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<h1 style="margin: 0;">Physics</h1> <p style="margin: 5px 0 0 0;">Unit: KPH0/4PH0</p> <p style="margin: 0 0 0 0;">Paper: 2P</p>			
Wednesday 5 June 2013 – Afternoon Time: 1 hour		Paper Reference KPH0/2P 4PH0/2P	
You must have: Ruler, calculator			Total Marks <div style="border: 1px solid black; height: 30px; width: 80px; margin: 0 auto;"></div>

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
– *there may be more space than you need.*
- Show all the steps in any calculations and state the units.
- Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets
– *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Write your answers neatly and in good English.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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EQUATIONS

You may find the following equations useful.

$$\text{energy transferred} = \text{current} \times \text{voltage} \times \text{time}$$

$$E = I \times V \times t$$

$$\text{pressure} \times \text{volume} = \text{constant}$$

$$p_1 \times V_1 = p_2 \times V_2$$

$$\text{frequency} = \frac{1}{\text{time period}}$$

$$f = \frac{1}{T}$$

$$\text{power} = \frac{\text{work done}}{\text{time taken}}$$

$$P = \frac{W}{t}$$

$$\text{power} = \frac{\text{energy transferred}}{\text{time taken}}$$

$$P = \frac{W}{t}$$

$$\text{orbital speed} = \frac{2\pi \times \text{orbital radius}}{\text{time period}}$$

$$v = \frac{2 \times \pi \times r}{T}$$

$$\frac{\text{pressure}}{\text{temperature}} = \text{constant}$$

$$\frac{p_1}{T_1} = \frac{p_2}{T_2}$$

$$\text{force} = \frac{\text{change in momentum}}{\text{time taken}}$$

Where necessary, assume the acceleration of free fall, $g = 10 \text{ m/s}^2$.



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P 4 1 5 6 0 A 0 3 2 0

Answer ALL questions.

1 Alpha and beta particles may be emitted by unstable nuclei.

(a) (i) When an unstable nucleus emits an alpha particle, its atomic (proton) number

(1)

- ☐ **A** increases by 1
- ☐ **B** stays the same
- ☐ **C** decreases by 2
- ☐ **D** decreases by 4

(ii) When an unstable nucleus emits an alpha particle, its mass (nucleon) number

(1)

- ☐ **A** increases by 1
- ☐ **B** stays the same
- ☐ **C** decreases by 2
- ☐ **D** decreases by 4

(b) Compared to a beta particle, an alpha particle

(1)

- ☐ **A** causes less ionisation
- ☐ **B** has less charge
- ☐ **C** has less mass
- ☐ **D** has less penetrating power



- (c) Describe how a teacher should measure the activity of a radioactive source using a Geiger-Muller detector.

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(Total for Question 1 = 7 marks)



2 A soldering iron is a tool used when joining electronic components in a circuit.

It has an electric heater.

(a) Soldering iron A operates when connected to the mains supply.



Soldering iron A

Soldering iron A is labelled 230 V, 30 W.

(i) What does **30 W** tell you about the energy transfer in the soldering iron?

(2)

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(ii) This soldering iron has an earth connection.

Explain how an earth connection protects the user.

(2)

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(b) Soldering iron B is connected to a low voltage power supply.



Soldering iron B

Soldering iron B is labelled 24 V, 70 W.

A student says:



I think that both soldering irons need a 3 A fuse.

(i) Use information from the soldering iron labels to evaluate this statement.

(3)

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(ii) There is a step-down transformer in the power supply for soldering iron B.

Describe the structure of a step-down transformer.

You may draw a labelled diagram to help your answer.

(3)

(Total for Question 2 = 10 marks)



3 James Dewar was a scientist who investigated liquid oxygen.

(a) He discovered that the boiling point of liquid oxygen is $-183\text{ }^{\circ}\text{C}$.

(i) Convert $-183\text{ }^{\circ}\text{C}$ to a temperature on the Kelvin scale.

(1)

Temperature = K

(ii) Use ideas about particles to describe the changes that happen when a liquid boils to form a gas.

(3)

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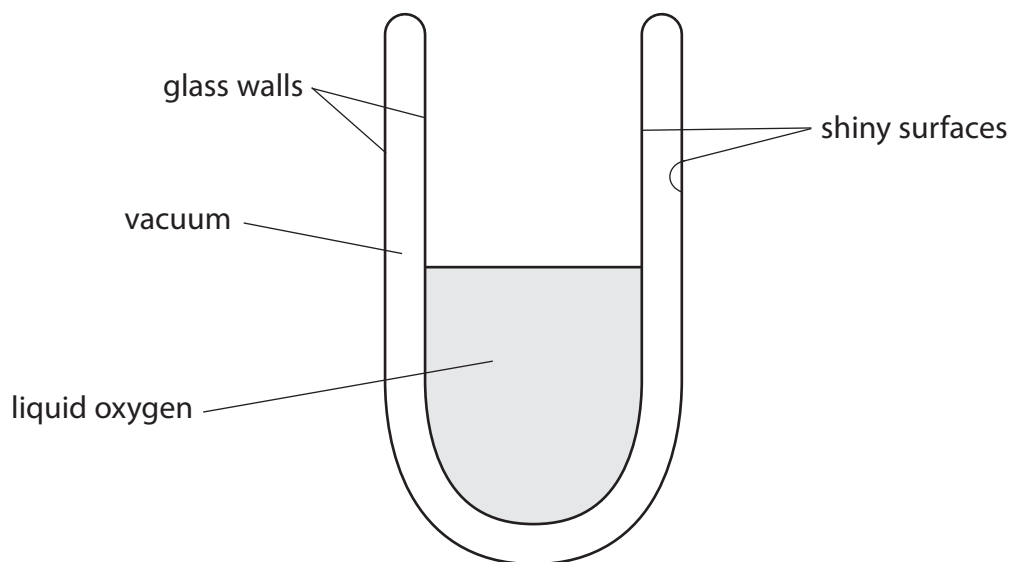
(b) Dewar invented a special flask for storing liquid oxygen in the laboratory.

It was designed to reduce heat flow from the air outside to the liquid oxygen inside.

The flask had two glass walls with a vacuum between them.

The inside glass surfaces were each covered with a thin layer of shiny metal.

The diagram shows a cross section of the flask.



(i) Explain how the **shiny surfaces** reduce the thermal energy transferred to the liquid oxygen from the laboratory.

(2)

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(ii) Explain how the **vacuum** reduces the thermal energy transferred to the liquid oxygen from the laboratory.

(2)

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(c) Dewar's flask did not have a lid when it was holding liquid oxygen.

Suggest why a lid was not needed.

(2)

(Total for Question 3 = 10 marks)



- 4 A lorry carries a load of hot asphalt – a runny mixture of small stones and tar.



- (a) The mass of the lorry and its load is 17 000 kg.

The velocity is 13 m/s.

- (i) State the equation linking momentum, mass and velocity.

(1)

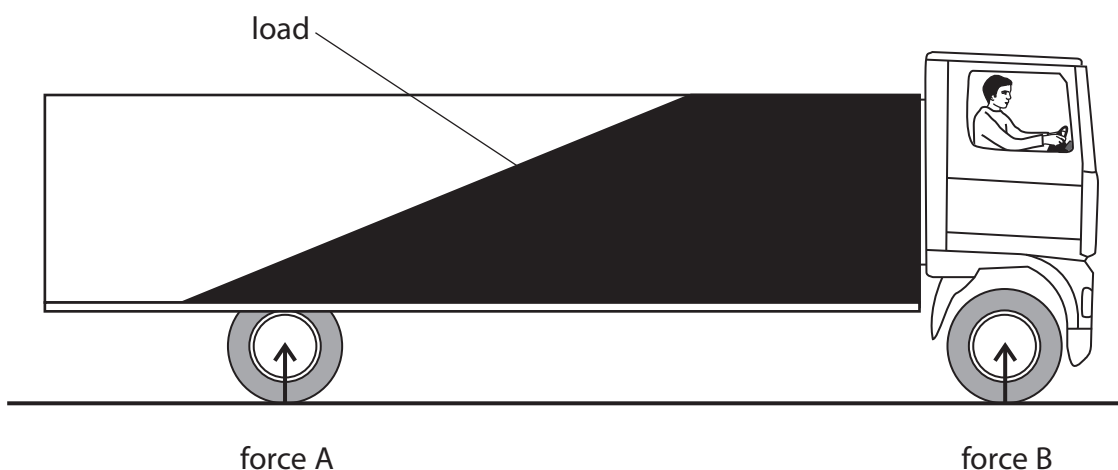
- (ii) Calculate the total momentum of the lorry and its load.

(2)

momentum = kg m/s



(b) The lorry stops suddenly and the load slides to the front, as shown below.



Force A and force B are upward forces from the road on the lorry.

- (i) Use ideas about momentum to explain why the load slides to the front when the lorry stops suddenly.

(2)

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- (ii) Use ideas about moments to explain why force B increases when the load slides to the front.

(3)

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(c) The force on the road from one of the tyres is 53 000 N.

The pressure of the air in this tyre is 390 kPa.

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

(1)

(ii) Calculate the area of this tyre in contact with the road.

(2)

Area = m²

(Total for Question 4 = 11 marks)



5 A student has some LEDs connected in a circuit. They emit light of different colours.

(a) (i) The different colours of light are waves which must have

(1)

- ☐ **A** the same amplitude in free space
- ☐ **B** the same frequency in free space
- ☐ **C** the same speed in free space
- ☐ **D** the same wavelength in free space

(ii) When an LED is on, it shows that

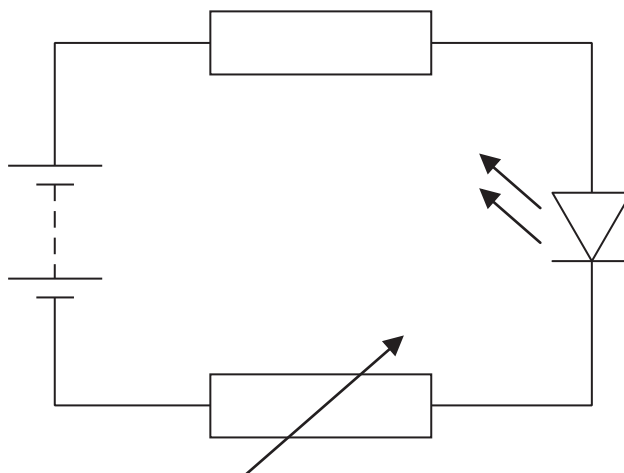
(1)

- ☐ **A** there must be alternating current in the circuit
- ☐ **B** there must be a current in the circuit
- ☐ **C** there is a fault in the LED
- ☐ **D** a fuse has blown



(b) An LED needs a minimum voltage to make it emit light.

The student investigates this minimum voltage using the circuit shown.



(i) The student uses a voltmeter to measure the voltage across the LED.

Add this voltmeter to the circuit diagram.

(2)

(ii) The student gradually increases the voltage across the LED and records the minimum voltage at which the LED emits light.

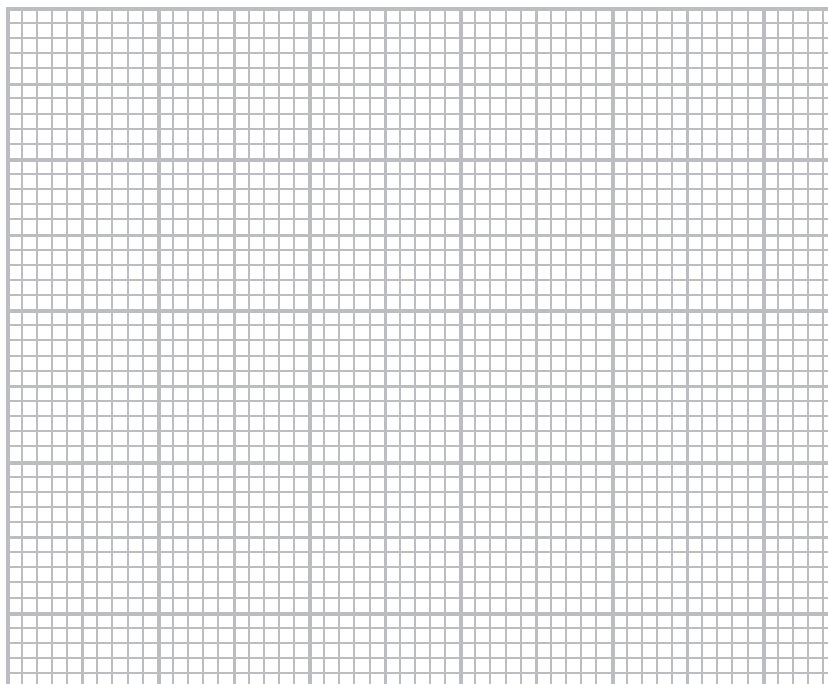
The results for some different LEDs are shown in the table.

Colour of light from LED	Minimum voltage in V
Red	1.7
Blue	3.6
Yellow	2.1
Orange	2.0
Green	3.0



Display the results of the student's investigation on the grid.

(4)



(iii) The student concludes:



The minimum voltage depends on the wavelength of the light emitted.

Evaluate the student's conclusion.

(2)

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(Total for Question 5 = 10 marks)



6 A wind turbine generates electricity for the National Grid.



(a) The useful energy transfer in the wind turbine is

(1)

- ☐ **A** chemical energy to electrical energy
- ☐ **B** gravitational potential energy to electrical energy
- ☐ **C** kinetic energy to electrical energy
- ☐ **D** sound energy to electrical energy



(b) The generator in the wind turbine transfers 39 MJ of energy in 1 minute.

The generator current is 490 A.

(i) Calculate the output voltage of the generator.

(3)

Voltage = V

(ii) The generator output voltage is then increased to 132 kV for transmission.

Explain why electrical energy is transmitted using very high voltages.

(4)

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QUESTION 6 CONTINUES ON THE NEXT PAGE



(c) The generator provides a direct current (d.c.).

This d.c. is changed to an alternating current (a.c.).

The frequency of the alternating current is 50 Hz.

(i) Explain the meaning of **50 Hz alternating current**.

(2)

(ii) Explain why the d.c. from the generator must be changed to a.c. before it is transmitted.

(2)

(Total for Question 6 = 12 marks)

TOTAL FOR PAPER = 60 MARKS

