IB · DP · Physics

50 mins 6 questions

Practice Paper 2

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Total Marks **/50**

1 (a) A motor is used to lift a 50 kg mass from rest up a vertical distance of 18 m in 0.3 minutes.

(a) Calculate the minimum power requires to the lift the mass.

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(3 marks)

(b) (b) Explain why the power of the motor is only a minimum.

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(2 marks)

(c) A different motor is used to lift an identical mass through the same distance in the same amount of time with an overall efficiency of 38 %. The mass experiences a resistive force of 170 N.

(c) Calculate the work required from the motor.

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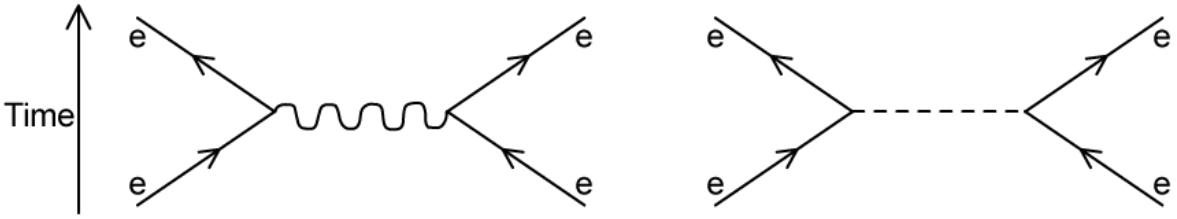
(3 marks)

2 (a) The Feynmann diagrams show two electroweak interactions between electrons. One of the exchange particles is a photon.



a) (i) Identify the other exchange particle which isn't a photon

[1]

(ii) Outline one difference between the two exchange particles

[1]

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(2 marks)

(b) b) Outline how interactions in particle physics are understood in terms of exchange particles.

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(2 marks)

(c) (c) Describe the significance of the Higgs Boson in the standard model of quarks and leptons.

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(2 marks)

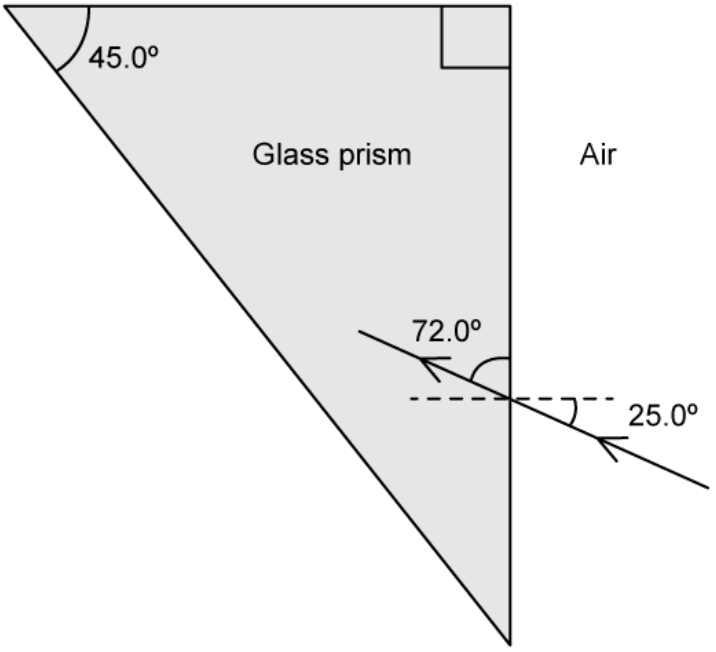
(d) The discovery of the Higgs Boson marked a huge accomplishment for particle physicists.

It was first hypothesised by Peter Higgs and his team in 1964 and then discovered by a large collaborative effort at the CERN particle physics laboratory much later in 2012.

(d) Explain what is meant by the term 'hypothesised' and suggest why it took over forty years to discover the Higgs Boson.

(3 marks)

3 (a) A ray of light passes from air into a glass prism.



As the light ray passes through the prism, it emerges back into the air.

(a) Calculate the critical angle from the glass to the air.

[2]

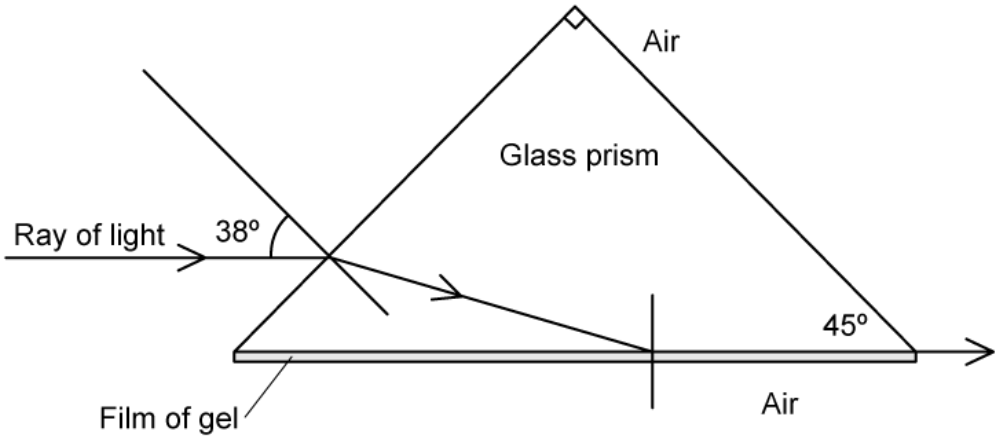
(2 marks)

(b) (b) On the diagram from part (a), draw the continuation of the path of the ray of light until it emerges back into the air, labelling the values of the angles between the ray and any normals.

[2]

(2 marks)

(c) The prism is rotated and one side is coated with a film of transparent gel. A ray of light strikes the prism, at an angle of incidence of 38°, and continues through the glass to strike the glass–gel boundary at the critical angle.



(c) Calculate the refractive index of the gel.

[3]

(3 marks)

(d) A ray of light now strikes the prism at an angle of incidence which means that it now refracts straight through the gel at the glass–gel boundary.

(d) Without calculation, explain how the critical angle for the glass–gel boundary differs from the critical angle for the gel–air boundary.

[2]

(2 marks)

4 (a) (a) State what is meant by an ideal gas.

[1]

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(1 mark)

(b) (b) State the conditions for a real gas to approximate to an ideal gas.

[3]

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(3 marks)

(c) (c) Describe how the ideal gas constant, *R,* is defined.

[2]

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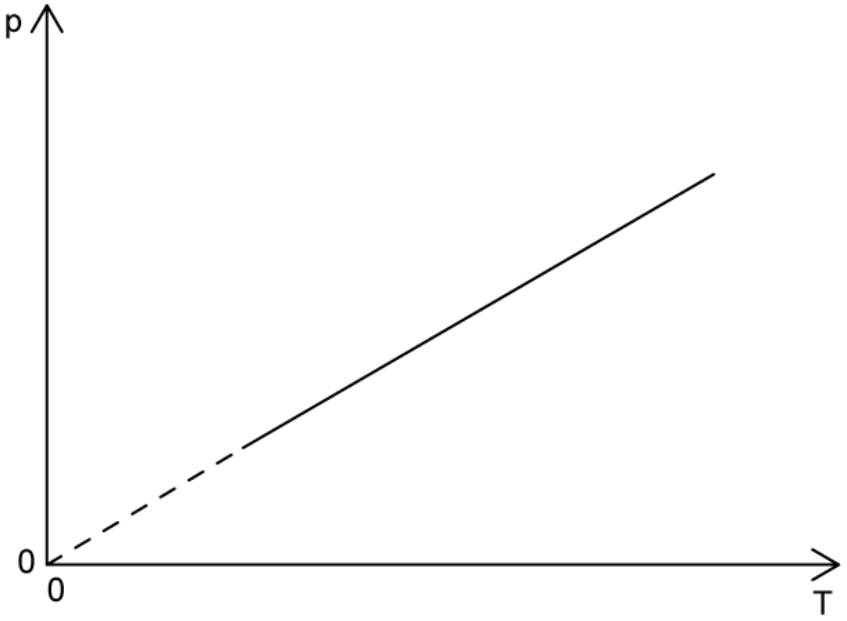
(2 marks)

(d) The graphs shows how pressure, *p*, varies with absolute temperature, *T,* for a fixed mass of an ideal gas.



(d) Outline the changes, or otherwise, to the volume and density of the ideal gas as the absolute temperature increases.

[2]

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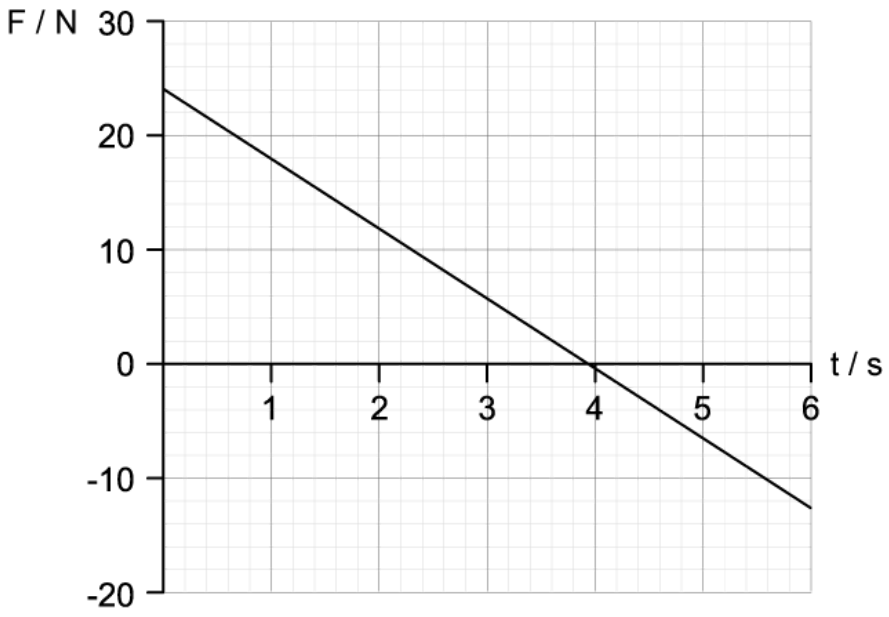
(2 marks)

5 (a) The force acts on a mass of 5.0 kg initially at rest.



(a) Show that the speed of the mass at t = 3 s is 8.4 m s^{-1}.

(4 marks)

(b) (b) Calculate the deceleration of the mass up to time t = 4 s.

(3 marks)

(c) (c) Calculate the total impulse experienced by the mass.

(3 marks)

6 (a) An industrial kiln is used for 'firing' ceramic and pottery items at very high temperatures.

The kiln emits electromagnetic radiation of peak wavelength, $\lambda_{max} = 3.75 \times 10^{-6}$ m and has a surface area of 150 m^2.

(a) Calculate the energy radiated per second.

[3]

(3 marks)

(b) (b) Justify each of the following safety features in the kiln by referring to thermal energy transfer.

(i) The installation of chimneys and vents.

[1]

(ii) Air space created below and around the kiln.

[1]

(iii) Shiny reflective surfaces fixed around the inside of the exterior walls.

[1]

(3 marks)