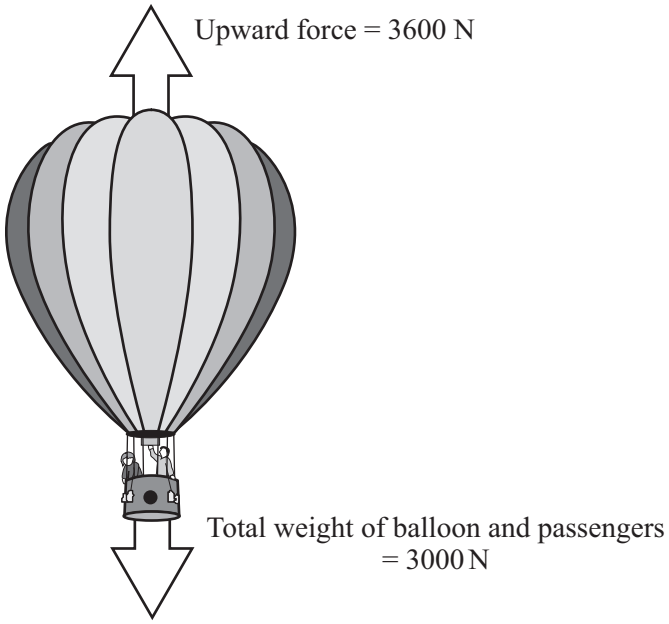
Weight = _____ N [3]

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Marks	Remark

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11 A hot air balloon is accelerating upwards as shown in the diagram below.



Calculate the acceleration of the hot air balloon.

You are advised to show your working out.

Acceleration = _____ m/s^2 [4]

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Marks	Remark

12 (a) A car of mass 550 kg is travelling at 20 m/s.
Calculate its kinetic energy.

You are advised to show your working out.

Kinetic energy = _____ J [3]

(b) Another car has a kinetic energy of 88 000 J. The driver of this car brings it to rest in 22 m. All of the kinetic energy of the car is converted into work by the car's brakes.
Calculate the average force applied by the car's brakes.

You are advised to show your working out.

Average braking force = _____ N [3]

THIS IS THE END OF THE QUESTION PAPER

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GCSE

Science: Double Award (Modular)

End of Module Tests

March 2010

Mark Schemes

Issued: May 2010

Rewarding Learning

General Certificate of Secondary Education
2009 – 2010

Science: Double Award (Modular)

Forces and Energy
End of Module Test

Higher Tier

[GDC02]

THURSDAY 25 FEBRUARY, MORNING

MARK SCHEME

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		AVAILABLE MARKS

GCSE SCIENCE: DOUBLE AWARD (MODULAR) 2010

Forces and Energy

End of Module Test

Higher Tier

Mark Scheme

1 $P = \frac{F}{A}$ [1]

$= \frac{630}{3}$ [1]

$= 210\ (N/cm^2)$ [1] 3

2 $Eff = \frac{\text{(Useful) energy}}{\text{(Total) energy in}}$ [1]

$= \frac{600}{2500}$ [1]

$= 0.24$ or 24% [1] 3

3 G [1]
G [1]
G I [1]
I [1] 4

4 **(a)** No

Line does not go through origin [1]

(b) 4 (cm) [1]

(c) Total $l = 10$ (cm) or line on graph [1]

Unknown load = 5 N ecf from (b) [1] 4

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				AVAILABLE MARKS
5	**(a)**	**(i)** D	[1]	
		(ii) Friction/centripetal	[1]	
	(b)	Momentum = mass × speed	[1]	
		= 1500 × 20	[1]	
		= 30 000 (kg m/s)	[1]	5
6	**(a)**	W = F × d	[1]	
		= 700 × (20 × 0.15)	[1]	
		= 2100 (J)	[1]	
	(b)	$P = \frac{W.D.}{Time}$	[1]	
		$= \frac{2100}{5}$ (e.c.f.)	[1]	
		= 420 (W)	[1]	6
7	**(a)**	Coal, oil (regardless of order)	[1]	
	(b)	**(i)** HEP	[1]	
		(ii) Non renewables Earth's oil & gas source will have (virtually) run out or policy decision or reduce global warming or reduce pollution or nonrenewables are being used too much 1/1	[1]	3
8	**(a)**	A – arrow (vert.) downwards		
		B – arrow (horizontally) left	[2]	
	(b)	Black is a better [1] absorber [1] of heat Shiny is a better reflector [2] Black is a poorer reflector [2]	[2]	4

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			AVAILABLE MARKS
9	**(a)** Accel = Gradient or $a = \frac{v-u}{t}$	[1]	
	$= \frac{6}{10}$ or equivalent	[1]	
	$= 0.6\ (m/s^2)$	[1]	
	(b) Constant velocity or steady velocity or steady speed	[1]	4
10	**(a)** Arrow vertically downwards at c. of g. (labelled with W.)	[1]	
	(b) ACM = CM or $\circlearrowleft M = M \circlearrowright$	[1]	
	$W \times 35 = 8 \times 85$	[1]	
	$W = 19.4\ (N)$	[1]	4
11	$F = ma$ or $RF = ma$	[1]	
	$3600 - 3000 = 300a$ } either LHS gets 1/1 RHS gets 1/1	[1]	
	$600 = 300a$	[1]	
	$a = 2\ (m/s^2)$	[1]	4
12	**(a)** $KE = \frac{1}{2}\ mv^2$	[1]	
	$= \frac{1}{2} \times 550 \times (20)^2$	[1]	
	$= 110{,}000\ (J)$	[1]	
	(b) Work done = Force × distance or equivalent	[1]	
	$88\ 000 = F \times 22$	[1]	
	$F = 4000\ (N)$	[1]	6
		Total	**50**

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