Class	Index Number	Name
15		

ST. ANDREW'S JUNIOR COLLEGE
JC 2 2016
Preliminary Examination Paper 2

PHYSICS, Higher 1 **8866/02**

13th Sept 2016 **2 hours**

READ THESE INSTRUCTIONS FIRST

Write your name, index number and Civics Group on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid..

Section A
Answer **all** questions.

Section B
Answer **any two** questions.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets **[ ]** at the end of each question or part question.

For Examiner's Use	
Paper 1	/ 30
Paper 2	
Section A	/ 40
Section B	/ 40
Total	/ 110
Percentage	/ 100
Grade	

This question paper consists of 24 printed pages including this page.

DATA AND FORMULAE

Data

speed of light in free space	c	=	3.00×10^{8} m s^{-1}
elementary charge	e	=	1.60×10^{-19} C
the Planck constant	h	=	6.63×10^{-34} Js
unified atomic mass constant	u	=	1.66×10^{-27} kg
rest mass of electron	m_e	=	9.11×10^{-31} kg
rest mass of proton	m_p	=	1.67×10^{-27} kg
acceleration of free fall	g	=	9.81 m s^{-2}

Formulae

uniformly accelerated motion	s	=	$ut + \frac{1}{2}at^2$
	v^2	=	$u^2 + 2as$
work done on/by a gas	W	=	$p\Delta V$
hydrostatic pressure	p	=	ρgh
resistors in series	R	=	$R_1 + R_2 + \ldots$
resistors in parallel	$1/R$	=	$1/R_1 + 1/R_2 + \ldots$

Section A – Answer all questions in the space provided

1 (a)

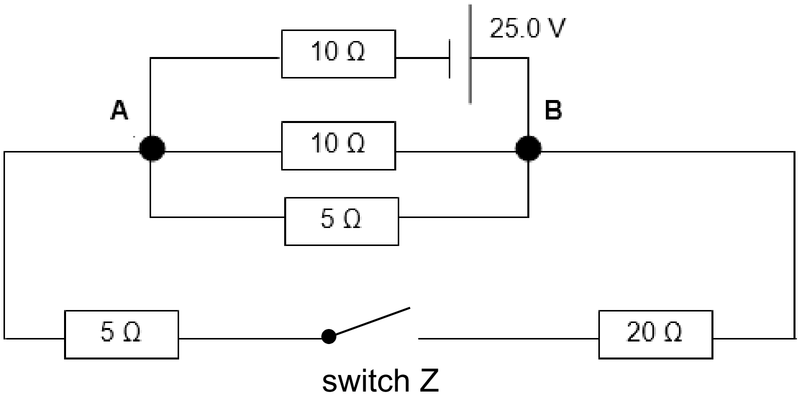


Fig. 1.1

Fig 1.1 is a circuit with a 25.0 V e.m.f. source that has negligible internal resistance. Switch Z is closed.

(i) Show that the total effective resistance of the circuit is 12.9 Ω. [2]

(ii) Calculate the potential difference between points **A** and **B**.

potential difference =…………………………V [2]

(iii) State and explain how the total power dissipated would change when switch Z is left open.

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

…………………………………………………………………………………... [2]

2 The graph of Fig. 2.1 shows how g, the acceleration due to gravity, varies with r, the distance from the centre of the Earth.

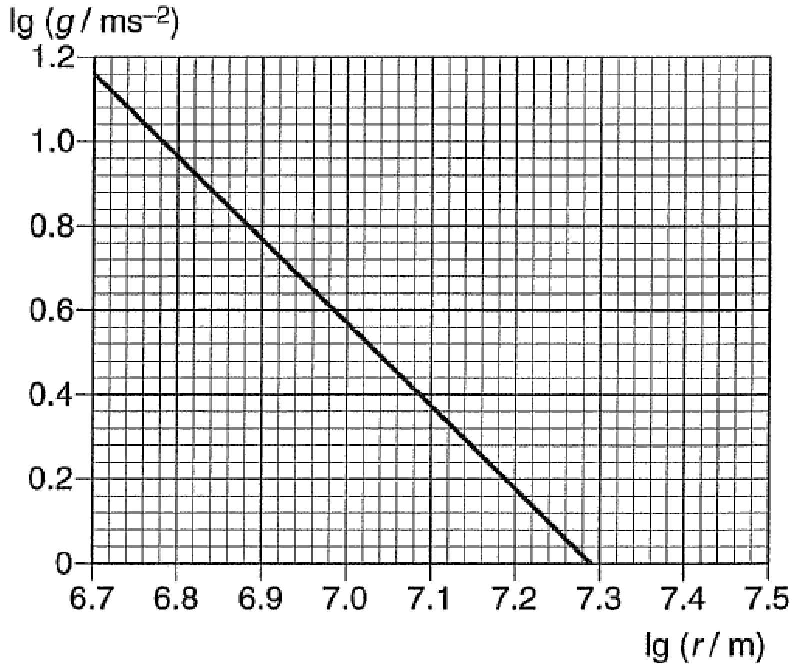


Fig. 2.1

(a) Calculate the gradient of the graph.

gradient = …………………..……. [1]

(b) State what can be inferred from the gradient of the graph calculated in **(i)** with regards to g and r.

……………...…………………………………………………………………………………. [1]

3 **(a)** In Fig. 3.1, there is a solenoid that causes a magnetic field of flux density, B, in the direction as shown. Describe an experiment to show how the force on a current-carrying conductor can be used to measure this magnetic flux density, B, using a current balance. Derive the expression for B. Use a diagram to support your answer.

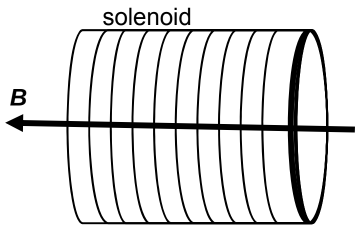


Fig 3.1

....

....

....

....

....

B =

[6]

(b) In the same magnetic field in **(a)**, electrons are projected upwards as shown in Fig. 3.2.

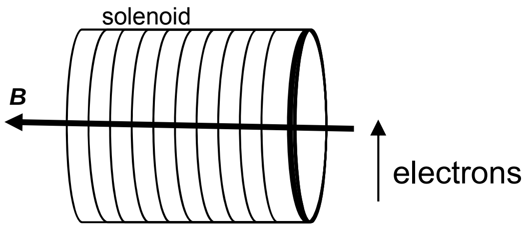


Fig 3.2

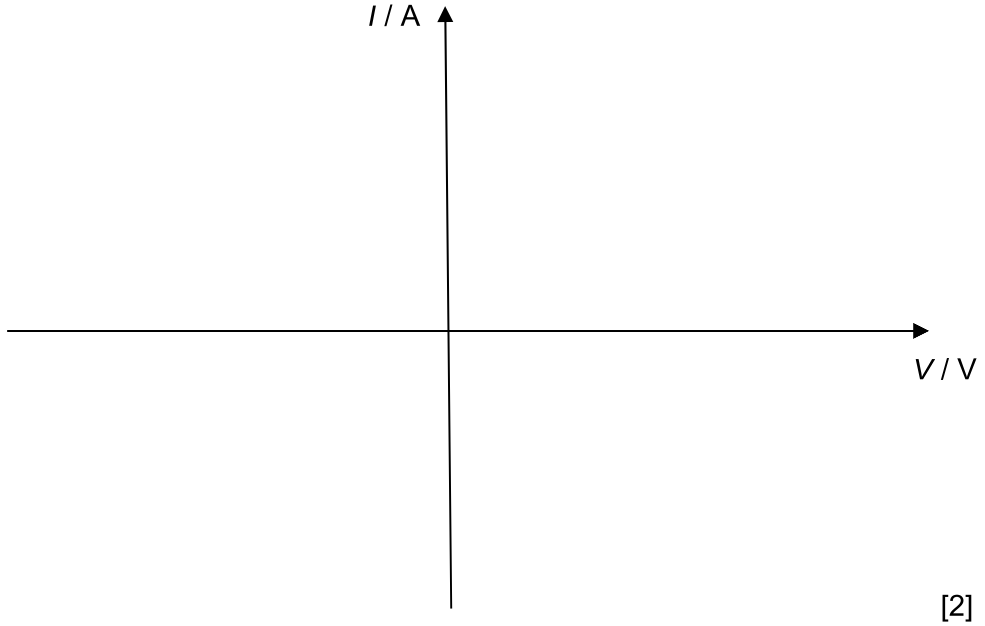
State and explain the instantaneous direction of deflection (if any) on the electrons.

....

.... [2]

4 **(a)** In 1887, Heinrich Hertz observed that when a metallic surface is exposed to monochromatic light, electrons may be emitted. He published these observations in the journal *Annalen der Physik* and it eventually came to be known as the photoelectric effect.

(i) Sketch a graph on the axes below to show the photocurrent-potential (I-V) characteristic obtained from a photoelectric effect experiment. Indicate the stopping potential on your graph.



[2]

(ii) A student wants to increase the magnitude of the stopping potential in the experiment by increasing the intensity of the incident radiation. This suggestion was disproved in an experiment conducted in his school's laboratory.

1. Explain why stopping potential is independent of the intensity of the incident radiation.

…………………………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………

………………………………………………………………………………………… [2]

2. Sketch, on the graph in **(i)**, the actual effect of increasing the intensity of the incident light. [1]

3. Suggest what he should change instead to achieve an increase in stopping potential.

…………………………………………………………………………………………[1]

(b) Fig. 4.1 shows a high voltage supply set up to produce energetic electrons to bombard the cool sodium gas in the discharge tube, giving rise to an emission line spectrum when the beam is passed through a diffraction grating. Fig. 4.2 shows some energy levels of the sodium atom.

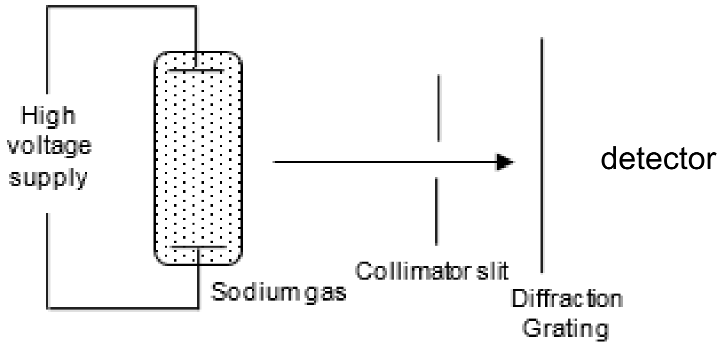


Fig. 4.1

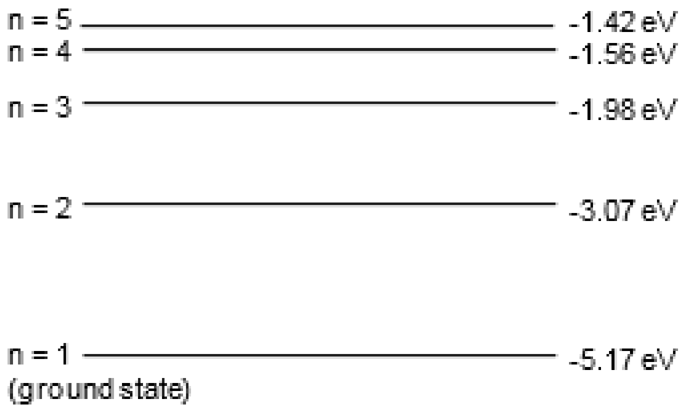


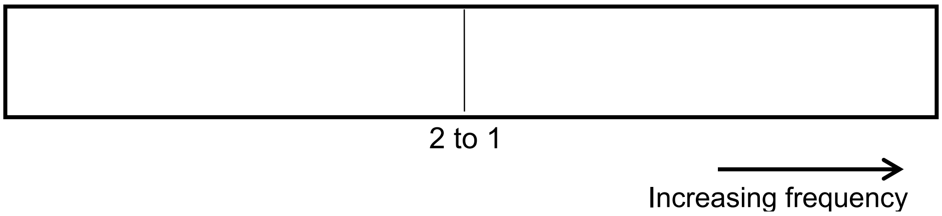
Fig. 4.2

Given that the bombarding electrons have a kinetic energy of 3.70 eV,

(i) Deduce the number of spectra lines which might be detected.

number of spectra lines = …………………. [1]

(ii) Sketch the positions of the lines on the emission spectrum below, indicating clearly the various transitions. The line due to the transition from n = 2 to n= 1 has been drawn for you. [2]



(iii) Calculate the wavelength of the light that was emitted due to the transition from n = 2 to n = 1.

wavelength = ………………………. m [2]

(iv) Determine the range of kinetic energy of the recoiling electrons after they have excited the sodium atoms.

range = ………..… eV ≤ KE ≤ ………..…eV [2]

5 Fig. 5.1a shows an alternating signal generator (with varying frequency) connected to a length of copper wire. Fig. 5.1b is observed in the wire at a specific frequency.

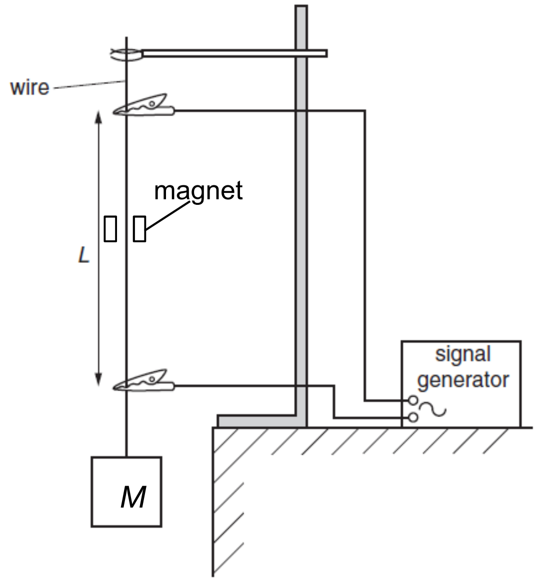


Fig. 5.1a

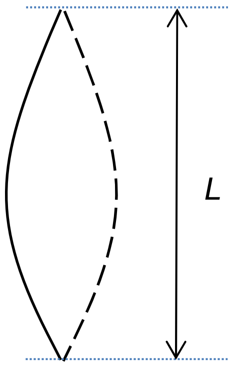


Fig. 5.1b

Mass M attached to the copper wire that hangs vertically has a mass of 3.00 kg.
The signal generator is switched on and causes the copper wire to oscillate.
The crocodile clips are moved until the length L for the maximum amplitude of oscillation is recorded as shown in Fig. 5.1b.
Length L denotes the length that stationary wave is observed on the wire.

Fig. 5.2 shows the variation with frequency f of length L.

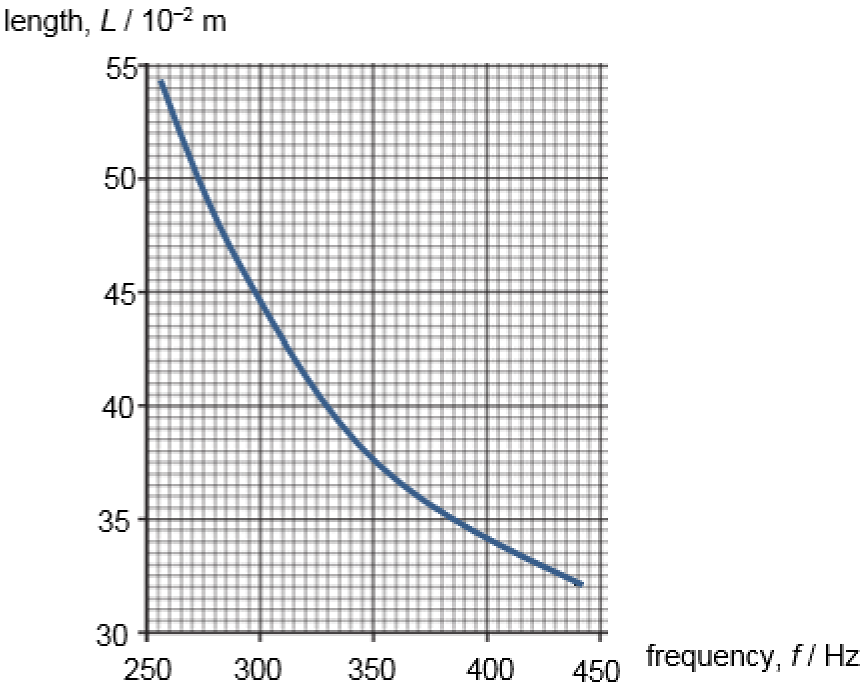


Fig. 5.2

(a) Derive the expression of *v* in term of *L* and *f* for this mode of stationary wave, where *v* is the speed of the wave in the wire.

[2]

(b) The variation between *f* and *m* is given by the expression

$$f - c = \frac{1}{2L}\sqrt{\frac{mg}{\mu}}$$

where μ and *c* are constants. *f* is the frequency when length of wire between the crocodile clips is *L*. The mass of the load is *m*. The constant μ is dependent on the material of the wire used on which stationary wave is observed.
An experiment is carried out to determine μ . The values of *f* are determined at *L* = 40.0 cm for different values of *m*.

Fig. 5.3 shows the readings obtained.

f / Hz	*m* / kg	$\sqrt{m}$ / $kg^{\frac{1}{2}}$
318	2.00	1.41
324	2.50	1.58
	3.00	
336	3.50	1.87
341	4.00	2.00
345	4.50	2.12
351	5.00	2.23

Fig. 5.3

(i) Use Fig. 5.2 to complete Fig. 5.3 for *m* = 3.00 kg. [1]

Fig. 5.4 is a graph of some of the data in Fig. 5.3.

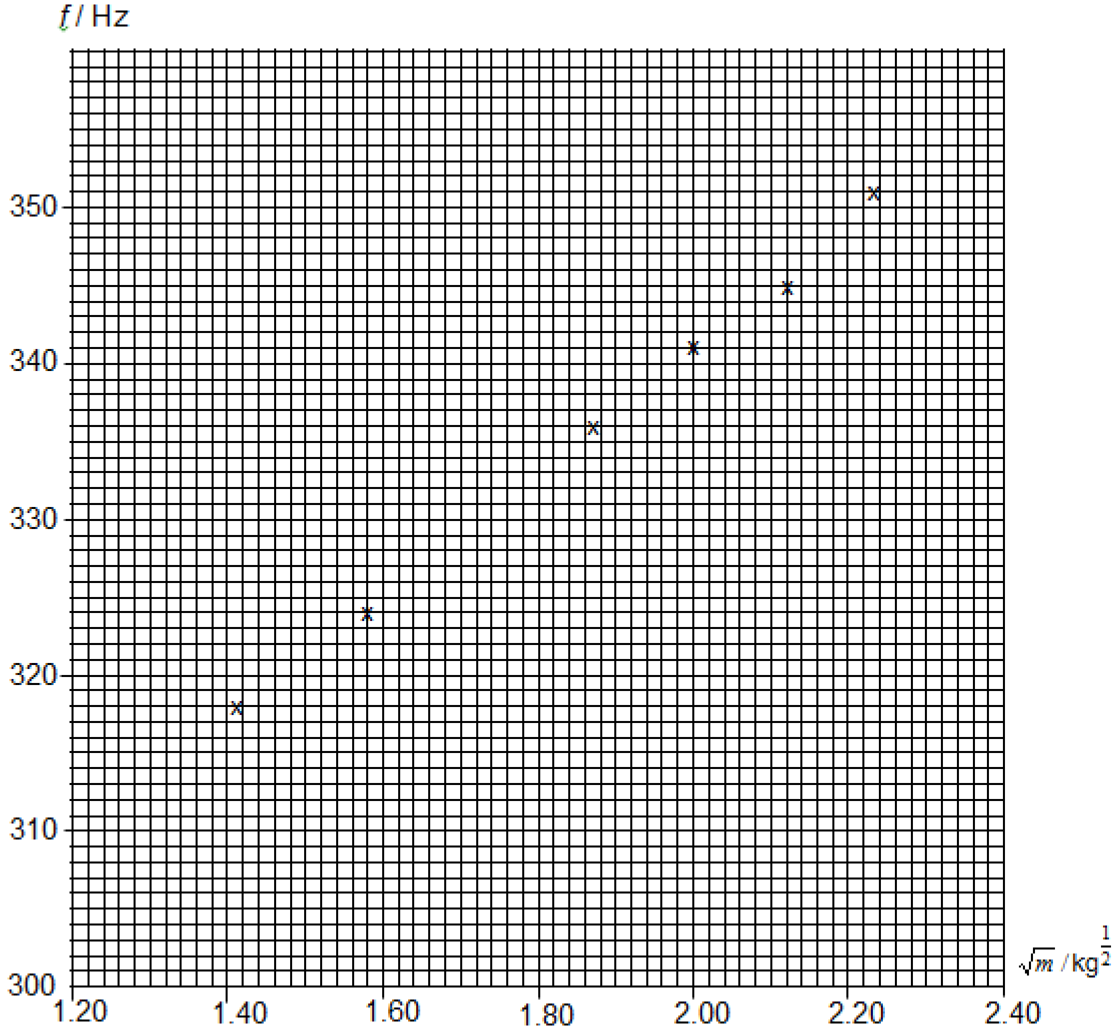


Fig. 5.4

(ii) On Fig. 5.4,

1. plot the point corresponding to m = 3.00 kg, and

2. draw the line of best fit for all the points. [2]

(iii) Explain why the graph in Fig. 5.4 supports the expression

$$f - c = \frac{1}{2L}\sqrt{\frac{mg}{\mu}}$$

....

....

....

....[2]

(iv) Hence, determine the value of μ .

μ = …………….. kg m^{-1} [2]

(v) Suggest two possible factors that could affect μ .

1. ………………………………………………………………………………

2. ……………………………………………………………………………… [2]

Section B – Answer two of the questions in this section.

6 **(a)** State three conditions for waves to have observable interference pattern.

1. ……………………………………………………………………………………

2. ……………………………………………………………………………………

3. …………………………………………………………………………………… [2]

(b) The apparatus illustrated in Fig 6.1 is used to demonstrate two-source interference using light.

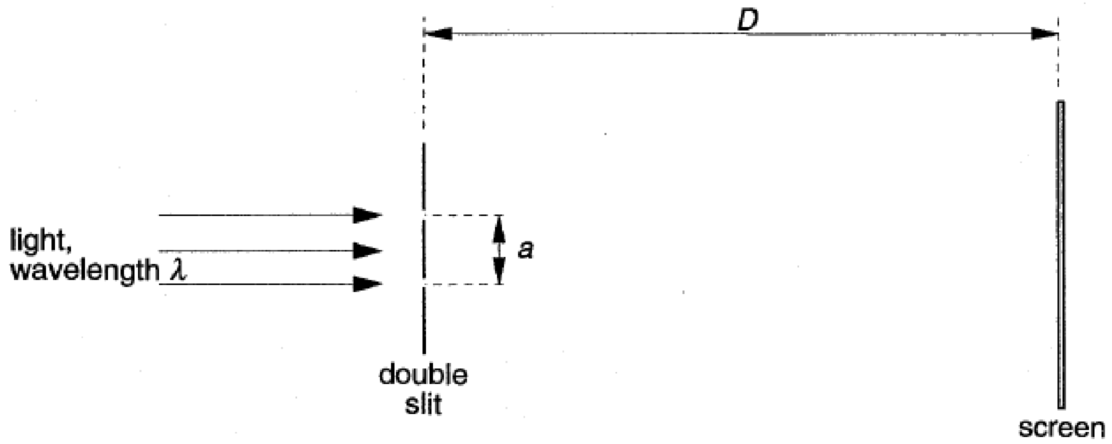


Fig. 6.1 (not drawn to scale)

The separation of the two slits in the double slit arrangement is *a* and the interference fringes are viewed on a screen at a distance *D* from the double slit. When light of wavelength λ is incident on the double slit, the separation of the bright fringes on the screen is *x*.

State and explain the effect, if any, on the separation of the fringes and on the contrast between the bright and dark fringes when the following changes are made.

1. The distance *D* is increased to *2D*, keeping *a* and λ constant.

Separation: ……………………………………………………………………………

Contrast: ………………………………………………………………………………

………………………………………………………………………………………

……………………………………………………………………………………… [2]

2. The incident light is polarised into a single plane before reaching the double slits.

Separation: …………………………………………………………………..…….

Contrast: ……………………………………………………………………......

………..……………………………………………………………………………..

………..………………………………………………………………………… [2]

(c) A ripple tank is used to demonstrate the interference pattern between water waves. The wave pattern produced is shown in Fig 6.2, where the solid line represents positions of the crests.

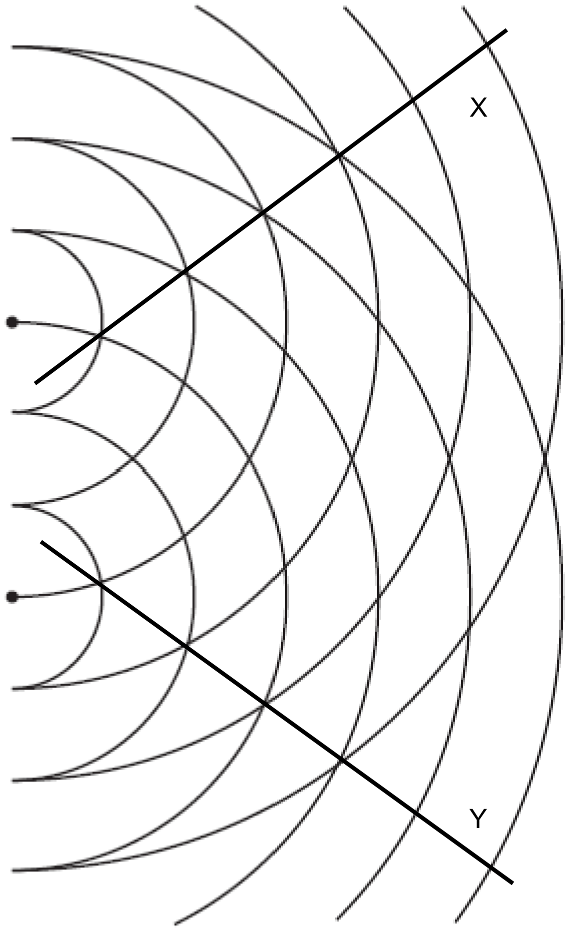


Fig 6.2

Sketch two possible lines to show where the minima would be seen between X and Y. Label these lines as D. [2]

(d) A glass tube, closed at one end, has dust sprinkled along its length. A sound source is placed near the open end of the tube, as shown in Fig 6.3.

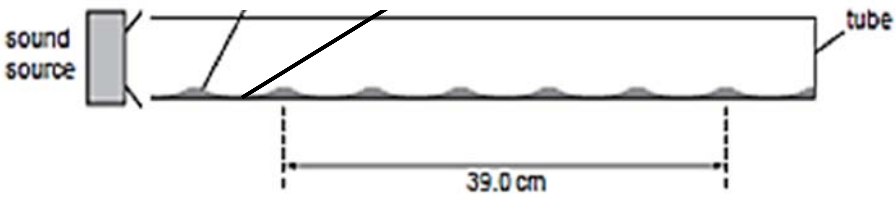


Fig 6.3

The sound emitted by the source is of constant frequency and the dust forms small heaps and depressions in the tube.

(i) Explain, by reference to the properties of stationary waves, why the heaps and depressions are formed.

…………………………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………[2]

(ii) The frequency emitted by the source is 2.14 kHz.
The distance between six heaps as shown in Fig 6.3 is 39.0 cm.
Calculate the speed of sound in the tube.

speed = ………………… m s^{-1} [3]

(iii) The volume from the sound source is increased. State and explain whether the distance between heaps and depressions would change.

…………………………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………[2]

(e) Wave **X** and Wave **Y** are superposed on each other at the same point. Their respective displacement – time graphs are as shown in Fig 6.4.

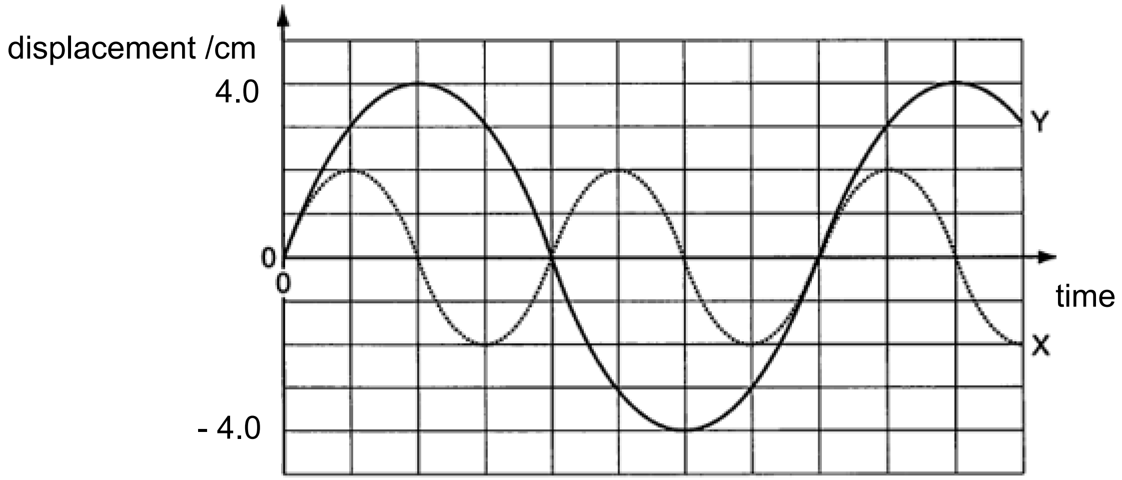


Fig. 6.4

(i) A student claims that wave **X** and wave **Y** are coherent with each other. Discuss the validity of his claim.

………………………………………………………………………………………………

………………………………………………………………………………………………

………………………………………………………………………………………………

…………………………………………………………………………………….. [2]

(ii) Deduce the amplitude of the resultant wave **Z**.

amplitude = ……………..………. cm [1]

(iii) Given that the intensity of **X** at that point is *I*, determine the intensity of resultant wave **Z** in terms of *I*.

intensity of Z = ……………………. [2]

7 **(a)** The four graphs in Fig. 7.1, plotted against time, show motions of different objects. Three of these graphs are possible for ordinary objects and one of them is impossible.

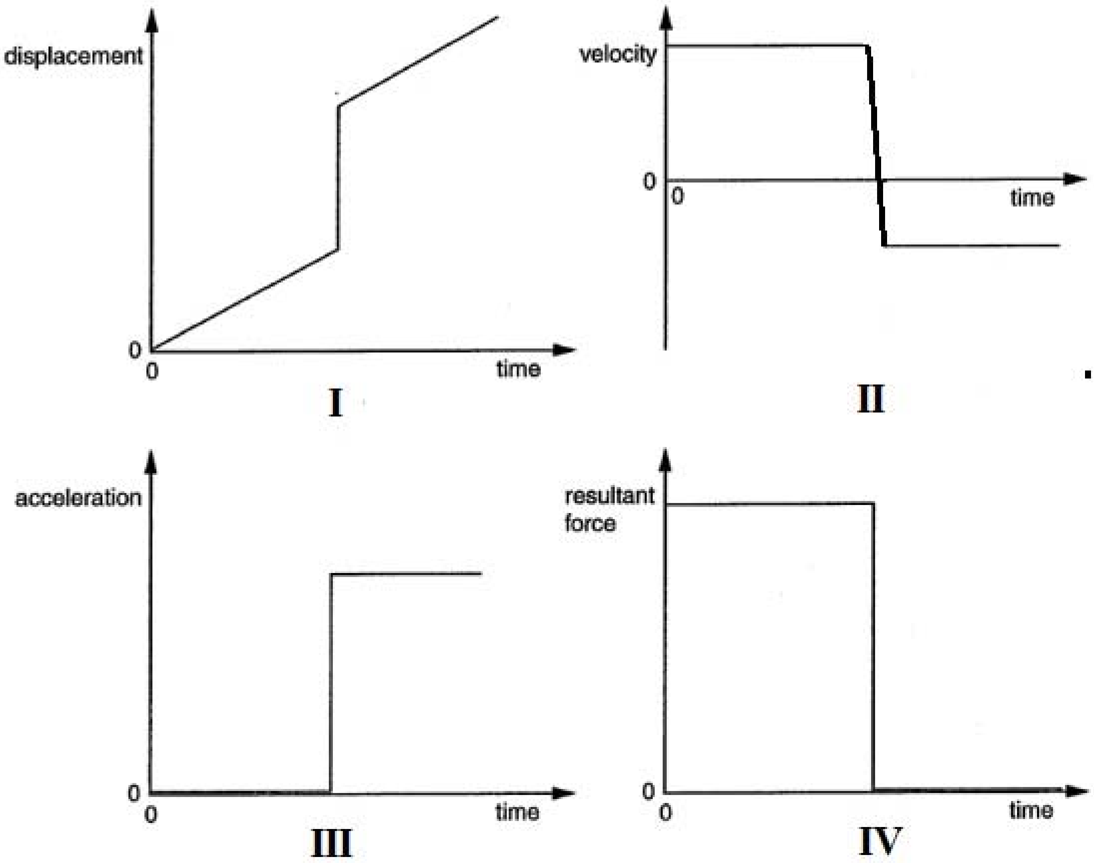


Fig. 7.1

(a) Identify the impossible graph and provide a reason for the selection.

The impossible graph is ……………..

The graph is impossible because ………………………………………………....

………………………………………………………………………………………

………………………………………………………………………………………[2]

(b) A young and reckless driver was speeding in his sports car at a constant speed of 200 km h^{-1} when he drove past a stationary traffic policeman. Assuming the policeman then went with an acceleration of 25 m s^{-2}, calculate how much time he took to catch up with this reckless driver.

time = ………………..…. s [2]

(c) A lorry changes its velocity from 50 m s^{-1} due East to 30 m s^{-1} due South.

(i) Draw a vector diagram to illustrate the change in velocity. [1]

(ii) Calculate the magnitude of the change in velocity

change in velocity = ……………….m s^{-1} [1]

(d) A girl falls vertically onto a trampoline as shown in Fig 7.2.

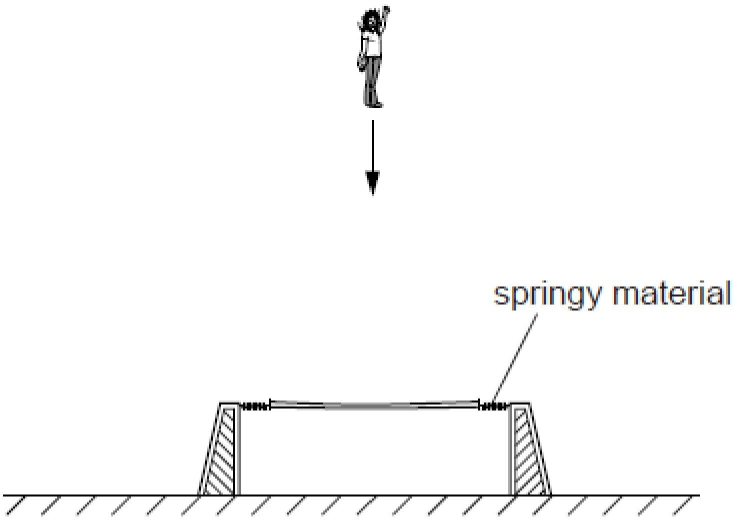


Fig 7.2

The trampoline consists of a central section supported by springy material. At time t = 0, the girl starts to fall. The girl falls vertically and hits the trampoline. She rebounds at the angle of 30° from vertical. The variation with time t of the vertical velocity v of the girl is illustrated in Fig 7.3.

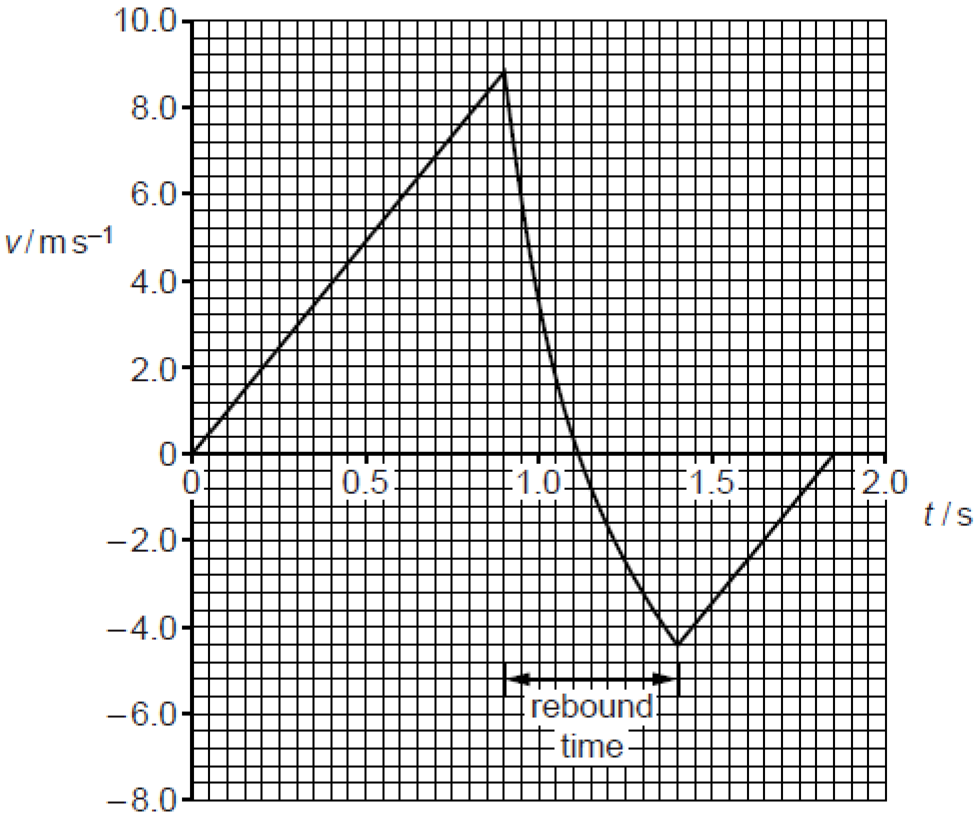


Fig 7.3

(i) Determine the distance fallen between t = 0 and when she hits the trampoline.

distance = ……………… m [2]

(ii) Determine the average acceleration during the rebound.

acceleration = …………………. m s^{-2} [2]

(iii) Use Fig 7.3 to compare, without calculation, the accelerations of the girl before and after the rebound. Explain your answer.

………………………………………………………………………………

………………………………………………………………………………

…………………………………………………………………………… [2]

(iv) Show that her speed after rebound is 5.08 m s^{-1} [1]

(v) Suggest why the speed after rebound is less than the speed she was just before she hits the trampoline.

………………………………………………………………………………

………………………………………………………………………………

…………………………………………………………………………… [2]

(vi) She was 40 cm above the ground when she rebounded. She rebounded at 30° from the vertical.

1. Calculate the maximum height above the ground she has reached after she has rebounded.

maximum height = ………………… m [2]

2. Calculate the horizontal distance travelled after she has landed on the ground.

horizontal distance = ……………. m [3]

8 **(a)** Explain what is meant by the centre of gravity of an object.

……………………………………………………………………………………………

…………………………………………………………………………………………… [1]

(b) A pendulum is fixed onto the ceiling of a train carriage as shown in Fig. 8.1. If the train is now cruising at constant speed towards the right as indicated, draw in Fig. 8.2 below and explain the resultant position of the pendulum.

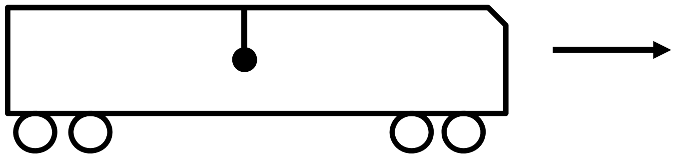


Fig. 8.1

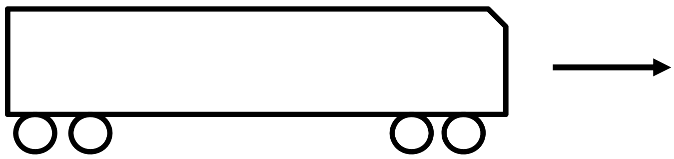


Fig. 8.2

……………………………………………………………………………………………

……………………………………………………………………………………………

…………………………………………………………………………………………… [2]

(c) A ladder, illustrated by the bold line, is resting inclined against a wall as shown in Fig. 8.3 below.

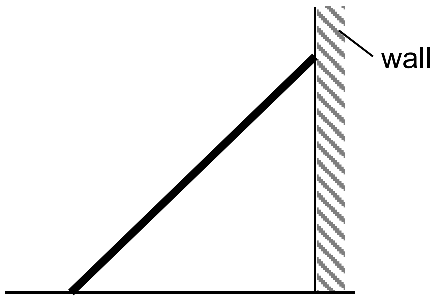


Fig. 8.3

A student claims that if the wall is frictionless but the ground is rough, the ladder cannot hold in its current position. Comment on his claim.

……………………………………………………………………………………………

……………………………………………………………………………………………

…………………………………………………………………………………………… [2]

(d) A hungry bear weighing 700 N walks out on a beam in an attempt to retrieve a basket of food hanging at the end of the beam as shown in Fig. 8.4 below. The beam is uniform, weighs 200 N and is 6.00 m long. The basket of food weighs 80 N.

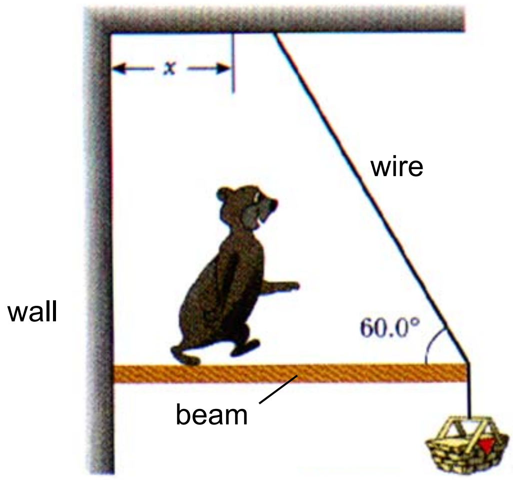


Fig. 8.4

(i) If the wire can withstand a maximum tension of 900 N, calculate x, the maximum distance the bear can walk before the wire breaks.

x = ……..……………..….. m [2]

(ii) When the wire is at maximum tension, calculate the magnitude of the force from the wall on the beam.

force = ……………………. N [3]

(iii) In his excitement to reach the food, the hungry bear leapt instead of walking gently before reaching x, and the wire was seen to break. Explain why this was so.

………………………………………………………………………….…………………

………………………………………………………………………….…………………

……………………………………………………………………………….....… [2]

(e) Explain the concept of work.

………………………………………………………………………………………………

………………………………………………………………………………………………

……………………………………………………………………………………………… [2]

(f) A table tennis ball falls vertically through air. Fig. 8.5 shows the variation of the kinetic energy E_k of the ball with distance h fallen. The ball reaches the ground after falling through a distance h_o.

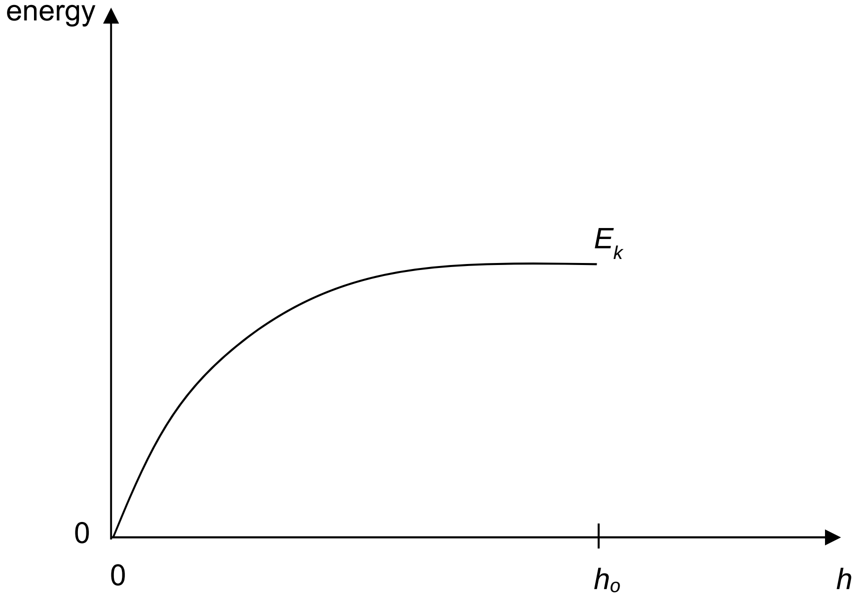


Fig. 8.5

(i) Explain the motion of the ball as shown by Fig. 8.5.

………………………………………………………………………………………………

………………………………………………………………………………………………

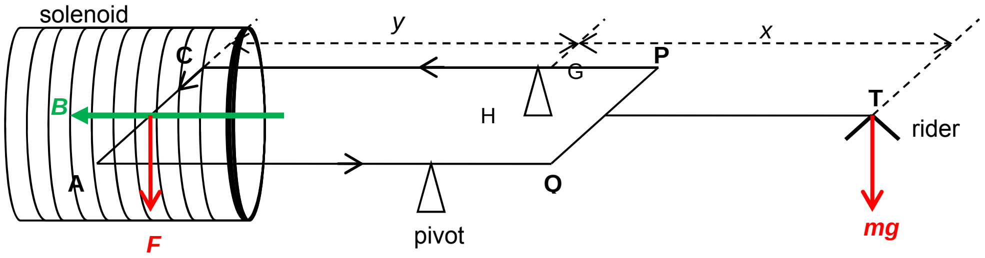
………………………………………………………………………………………………

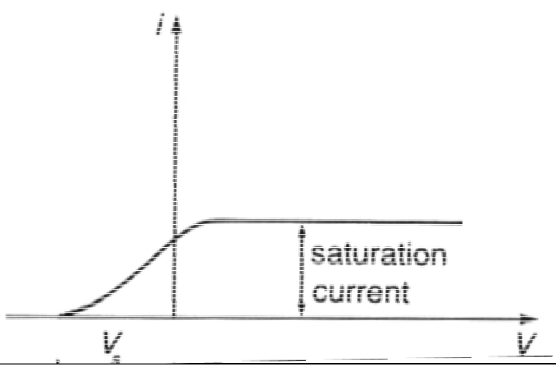
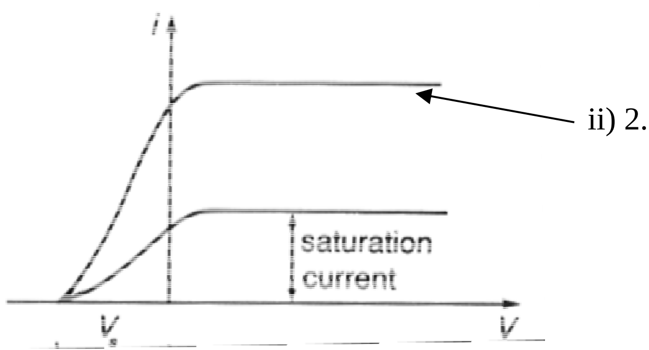
……………………………………………………………………………………………… [3]

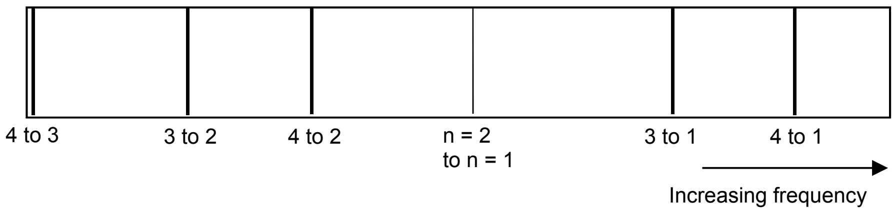
(ii) On Fig. 8.5, draw a line to show the variation with h of the gravitational potential energy E_p of the ball. At h = h_o, the potential energy is zero. [3]

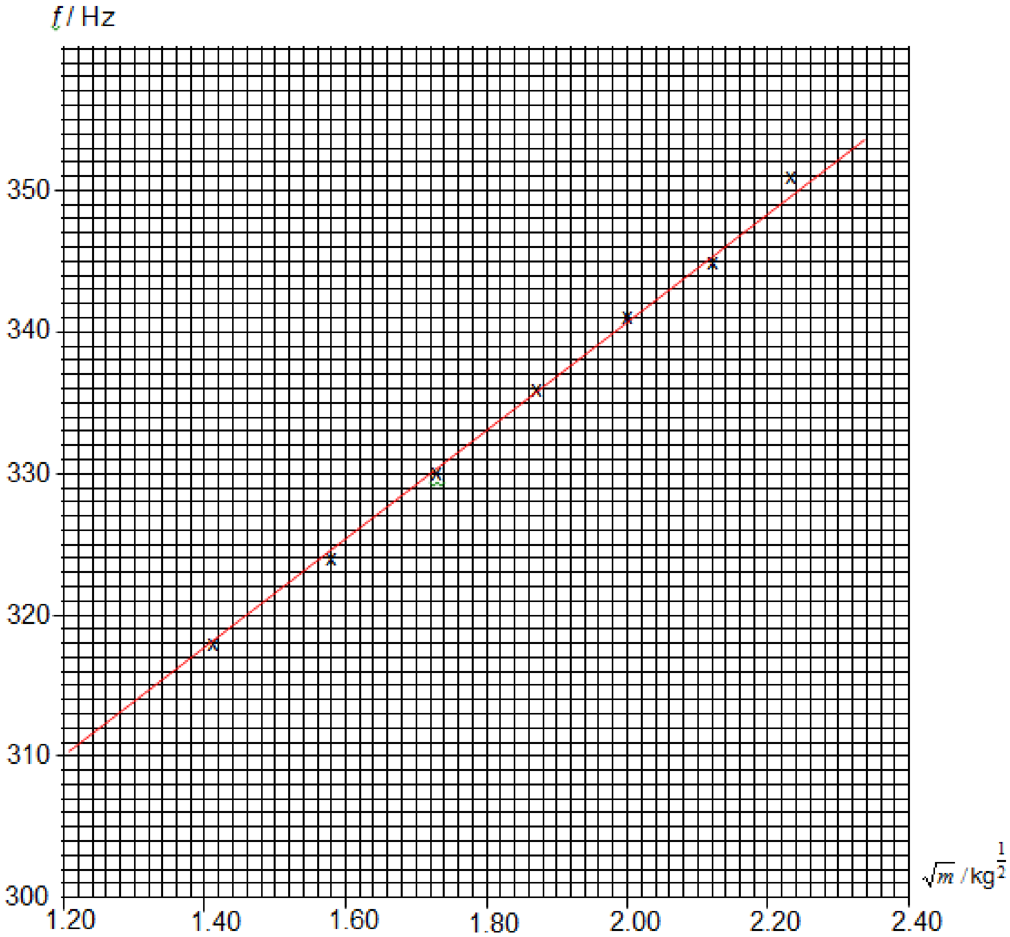
-- END OF PAPER –

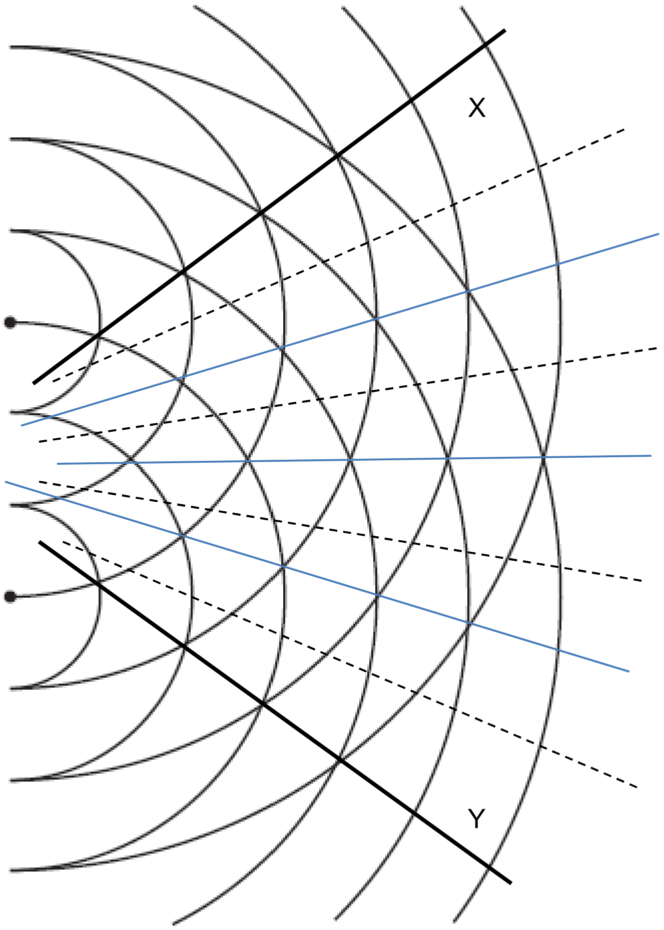
JC2 H1 Physics Prelims 2016 Solutions

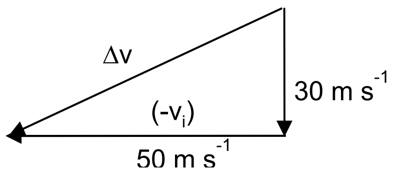
1ai	The circuit can be rearranged such that the 10Ω, 5 Ω and 5Ω + 20Ω are in parallel, and in series with the cell and 10Ω. [1 mark given for implying the 5Ω 10Ω 25Ω are in parallel] Effective resistance = $10 + [\frac{1}{10} + \frac{1}{5} + \frac{1}{25}]^{-1}$ = 12. 9 Ω	[1] [1]
ii)	Potential difference between points A and B = emf – p.d. across the 10 Ω that is in series with the rest of the resistors = 25.0 – $(\frac{10}{12.94} \times 25)$ = 25.0 – 19.37 = 5.68 V	[1] [1]
iii)	When switch Z is open, the parallel circuit has lost a branch and the effective resistance increased. R_{Total} increased $P_{Total} = \frac{Emf^2}{R_{Total}}$ would have decreased.	[1] [1]
2a	Gradient $= \frac{0.18 - 1.16}{7.20 - 6.70}$ = -1.98 (must include sign) (accept -1.90 to -2.10)	[1]
b	$g \propto \frac{1}{r^2}$ OR *g* is inversely proportional to the square of the distance from the centre of the Earth, OR *g* obeys the inverse squared law	[1]
3a)	The diagram shows a current balance consisting of a rectangular wire frame, ACPO, pivoted about a horizontal axis, GH. Current I flows into the conducting frame through G and out at H after passing through C and A.  Diagram – [1] pivot with F_B and mg downwards. [1] correct direction of current labelled *I* [1] distance between pivot and forces labelled [1] *L* being the distance of wire AC. The wire frame is positioned so that AC is perpendicular to the magnetic field within the solenoid. When a current I passes through the frame, a downward magnetic force, F, acts on AC of length L. (The direction of this force can be found using Fleming's Left Hand Rule).	

	To balance the frame again (i.e. restore equilibrium), an additional mass m (the rider) is added at T. By the Principle of moments, Clockwise moments = Anticlockwise moments $mg \cdot x = F \cdot y$ $= BIL \sin 90° \cdot y$ $\Rightarrow B = \dfrac{mgx}{ILy}$	[1] [1]
b)	Into the paper. The current due to electrons is downwards. By Fleming's Left Hand rule, there will be a magnetic force Into the paper.	[1] [1]
4ai	 1 mark for shape, 1 mark for labelling axes and stopping potential	[2]
ii)1	Increasing the light intensity simply increases the number of photons per unit time falling on the metal, because frequency *f* of light is kept constant. However, the incident photons still impart the same amount of energy hf to every electron because the frequency f of light is kept constant. This means that the maximum kinetic energy of the emitted photoelectrons will remain unchanged, and hence the stopping voltage also remains unchanged with increasing light intensity. OR (Einstein's photoelectric equation) and stating stopping potential only depends on work function and frequency.	[1] [1]
2.		[1]
3.	Change metal to one with smaller work function OR increase the frequency of incident radiation (use light of higher frequency)	[1]
bi	6	[1]

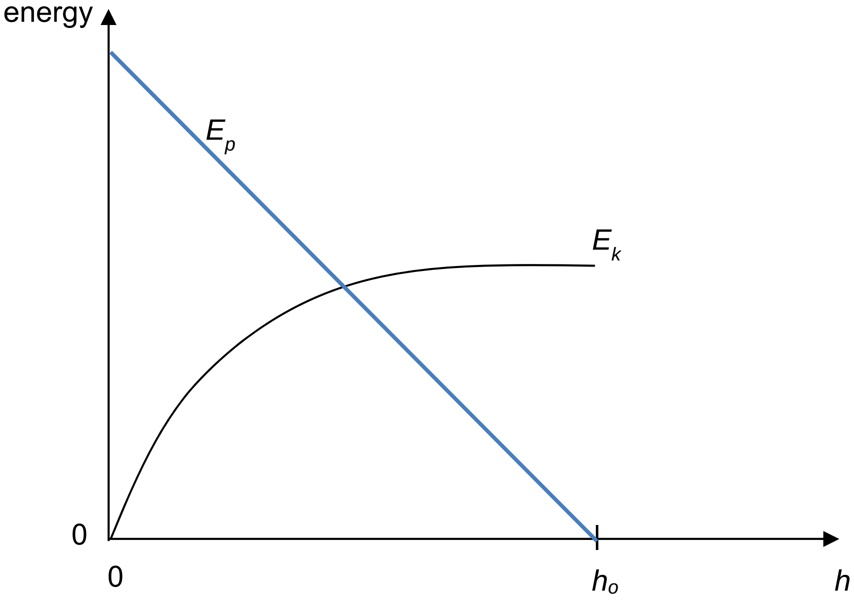
	(sodium atoms can only be excited to n = 4, since (–1.56 – (-5.17)) = 3.61 eV is less than KE of bombarding electrons of 3.70 eV)	
ii)	 -1 for each missing line or wrong sequence. Award full marks as long as there are 6 correct lines. Zero marks for only 3 correct lines.	[2]
iii)	$\Delta E = \frac{hc}{\lambda}$ $\lambda = \frac{6.64 \times 10^{-34} \times 3 \times 10^{8}}{(5.17 - 3.07) \times 1.6 \times 10^{-19}}$ $= 5.93 \times 10^{-7}$ m	[1] [1]
iv)	0.09 eV ≤ KE ≤ 1.60 eV [1 mark for each answer] Workings Energy difference between level 1 and 2 = -3.07 – (-5.17) = 2.10 eV KE = 3.70 – 2.10 = 1.60 eV Energy difference between level 1 and 3 = -1.98 – (-5.17) = 3.19 eV KE = 3.70 – 3.19 = 0.51 eV Energy difference between level 1 and 4 = -1.56 – (-5.17) = 3.61 eV KE = 3.70 – 3.61 = 0.09 eV (no ecf)	[2]
5a	$v = f\lambda$ distance between node and node is ½ λ = L $v = 2Lf$	[1] [1]
bi)	330, 1.73	[1]

ii)		[2]
iii)	From equation, if f is plotted against $m^{1/2}$, a straight line will be obtained, with positive gradient.	[1] [1]
iv)	From the equation, gradient $= \dfrac{\sqrt{g}}{2L\sqrt{\mu}} = \dfrac{350 - 320}{2.24 - 1.46}$ $= 38.462$ $\mu = \dfrac{9.81}{4\text{x } 0.4^2 \text{ x } 38.462^2} = 1.04 \text{ x } 10^{-2}$ kg m^{-1}	[1] [1]
v)	The thickness/ cross-sectional area of the wire The density of the wire Temperature (not significant) Do Not accept: material	[1] [1]
	Section B	
6a	Any 3 of the 4 possible conditions: coherent, have about the same amplitude, of the same type, both polarized in the same direction, or unpolarised [-1 for missing or errors of conditions]	[2]
b1.	Separation: Increased to <u>2x</u>, since <u>x = λD/a</u>	[1]

	Contrast: Dark fringe is just as dark, and bright fringe is less bright since intensity decreases with distance, hence contrast is less.	[1]
2.	Separation: No change, since $x = \lambda D/a$ Contrast: decreases, since polarization causes intensity to decrease, hence bright fringe is less bright, dark fringe is just as dark.	[1] [1]
c)	 Solid lines – Maxima. Broken lines – Minima 1 mark for each correct line of minima drawn.	[2]
di)	At (displacement) antinodes where there are depressions, wave has maximum amplitude (of vibration) At (displacement) nodes where there are heaps, amplitude of vibration is zero / minimum.	[1] [1]
ii)	$2.5\lambda = 39.0$ cm $\rightarrow \lambda = \frac{0.39}{2.5} = 0.156$ m $v = f\lambda$ $v = 2.14 \times 10^3 \times 0.156$ $= 334$ m s^{-1}	[1] [1] [1]
iii)	Distance between the heaps and depressions will remain the same. When the volume increases, only the amplitude of the heaps/sound will increase. The wavelength/frequency remains the same.	[1] [1]
ei)	Not valid, as the waves are of different frequency/period. Thus, their phase difference changes with time.	[2]
ii)	5.0 cm	[1]
iii)	$\frac{I}{I_Z} = \left(\frac{2.0 \text{ cm}}{5.0 \text{ cm}}\right)^2$	[1]

	$I_Z = 6.25\ I$	[1]
7a	Graph I. The object is <u>at more than 1 position</u> at the same time/ instantaneously OR object requires infinite speed (during the vertical part of the graph)	 [2]
b)	Both the police and driver covered the same distance from when the police set off. Velocity of sports car is 200 km h^{-1} = 55.56 m s^{-1}. Distance covered by sports car is = $ut + ½at^2 = 55.56t$ Distance covered by policeman is $ut + ½at^2 = ½(25)t^2$. Equating the two distances, which are similar $55.56t = ½(25)t^2$ $t = 4.44$ s.	 [1] [1]
ci)		[1]
ii)	$\Delta v^2 = 50^2 + 30^2$ $\Delta v = 58.3$ m s^{-1}	 [1]
di)	From the Area of graph = ½ x 8.8 x 0.9 = 3.96 m OR Knowing u = 0 and t = 0.9 and g = 9.81 $s = ut + ½\ a\ t^2 = 0 + ½\ 9.81\ 0.9^2$ $s = 3.97$ m	[1] [1] [1] [1]
ii)	Velcocity changes from 8.8 to -4.4 in 0.5 s Average acceleration = $\frac{8.8-(-4.4)}{0.5}$ = 26.4 m s^{-2}	 [1] [1]
iii)	They share the same gradient, hence they have same acclerations. Same acceleration of free fall, 9.81	[1] [1]
iv)	Given rebound vertical velcocity is 4.4 m s^{-1} and rebound at 30° from vertical, Rebound speed = $\frac{4.4}{\cos 30°}$ = 5.08	 [1]
v)	Some of the Kinetic Energy was converted to work done against the resistive forces during rebound, Therefore, KE before she rebounds is less than the KE after rebound.	[1] [1]
vi) **1.**	Using the graph, it took 0.45 to drop the velocity from -4.4 to zero. Area = ½ x 4.4 x 0.45 = 0.99 m Maximum height = 0.99 m + 0.40m = 1.39 m OR Using u = -4.4 m s^{-1}, t = 0.45 and g = 9.81 $s = ut + ½\ at^2 = ½ \rightarrow s = 0.987$ m Maximum height = 0.987 + 0.4 = 1.39 m	 [1] [1] [1] [1]
2.	Using Upwards as positive, s = - 0.4, u = 4.4, a = -9.81 $s = ut + ½\ at^2 = ½ \rightarrow -0.4 = 4.4t + ½\ (-9.81)\ t^2$ t = 0.980 s Horizontal distance = 0.980 x 5.08sin30° = 2.49 m	 [1] [1] [1]

8a)	The single point through which the entire weight of the object may be considered to act.	[1]
b)	Vertical pendulum (drawn) because there is no acceleration and hence no resultant force acting on the pendulum bob in the horizontal direction. The bob is in equilibrium.	[1] [1]
c)	The student's claim is invalid. Translational equilibrium is still possible, since Horizontally, friction from the floor = normal reaction from the wall, and Vertically, weight of ladder = normal reaction from the ground. Rotational equilibrium is also possible, since moments due to weight = moments due to normal reaction at wall. OR the three forces acting on the ladder will meet at a point, and the three forces added vectorially form a closed triangle (or draw a a closed triangle diagram)	 [1] [1] [2]
di)	Taking moments about the hinge between the beam and the wall, Anti-clockwise moments = Clockwise moments $900 \sin 60^\circ (6) = 700x + 200(3) + 80(6)$ $x = 5.14$ m	 [1] [1]
ii)	Let F_X and F_Y be the horizontal and vertical components of the forces of the wall on beam. Horizontally, $F_x - T\cos 60^\circ = 0 \rightarrow F_X = 450$ N Vertically, $F_y + T\sin 60^\circ - 700 - 80 - 200 = 0 \rightarrow F_Y = 200.6$ Combining the vertical and horizontal force: $F = \sqrt{450^2 + 200.6^2}$ $= 493$ N	 [1] [1] [1]
iii)	If the bear leaps, the downward force on the beam is larger than its weight used in the computation of **(i)**, because according to Newton's Third Law, it would need to push itself off with a force larger than its weight to leap which results clockwise moments larger than the (maximum) anti-clockwise moments due to the maximum tension in the wire.	[1] [1]
e	Work is the product of force and displacement / distance in direction of force moved in the direction of the force.	[1] [1]
fi	Ball falls from rest with decreasing acceleration and eventually reaches a constant speed/ terminal velocity. Due to increasing air resistance on the ball. At terminal velocity, air resistance equals to its weight.	[1] [1] [1]

<table>
<tr><td>fii</td><td>
Fig. 7.5

Straight line with <u>negative</u> gradient
y-axis intercept <u>above maximum E_k</u>
reasonable <u>gradient</u> (same magnitude as that for E_k initially)
Note:
From $v^2 = u^2 + 2as$, for the case of no air resistance.
½ mv^2 = 0 + mas → hence E_k vs displacement graph should be a straight line.
However question shows a curve. Hence showing presence of air resistance.
Initial gradient of E_k graph = ma = mg (since speed = 0).</td><td>[1]
[1]
[1]</td></tr>
<tr><td></td><td></td><td></td></tr>
</table>