BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF SCIENCE

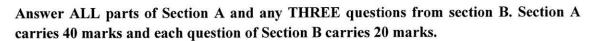
DEPARTMENT OF MATHEMATICS AND PHYSICS

Diploma Physics

MW 5053

PH007: Mechanics

Duration: Three (3) hrs



Section A

1.			
	a.	Determine whether the following equation is dimensionally consistent	$: v^2 =$
		$u^2 + 2as$, where u and v are the initial and final speeds, a is the acceleration	eration
		and s is the distance travelled.	[4]
	b.	The position of a particle moving along the x-axis varies with time acc	ording
		to the relation $x = t^3 - 12t + 20$, where x is in meters and t is in second	ıds.
		i. Determine the velocity and acceleration as a function of time.	[4]
		ii. Find the time at which the velocity will be zero	[2]
	c.	A ball is dropped from the top of a building. Find	
		i. The acceleration	[1]
		ii. The distance it falls in 2 seconds	[3]
		iii. Its velocity after falling 15 m	[3]
		iv. The time it takes to fall 25 m	[3]
	d.	Define conservative and non conservative forces and give one examp	ole for
		each	[4]
	e.	Given that $\mathbf{A} = 4\mathbf{i} - 2\mathbf{j} - \mathbf{k}$ and $\mathbf{B} = \mathbf{i} + 4\mathbf{j} - 4\mathbf{k}$. Determine	
		i. The angle between A and B	[3]
		ii. <i>A.B</i>	[3]
		iii. The magnitude of A	[3]
		iv. $A + B$	[2]
	f.	A satellite orbits the earth at a height (from the surface) of 150 km, who	
		free fall acceleration is $9.8 m/s^2$. Given that the radius of the earth is	6.4 ×
		10 ⁶ m. Calculate the orbital speed and period of the satellite.	[5]

Section B

2.			
	a.	State Newton's laws of motion and give the corresponding mathema	tical
		form.	[6]
	b.	A box of mass=10 kg is initially at rest on surface with coefficient of kin	netic
		friction $\mu_k = 0.2$. The box is pulled horizontally by a force F=50 N	that
		makes an angle of $\theta = 60^{\circ}$ with the horizontal. Calculate	
		i. the speed of the box after it moves a distance of 4 m.	[6]
		ii. The work done by the force over 4 m distance	[3]
		iii. what is the kinetic energy of the box at the distance of 4m	[3]
		iv. Explain why the answer in(ii) is different from the one in (iii)	[2]
3.			
	a.	A ball is thrown with an initial speed v of 30 m/s at an angle of 53.1° to	the
	٠.	horizontal.	
		i. State two assumptions that are made when analysing projectile mo	otion
		within the earth's atmosphere.	[2]
		ii. Find the x and y components of the velocity	[2]
		iii. Calculate the maximum height H and	[3]
		iv. the time taken to reach the maximum height	[3]
	h	A tram of 5000 kg, travelling at 15 m/s strikes a stationary 5000 kg tram	
	0.	locks onto it. If the trams move together, what is the common speed	
		collision?	[4]
	C.	A wheel accelerates form rest to an angular speed of 25 rad/s in 10 s	
	٠.	Calculate the	
		i. Angular acceleration of the wheel	[3]
		ii. Tangential and radial acceleration of a point 10 cm form the centre	
4.		Zungenam unt zum er zu g	
••	a.	With the aid of a diagram, explain how a material would behave und	ler a
	(55.5)		10]
	b.	A small sphere of mass m=2 grams is released from rest in large vessel f	illed
		with oil. The sphere reaches a terminal speed $v_t = 3 \text{ cm/s}$.	
			[5]
		ii. Given that the acceleration of the sphere at some point is 3.5 i	
		calculate the drag force on the object.	[3]
		iii. If the mass is increased while the volume of the ball is kept the sa	ame,
		explain how the forces acting on the sphere change.	[2]
5.			
	a.	State Newton's law of gravitation, and express it mathematically, definin	g all
	8	the quantities in the equation	[5]
	b.	A 1000 kg satellite is to be placed in a circular orbit 300 km above the sur	
		of the earth. The radius and mass of the earth are 6380 km and 5.97×10^2	
		i. If the satellite is to stay in orbit at that height, calculate the sp	
		period and centripetal acceleration.	[9]

	11.	How much work must be done to place the satellite at that neighborship.	;nt: [+]
	iii.	Explain why the gravitational potential is always negative	[2]
	****	2	
a.	A spri	ing of length 5 cm is compressed by a force of 10 N and i	ts length
		es to 4 cm. Determine	
	i.	the spring constant	[2]
	ii.	energy stored in the spring when compressed to 4 cm	[2]
b.		any three uses of artificial satellites	[3]
c.		two disadvantages of geostationary orbits	[2]
a.		dulum consists of a big sphere of mass $m=30 \text{ kg}$ hung from the	end of a
	steel w	Fire that has a length $L = 15$ m, a cross-sectional area $A = 9 \times 10^{-6}$ n	n^2 , and
	Voun	g's modulus $Y = 200 \times 10^9$ N/m ² . Calculate the	
	i.	Tension force in the string	[2]
	ii.	tensile stress on the wire	[3]
			[4]
	iii.	change in length.	[2]
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6.

THE END